



# 13<sup>TH</sup> | ISUPTW

International Symposium on  
Ultrafast Phenomena and THz Waves



## Conference Program

April 27-30  
2026

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# Committees

## Conference Chairs



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University of Rochester, USA



**Ruxin Li**  
ShanghaiTech University, China



**Tiejun Cui**  
Southeast University, China

## General Conference Chair



**Xiaojun Wu**  
Beihang University, China

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Institute of Physics Chinese  
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**Ye Tian**  
Shanghai Institute of Optics  
and Fine Mechanics, Chinese  
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 **Technical Program Committee**

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**Wenhui Fan**, Xi'an Institute of Optics and Precision Mechanics, CAS, China

**Shaobo Fang**, Institute of Physics CAS, China

**Min Hu**, University of Electronic Science and Technology of China, China

**Shu-Wei Huang**, University of Colorado, USA

**Tobias Kampfrath**, Free University of Berlin, Germany

**Weiwei Liu**, Nankai University, China

**Wei Liu**, Sun Yat-sen University, China

**Tzu-ming Liu**, University of Macau, China

**Zhen Qiu**, Michigan State University, USA

**Liwei Song**, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

**Dong Sun**, Peking University, China

**Zhipei Sun**, Aalto University, Finland

**Zhen Tian**, Tianjin University, China

**Huabin Wang**, Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences

**Tianwu Wang**, Aerospace Information Research Institute, Chinese Academy of Sciences, China

**Wenting Wang**, Beijing Institute of Technology, China

**Min Xin**, Tianjin University, China

**Yudong Yang**, Songshan Lake Materials Laboratory, China

**Peng Ye**, Institute of Physics CAS, China

**Dongfang Zhang**, Shanghai Jiaotong University, China

**Zhiqing Zhang**, Nankai University, China

**Jingdi Zhang**, The Hong Kong University of Science and Technology, China

**Gengji Zhou**, Shanghai Institute of Optics and Precision Mechanics CAS, China

# Sponsors

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GENUINE

# General Information

**Conference Venue:** Beihang University International Innovation Institute C1 Conference Center (北京航空航天大学国际创新研究院 C1 会议中心)

**Address:** No. 166 Shuanghongqiao, Yuhang District, Hangzhou City, Zhejiang Province, China (杭州市余杭区双红桥 166 号)

## Speaker Preparation

Time of an plenary talk will be 45 min, invited talk will be 20 min and an oral talk will be 10 min, including Q&A. For all oral speakers, please arrive at the session room 30 min before your talk for uploading and checking the PPT. The presentation language is English. No shows of the oral presentation will be recorded and these papers will not be published.

**Please note that all projection screens at the venue have a 16:9 aspect ratio.**

## Poster Preparation

Authors are required to stand by their poster during the poster session for discussion. Please make sure to print your mobile tel. and email in the poster, because the conference staff will contact the winner of Best Poster Award, which will be selected on site.

**Poster session:** Tuesday, Apr. 28, 15:50-16:05

**Poster board size:** 0.95 m (length) \* 2.47 m (height), recommended poster size:0.8m\*1.2m

**Set-up time:** Apr. 28, 08:00-15:55

Poster presenters are responsible to remove their poster, and the conference staff will not collect the posters left at the end of the poster session. No shows of the poster will be recorded and these papers will not be published.

## Lunches & Dinners

12:00-13:30, Apr. 28-30, North Canteen (北区食堂) ; 17:30-19:30, Apr. 27-30, North Canteen (北区食堂)

## Banquet and Award Ceremony

**Location:** Exhibition Hall (C5 科教美育中心) 18: 30-20:30

The banquet and award ceremony of the International Symposium on Ultrafast Phenomena and THz Waves (ISUPTW) will be held on Tuesday, Apr. 28, 18:30-20:30.

A ticket is provided within the badge of the all the attendees.

## Awards

The following awards will be present at the banquet:

### X-C Zhang Award

The winners will be selected by The Award Committee and presented on site.

### Lingxi Award

The winners will be selected by The Award Committee and presented on site.

### Best Oral Award

The winners will be selected by reviewers on site during the best oral award.

### Best Poster Award

The winners will be selected by reviewers on site during the poster session.

## Program at a Glance

	Apr.27	Apr.28	Apr.29	Apr.30	Address
Registration	10:00-21:00				Manju Prestige Hotel (Hangzhou Liangzhu Ancient City Ruins) 开元曼居臻选酒店 (杭州良渚古城遗址店)
Registration		08:00-19:00	08:30-18:00	08:30-16:00	C1 Conference Center C1 会议中心
Opening Ceremony		08:30-08:45			Room 1016, C1 Conference Center C1 会议中心 1016 会议室
Plenary Session		08:45-12:00	08:45-12:00	08:45-12:00	Room 1016, C1 Conference Center C1 会议中心 1016 会议室
Symposium I: Terahertz science and technology		13:30-18:25	13:30-18:25	13:30-18:15	Room 2001、2002、2003, C1 Conference Center C1 会议中心 2001 会议室、2002 会议室、2003 会议室
Symposium II: Ultrafast Phenomena		13:30-18:25	13:30-18:15	13:30-18:15	Room 1016, C1 Conference Center C1 会议中心 1016 会议室
Poster Session		15:50-16:05			Outside Room 1016, C1 Conference Center C1 会议中心 1016 会议室走廊
Lingxi Award Selection		13:30-16:00			Room 1013, C1 Conference Center C1 会议中心 1013 会议室
Best Oral Award Selection		13:30-16:02			Room 1014, C1 Conference Center C1 会议中心 1014 会议室
Banquet		18:30-20:30			Exhibition Hal C5 科教美育中心

# Map



# Program

April 28th Opening Ceremony & Plenary Sessions Room 1016, C1 Conference Center	
Time	Content
Presider: Xiaojun Wu	
08:30-08:45	Opening Ceremony
Presider: Ye Tian	
08:45-09:30	<b>Recent Progress of X-ray Free-Electron Laser Facilities in Shanghai: Advancing Ultrafast and Terahertz Sciences</b> <b>Zhentang Zhao</b> Shanghai Advanced Research Institute, Chinese Academy of Sciences
09:30-10:15	<b>When Metasurfaces Meet Vectorial Photodetection</b> <b>Cheng-Wei Qiu</b> National University of Singapore
10:15-10:30	Coffee Break
Presider: Guoqing Chang	
10:30-11:15	<b>Strong Attosecond Light Source</b> <b>Yuxi Fu</b> Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences
11:15-12:00	<b>Terahertz Diagnosing Carriers, Sensing, and Effects</b> <b>Chao Chang</b> Peking University
12:00-13:30	Lunch

# Abstracts

## Plenary Talk

### Recent Progress of X-ray Free-Electron Laser Facilities in Shanghai: Advancing Ultrafast and Terahertz Sciences

Zhentang Zhao

Shanghai Advanced Research Institute, Chinese Academy of Sciences

**Abstract:** Free-electron lasers (FELs) have revolutionized the study of ultrafast dynamics by providing ultra-high peak power, fully coherent X-ray pulses. This talk presents the current status and recent advancements of the X-ray free-electron laser facilities located in Shanghai, China. The Shanghai Soft X-ray Free-Electron Laser Facility (SXFEL), the first of its kind in China, has successfully achieved its design goals and operates as a premier user facility. Furthermore, the Shanghai High Repetition Rate XFEL and Extreme Light Facility (SHINE) is currently under construction. SHINE is designed to deliver femtosecond X-ray pulses at a repetition rate of up to 1 MHz, utilizing an 8 GeV superconducting linear accelerator. These cutting-edge facilities enable unprecedented capabilities in probing ultrafast phenomena. Additionally, recent developments in generating high-power, continuously tunable narrowband terahertz (THz) radiation using FEL electron beams will be discussed. These milestones represent a significant leap forward in bridging the THz gap and providing novel tools for exploring fundamental material excitations on the femtosecond timescale.



**Biography:** Zhentang Zhao is an Academician of the Chinese Academy of Engineering (CAE) and a Professor at the Shanghai Advanced Research Institute (SARI), CAS, currently serving as Director of the Shanghai Synchrotron Radiation Facility (SSRF) and project director of SHINE facility. He received his Ph.D. from Tsinghua University and has dedicated his career to accelerator science and technology. Professor Zhao has been a leading figure in the development of several large research facilities in China. His primary research interests encompass accelerator physics and technology, synchrotron radiation light sources, and free-electron lasers. Throughout his persistent career, Professor Zhao has made significant contributions to advancing accelerator light sources in China, including the generation of ultrashort, high-brightness X-ray and terahertz sources.

## When metasurfaces meet vectorial photodetection

Chengwei Qiu

National University of Singapore

**Abstract:** In this talk, we introduce a series of metasurface-mediated photodetectors, which allows high sensitivity, low-power consumption, fast response, wavelength-polarization selectivity especially at room temperature. We particularly show how machine learning could enable high-dimensional detection. Also, we counter-intuitively demonstrate what one could excel without machine learning.



**Biography:** He is Provost's Chair Professor in National University of Singapore. He is the recipient of President's Science Award 2023, the highest science distinction in Singapore. He was elected Fellow of Academy of Engineering Singapore, and Fellow of ASEAN Academy of Engineering and Technology. He is Fellow of APS, Optica, SPIE and The Electromagnetics Academy, US. He is well

known for his research in structured light and interfaces. He was the recipient of MIT TR35@Singapore Award in 2012, Young Scientist Award by Singapore National Academy of Science in 2013, Engineering Researcher Award 2021 in NUS, World Scientific Medal 2021 by Institute of Physics, Singapore, Achievement in Asia Award (Robert T. Poe Prize) by International Organization of Chinese Physicists and Astronomers in 2022, and Joseph Fraunhofer Award 2026 by Optica, etc. He has been Highly Cited Researchers since 2019. As an overseas partner, he has been awarded China's Top 10 Optical Breakthroughs for 6 times (2019, 2020, 2021(one in Fundamental Research, and one in Applied Research), 2023, 2025). He is Editor-in-Chief for eLight. He also serves in Editorial Advisory Board for Laser and Photonics Review, Advanced Optical Materials, and ACS Photonics.

## Strong attosecond light source

Yuxi Fu

Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences

**Abstract:** After the generation and characterization of attosecond pulse at the beginning of this century, attosecond science has attracted a lot of attention due to its significant potential applications in revealing dynamics of electrons. Up to now, isolated attosecond pulses can be generated by high-order harmonic generation (HHG), free electron laser (FEL) and laser driven plasma emission. Attosecond facilities have also been constructed or proposed in different countries. In this presentation, I will show our work on generating attosecond pulses in the soft x-ray, XUV and visible regions, with potential maximum peak power reaches GW and even stronger, with a table-top scale. These high-energy isolated attosecond pulses will be significant for high spatial-temporal resolution imaging, ultrafast dynamics capturing of electrons, and strong attosecond laser field physics.



**Biography:** Yuxi FU got his Ph.D in State Key Laboratory of Strong Field Laser Physics, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences in 2010. From 2010 to 2019, he worked in attosecond science research team of RIKEN. Then, he joined Xi'an Institute of Optics and Precision Mechanics (XIOPM) . He is currently the deputy director of XIOPM and Director of state key laboratory of ultrafast optical science and technology. His research interest includes strong infrared femtosecond laser technology, attosecond science and technology, and ultrafast dynamics.

## Terahertz diagnosing carriers, sensing, and effects

Chao Chang

Peking University

**Abstract:** The traditional method for carrier diagnosis, the Hall effect, is a contact-based detection technique that is highly susceptible to contact resistance; it also requires a long integration time and cannot measure carrier lifetime. We established a non-contact, ultrafast diagnostic method based on THz reflectance and angular-resolved spectroscopy for characterizing carrier parameters. The results showed that trace doping of 0.03% SnS<sub>2</sub> increased the THz reflectivity, indicating an enhancement in carrier concentration; meanwhile, this doping reduced carrier lifetime while improving carrier mobility [Science]. THz spectroscopy enables specific diagnosis of free carriers and simultaneous acquisition of multidimensional parameters (e.g., mobility, diffusion length, and lifetime via the field-relaxation effect), thus fully revealing the entire process of carrier dynamics. Our experiments demonstrated that compared with the control group, the optimized group achieved a significant improvement in carrier mobility and diffusion length [Nature]. We proposed and fabricated a broadband spectral diagnostic chip with continuously graded resonant frequencies, which enables specific discrimination and quantitative diagnosis of multi-biomolecule mixtures [Nature Communications]. Our research revealed that THz waves can specifically regulate retinal—the key molecule of the optic nerve—to achieve reversible conformational transition from the dominant conformation to the minor conformations. [Nature Communications].



**Biography:** Prof. Chang is a recipient of the National Science Fund for Distinguished Young Scholars and Leading Talent of the Ten-Thousand Talents Program. He is also included in the National Hundred, Thousand and Ten Thousand Talents Project, honored as a Expert with Outstanding Contributions, and granted the Special Government Allowance of the State Council. Engaged in the field of radiation physics, he has won the National Natural Science Award (1st). His other accolades include the Ho

Leung Ho Lee Prize, the Tan Kah Kee Young Scientist Award, the Special Award of the China Youth Science and Technology Award, the Qiushi Outstanding Young Scholar Award, and the Exploration Prize. As the first author or corresponding author, he has published more than 120 SCI-indexed papers in prestigious journals such as Science, Nature and PNAS, which have been cited over 8,000 times. He has been selected as a Elsevier Highly Cited Chinese Researcher.

<b>April 28th Session 1 Terahertz Source I Room 2001, C1 Conference Center</b>	
Presiders: Longqing Cong, Qijie Wang	
13:30-13:50	<b>Recording H-Bond Networks in Action: The Inter-Molecular Localized Forces Behind Chemistry and Biology</b> <b>Sergio Carbajo</b> University of California, Los Angeles (UCLA)
13:50-14:10	<b>Terahertz Semiconductor Quantum Cascade Lasers and Applications</b> <b>Juncheng Cao</b> Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
14:10-14:30	<b>High-Performance Terahertz Quantum Cascade Lasers and Applications in Imaging and Sensing</b> <b>Chongzhao Wu</b> Shanghai Jiao Tong University
14:30-14:50	<b>Quantum Cascade Lasers and Their Prospects for Deep-Sea Detection Applications</b> <b>Junqi Liu</b> Ocean University of China
14:50-15:10	<b>High Power THz Sources based on Quantum Cascade Lasers</b> <b>Quanyong Lu</b> Beijing Academy of Quantum Information Sciences
15:10-15:30	<b>Intense Laser Driven Strong Terahertz Radiation</b> <b>Yutong Li</b> Institute of Physics, Chinese Academy of Sciences
15:30-15:50	<b>Generation and Manipulation on Terahertz Radiation from Laser Plasmas</b> <b>Yanping Chen</b> Shanghai Jiao Tong University
15:50-16:05	Coffee Break
Presiders: Juncheng Cao, Chongzhao Wu	
16:05-16:25	<b>Electrically-pumped Terahertz topological photonic crystals lasers</b> <b>Qijie Wang</b> Nanyang Technological University, Singapore
16:25-16:45	<b>Strong-Field-Driven Tunneling Transport of Excitons in Van Der Waals Material</b> <b>Jingdi Zhang</b> The Hong Kong University of Science and Technology

16:45-17:05	<b>Optical Pump-Terahertz Emission Investigation of Ultrafast Magnetization Dynamics</b> <b>Zuanming Jin</b> University of Shanghai for Science and Technology
17:05-17:25	<b>All-Solid-State Femtosecond Lasers for High-Power Broadband THz Generation</b> <b>Wenlong Tian</b> Xidian University
17:25-17:45	<b>Synchronizing Terahertz Wave Generation with Attosecond Bursts in Water</b> <b>Dongwen Zhang</b> National University of Defense Technology
17:45-18:05	<b>Hybrid Metasurfaces for All-Optical Terahertz Ultrafast Computational Spectrometer and Single-Pixel Imaging</b> <b>Longqing Cong</b> Southern University of Science and Technology
18:05-18:15	<b>Laser-Induced Magnetization Dynamics in Ultrathin CeTbG Films</b> <b>Stanislaw Jakimowicz<sup>1</sup>, Wenhao Di<sup>2</sup>, Anhua Wu<sup>2</sup>, Jun Qin<sup>3</sup>, Lei Bi<sup>3</sup>, Andrzej Stupakiewicz<sup>1</sup></b> 1.University of Bialystok,2.Shanghai Institute of Ceramics Chinese Academy of Sciences,3.University of Electronic Science and Technology of China
18:30-20:30	Banquet

<b>April 28th Session 2 Terahertz Source II Room 2002, C1 Conference Center</b>	
Presiders: Weiwei Liu, Tianwu Wang	
13:30-13:50	<b>Terahertz Nonlinear Photonics</b> <b>Liwei Song</b> Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences
13:50-14:10	<b>Terahertz Frequency Upconversion in a Narrow Gap Semiconductor</b> <b>Luyi Yang</b> Tsinghua University
14:10-14:30	<b>Terahertz Semiconductor Laser Chaos</b> <b>Hua Li</b> Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
14:30-14:50	<b>Transfer-Matrix-with-Source Modeling of Spintronic Terahertz Emitters: Unified Emission and Geometry-Aware Transport Description</b> <b>Yingshu Yang</b> China Academy of Engineering Physics (CAEP)
14:50-15:10	<b>Terahertz Emission Spectroscopy Evidences Sub-Nanometer Orbital Diffusion Lengths in Heavy Metals</b> <b>Zhensheng Tao</b> Fudan University
15:10-15:30	<b>THz Generation Enhanced by Resonance of Nonlinearity in Rb-Doped KTP Crystal for High-Energy Application</b> <b>Dongwei Zhai</b> Qingdao University
15:30-15:50	<b>Ultrafast Laser Technologies and Products from Han's Laser</b> <b>Qitao Lue</b> Han's Laser Technology Industry Group Co., Ltd.
15:50-16:05	Coffee Break
Presiders: Liwei Song, Hua Li	
16:05-16:25	<b>Femtosecond Laser Filament Based Ionizing Radiation Sensing</b> <b>Weiwei Liu</b> Nankai University
16:25-16:45	<b>High-Efficiency Attosecond-Resolution THz Streaking of Relativistic Electron Beams</b> <b>Peng Lv</b> Tsinghua University
16:45-17:05	<b>Optically Inspired Terahertz Integrated Devices and Their Micro/Nano Fabrication</b> <b>Xuecou Tu</b> Nanjing University

17:05-17:25	<b>Spintronic Terahertz Emission in High-Quality 2D Materials</b> <b>Tianxiao Nie</b> Beihang University
17:25-17:45	<b>Pressure Modulated Terahertz Emission in Gallium Telluride</b> <b>Tianwu Wang</b> Aerospace Information Research Institute, Chinese Academy of Sciences
17:45-18:05	<b>Flexible Generation of Multiple Terahertz Fields by NIR Wavefront Manipulation</b> <b>Shixiang Xu</b> Shenzhen University
18:05-18:25	<b>Phase-Driven Electron Dynamics with Intense Terahertz Waveforms</b> <b>Yushan Zeng</b> Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences
18:30-20:30	Banquet

<b>April 28th Session 3 Terahertz Functional Devices Room 2003, C1 Conference Center</b>	
Presiders: Yan Zhang, Qiye Wen	
13:30-13:50	<b>Terahertz Applications on Non-Destructive Test and Semiconductor</b> <b>Min Hu</b> University of Electronic Science and Technology of China
13:50-14:10	<b>Nonlinear Optical Metabolomics for Disease Diagnosis</b> <b>Tzu-ming Liu</b> University of Macau, China
14:10-14:30	<b>Terahertz Dielectric Metasurfaces with Broken Spatial Symmetry</b> <b>Kebin Fan</b> Nanjing University
14:30-14:50	<b>Terahertz Metasurfaces for Dynamic Wavefront Shaping and Their Applications</b> <b>Shengnan Guan, Jierong Cheng</b> Nankai University
14:50-15:10	<b>Topological Photonic Chips for Terahertz Wireless Communications</b> <b>Wenhao Wang</b> Westlake University
15:10-15:30	<b>Terahertz Metasurfaces and Its Application Based on Sequential Structure of Functional Units</b> <b>Guozhong Zhao</b> Capital Normal University
15:30-15:50	<b>Momentum-Engineered Thz Vacuum Electronics Devices</b> <b>Chao-Hai Du</b> Peking University
15:50-16:05	Coffee Break
Presiders: Min Hu, Wenhao Wang	
16:05-16:25	<b>Ultrafast Nanophotonic Information Processing Chip</b> <b>Xiaoyong Hu</b> Peking University
16:25-16:45	<b>Pulse Characteristic Modulation and Transient Measurement of Ultrafast Fiber Lasers</b> <b>Lin Ke</b> Singapore Institute of Technology (SIT)
16:45-17:05	<b>High Power Vortex Wave Generation with TWTs and Meta-Surface</b> <b>Jinjun Feng</b> Beijing Vacuum Electronics Research Institute

17:05-17:25	<b>Optically Addressed Programmable Metasurface for Terahertz Wavefront Modulation</b> <b>Yan Zhang</b> Capital Normal University
17:25-17:45	<b>Inverse Design of Reconfigurable Terahertz Metasurfaces</b> <b>Wenhui Fan</b> Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences
17:45-18:05	<b>Broadband Electromagnetic Absorbing Materials and the Applications in Terahertz Devices</b> <b>Qiye Wen</b> University of Electronic Science and Technology of China
18:05-18:25	<b>Spatiotemporal Coding Terahertz Plasmonic Vortex on-Chip Interferometer</b> <b>Fei Fan</b> Nankai University
18:30-20:30	Banquet

<b>April 28th Session 4 Ultrafast Laser Technology and Devices Room 1016, C1 Conference Center</b>	
Presiders: Yi Liu, Shaobo Fang	
13:30-13:50	<b>Femtosecond Laser Induced Phenomena in Transparent Materials--Their Mechanisms and Applications</b> <b>Jianrong Qiu</b> Zhejiang University, China
13:50-14:10	<b>Competing Lattice and Defect Dynamics Govern Terahertz-Induced Ferroelectricity in Quantum Paraelectric SrTiO<sub>3</sub></b> <b>Jingbo Qi</b> University of Electronic Science and Technology of China
14:10-14:30	<b>Development of a Table-Top Ultrafast Hard X-Ray Diffraction Apparatus</b> <b>Runze Li</b> ShanghaiTech University
14:30-14:50	<b>A Cep-Stabilized Opcpa System with Above 5 Tw Output at 1 Khz Repetition Rate</b> <b>Yudong Yang</b> Songshan Lake Material Laboratory, China
14:50-15:10	<b>Ultrafast Spectroscopy of Correlated Fermion-Boson Mixtures in 2D Materials</b> <b>Hyunyong Choi</b> Seoul National University, Korea
15:10-15:30	<b>Ultrafast Photo-Magnetic Recording in Dielectrics</b> <b>Andrzej Stupakiewicz</b> University of Bialystok, Poland
15:30-15:50	<b>High-Repetition-Rate Ultrashort Pulsed Fiber Lasers</b> <b>Yue Zhou</b> Beijing University of Post Technology, China
15:50-16:05	Coffee Break
Presiders: Runze Li, Yue Zhou	
16:05-16:25	<b>Second-Harmonic Generation in 2D Materials</b> <b>Ting Yu</b> Wuhan University, China
16:25-16:45	<b>Ultrafast Laser Writing of Optical Waveguides in Transparent Materials</b> <b>Feng Chen</b> Shandong University, China
16:45-17:05	<b>Ultrafast Lasers in Large-Scale Scientific Facilities: Challenges and Opportunities</b> <b>Wei Liu</b> Sun Yat-sen University, China
17:05-17:25	<b>Mono-Cycle Ytterbium Laser-Driven Terahertz Generation</b> <b>Shaobo Fang</b> Institute of Physics CAS, China

17:25-17:45	<b>Yb-Fiber Laser Delivering <math>\mu</math>J-Level Femtosecond Pulses with Tunable Repetition Rate</b> <b>Gengji Zhou</b> Shanghai Institute of Optics and Fine Mechanics, CAS
17:45-18:05	<b>Spatiotemporal Structuring of Ultrafast Light Pulses</b> <b>Qiwen Zhan</b> University of Shanghai for Science and Technology
18:05-18:25	<b>Generation of Spatiotemporal Vortex and Skyrimions in the Euv Range</b> <b>Yi Liu</b> University of Shanghai for Science and Technology
18:25-20:30	Banquet

<b>April 28th Session 5 Lingxi Award Selection Room 1013, C1 Conference Center</b>	
Presiders: Peiyan Li	
13:30-13:38	<p><b>Terahertz Nanoscopy of Two-Dimensional Material Heterostructures</b>  <b>Fucheng Qiu<sup>1,2*</sup>, Chang Wang<sup>3</sup>, Zhiyong Tan<sup>3</sup>, Juncheng Cao<sup>3</sup>, Huabin Wang<sup>1,2</sup></b>            1.Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, 2.Chongqing School, University of Chinese Academy of Sciences, 3. Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences</p>
13:38-13:46	<p><b>A Flexible Multiparameter Terahertz Microdetector Based on Graphene Plasmon Polaritons</b>  <b>Liu Shaojing, Chen Huanjun*</b>            Sun Yat-sen University</p>
13:46-13:54	<p><b>A Reconfigurable Terahertz Neuromorphic Chip for Penetrative Dynamic Vision and Compressed Information Transmission</b>  <b>Huijun Zhao, Fei Fan*</b>            Nankai University</p>
13:54-14:02	<p><b>Denoised Terahertz Quantum Cascade Laser Spectroscopy Based on Unet-Based Deep Learning</b>  <b>Zhao Yanan, Ma Zejun, Lu Quanyong*</b>            Beijing Academy of Quantum Information Sciences</p>
14:02-14:10	<p><b>Polarization-Controlled Terahertz Metasurfaces for Non-Hermitian Sensing</b>  <b>Xintong Shi<sup>1,3</sup>, Shan Yin<sup>2</sup>, Hai Lin<sup>3</sup>, Tingting Liu<sup>1</sup>, Shuyuan Xiao<sup>1</sup></b>            1. School of Information Engineering, Nanchang University, China            2. School of Optoelectronic Engineering, Guilin University of Electronic Technology, China            3. College of Physical Science and Technology, Central China Normal University, China</p>
14:10-14:18	<p><b>Terahertz Metasurface Sensing and Detection</b>  <b>Xiang Zhang</b>            Xi'an University of Technology</p>
14:18-14:26	<p><b>Thz Intelligent Robot: Unsupervised Machine Learning Enabled Terahertz Intelligent Inspection System with Conformable Robotic Scanning</b>  <b>Sai Han</b>            College of Artificial Intelligence, China University of Petroleum (Beijing), China</p>
14:26-14:34	<p><b>Terahertz Biochemical Sensing Based on Meta-Atomic Resonance Effect Metasurface Sensors</b>  <b>Jingyi Shu</b>            Beijing Institute of Technology(Zhuhai)</p>
14:34-14:42	<p><b>Enabling Continuous THz Band Coverage via Precise ElectronBeam Tailoring in Free-electron Lasers</b>  <b>Yin Kang, Kaiqing Zhang, Chao Feng, Zhentang Zhao, Zhentang Zhao</b>            Shanghai Advanced Research Institute, Chinese Academy of Sciences, China</p>

14:42-14:50	<b>Quantum Mechanical Simulations of Strong-Field Control of Intralayer Excitons in Van Der Waals Heterostructures</b> <b>ZHU Siyuan,ZHOU Xiaoyue,ZHANG Jingdi*</b> The Hong Kong University of Science and Technology
14:50-14:58	<b>High-Performance Terahertz Modulators Induced by Substrate Field in Te-Based all-2D Heterojunctions</b> <b>Pujing Zhang</b> Capital Normal University

<b>April 28th Session 6 Best Oral Award Selection Room 1014, C1 Conference Center</b>	
Presiders: Jiahua Cai	
13:30-13:38	<b>Harnessing Van Hove Singularities for Terahertz Photoresponse in <math>RbV_3Sb_5</math> Metals</b> <b>Yingdong Wei<sup>1,2</sup></b> 1.State Key Laboratory of Infrared Physics, Shanghai Institute of Technical Physics,2.School of Physical Science and Technology, ShanghaiTech University
13:38-13:46	<b>Spacetime Imaging of Group and Phase Velocities of Terahertz Plasmon Polaritons in <math>Bi_2Se_3</math></b> <b>Jingwen Yu,Ran Wang,Xiaoqiuyan Zhang,Zhuocheng Zhang,Qiyu Zhang,Min Hu*</b> University of Electronic Science and Technology of China
13:46-13:54	<b>Nitrogen-Doped Diamond As A New Material for High-Power Photoconductive Thz Antenna</b> <b>Maxim Komlenok*</b> Prokhorov General Physics Institute of the Russian Academy of Sciences
13:54-14:02	<b>Coherent Seeding and Controlling Dynamical Ferroelectricity by Phonon Anharmonicity</b> <b>Junhan Huang</b> Peking University
14:02-14:10	<b>Optical Modulation of Terahertz Radiation by Ultrathin Continuous Films of Gold via Optical Pump-Terahertz Probe Spectroscopy</b> <b>Maksim I. Paukov, Dmitry I. Yakubovsky, Maria G. Burdanova</b> Moscow Institute of Physics and Technology, Russia
14:10-14:18	<b>Polarization-Tunable Spin-Based Terahertz Emitter by Halbach Array</b> <b>Chenyini Xu,Zehao Yang,Xiaojun Wu*</b> School of Electronic and Information Engineering, Beihang University
14:18-14:26	<b>Localized In-Plane Ferroelectric Field Enabled Fast-Response Visible-to-Terahertz Photodetection in Graphene/<math>LiNbO_3</math> Heterostructure</b> <b>Zhigang He,Huanjun Chen*</b> Sun Yat-sen University
14:26-14:34	<b>Enhanced Thz Emission Signals Based on Antiferromagnet-Heavy Metal Heterostructures</b> <b>Da Tian,Caihong Zhang*,Jingbo Wu,Kebin Fan,Biaobing Jin,Jian Chen,Peiheng Wu</b> Nanjing University
14:34-14:42	<b>Single Femtosecond Level Jitter Ultrashort Electron Bunch</b> <b>Dongfang Zhang*, Jiaqi Zheng</b> Shanghai Jiao Tong University
14:42-14:50	<b>Multi-Parameter Terahertz Micro-Detection Enabled by Symmetry-Broken Driven Unidirectional Electron Flow</b> <b>Tianxiang Yu,Huanjun Chen*</b> Sun Yat-sen University

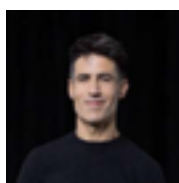
14:50-14:58	<b>A D-Band Gcpw-to-Siw Transition on Glass Using Tgv Technology for Terahertz Systems</b> <b>Zhaoying Li</b> Beihang University
14:58-15:06	<b>A 110-170 Ghz Biosensor Using a Tgv-Based Gcpw-to-Siw Resonator</b> <b>Lianggong Wen*, Shi kaiwen, Zhaoying Li, Ran Wang</b> School of Integrated Circuit Science and Engineering, Beihang University, China
15:06-15:14	<b>Terahertz Detection Using Rydberg Atoms and Its Applications</b> <b>Wang Junnan, Hou Lei*</b> Xi'an University of Technology
15:14-15:22	<b>Antiferromagnet-Topological Insulator Heterostructure for Polarization-Controllable Terahertz Generation</b> <b>Yu Cheng<sup>1,2</sup>, Jimin Zhao<sup>1,2,3*</sup></b> 1. Beijing National Laboratory for Condensed Matter Physics and Institute of Physics, Chinese Academy of Sciences, 2. School of Physical Sciences, University of Chinese Academy of Sciences, 3. Songshan Lake Materials Laboratory
15:22-15:30	<b>High-Precision Characterization of Nanomaterials via on-Chip Waveguide-Coupled Terahertz Time-Domain Spectroscopy</b> <b>Jiang Peng, Dongwei Zhai*</b> School of Physical Sciences, Qingdao University
15:30-15:38	<b>Quantitative Analysis of Subsurface Optical Properties via Terahertz Scattering-Type Scanning Near-Field Optical Microscopy</b> <b>Shuchao Yu, Min Hu*</b> University of Electronic Science and Technology of China
15:38-15:46	<b>A Reconfigurable Terahertz Neuromorphic Chip for Penetrative Dynamic Vision and Compressed Information Transmission</b> <b>Huijun Zhao, Fei Fan*</b> Nankai University
15:46-15:54	<b>Repetition-Rate-Dependent Radiation Dynamics in Femtosecond Laser Filamentation with Pulse Accumulative Effect</b> <b>Chaopeng Yang*, Tie-Jun Wang, Yaoxiang Liu</b> Shanghai Institute of Optics and Fine Mechanics
15:54-16:02	<b>Strain-Controlled Optical Elements Based on Carbon Nanotubes for the Terahertz Frequency Range</b> <b>Arina V. Radivon, Aleksey V. Arsenin, Maria G. Burdanova</b> Moscow Institute of Physics and Technology, Russia

# Recording H-bond networks in action: the inter-molecular localized forces behind chemistry and biology

Sergio Carbajo

University of California Los Angeles (UCLA), SLAC Accelerator National Laboratory, Stanford

**Abstract:** Hydrogen-bond (H-bond) networks govern energy flow, structural stability, and reactivity across chemical and biological systems, yet their collective dynamics remain difficult to observe on their intrinsic timescales. Here we present new measurements that directly probe the ultrafast intermolecular forces shaping O–H stretching and H–O–H bending dynamics within extended H-bonded networks for the first time. By driving systems far from equilibrium, we resolve how localized vibrational coordinates couple to their surrounding network, revealing sub-picosecond to picosecond energy redistribution pathways that bridge molecular motion and mesoscale structural response. Our results show that H-bond topology actively modulates vibrational lifetimes, anharmonic coupling, and transient structural correlations, enabling a real-time view of how collective hydrogen-bond rearrangements gate energy flow in biochemistry and thus, illuminating fundamental mechanisms underlying chemical reactivity and biological dynamics.



**Biography:** Dr. Sergio Carbajo is a physicist and interdisciplinary scientist whose research spans ultrafast photonics, nonlinear and quantum optics, and advanced light-matter interactions. He is an Associate Professor in the Departments of Electrical & Computer Engineering and Physics & Astronomy at the University of California, Los Angeles (UCLA), and a Visiting Professor at the

Stanford University SLAC National Accelerator Laboratory Photon Science Division, where his work bridges fundamental science and cutting-edge instrumentation development. Carbajo directs the Quantum Light-Matter Cooperative, an academic-industry-national laboratory consortium focused on understanding and controlling light-driven processes for broad scientific and technological impact. He has made significant contributions to ultrafast sciences, including the generation and shaping of intense laser pulses, electron acceleration techniques, and strong-field terahertz science — all central to advancing THz-relevant technologies and applications. His work has earned prestigious recognitions, including the Nature Light: Science & Applications Rising Star Award, Humboldt Research Fellowship, and multiple U.S. Department of Defense Young Investigator Awards. Carbajo's research blends experimental innovation with theoretical insight to push the frontiers of light-matter interrogation on ultrafast timescales.

# Terahertz semiconductor quantum cascade lasers and applications

Juncheng Cao

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China

**Abstract:** Terahertz (THz) technologies have significant application prospects in physics, material science, biology, astronomy, information science and national security. THz radiation sources and detectors are the key devices for THz wave applications. In this report, we focus on the research progresses of the interaction physics between THz radiation and low dimensional semiconductors, the material growth and device fabrication of THz quantum cascade lasers and THz quantum well detectors, as well as the ultrafast wireless communication, high resolution imaging and other applications based on these THz quantum devices.



**Biography:** Prof. Juncheng Cao received his Ph.D. degree in electrical engineering from the Southeast University, Nanjing, China. He is currently the Terahertz (THz) opto-electronics group leader at Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China. He got the National Fund for Distinguished Young Scholars of China, the Natural Science Award of Shanghai (the Peony Award), the First-Class Award for Technological Invention of Shanghai Issued by the Shanghai Municipal Science and Technology Commission, the First-Class Award for Technological Invention of the China Institute of Communication, and the Excellent Teacher Award from Chinese Academy of Sciences. He is a member of the National "Million Talents Program". His current research interests include THz physics, THz semiconductor quantum devices and their applications in THz communication and imaging. He has more than 300 publications in refereed journals, including Physical Review Letters, Nature Communications, and Science Advances.

# High-performance terahertz quantum cascade lasers and applications

Chongchao Wu

Shanghai Jiao Tong University

**Abstract:** In this talk, I will present our research on high performance terahertz quantum cascade lasers (THz QCLs) in terms of narrow beam pattern, frequency tunability, high output power and accurate predictions of resonant mode characteristics for THz QCLs with distributed feedback. Furthermore, I will discuss our recent developments of THz QCLs-based imaging and sensing.



**Biography:** Prof. Chongchao Wu is a tenured Associate Professor at Shanghai Jiao Tong University. His research interests are terahertz quantum cascade lasers and terahertz technology. He has published in journals such as Nature, Optica, Nature Communications, Advanced Science, Laser & Photonics Reviews, ACS Photonics, Photonics Research, Nanophotonics, APL Photonics, Journal of Lightwave Technology, Optics & Laser Technology, Optics Express, Optics Letters and presented on CLEO, IEEE Photonics Conference, SPIE Photonics West, IRMMW-THz, IQCLSW. He serves as the Early Career Editorial Board of Photonics Insights, Journal of Infrared and Millimeter Waves. His research has been reported by Science Daily, Phys.org, Optics and Photonics News. He received B.S. degree from Fudan University, Shanghai, China and Ph.D. degree from Lehigh University, Pennsylvania, US. He performed postdoctoral research at Columbia University, New York, US.

# Quantum Cascade Lasers and Their Prospects for Deep-Sea Detection Applications

Junqi Liu

The Faculty of Information Science and Engineering, Ocean University of China

**Abstract:** Quantum cascade lasers (QCLs) are regarded as a revolution and milestone in the theory of semiconductor lasers, featuring a compact structure, high electro-optical conversion efficiency, and a broad wavelength coverage ranging from the mid-infrared to the terahertz band. Deep-sea exploration advances science, protects marine health, and sustains ocean resources. QCL spectroscopy technology, leveraging the molecular fingerprint spectral characteristics of the mid-to-far-infrared band and the advantages of high precision and high sensitivity of lasers, is expected to provide accurate and efficient technical support for core tasks such as deep-sea substance identification, environmental monitoring, and resource exploration.



**Biography:** Prof. Liu Junqi is a PhD supervisor and Professor at the Ocean University of China, also a concurrent research fellow at the Institute of Semiconductors, CAS. He obtained his PhD from the Institute of Semiconductors, CAS. His research focuses on infrared & terahertz semiconductor devices and quantum cascade lasers (QCLs) & detectors. He has achieved landmark innovations: developing the world's first practical room-temperature high-speed QCL and Asia's first GaAs/AlGaAs-based QCL, with a breakthrough of over 1 W terahertz QCL output power. He has led and undertaken more than 20 national key projects, published 200+ academic papers and applied for 40+ patents. He is a member of IEEE and other academic societies, a winner of the Second Prize of Beijing Municipal Technology Invention Award, engaging in cutting-edge optoelectronic research.

## High power THz sources based on quantum cascade lasers

Quanyong Lu

Beijing Academy of Quantum Information Sciences

**Abstract:** The terahertz sources based on quantum cascade lasers (QCLs), as an type of emerging solid-state source of terahertz radiation, have garnered significant attention in numerous application fields such as medicine, sensing, and communication. In this talk, I will first briefly introduction our recent work on room temperature THz sources based on difference-frequency generation from mid-IR QCLs. Then I will present our latest work on symmetry-protected bound state in the continuum terahertz quantum-cascade surface-emitting lasers. A well-defined vortex beam with a high power exceeding 1 W and robust single-mode operation is demonstrated from a BIC-enabled QCSEL at 3.9 THz.



**Biography:** Quanyong Lu received his doctoral degree from Institute of Semiconductors, Chinese Academy of Sciences and went to Center for Quantum Devices, Northwestern University as postdoctoral researcher and then Research Assistant Professor from 2010 to 2020. He was a Senior RD-chip Engineer in Applied Optoelectronics Inc. in 2020-2021. He joined Beijing Academy of Quantum Information Sciences (BAQIS) in November 2021. He has demonstrated the first continuous wave THz semiconductor source based on on-chip difference frequency generation, the first room temperature semiconductor THz comb, the highest power mid-IR single mode laser, and the highest power mid-IR laser array, and high bightness THz quantum cascade laser. His current research is focused on quantum light sources and systems, including quantum cascade lasers, frequency comb, terahertz laser sources, and other quantum light sources.

## Intense laser driven strong terahertz radiation

Yutong Li

Institute of Physics, Chinese Academy of Sciences

**Abstract:** Recently Terahertz (THz) radiation from laser-produced plasmas has attracted much interest since plasmas can work at arbitrarily high laser intensity. We systematically investigate the generation of strong THz radiation from solid targets irradiated by ultraintense laser pulses with relativistic intensities exceeding  $10^{18} \text{W/cm}^2$ . The numerous energetic MeV fast electrons produced by the high-intensity laser pulses serve as the primary source of the THz radiation. To enhance the THz radiation, a variety of techniques have been employed. The optimized energy of the terahertz pulses can reach the millijoule to hundreds of millijoules range, depending on the specific parameters of the driving laser pulses. Additionally, we have conducted preliminary studies exploring the new physics driven by the strong terahertz pulses, such as the excitation of biological protein dynamics, water dynamics, and THz-induced plasma.



**Biography:** Yutong Li is the professor, Director of the Key Laboratory of Optical Physics, the Institute of Physics, CAS. His research interests include the inertial confinement fusion, strong THz radiation driven by high intensity lasers, and laboratory astrophysics. He has published more than 200 papers in peer-reviewed journals. He has won awards including Young and middle-aged leading science and technology innovation talents; Winner of the National Science Fund of China for Distinguished Young Scholars; Second Class Prize of National Natural Science Award, etc.

# Generation and Manipulation on Terahertz Radiation from Laser Plasmas

Yanping Chen

Shanghai Jiao Tong University

**Abstract:** Terahertz radiation is essential for various applications, such as remote terahertz sensing and imaging, terahertz spectroscopy, electron acceleration and reshaping, molecular dynamics, and diagnostic of high power laser-matter interaction. Terahertz radiation from laser plasmas is considered to be an ideal desktop strong terahertz source, which has the advantages of wide radiation spectrum and no damage threshold. This talk focuses on the recent progresses on generation mechanism and manipulation of terahertz radiation in our group.



**Biography:** Yanping Chen, Professor in Shanghai Jiao Tong University. She received her Ph.D. degree in Physics from University Laval in Canada in 2010. Her research focuses on ultrafast laser science, terahertz science and technology, and applications of terahertz waves. She started establishing her research group on terahertz photonics in Shanghai Jiao Tong University (SJTU) in 2012. She has published over 50 peer-reviewed journal papers, including Nature Photonics, Physical Review Letters, Laser & Photonics Reviews, with more than 1500 citations.

# Electrically-pumped Terahertz topological photonic crystals lasers

Qijie Wang

Nanyang Technological University, Singapore

**Abstract:** In electrically-pumped semiconductor lasers, microfabricated structures like photonic crystals have been employed to reduce device footprints. Recently, topological concepts have been integrated into the design of photonic crystal lasers, enabling unprecedented robustness to perturbations and unique laser performance. In this talk, I will present how band topology, which is invariant under small deformations, generates robust topological lasing states in semiconductor laser platforms. In addition, I will introduce how photonic crystals lasers are designed using other promising topological concepts, such as Dirac vortex (or Majorana zero) cavities and topologically nontrivial flatband bound states in the continuum (BICs), for achieving robustness of lasing frequencies, structural beam engineering, and miniaturization while maintaining good laser performance.



**Biography:** Prof. WANG Qijie is a President Chair Professor in Optoelectronics at the School of Electrical and Electronic Engineering (EEE) and the School of Physical and Mathematical Sciences (SPMS), and the Associate Dean (Graduate) of College of Engineering, Nanyang Technological University, Singapore. He is an IEEE and OPTICA Fellow. He is a co-recipient of the Institution of Engineers Singapore, Prestigious Engineering Achievement Team Award of Singapore twice in 2005 and 2017, respectively, the prestigious Singapore Young Scientist Award 2014, Nanyang Research Award 2015 (Young Investigator), ARC Sciences Nanotechnology Medal and Prize, 2021, NTU College of Engineering Research Excellence Award, 2022, and X-C Zhang Award, 2026.

# Strong-field-driven tunneling transport of excitons in van der Waals material

Jingdi Zhang

Department of Physics, Hong Kong University of Science and Technology

**Abstract:** We demonstrate how strong field of laser pulse can drive ultrafast exciton transport in a van der Waals heterostructure. In the presence of coherent drive of the string field, a pronounced layer-to-layer up-conversion of intralayer excitons can take place on the femtosecond timescale. Comprehensive frequency- and field-dependent study shows novel scaling law in the framework of Keldysh criterion, strongly suggestive of tunneling transport of excitons in the non-perturbative regime as the dominant mechanism. Theoretical analysis further reveal that the strong in-plane field actively dresses the exciton wavefunctions, effectively bridging the interlayer energy gap and facilitating the tunneling dynamics. These results establish strong-field excitation as a powerful new degree of freedom for manipulating interlayer transport in 2D heterostructures.



**Biography:** Dr. Jingdi Zhang is now Assistant Professor of Physics at the Hong Kong University of Science and Technology (HKUST). He received his B.S. degree at University of Science and Technology of China with Prof. Xianhui Chen and Ph.D. degree at Boston University with Prof. Richard D. Averitt. He was a postdoctoral researcher at University of California, San Diego, supervised by Prof. Richard D. Averitt and Dmitri N. Basov. Dr. Zhang's current research interest includes light-matter interaction in quantum materials and time-varying metamaterials.

# Optical pump-terahertz emission investigation of ultrafast magnetization dynamics

Zuanming Jin

University of Shanghai for Science and Technology

**Abstract:** Understanding spin dynamics on ultrafast timescales offers not only fundamental insights into the coupling of both electrons and phonons with spins but also opportunities for faster and more efficient spintronic devices. However, reliable access to ultrafast spin dynamics in materials and devices under realistic device-operation conditions remains a challenge. Here, we demonstrate a spectroscopic method of optical pump-terahertz (THz) emission (OPTE), which gives direct access to the ultrafast demagnetization and re-magnetization dynamics in a contact-free method under ambient conditions. The observation time window is not limited by the pulse width of THz radiation emitted by the sample. We measure the ultrafast spin dynamics in a laser-excited Fe monolayer. Our measurements disentangle distinct components originating from (i) the ultrafast magnetization quenching that occurs in less than 0.5 ps and (ii) the fast and slow magnetization recoveries that correspond to the spin–lattice coupling and heat diffusion from the sample into the substrate/surroundings, respectively. The OPTE can be a platform to probe and optimize the performance of magneto-optical recording materials and THz emission applications.



**Biography:** Zuanming Jin is a professor at the University of Shanghai for Science and Technology.

He has published more than 40 papers (as the first or the corresponding author) in international scientific journals, including Nature Physics, Light: Science & Applications, etc. He is also in charge

of the National Natural Science Foundation of China (both the general, youth, and outstanding youth foundation programs). He was selected as Shanghai Rising-Star Program by the Science and Technology Commission of Shanghai Municipality, Young Eastern Scholar, Chen Guang and Shu Guang Project by Shanghai Municipal Education Commission etc.

# All-solid-state femosecond lasers for high-power broadband THz generation

Wenlong Tian

Xidian University

**Abstract:** High-power broadband terahertz radiation sources play a pivotal role in terahertz spectroscopy and imaging applications. Current research has achieved ultrafast terahertz pulses exceeding 100 mW through optical rectification techniques, using high-average-power ytterbium-based femtosecond lasers to drive nonlinear crystals. A key factor in further enhancing the average power and spectral bandwidth of terahertz radiation lies in developing femtosecond-driven lasers with high average power and short pulse widths, along with high-quality nonlinear crystals. This report details our group's recent progress in this field, including the development of a 20 W, 60 fs ytterbium-doped all-solid-state femtosecond oscillator and a 10 mJ-scale, hundred-watt average-power ytterbium-doped all-solid-state femtosecond amplifier, as well as their applications in generating high-power, broadband terahertz radiation.



**Biography:** Wenlong Tian, Professor and PhD Supervisor. He received his Ph.D. in Optical Engineering from Xidian University in 2016. From June 2018 to July 2020, he was supported by the OCPC Program to conduct postdoctoral research at the Deutsches Elektronen-Synchrotron (DESY) in Germany. Currently, he serves as the lead researcher for the short-pulse terahertz beamline of the "Advanced Attosecond Laser Infrastructure". He focuses on research areas including high-power,

high-energy femtosecond laser generation technology, nonlinear optics and terahertz pulse generation technology. He has published over 40 high-impact academic papers as the first or corresponding author, attended more than 40 domestic and international academic conferences, delivered 20 invited talks, and obtained 15 national invention patents.

# Synchronizing Terahertz Wave Generation with attosecond Bursts in Water

Dongwen Zhang

National University of Defense Technology

**Abstract:** We perform a joint measurement of terahertz waves and high-harmonics generated from a water film driven by a fundamental laser pulse and its second harmonic. By correlating their dependence on the phase delay between the two pulses, we determine the generation of THz waves in tens of attoseconds precision. Compared with simulations and models, we find that the laser-assisted soft collision of the electron wave packet with the water molecule ion plays a key role. It is demonstrated that the ionizing and rescattering process, being indispensable in high-harmonic generation processes, dominates THz wave generation as well in a more elaborate way. The new finding might be helpful for the full characterization of the ultrafast processes in the radiolysis of water.



**Biography:** Dongwen Zhang received the Ph.D. degree in physics from the National University of Defense Technology, Changsha, China, in 2008. He is currently a Professor with the Department of Physics, National University of Defense Technology. His research interests include strong field physics, photon-based THz technology, time-resolved THz spectroscopy of ultrafast phenomena, and high-harmonic generation spectroscopy in condense matter.

# Hybrid Metasurfaces for All-Optical Terahertz Ultrafast Computational spectrometer and single-pixel imaging

Longqing Cong

Southern University of Science and Technology

**Abstract:** Terahertz (THz) spectrum holds immense potential for applications in chemical sensing, biomedical diagnostics, and security screening. However, conventional THz spectrometers rely on mechanical delay lines and coherent detection, posing major challenges for miniaturization, speed, and cost. Here, we report an active hybrid metasurface that functions as a low-correlation and ultrafast spectral/spatial light modulator for THz computational spectrometer and single-pixel imaging. Dispersion-engineered metasurface with multiple quasi-bound states in the continuum achieves dense high quality factor resonances across a spectral range (0.30-0.55 THz), enabling dynamic modulation through all-optical excitation of integrated silicon patches. Temporally modulated metasurfaces form a measurement matrix for incoherent single-pixel detection, allowing nanosecond-scale spectral reconstruction with a resolution of 0.03 THz covering a 0.25 THz bandwidth. Extending this platform to a pixelated metasurface array, we demonstrate ultrafast THz single-pixel imaging with  $3\times 3$  pixels. This CMOS-compatible, circuit-free strategy enables ultrafast, compact, and high-resolution THz spectroscopy and imaging, and offer a scalable pathway toward next-generation THz photonic devices.



**Biography:** Longqing Cong received PhD from Nanyang Technological University and performed postdoctoral research at Nanyang Technological University and the University of Pennsylvania. His research interests include terahertz photonics, metamaterials, photonic crystals, and their applications in terahertz communications, imaging, and sensing. He has published over 60 peer-reviewed journal papers in Nature Communications, Science Advances, Physical Review Letters, Light: Science and

Applications, with more than 7400 citations. He serves on the editor board of the journal Ultrafast Science (Science Partner Journal), Photonix (IF: 19) and Chinese Laser Press. He was awarded the gold medal of “MRS Singapore best PhD thesis”, the World’s Top 2% Scientists by Elsevier, Best Young Scientist by IEEE Photonics Society, and the WuSi Medal of Shenzhen Government.

# Laser-induced magnetization dynamics in ultrathin CeTbIG films

Stanislaw Jakimowicz<sup>1</sup>, Wenhao Di<sup>2</sup>, Anhua Wu<sup>2</sup>, Jun Qin<sup>3</sup>, Lei Bi<sup>3</sup>, Andrzej Stupakiewicz<sup>1</sup>

<sup>1</sup>Faculty of Physics, University of Bialystok, Poland

<sup>2</sup>Shanghai Institute of Ceramics Chinese Academy of Sciences, China

<sup>3</sup>University of Electronic Science and Technology of China, China

**Abstract:** The ferrimagnetic garnets have a large scale of the functionality of optical and magnetic phenomena on intrinsic time-scales of the fundamental interactions governing the atomic, orbital or spin motion. In particular, finding for new mechanisms for ultrafast all-optical switching of magnetization is a widely researched topic, motivated both by its application potential and its value for fundamental research on light-matter interactions. Here, we demonstrate the excitation of ultrafast magnetization dynamics in a 100 nm thick CeTb-doped iron garnet film using time-resolved pump-probe method. The light pumping of the garnet was introduced in the form of linearly polarized pulses with a duration of about 50 fs. The pump wavelength was range of 500-1500 nm and the probe was set on 800 nm. Measurements were conducted on function of external magnetic field, state of pump polarization, pump fluence and pump wavelength at room temperature. The roles of the intrinsic dynamic, magnetic and optical properties in the processes of ultrafast laser-induced magnetization dynamics have been studied. Our results show the polarization-dependent coherent spin precession with a high Gilbert damping. This precession excitation provide to optically induced magnetoelastic anisotropy in a garnet film. Obtained results show that the near-infrared pulse induced phenomena that are usually observed in the far-infrared range at energy corresponding to the spin-phonon interactions in condensed matter.

# Terahertz Nonlinear Photonics

Liwei Song

State Key Laboratory of Ultra-intense Laser Science and Technology, Shanghai Institute of Optics and Fine Mechanics,  
Chinese Academy of Sciences

**Abstract:** The synergistic integration of ultrafast laser systems with nonlinear optical frequency conversion techniques has catalyzed a paradigm shift in high-field terahertz (THz) source development. Modern THz sources now deliver tunable spectral characteristics across multiple frequency bands, offering tailored excitation capabilities for probing non-equilibrium states in low-photon-energy condensed matter systems. The marriage of these intense THz sources with ultrafast pump-probe spectroscopy has opened unprecedented observational windows into THz-driven non-equilibrium dynamics. By leveraging both high peak fields (up to 10 MV/cm scale) and optimal photon energies (meV range), these THz excitations enable coherent manipulation of quantum states and lattice interactions with femtosecond precision. This talk will explore cutting-edge strategies for high-field THz generation and nonlinear photonics within the THz regime.



**Biography:** Liwei Song serves as Professor at Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, specializing in ultrafast laser technology and high-field THz science. He has developed a series of laser-driven high-field THz sources and ultrafast laser systems. With 50+ peer-reviewed publications in prestigious journals such as Nature Photonics and Nature Communications, he has led 10+ research projects. Recognized with the CAS High-Level Talent Award, he fosters interdisciplinary collaborations at the nexus of ultrafast optics, THz nonlinear spectroscopy, and quantum material manipulation, establishing innovative methodologies for probing fs to ps scale non-equilibrium dynamics in condensed matter systems.

# Terahertz frequency upconversion in a narrow gap semiconductor

Luyi Yang

Tsinghua University

**Abstract:** Terahertz (THz) frequency upconversion is crucial for advancing high-speed communication, computation, novel imaging and spectroscopic techniques. Here, we study the THz harmonic generation in the InSb/CdTe semiconductor heterostructure. We observe efficient second-harmonic generation, which is sensitive to the heterostructure configuration and exhibits a dependence proportional to the in-plane magnetic field. Through theoretical analysis, we confirm that the second-harmonic response originates from spin-orbit coupling, which enables a nonlinear transport response in the presence of a magnetic field. Additionally, we achieve efficient third harmonic generation, rivalling well-known Dirac materials like graphene and Cd<sub>3</sub>As<sub>2</sub>. This work not only establishes a novel approach for advancing THz optoelectronic devices, but also opens up a new avenue for studying nonlinear transport phenomena in the THz frequency range.



**Biography:** Prof. Luyi Yang received her B.S. in physics and mathematics from Tsinghua University (2007). She earned her Ph.D. in physics from the University of California at Berkeley (2013). Then she worked as a Los Alamos Director's Postdoctoral Fellow at the National High Magnetic Field Laboratory at Los Alamos. She became an Assistant Professor at the University of Toronto in 2016. She joined the Department of Physics, Tsinghua University as an Associate Professor in September 2019. Her research interests focus on the development of novel optical spectroscopies and their application to problems at the forefront of condensed matter and materials physics.

## Terahertz semiconductor laser chaos

Hua Li

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

**Abstract:** In the terahertz (THz) spectral range, due to the lack of effective THz light sources and high-speed detectors, chaos generation in THz semiconductor lasers, e.g., quantum cascade lasers (QCLs), is particularly challenging. In this work, we experimentally show a THz chaos source based on a sole multimode THz QCL without any external perturbations. Such a dynamical regime is characterized by the largest Lyapunov exponent associated to the temporal traces of the measured radio frequency (inter-mode beatnote) signal of the laser. To understand the physical mechanism of the chaos generation in THz QCLs, a model based on two coupled complex Ginzburg-Landau equations is developed to systematically investigate the effects of the linewidth enhancement factor and group velocity dispersion on the chaotic regime. This model allows us to show that the chaos generation in the THz QCL can be ascribed to the system attaining the defect mediated turbulence regime. Our findings pave the way for the generation of controllable and integrated THz chaos sources, as well as potential applications.



**Biography:** Hua Li, Ph.D., Professor of Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS). His research interests include high performance terahertz semiconductor lasers and detectors, frequency combs, and dual-comb sources.

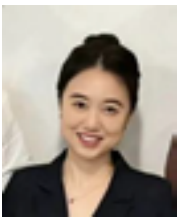
He has published more than 100 peer-reviewed papers, delivered more than 50 invited talks at international conferences, and obtained more than 20 licensed China invention patents and 1 licensed international PCT patent. He is the recipient of National Science Fund for Distinguished Young Scholars, National Science Fund for Excellent Young Scholars, Shanghai Outstanding Academic Leaders, Shanghai Youth Top Talent Support Program, High Level Talent Program of CAS, Special government allowances of the State Council, etc. He was awarded some prizes, e.g., the Second Prize of Shanghai Natural Science Award, the Xi-Cheng Zhang Award, the Excellent Scientist of Chinese Institute of Electronics, the President prize of the Chinese Academy of Sciences, etc.

# Transfer-matrix-with-source modeling of spintronic terahertz emitters: Unified emission and geometry-aware transport description

Yingshu Yang

Institute of Fluid Physics, China Academy of Engineering Physics

**Abstract:** Spintronic terahertz emitters (STEs) generate THz radiation via ultrafast spin currents. However, optimizing them is difficult as emission depends on both complex spin dynamics and electromagnetic wave propagation in multilayers. We present a unified framework using a Transfer-Matrix-with-Source method (TMMS). Derived from Maxwell's equations, it embeds spatial current-source terms directly into a transfer-matrix formalism. This allows self-consistent calculation of THz emission while rigorously handling propagation, interference, and reflections in realistic stacks. The model simultaneously provides the transmitted and reflected THz fields, linking emission to standard characterization. Integrated with this is a geometry-aware description of spin transport, including finite diffusion lengths and interface effects. This constructs physical current-source profiles within the TMMS calculation. The combined approach quantitatively shows how layer order, thickness, and pumping geometry alter the source distribution and final THz output, enabling rational device design.



**Biography:** Yingshu Yang is an Assistant Professor at the Institute of Fluid Physics, China Academy of Engineering Physics (CAEP). Her research focuses on the theoretical modeling of ultrafast spin dynamics, spin-to-charge conversion, and terahertz emission in spintronic heterostructures and 2D materials. She was previously a Postdoctoral Research Fellow at

Nanyang Technological University (NTU), Singapore, where she also earned her Ph.D., following an MSc in Optics and Photonics from Imperial College London.

Dr. Yang developed a theoretical framework and that unifies spin transport with electromagnetic propagation to model spintronic terahertz emitters. She has authored/co-authored 12 publications in leading journals, including Physical Review B, Advanced Optical Materials, Applied Physics Letters and Nano letters. Her contributions have facilitated international collaborations, and she serves as a reviewer for journals such as Physical Review Letters.

# Terahertz Emission Spectroscopy Evidences Sub-Nanometer Orbital Diffusion Lengths in Heavy Metals

Zhensheng Tao

Department of Physics, Fudan University

**Abstract:** The orbital angular momentum of electrons offers a promising, yet underexplored, degree of freedom for ultrafast, energy-efficient information processing. As the foundation of orbitronics, understanding how orbital polarizations propagate and convert into charge currents is essential but remains elusive due to the challenge in disentangling orbital and spin dynamics in thin films. While some theoretical studies predict that orbital transport is constrained to sub-atomic-layer scales in materials, recent experiments have reported exceptionally long orbital diffusion lengths. To address this contradiction, we combine terahertz emission spectroscopy with a wedge-sample platform to systematically investigate spin and orbital transport in heavy metals with sub-nanometer resolution. Our measurements access the previously unexplored thin-film regimes ( $<3$  nm), uncovering anomalous behaviors that challenge the prevailing interpretations of long-range orbital transport. We consistently find the orbital diffusion lengths ( $\lambda_L$ ) to be substantially shorter than the spin diffusion lengths ( $\lambda_S$ ) in heavy metals, with  $\lambda_L$  in W approaching 0.36 nm. Interface-sensitive control experiments further *rule out* interfacial orbital-to-charge conversion as the dominant mechanism, supporting the bulk inverse orbital Hall effect as the primary conversion process.



**Biography:** Zhensheng Tao is a Professor and PhD Supervisor in the Department of Physics at Fudan University. He received his bachelor's and master's degrees from the Department of Physics at Fudan University. In 2014, he earned his PhD from Michigan State University, USA, and subsequently conducted postdoctoral research at the JILA Institute, University of Colorado Boulder.

His research focuses on ultrafast strong-field optics and ultrafast light-matter interactions. He has published more than 40 peer-reviewed papers in journals including Science, Nature Nanotechnology, Physical Review Letters, and Science Advances. He has received several academic honors, including the Shanghai "Oriental Scholar" Distinguished Professorship, the Alexander von Humboldt Fellowship (Germany), and the "XiDe Young Professor" Award from the Department of Physics at Fudan University.

# THz generation enhanced by resonance of nonlinearity in Rb-doped KTP crystal for high-energy application

Dongwei Zhai

Qingdao University

**Abstract:** We demonstrate enhanced terahertz generation in Rb-doped KTP crystals via resonance of nonlinearity under tunable optical pumping (1.55–4.00 eV). A pronounced efficiency peak near the half-bandgap (~1.9 eV) is directly linked to a resonant increase in the second-order nonlinear susceptibility  $\chi^{(2)}$ , which is driven by two-photon absorption. The conclusion is supported by combined transmittance and TPA coefficient analyses, well-modeled by a three-level system, and experimentally validated by the matching profiles of the TPA coefficient and the terahertz emission peak. This work clarifies the mechanism behind the anomalous terahertz response and offers a spectral strategy for engineering high-energy terahertz sources.



**Biography:** Dongwei Zhai received his Ph.D. degree in Laboratory IMEP-LAHC at University of Savoie Mont Blanc (France), 2018-2022. He was supervised by Prof. Jean-Louis Coutaz and worked on nonlinear THz sources and the related ultrafast phenomena. His Ph.D. scholarship and the project is fully funded by ANR (France), which is in collaboration with international groups, KTH Royal Institute of Technology, Alborg University, and National Tsinghua University. He joined Qingdao University in 2023 and got Distinguished Young Scholars of Shandong province in 2024. Presently, he is an Assoc. prof, working on nonlinear THz spectroscopy. He has given 15 talks on international conferences and co-authored more than 20 articles on peer-reviewed journals.

## Ultrafast Laser Technologies and Products from Han's Laser

Qitao Lue

Han's Laser Technology Industry Group Co., Ltd.

**Abstract:** During last 15 years, Han's Laser Technology Industry Group Co., Ltd. has developed several ultrafast laser technology platforms and launched corresponding products mainly for industrial applications. This presentation will give an overview, including all-fiber-, bulk crystal-, and disc-based ultrafast laser technologies. They offer a wide range of laser parameter combinations, such as pulse width, pulse energy, repetition rate, and average power. Especially, the combination of tens of mJ pulse energy and high average power is most suitable as pumping source for efficient Terahertz pulse generation.



**Biography:** Deputy General Manager and Chief Technology Officer of Han's Laser Technology Industry Group Co., Ltd. He graduated from Huazhong University of Science and Technology with a degree in laser technology, earned a Ph.D. in physics from the Technical University of Berlin. After working at Rofin-Sinar Laser GmbH and Coherent Inc. for more than 15 years, he joined Han's Laser as CTO in 2008. He has published more than 100 academic papers in international journals, filed 4 German patents and dozens of Chinese patents. The high-power UV lasers and high-power ultrafast laser sources he has led in research and development have achieved comprehensive performance for diverse industrial applications. As a key technology leader, he collaborated with several universities in China to establish provincial collaborative innovation platforms such as the "Han's Industrial Laser Technology Research Institute," the "Guangdong Enterprise Key Laboratory for Industrial Ultrafast Laser Technologies".

## Femtosecond Laser Filament based Ionizing Radiation Sensing

Weiwei Liu

Nankai University

**Abstract:** We propose a novel filament-based ionizing radiation sensing method. It is demonstrated that the energetic electrons produced by  $\alpha$  radiation in air can be effectively accelerated within the filament, serving as seed electrons, which will enhance nitrogen fluorescence. The extended nitrogen fluorescence lifetime of  $\sim 1$  ns is also observed. Lastly, the combined microscopic model was elaborately established to quantitatively explain the modulation of nitrogen fluorescence emission from filament by ionizing radiation. These findings provide insights into the intricate interaction among ultra-strong light field, plasma and energetic particle beam, potentially suggesting a promising novel avenue for remote sensing of ionizing radiation.



**Biography:** Weiwei Liu received his Ph. D degree from Université Laval, Canada, in 2005, and joined Nankai University in 2007 as a full professor. His research interest mainly focuses on the ultrafast laser optics, THz science and technology, and applications. He has already published more than 300 scientific papers in peer-reviewed journals with more than 12,000 citation, and H-index reaches 56 (Google Scholar). Prof. Liu has given more than 100 invited talks in international conferences worldwide. Now, he is serving as the dean of College Electronic Information and Optical Engineering, member of the standing committee of Chinese Optical Society and vice president of Optical Society of Tianjin, topic editor of Optics Lettes, Optica fellow, etc..

# High-efficiency attosecond-resolution THz streaking of relativistic electron beams

Peng Lv

Tsinghua University

**Abstract:** Terahertz (THz) streaking is a powerful technique for ultrafast longitudinal diagnosis of relativistic electron beams, as THz pulses generated via optical rectification are intrinsically synchronized to the driving laser and exhibit wavelengths well matched to the characteristic phase-space dimensions of relativistic electron bunches. However, the temporal resolution of THz streaking is often constrained to the femtosecond-level by the available THz pulse energy and the efficiency of the THz-electron interaction. In this talk, we introduce a high-efficiency THz streaking scheme and the corresponding experiments conducted at the FORTRESS (Facility Of Relativistic Time-Resolved Electron Source and Scattering) of Tsinghua University. Using single-cycle THz pulses with only a few microjoules of energy, the measurement precisions of 100 as level for bunch length and 10 as level for arrival time have been achieved. These results demonstrate the potential of THz streaking as a practical attosecond-level diagnosis tool for the next-generation ultrafast electron beam facilities.



**Biography:** Peng Lv is a PhD candidate at Tsinghua University working in the field of accelerator-based ultrafast electron beams. His research interests include terahertz-driven beam manipulation, acceleration, attosecond-level longitudinal diagnosis, ultrafast electron sources and diffraction (UED) applications. He spearheaded the construction and commissioning of the FORTRESS beamline at Tsinghua, and played a key role in achieving low  $10^{-5}$  beam energy stability and few-fs temporal control precision. He has conducted studies on high-efficiency THz–electron interaction techniques to support the research on advanced beam manipulation, and has coordinated the ultrafast electron diffraction experiments for quantum materials and molecular science.

# Optically Inspired Terahertz Integrated Devices and Their Micro/Nano Fabrication

Xuecou Tu

Nanjing University

**Abstract:** With the advancement of silicon photonic chip manufacturing technology, silicon-based optoelectronic integration has made significant strides in areas such as optical detection, communication, and computing. Silicon-based optoelectronic integration offers valuable insights for terahertz chip technology research. By combining optical techniques and solid-state circuit technology, the developed terahertz waveguide integrated circuits can effectively reduce transmission losses and parasitic effects. This opens up new avenues for the realization of integrated high-speed terahertz devices and holds the potential to construct a new generation of terahertz communication architectures, thereby supporting the development of future terahertz microsystems. This presentation will focus on the design and fabrication of silicon-based waveguides, and their application in the design and development of terahertz integrated devices. The goal is to achieve efficient transmission and control of on-chip terahertz signals. Furthermore, the presentation will explore the hybrid integration of active chips like detector diodes with functional silicon-based waveguide chips, aiming to enhance or expand the detection efficiency and functionality of terahertz devices.



**Biography:** Xuecou Tu, a Professor-Level Senior Engineer at Nanjing University, is a distinguished member of the Dengfeng Talent Program, a national-level young talent, and an outstanding youth talent in Jiangsu Province. His research primarily focuses on micro-nano optoelectronic chips and their fabrication. His achievements have earned him two provincial and ministerial-level awards. As the first or corresponding author, he has published multiple papers in prestigious journals such as Nature, with over 1,000 citations. Four of his papers have been recognized as ESI Highly Cited Papers. Additionally, he holds more than 30 authorized Chinese invention patents.

# Spintronic Terahertz Emission in high-quality 2D Materials

Tianxiao Nie

Beihang University

**Abstract:** The advancement of future information technology requires efficient terahertz (THz) radiation sources and high-performance THz devices to support high-speed data transmission and information processing. At the material level, two-dimensional materials with atomically flat surfaces and topological materials featuring unique band structures present highly attractive opportunities for spin-based THz radiation and modulation. This report systematically investigates spin-based THz radiation in high-quality crystalline heterostructures  $(\text{Bi}_{1-x}\text{Sbx})_2\text{Te}_3/\text{Fe}$  through band structure engineering. By combining THz time-domain spectroscopy (THz-TDS) with electrical transport measurements, we elucidate the intrinsic connection between the Fermi level position and the Dirac point in topological insulators. Furthermore, introducing Bi layer with strong spin-orbit coupling generates Rashba mediated Dirac surface state, significantly enhancing terahertz emission efficiency. Subsequently, a complete van der Waals heterostructure  $\text{Bi}_2\text{Te}_3/\text{Fe}_4\text{GeTe}_2$  was fabricated via molecular beam epitaxy. Utilizing optical pump-THz probe (OPTP) spectroscopy, ultrafast laser-induced terahertz switching was achieved based on the synergistic effects of carrier accumulation at the interface and thermal effects. Through atomic-level engineering, high-quality circularly polarized terahertz radiation with an ellipticity exceeding 0.9 was achieved across an ultra-wide bandwidth exceeding 1 THz. This study provides novel design insights for optoelectronic terahertz emission based on two-dimensional topological materials, laying the foundation for future high-speed terahertz information technology.



**Biography:** Tianxiao Nie is currently a Professor and the Vice Dean of the School of Integrated Circuit Science and Engineering at Beihang University. He specializes in spintronic memory materials, devices, and spin-terahertz technologies. Dr. Nie has published more than 100 peer-reviewed papers in journals including Nature Communications and Advanced Materials, with over 5,900 citations and an H-index of 30. He holds over 40 patents and has contributed book chapters to Elsevier and Wiley. His professional service includes roles on the Youth Editorial Boards of InfoMat and InfoScience, Newton, the IOP China Editorial Advisory Board, and as Executive Chair of the ACM/IEEE NANOARCH conference, etc.

# Pressure Modulated Terahertz Emission in Gallium Telluride

Tianwu Wang

Aerospace Information Research Institute, Chinese Academy of Sciences (AIRCAS)

**Abstract:** THz time-domain spectroscopy has become a powerful non-contact method to study physics, material science, biomedical science, et al. However, once the material is fabricated, there is limited method to modulate THz emission due to the intrinsic dependence of generation mechanisms-optical rectification (OR) and shift current (SC)-on fixed material properties such as lattice symmetry and electronic structure. Here, we demonstrate hydrostatic pressure as an effective in situ way for modulating THz emission in a two-dimensional GaTe crystal. Using ultrafast THz emission spectroscopy in a diamond anvil cell (DAC), we observe a more than 13-fold enhancement in THz output under compression. By tuning the excitation wavelength, we uncover a pressure-induced THz emission transition from bound-electron OR to free-carrier SC.



**Biography:** Tianwu Wang is the researcher of Aerospace Information Research Institute, Chinese Academy of Sciences (AIRCAS) and the Supervisor of Doctorate Candidates at University of Chinese Academy of Sciences. He received his Ph.D. degree in Technical University of Denmark (DTU) and worked as a postdoctoral researcher in University of Alberta in Canada. He was awarded by the high-level researcher program of Chinese Academy of Sciences. He developed the first THz scanning tunneling microscope in China. His research interests include time-resolved THz spectroscopy, near field THz spectroscopy (THz-SNOM, THz-STM), and ultrafast dynamics of 2D materials.

# Flexible generation of multiple terahertz fields by NIR wavefront manipulation

Shixiang Xu

Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province, College of Physics and Optoelectronic Engineering, Shenzhen University

**Abstract:** Great challenge is facing due to the underdeveloped terahertz (THz) components and strong THz diffraction for THz field manipulation. This talk reports Flexible generation of multiple terahertz fields by NIR wavefront manipulation. Here, utilizing two specially engineered Pancharatnam-Berry (PB) plates, the NIR manipulation allows to modulate independently a pair of wavefront phases in horizontal or vertical directions, only requiring the target phases have equal partial differential to the corresponding spatial variables. Accordingly, it can enable separate or simultaneous modulations of wavefront phases upon NIR incidence by simply moving one PB plate. This all-optical and all-passive design simplifies the system configuration and enhances stability. A proof-of-principle experiment successfully demonstrates the dynamic generation and manipulation of THz vortex, Bessel, and vortex-Bessel fields with adjustable topological charge and “diffraction-free” distance by simple moving one of the PB plates. This mechanism offers a flexibly way to realize dynamic and multiple-wavefront manipulation of light fields, especially where direct phase modulation is practically restricted, e.g. in the THz domain, so has potential applications in THz communication, imaging, sensing, and others.



**Biography:** Shixiang Xu, a professor of Shenzhen University, completed his PhD in 1998 from Shanghai Institute of Optics and Fine Mechanics, China. Currently, he serves as a member of Laser Professional Committee, high-speed photography Professional Committee of Chinese Optical Society.

He was gained Shanghai Pujiang talent Fund. In 2023, He has awarded the First Prize of Shanghai Technical Invention. Up to date, has gained more than 20 funds at National, provincial and ministerial-level. He has published more than 180 papers in peer-reviewed journals, such as Nat. Communications, Adv. Photon., Laser Photon. Rev. et. al., and authorized more than 30 patents. His research interests include ultrashort pulse laser, ultrafast imaging, terahertz optics, and manipulation of light field.

# Phase-Driven Electron Dynamics with Intense Terahertz Waveforms

Yushan Zeng

Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

**Abstract:** Recent advances in strong-field terahertz sources have opened new opportunities for controlling light-matter interactions at extreme intensities. These developments, including high-power generation from crystalline materials and novel amplification mechanisms, provide a unique platform for manipulating electron dynamics with high energy gain and subcycle precision. Meanwhile, strong-field THz pulses enable diverse electron manipulation schemes. Using THz-driven surface waves in integrated waveguides, electron acceleration achieving 1.1 MeV energy gain has been demonstrated through synchronized phase control. A direct reconstruction method using phase-stable THz pulses has further been developed to resolve electron emission dynamics from nanotips, confirming tunneling emission and revealing strong emission suppression under specific phase conditions. These advances establish a versatile framework for strong-field THz photonics, spanning electron acceleration and coherent manipulation toward programmable electron beam applications.



**Biography:** Yushan Zeng is an associate researcher at the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. Her research focuses on terahertz-driven free-electron control, intense THz source development, and ultrafast electron dynamics. She has made key contributions to terahertz surface-wave amplification and electron acceleration, achieving MeV-scale energy gain in THz-driven waveguide structures. Dr. Zeng has published over 20 papers, including articles in *Nature*, *Nature Photonics*, *PRL*, and *Optics Express*, etc.

## Terahertz applications on non-destructive test and semiconductor

Min Hu

University of Electronic Science and Technology of China

**Abstract:** As a completely new frequency band in the electromagnetic spectrum, terahertz has great potential applications in many fields, but is limited by its long wavelength. Scattering near-field techniques combined with atomic force microscopy hold new promise for terahertz super-resolution imaging spectroscopy and its applications. This presentation will introduce the technology of terahertz near-field optical systems, especially the characteristics of imaging spectroscopy for near-field systems in the terahertz frequency band that are different from those in other frequency bands. The report will also introduce the development history of terahertz near-field systems, as well as the applications and bottleneck limitations in the fields of material analysis, biomedicine, semiconductor detection, etc. The report will also analyse and discuss the bottlenecks faced by terahertz near-field systems, such as signal-to-noise ratio, antenna resonance effect, and wavevector spectrum, and point out the solutions to these problems. Finally, the report will show the future development prospects of terahertz near-field systems.



**Biography:** HU Min, full professor at University of Electronic Science and Technology of China (UESTC), serves as the head of the Terahertz Science Research Center at the School of Electronics, UESTC, and as the deputy director of a key laboratory funded by the Ministry of Education. He has been selected into the Sichuan Tianfu Qingcheng Elite Program and holds positions as a member of the International Committee of the International Infrared, Millimeter, and Terahertz, as well as a deputy director of the Terahertz Branch of the Institute of Electronics. Hu has dedicated his career to researching free-electron terahertz radiation sources, terahertz near-field microscopes, and terahertz imaging systems. In recent years, he has led and undertaken numerous national-level terahertz projects, including key research and development plans from the Ministry of Science and Technology, key projects from the National Natural Science Foundation of China, and general projects. He has published over 100 SCI papers in academic journals, such as Nature Photonics, and holds over 50 authorized invention patents. He has received one first prize from the Sichuan Provincial Natural Science Award and one third prize for technological invention.

## Nonlinear Optical Metabolomics for Disease Diagnosis

Tzu-ming Liu

University of Macau, China

**Abstract:** Metabolomes, as the biochemical foundation of the central dogma, directly reflect phenotypic changes in the human body and provide feedback across all layers of omics. However, the labor-intensive sample preparation required for mass spectrometry and the lack of spatial information in tissues hinder their broader application in biomedicine. To address these challenges, we propose nonlinear optical metabolomics, a novel approach that leverages the intrinsic fluorescence and harmonic generation of metabolites in biological fluids and tissues. By analyzing multiphoton spectra and decay lifetimes at different excitation wavelengths, this method enables the differentiation of optical signals from distinct metabolites, facilitating their semi-quantification. Unlike conventional mass spectrometry, nonlinear optical metabolomics allows direct, reagent-free measurements, making it particularly suitable for continuous monitoring and early detection of acute illnesses. Additionally, when combined with lifetime imaging systems, it offers spatial metabolomic insights at sub-cellular resolution, opening new avenues for advancements in precision medicine.



**Biography:** Prof. Tzu-Ming Liu received Ph.D. degrees in Photonics & Optoelectronics from National Taiwan University in 2004. Dr. Liu was an assistant professor since 2009 and became an associate professor in the Institute of Biomedical Engineering, National Taiwan University. He developed 800-2300 nm infrared femtosecond lasers to perform nonlinear optical microscopy in vivo and medical spectroscopy in situ. In 2012, he visited Wellman Center for Photomedicine, Massachusetts General Hospital in USA and built multicolor infrared femtosecond laser sources for multi-label multi-photon microscopy. In 2016, he moved to University of Macau as Associate Professor. He extended his multidimension imaging platform with functional probes and transgenic labeled mice to study the complicated tumor microenvironment. He also developed blood fluorescence spectroscopy technology for the early diagnosis of sepsis and acute kidney injury.

# Terahertz Dielectric Metasurfaces with Broken Spatial Symmetry

Kebin Fan

Nanjing University

**Abstract:** Symmetry breaking serves as the foundation for understanding numerous physical phenomena and plays a crucial role in physics. Within the field of electromagnetics, symmetry breaking gives rise to a variety of intriguing effects, such as directional light scattering, supercavity lasing, and topologically protected states. In this presentation, we will introduce novel phenomena and functionalities achieved by introducing spatial symmetry breaking into terahertz dielectric metasurfaces. We will discuss how microstructures are designed to perturb the spatial symmetry of dielectric metasurfaces, enabling perfect absorption in ultrathin films, "Janus"-like holographic imaging, and perfect coherent absorption under weak coupling conditions. Finally, we will also present applications of symmetry-broken dielectric metasurfaces in high-sensitivity detection.



**Biography:** Kebin Fan, Associate Professor at the School of Electronic Science and Engineering, Nanjing University, was selected into the Young Talents Program of the National High-Level Talent Plan in 2019. He has long been engaged in research on the manipulation and detection of infrared and terahertz waves using metasurfaces. He has made significant achievements in areas such as the interaction mechanisms between artificial electromagnetic materials and other materials, as well as innovative applications of artificial electromagnetic materials. In this field, he has published over 70 SCI-indexed papers in journals including Nature, Physical Review Letters, Light: Science & Applications, Advanced Materials, and Optica, as well as one English monograph. His work has been cited more than 10,000 times, with an h-index of 42. He has been consecutively listed among the World's Top 2% Scientists for five years and was recognized as a Clarivate Highly Cited Researcher in 2025.

# Terahertz metasurfaces for dynamic wavefront shaping and their applications

Jierong Cheng

Nankai University

**Abstract:** Terahertz (THz) waves demonstrate broad potential application prospects in next-generation wireless communications, radar detection, imaging technologies, and information processing, thanks to their unique advantages including a wide frequency spectrum, low photon energy, and high spatial resolution. The dynamic control and multifunctional integrated modulation of THz beam propagation direction and wavefront morphology constitute the core key to improving beam gain, enabling mobile information transmission, and carrying out high-speed information processing. This report presents a series of research achievements based on twisted metasurfaces, multiplexed metasurfaces and liquid crystal metasurfaces, which realize THz beam dynamic scanning, multifunctional logic gate construction, and polarization characteristic analysis and detection. These findings are conducive to enhancing the multidimensional THz beam shaping capability of communication, sensing and imaging systems, as well as improving their effectiveness in perceiving the external environment.



**Biography:** Dr. Jierong Cheng received the Ph.D. degree in Northeastern University of USA. She is now a professor in School of Electronic Information and Optical Engineering, Nankai University. The main research field is terahertz metamaterial functional devices and spectral imaging applications. More than 40 papers have been published in Nano Letters, Laser & Photonics Reviews, Photonics Research and other journals, and 4 invention patents have been authorized. Led 4 projects from National Natural Science Foundation of China, and participated in National Key Research and Development Program of China.

# Topological photonic chips for terahertz wireless communications

Wenhao Wang

Westlake University

**Abstract:** Terahertz (THz) wireless communication holds immense potential to revolutionize future 6G to XG networks with high capacity, low latency and extensive connectivity. Efficient THz antennas are essential for energy-efficient connections, compensating path loss, optimizing resource usage and enhancing spectral efficiency. However, current THz antennas face several challenges, including notable loss, limited bandwidth, constrained spatial coverage and poor integration with on-chip THz circuits. Here we present an on-chip broadband THz topological beamformer using valley vortices for waveguiding, splitting and perfect isolation in waveguide phased arrays. The THz beamformer achieves complete 360° azimuthal beamforming with gains of up to 20 dBi, enabling a 72-Gbps chip-to-chip wireless link over 300 mm and eight simultaneous 40-Gbps wireless links. We further demonstrate THz topological leaky-wave antenna (LWA) that unifies leaky and guided topological edge states on a single silicon chip. The topological LWA enables beam scanning over 75% of the entire three-dimensional solid-angle space, enabling bidirectional dual-channel terahertz wireless links.



**Biography:** Wenhao Wang is an Assistant Professor in the School of Engineering at Westlake University. He received his B.Eng. degree from Beijing University of Chemical Technology in 2016 and his Ph.D. degree from the University of Electronic Science and Technology of China in 2022. He then conducted postdoctoral research at Nanyang Technological University, Singapore. His research interests include terahertz photonics, terahertz wireless communications, and photonic topological insulators. He has published over 30 peer-reviewed papers in leading journals, including Nature, Nature Photonics, Light: Science & Applications, Nature Communications, and Advanced Materials, with more than 1,900 total citations. His work has been featured by international media outlets such as IEEE Spectrum, Science Alert, and MIT Technology Review. He serves as an independent reviewer for journals including Advanced Materials, Nano Letters, ACS Photonics, Laser & Photonics Reviews, Opto-Electronic Advances, Advanced Optical Materials, Nanophotonics, Photonics Research, and Optics Letters.

# Terahertz Metasurfaces and Its Application Based on Sequential Structure of Functional Units

Guozhong Zhao

Dept. of Physics, Capital Normal University

**Abstract:** In this talk, the terahertz metasurface and its applications is presented. Terahertz metasurfaces based on the sequential structure of functional units are designed, fabricated and measurement for the different functional devices. Terahertz filter, polarizer, attenuator, polarization convertor and vortex beam generator are designed and analyzed by the simulation and partly experimental characterization. Based on the application requirements for biochemical sensing and detection, as well as our previous work on the design, fabrication, characterization, and mechanistic analysis of terahertz metasurfaces utilizing a sequential structure of functional units, we have developed a high-quality-factor terahertz metasurface sensing chip. This work explores methods for enhancing the sensitivity of biochemical molecular sensing using terahertz metasurfaces, providing a valuable reference for the development of highly sensitive terahertz sensing technologies.



**Biography:** Prof. Dr. Guozhong Zhao is engaged in long-terms work on terahertz spectroscopy, terahertz imaging, terahertz sensing, terahertz functional materials and devices. He is graduated from Institute of Physics, Chinese Academy of Sciences in China. After three years of postdoctoral work at TU Delft and TU/e in Netherlands, he enter into Key Lab of Terahertz Optoelectronics, Ministry of Education, in Capital Normal University, Beijing. He is working actively on the advancing fundamental applied research in terahertz spectroscopy, imaging, and sensing technologies. These works focus on the applications such as measurement material property, substance identification, screening and imaging human security, and biochemical sensing and detection. In recent years, he is working on the terahertz sensing detection of biochemical substances based on the terahertz metasurfaces.

# Momentum-Engineered THz Vacuum Electronics Devices

Chaohai Du

Peking University

**Abstract:** Terahertz (THz) technologies demand compact, high-power, spectrally agile sources for communications, sensing, and defense. Vacuum electronic devices, which feature wide spectral tunability, high power density, and geometries scalable from millimeters to microns, have re-emerged as promising solutions. This work reports progress on THz vacuum electronic devices based on subwavelength periodic microstructures. By utilizing the principle of free electron excited Cherenkov Radiation, we implement momentum engineering via spoof surface plasmons and grating architectures to achieve precise momentum matching with Floquet–Bloch harmonics. This allows deterministic control over radiation, including tunable far-field directivity, wideband polarization synthesis, and broadband tunable vortex beams carrying defined orbital angular momentum. We further propose an all-electric THz frequency-comb concept that exploits symmetry-broken quasi-bound states in the continuum (BICs) to produce extreme near-field enhancement and comb-like spectra without optical pumping. Emphasizing microscale control of electron-wave interactions, this work establishes design principles for compact, multifunctional THz vacuum electronic sources for radar, electronic warfare, and spectroscopic sensing applications.



**Biography:** Dr. Chao-Hai Du is a Research Professor at Peking University, a committee member of the IEEE VETC. He has received awards, including The Newton Advanced Fellowship from the Royal Society in the UK and The Distinguished Young Scientist Fund from the Beijing Natural Science Foundation. He was also honored with the IEEE Young Scientist Award in Vacuum Electronics, as the first Chinese recipient of this award. His research interests focus on millimeter and terahertz-wave electronics, and he has published over 80 papers in journals such as *Light: Science and Applications*, *Advanced Science*, *Advanced Functional Materials*, *Laser & Photonics Reviews*, *Photonics Research*, *IEEE EDL*, and *IEEE TED*. He developed the time and frequency-domain theory for millimeter-wave and THz gyrotron devices and was invited to publish a monograph with Springer. He has led over-10 national projects.

## Ultrafast nanophotonic information processing chip

Xiaoyong Hu

Peking University

**Abstract:** Ultrafast response and low-energy-consumption nanophotonic devices are essential units of integrated photonic information processing chips. By combining silicon nanostructure with anti-party-time symmetry and nonlinear optical material Bi<sub>2</sub>Se<sub>3</sub>, an optical modulator with a response time of 1.2 ps and low energy consumption of 10fJ is realized. Moreover, by using nonlinear activation function device made of silicon nanostructure covered with nonlinear optical material Bi<sub>2</sub>Se<sub>3</sub>, we also realized ultrafast silicon-based nanophotonic neural network chip for ultrafast information processing, including all-optical logic operation and complicated computing.



**Biography:** Xiaoyong Hu is a professor in Department of Physics, Peking University. He obtained Bachelor's degree from Hebei University in 1995, Master's degree from Hebei University in 2001, and Doctoral degree from Institute of Physics, Chinese Academy of Sciences, in 2004, respectively.

After engaged in postdoctoral research in professor Qihuang Gong's group in Peking University from 2004-2006, he joined in Department of Physics, Peking University. His research interest focuses on the research of novel third-order nonlinear photonic materials, photonic crystal topological insulators, and optical neural network chips. He has published over 170 papers, including 3 Nature Photonics, 1 Nature Materials, 3 Science Advances, 5 Nature Communications, 3 Physical Review Letters.

# Pulse Characteristic Modulation and Transient Measurement of Ultrafast Fiber Lasers

Lin Ke

Shandong University of Science and Technology, Singapore Institute of Technology

**Abstract:** Ultrafast lasers play an important role in precision machining, biomedical applications and ultrafast spectroscopy. The precise control of ultrafast laser pulse characteristics, such as wavelength, intensity, pulse width and laser state, is required for numerous applications and scientific investigations. Furthermore, ultrafast lasers can serve as exceptional nonlinear optical platforms for frontier scientific research, and the transient dynamic processes they contain necessitate thorough exploration. This paper presents a new controllable parameter in the optical modulator that successfully achieves long-term stable dynamic regulation of different laser states in ultrafast lasers, solving the problem of insufficient regulation capability in ultrafast lasers based on passive modulator devices. Furthermore, using the time-stretched dispersive Fourier transform technique, transient phenomena occurring during the regulation of ultrafast laser characteristics were measured and analysed. This revealed novel internal dynamic mechanisms and provided a new perspective on the regulation of ultrafast laser characteristics.



**Biography:** Ke Lin has worked at Singapore A\*Star for 27 years, with extensive expertise in photophysics and electrical/optical characterization of photonic, nanophotonic, terahertz (THz), green photonics, and semiconductor optoelectronic materials and devices. She has led numerous THz-related projects across aerospace, food, biomedical, healthcare, and semiconductor sectors,

including THz emitter development, metamaterials, and superlens technologies. As Principal Investigator, Ke Lin heads IMRE A\*Star's Ultra-fast and THz laboratories, overseeing advanced systems such as THz time-domain spectroscopy, Optical Pump THz Probe (OPTP), THz Pump THz Probe (TPTP), and time-resolved photoluminescence setups. Through her leadership, Ke Lin has a strong track record of integrating complex photonic systems, guiding multidisciplinary research teams, and translating advanced THz technologies into practical applications, bridging fundamental research and industry.

# High power vortex wave generation with TWTs and meta-surface

Jinjun Feng

Beijing Vacuum Electronics Research Institute (BVERI)

**Abstract:** Vortex wave has potential application in high-throughput and high data rate wireless communications but suffers from short distance for the reason of high transmission loss in the millimeter wave and terahertz frequency regime. To address this issue, a scheme for high power vortex wave generation is proposed using a TWT and a metasurface which combines the high power of vacuum electron devices at high frequencies and the spatial phase controlling of the meta-surface. First, the design and calculation of a dielectric meta-surface using an array of cylinders was carried out and the results show that the transmission is over 75% and a vortex wave carrying orbital angular momentum (OAM) with topological charge  $l = +1$  was successfully generated at the frequencies from 71GHz to 76GHz. Then a vortex wave radiation chain consists of an E-band TWT, a horn antenna and the designed metasurface was experimentally constructed, in which the horn antenna converts the TE<sub>10</sub> mode from the TWT into a quasi-plane wave, and the metasurface controls the helical phase front. Full-wave simulations predict a mode purity of 97 % across the 5 GHz bandwidth. A vector-network-analyzer-based 3-D near-field scanning system operating at 74 GHz was used to acquire amplitude and phase data; the measured mode purity is 30.7 % for  $l = +1$  vortex wave. These results demonstrate the feasibility of using a TWT–metasurface combination for high-power OAM multiplexing in future E-band transmission links.



**Biography:** Jinjun Feng, got the bachelor degree from Tsinghua University and Ph. D from Beijing Vacuum Electronics Research Institute. Now he is a Fellow of CIE, China, a fellow of the IET, UK, and a senior member of IEEE. He is the Recipient of IEEE John R Pierce Award of the Excellent in Vacuum Electronics in 2019. His main Research interests include vacuum electronics and related high frequency and high power devices.

# Optically Addressed Programmable Metasurface for Terahertz Wavefront Modulation

Yan Zhang

Department of Physics, Capital Normal University

**Abstract:** Metasurfaces are a class of artificial materials capable of manipulating the amplitude, phase, and polarization of electromagnetic waves. However, in conventional metasurfaces, the functionalities are fixed once fabrication is completed, which limits their adaptability to practical applications. In contrast, dynamically tunable or pixel-level programmable metasurfaces are more suitable for applications such as terahertz communications and terahertz imaging. Here, we propose several types of optically addressed metasurfaces for dynamic control of terahertz wavefronts. The first design is a silicon-based metasurface capable of storing 46 distinct images. The second design employs a metasurface composed of photogenerated carriers induced by structured optical pumping. By modifying the spatial pattern of the pump light, the carrier distribution—and consequently the effective metasurface configuration—can be reconfigured, enabling dynamic functionality. As a demonstration, a tunable lens with variable focal length and focal position is realized. The third design integrates a coding metasurface with vanadium dioxide ( $\text{VO}_2$ ). Under structured optical excitation, the phase transition of  $\text{VO}_2$  induces phase modulation in the meta-cells, allowing them to perform different functions. A meta-cell with 2-bit phase modulation is designed, and experimental results demonstrate its capability for dynamic wavefront control. These optically programmable metasurfaces provide versatile and reconfigurable platforms for terahertz wave manipulation and are expected to offer powerful tools for future terahertz technologies.



**Biography:** Prof. Dr. Yan Zhang, director of Beijing Key Lab for Metamaterials and Devices. His research interests include terahertz imaging and spectroscopy, surface plasmonic optics, optical information processing. He has published more than 300 prereviewed papers and delivered more than 50 invited talks in the international conferences. He is a fellow of OPTICA.

## Inverse design of reconfigurable terahertz metasurfaces

Wenhui Fan

Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences

**Abstract:** Metasurfaces, as artificially engineered two-dimensional materials, demonstrate significant potential in terahertz communications, imaging, and sensing applications. However, conventional metasurface designs confront challenges, such as limited functionality, insufficient efficiency, and difficulties in correcting broadband chromatic aberration. Currently, the design and optimization of metasurfaces usually rely on the physical knowledge and design experience of researchers, which often require a long simulation time and a large amount of computing resources. Moreover, the initial structure of the meta-units is solely based on the researchers' cognition and relatively simple geometric shapes, which limits the design accuracy of the metasurfaces and the broader control ability of the functional devices over electromagnetic waves. Although the use of deep learning algorithms can overcome the inherent computational time-consuming and complex operation defects of traditional methods, the metasurfaces usually have complex spectral responses and sharp resonance peaks within the operating frequency band, the inverse design of phase-controlled metasurfaces still faces the defect of large errors. Here, an inverse design strategy integrating physical mechanism analysis and deep learning algorithms is proposed, which reduces the demand for data training and decreased the number of iterations. Even with a large amount reduction in data 'feeding', the design efficiency and accuracy are still improved.



**Biography:** Professor Wen-Hui FAN achieved his Doctor of Science degree in 1998, and serves as a senior researcher in Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences since 2007 after working in UK nearly six years. His main research fields include terahertz science and technology, interaction between ultra-short pulse lasers and matter, and ultrafast photon technology, and so on. He has been selected as an expert with special government allowance by the State Council, a recipient of the BR program priority support by the Chinese Academy of Sciences, and an outstanding returning overseas scholar from Shaanxi Province. Currently, he is a member of the China Bing Gong Society's Professional Committee for Terahertz Application Technology, the deputy editor-in-chief of Ultrafast Science, and a member of the editorial board of Acta Photonica Sinica. So far, he has delivered over 40 invited talks at international conferences, published 166 academic papers and authorized over 15 patents. The graduate students he supervised have received honors, such as the "Bo Xin Program", the "National Scholarship", the "Doctoral Scholarship for Zhu Li Yuehua" and the "President's Award of the Chinese Academy of Sciences".

# Broadband Electromagnetic Absorbing Materials and the Applications in Terahertz Devices

Qiye Wen

University of Electronic Science and Technology of China

**Abstract:** This report investigates the characteristics of high-frequency electromagnetic loss in terahertz (THz) bands, and proposes novel low-dimensional conductive materials represented by MXene, together with their underlying mechanisms for high-frequency and broadband electromagnetic loss. It highlights the development of multi-morphology and multi-functional electromagnetic wave-absorbing materials based on the synergistic integration of magnetic, electric, and dielectric multi-loss mechanisms, enabling ultra-broadband absorption spanning GHz to THz. Furthermore, the report elaborates on the versatile applications of broadband wave-absorbing materials in THz devices and components, including wave-absorbing matching loads, waveguide couplers, phased array antennas, high-power combining modules, packaging and testing of communication modules, and metrological calibration devices.



**Biography:** Wen Qiye is a full professor from University of Electronic Science and Technology of China (UESTC). His researches focused on THz electromagnetic shielding and absorbing materials, high metrology and testing, and integrated packaging technologies for next-generation electronic information technologies. He has published over 160 papers in prestigious journals such as Nature Photonics, Nature Communications, Advanced Functional Materials, Advanced Science, et al. He also secured more than 40 invention patents. The broadband terahertz electromagnetic wave-absorbing materials have been successfully applied in a variety of terahertz functional devices and components, and have provided important support for their research work of national key projects.

# Spatiotemporal Coding Terahertz Plasmonic Vortex on-Chip Interferometer

Fei Fan

Nankai University

**Abstract:** Plasmonic vortices (PV) stimulated from metallic micro-nano structures hold great promise for improving on-chip data capacity. However, the manipulation freedom degree and reconfigurability of current PV devices still need further development in the terahertz regime, especially the simultaneous excitation of two or more PV modes and their coherent synthesis. This report will present our team's recent work on spatiotemporal coding terahertz PV interferometer and its applications in logical photonic computing. This metadvice can dynamically manipulate the transient evolution of spin-orbital angular momentum in the time domain, and the superposition field distribution in the frequency domain. By introducing sufficient surface wave path difference, different modes can be modulated independently within the separated time window based on the liquid crystal encodings. This space-time correlation coding enables to dynamically control the mode weightings, and finally obtain 16 superposition distributions. This reconfigurable on-chip interferometer and its dynamic spatiotemporal regulation mechanism pioneer an avenue for intelligent perception and photonic computing.



**Biography:** Fei Fan is Professor, PhD Supervisor and Vice Dean of the College of Electronic Information and Optical Engineering at Nankai University, also Deputy Director of the Tianjin Key Laboratory of Optical Sensors and Sensing Network Technology and a Young Discipline Leader of Nankai University; his research focuses on original work of terahertz structural and functional devices and their applications in communications, spectroscopy and sensing, with over 100 papers published as the first or corresponding author in top optoelectronic journals including Nature Communications, Advanced Materials, Optica, Advanced Functional Materials, Laser & Photonics Reviews, Advanced Science and Photonics Research. He has presided over and participated in multiple major research projects such as the Key and General Programs of the National Natural Science Foundation of China, the National Key R&D Program and the 973 Program, been selected for talent programs including the Tianjin Science and Technology Talent Program, the Young Talent Support Program and the Tianjin "131" Talent Project, and won two Second Prizes of the Tianjin Natural Science Award (ranking 1st and 2nd respectively) as well as the Special Prize of the Tianjin Teaching Achievement Award and other honors.

# Femtosecond laser induced phenomena in transparent materials--their mechanisms and applications

Jianrong Qiu

Zhejiang University, China

**Abstract:** Femtosecond laser is an extreme physical condition. It has been widely used for additive, subtractive and equal material manufacturing due to its ultra-short laser pulse and ultrahigh light intensity. When a transparent material e.g. glass is irradiated by a tightly focused femtosecond laser, the photo-induced reaction occurs only near the focused part of the laser beam inside the glass due to the multiphoton processes. In this talk, we will describe what happened during and after the fs laser irradiation in transparent materials, some observations of interesting phenomena, e.g. precipitation of bandgap tunable nanocrystals and formation of periodically distributed nanocrystals etc. The mechanisms and promising applications of these phenomena are also discussed.



**Biography:** Jianrong Qiu is a professor of Zhejiang University, China. His main research fields are photonic materials and laser interaction with matter. He has published 500 papers in Science, Nature Electronics, Nature Photonics etc with citation more than 42500 times (Web of Science). The research achievements of his group were elected as top ten scientific advances in China (2022) and China's top 10 breakthroughs in optics (2020, 2022). He received Otto-Schott Award from the Ernst Abbe Fund, Germany and G. W. Morey Award from the American Ceramic Society. He is fellow of Optica and the American Ceramic Society, academican of the European Academy of Sciences.

# Competing Lattice and Defect Dynamics Govern Terahertz-Induced Ferroelectricity in Quantum Paraelectric SrTiO<sub>3</sub>

Jingbo Qi

University of Electronic Science and Technology of China

**Abstract:** Intense terahertz (THz) pulses induce transient inversion-symmetry breaking in quantum paraelectric SrTiO<sub>3</sub>, yet the underlying mechanism remains controversial. Using fields up to  $\sim 1.1$  MV/cm, we reveal spatially inhomogeneous THz-field-induced second harmonic generation (TFISH) governed by competing lattice and defect dynamics [1]. Short-lived coherent antiferrodistortive (AFD) modes suppress dipole correlations within  $\sim 5$  ps, while heavily damped soft/AFD modes and a defect-induced low-frequency mode ( $\sim 0.1$ - $0.3$  THz) jointly prevent long-range ferroelectric coherence in oxygen-vacancy-rich regions. Collective modes manifested by oscillatory TFISH components exhibit softening followed by hardening below a critical temperature  $T^* \sim 28$  K, confirming transient ferroelectric order where defects are sparse. These results reconcile conflicting interpretations, establish defect-mediated competition as a central regulator of light-induced ferroelectricity, and open routes to ultrafast control of quantum materials. [1] L. Cheng, K. Hu, S. Yang, Yan Liang, Jiandi Zhang, and J. Qi, arXiv:2512.01253 (2025)



**Biography:** Jingbo Qi, a professor at the University of Electronic Science and Technology of China.

He got his Ph.D. from Vanderbilt University. He was ever a postdoctoral associate in the National High Magnetic Field Laboratory and Los Alamos National Laboratory, respectively. His main research interest focuses on using the ultrafast optical spectroscopy and terahertz spectroscopy to

study the dynamical properties in various systems such as topological, magnetic, and strongly correlated materials. The related results are published in Phys. Rev. Lett., Nat. Commun. and etc.

# Development of a Table-top Ultrafast Hard X-ray Diffraction Apparatus

Runze Li

ShanghaiTech University

**Abstract:** Ultrafast X-ray diffraction (UXRD) directly tracks lattice degree of freedom, offering a powerful route to study structural phase transitions, electron–lattice coupling, and to benchmark ultrafast control of quantum materials. Here we present a tabletop ultrafast hard X-ray diffraction apparatus developed in-house. It is driven by femtosecond laser irradiation of copper tape. With 1 kHz, 35 fs, 3.0 mJ/pulse irradiation, the laser-plasma X-ray source stably delivers Cu K $\alpha$  characteristic line at 8.04 keV with a photon flux up to  $10^{10}$  photons/s. The instrument combines a compact footprint, high repetition rate, and strong detection sensitivity, enabling high spatiotemporal-resolution diffraction experiments in a standard laboratory setting. Using this platform, we have initiated lattice-dynamics studies in representative oxide thin films, observing transient lattice expansion following femtosecond optical pumping and correlating the response with electron–phonon energy transfer and thermally driven heating. These results validate instrument performance and highlight its potential for probing ultrafast structural responses in complex materials.



**Biography:** Dr. Li is currently an assistant professor of physics at the School of Physical Science and Technology, ShanghaiTech University. He received his Ph.D. from the Department of Physics, Shanghai Jiao Tong University (supervised by Prof. Jie Zhang) in 2014. Before joining ShanghaiTech in 2020, he worked with Prof. Peter M Rentzepis as a Postdoctoral Research Associate and Assistant Research Scientist at the Electrical and Computer Engineering Department, Texas A&M University. His research interests include utilizing femtosecond optical, electron, and X-ray pulses to reveal various ultrafast dynamics in condensed matter systems. Research Group Website: [www.ultrafast.cn](http://www.ultrafast.cn)

# A CEP-stabilized OPCPA system with above 5 TW output at 1 kHz repetition rate

Yudong Yang

Songshan Lake Materials Laboratory

**Abstract:** High-power, high-energy, few-cycle lasers serve as powerful tools for generating high-brightness attosecond pulses and an effective means for opening new avenues in strong-field light-matter interaction research. This report primarily introduces our research progress on high-power, high-energy, few-cycle optical parametric light sources. Based on optical parametric chirped-pulse amplification (OPCPA) technology, we have constructed a high-power optical parametric amplification system, in which a Yb:KGW laser and an Nd:YAG laser are used to respectively pump the front-end optical parametric seed source and the optical parametric power amplification stage. The system delivers CEP-stable, near-infrared, high-energy sub-10 fs laser pulses with a repetition rate of 1 kHz, a central wavelength around 800 nm, an average power >50 W, and a peak power >5 TW.



**Biography:** Yudong Yang is a research scientist at Songshan Lake Materials Laboratory, where he is building a high brightness HHG XUV source. He received his bachelor's and master's degrees in physics from Sun Yat-sen University (Guangzhou, China) and Peking University (Beijing, China) in 2009 and 2012 respectively. In 2012, he joined the Ultrafast Optics and X-rays group of Prof. Franz X. Kärtner at CFEL, DESY as PhD student in Hamburg University (Hamburg, Germany) and received his PhD in 2017. After the PhD, he continued in the UFOX group as postdoc. During that time, he and coworkers achieved the first demonstration of sub-cycle millijoule-level pulses generated via parallel parametric waveform synthesis. He also demonstrated the direct generation of HHG isolated attosecond pulses without the use of gating techniques via this unique laser source. In 2021, he joined Songshan Lake Materials Laboratory (Dongguan, China). His research interests include few-cycle femtosecond lasers and sub-cycle optical waveform synthesizers, ultrafast XUV/soft X-ray sources, and attosecond science.

# Ultrafast spectroscopy of correlated fermion-boson mixtures in 2D materials

Hyunyong Choi

Department of Physics and Astronomy, Seoul National University, Seoul, Korea

**Abstract:** Two-dimensional semiconductors and their moiré superlattices offer a unique platform to explore correlated electrons (fermions) and exciton (boson) dynamics. In this talk, I will present recent ultrafast spectroscopic probes of such fermion-boson mixed moiré superlattices. Starting with the ultrafast Stark spectroscopy of Fermi-polarons in monolayer WSe<sub>2</sub>, then I will discuss the twist angle-tuned WSe<sub>2</sub>/WS<sub>2</sub> heterobilayers, where how the moiré interlayer exciton (IX) formed and thermalized is probed using ultrafast intralayer resonances. Furthermore, by tuning the exciton filling with a continuous-wave pump and applying femtosecond pump-probe spectroscopy, we uncover a 10 ps recovery governed by bosonic hopping that precedes the ~30 ps thermalization of interlayer excitons. This hierarchy reveals the nonequilibrium fermion-boson-mixed Hubbard physics in moiré materials.



**Biography:** Hyunyong Choi is a Professor of Physics and Astronomy at Seoul National University.

He received his BS degree in Electrical Engineering from Yonsei University in 2002 and his MS and

Ph.D. degree in Electrical Engineering and Computer Science from the University of Michigan, Ann

Arbor in 2004 and 2007, respectively. He did his postdoctoral researches at the Lawrence Berkeley

National Laboratory from 2008 to 2010. He has been an Assistant (2011-2015) and an Associate Professor (2015-2019)

in Yonsei University. Since 2019, he has been in the Department of Physics and Astronomy at Seoul National

University. His research group is interested in the ultrafast light-matter interaction, with emphasis on the time-resolved

optical and terahertz spectroscopy of quasiparticle dynamics in low-dimensional quantum materials.

# Ultrafast photo-magnetic recording in dielectrics

Andrzej Stupakiewicz

Faculty of Physics, University of Białystok, Poland

**Abstract:** In the last decade ultrafast magnetism enjoys bright perspective of providing the possibility to all-optical control of spins at an femtosecond time scale. In the applications, the ultrafast magnetic recording in medium with is expected to provide for the increasing efficiency writing requirements. This in turn strongly fuels the research into alternative approaches, among which very promising seems to be the all-optical magnetization switching based on ultrafast laser pulses, demonstrated in different systems in the last years. One of the most elegant approaches for nonthermal magnetic recording with light is the photo-magnetism which is based on a resonant optical excitation of strongly anisotropic ions in iron garnet dielectrics using linearly polarized light. Employing femtosecond laser pulse, the mechanism of photo-magnetic effect in garnets was demonstrated to enable switching of the magnetization states (i.e. recording the "0" and "1" magnetic bits). Additionally, we demonstrated that with femtosecond pulses it is possible to write and rewrite magnetic bits with a frequency of up to 50 GHz. Our results reveal the principles to be employed in achieving cold and ultrafast magnetic recording in dielectrics far beyond today's state of the art, thus approaching the quantum limit.



**Biography:** Andrzej Stupakiewicz received his Ph.D. in Physics in 2000 at the Institute of Physics, Polish Academy of Sciences. He works at the Faculty of Physics of the University of Białystok, Poland, where he has been a professor since 2012 and has led the TEAM Lab since 2018. He received individual scientific awards from the Polish Physical Society, the Polish Academy of Sciences, and the Ministry of Education and Science. Presently, his main research interests focus on ultrafast photo-magnetism, phononics, plasmonics and magnetic recording. He has co-authored more than 120 publication (e.g. Nature, Nature Phys., Nature Comm.).

## High-Repetition-Rate Ultrashort Pulsed Fiber Lasers

Yue Zhou

Beijing University of Posts and Telecommunications

**Abstract:** In this talk, we report our research on high-repetition-rate ultrashort pulsed fiber lasers. For femtosecond pulse generation and supermode noise suppression at multi-GHz pulse repetition rates, as well as few-cycle pulse generation at hundred-MHz repetition rates, an all-fiber erbium-doped fiber laser based on NPE (Nonlinear Polarization Evolution) and regenerative harmonic mode-locking was designed, successfully achieving 10 GHz pulse repetition rate, 583 fs pulse width, and supermode noise suppression greater than 80 dB. Furthermore, a fully polarization-maintaining all-fiber erbium-doped fiber laser based on NALM (Nonlinear Amplifying Loop Mirror) and regenerative harmonic mode-locking was designed, achieving 10 GHz repetition rate, 537 fs pulse width, >80 dB supermode noise suppression, and a single-sideband (SSB) phase noise of  $-135.2$  dBc/Hz at 10 kHz offset.



**Biography:** Zhou Yue, Associate Professor, Doctoral Supervisor, obtained his Bachelor's degree from the Department of Electronic Engineering at Shanghai Jiao Tong University in 2008 and his Ph.D. from the Department of Electrical and Electronic Engineering at The University of Hong Kong in 2012. He conducted postdoctoral research at the Massachusetts Institute of Technology in the USA and the German Electron Synchrotron (DESY) from 2013 to 2014. His main research directions include ultrafast fiber optics, fiber lasers and optical frequency combs, nonlinear optics, and biophotonics. He has published over 50 papers in top-tier international journals and conferences and is an active reviewer for renowned Optical Society of America journals such as Optics Letters and Optics Express. He received the IEEE Photonics Society Graduate Student Fellowship and awarded The University of Hong Kong Outstanding Research Postgraduate Student Award. He has led and undertaken numerous national, ministerial, provincial, university-level, and industry collaborative projects, including the National Natural Science Foundation of China and equipment pre-research projects.

# Ultrafast Dynamics and Stability of Electron-Hole Liquid in 2D Semiconductors

Ting Yu

Wuhan University

**Abstract:** The electron-hole liquid (EHL) represents a distinct macroscopic quantum state that emerges under high-density excitonic excitation. As a condensed phase stabilized by intense many-body Coulomb interactions, EHL offers significant potential for applications in high-power photonics and quantum information science. Despite its importance, the microscopic mechanisms governing EHL formation remain elusive. Conventionally, the transition to an EHL phase is identified via photoluminescence (PL) spectroscopy, characterized by a pronounced spectral redshift and a nonlinear enhancement in emission intensity. However, temporally resolved insights into the ultrafast dynamics of these states are currently limited. In this work, we investigate the dynamical evolution of EHL by combining steady-state optical excitation with femtosecond transient absorption (TA) spectroscopy. Our results reveal consistent spectral signatures between the TA and PL measurements, which, coupled with a markedly extended kinetic lifetime, provide compelling evidence for the formation and stabilization of the EHL phase. This study underscores the potential of liquid-like charge excitations as a robust platform for exploring fundamental quantum phenomena and engineering next-generation optoelectronic devices.



**Biography:** Dr. Ting YU is now a professor at School of Physics Science and Technology, Wuhan University, China. He received his PhD from Department of Physics, National University of Singapore in 2003. He was promoted to be a full professor of Division of Physics and Applied Physics, Nanyang Technological University, Singapore in 2017. Dr. YU has received many prestigious awards including Nanyang Excellence Award for Research and Innovation (2008),

National Young Scientist Award, National Research Foundation Fellowship Award (2009), Outstanding Young Scientist for the 3rd Inter Academy Panel/World Economic Forum (Summer Davos Forum) and Institute of Physics Singapore, Nanotechnology award (2011) et al. His research interests cover fabrication of low dimensional, especially 2D materials and investigation of their optical, opto-electronic and opto-magnetic properties for developing novel electronics, optoelectronics and opto-spintronics. He has published more than 330 SCI papers and received over 35,000 nonself-citations. His H-index is 108.

# Ultrafast laser writing of optical waveguides in transparent materials

Feng Chen

Shandong University

**Abstract:** Ultrafast laser writing has emerged as a powerful and versatile technique for the three-dimensional fabrication of optical waveguides in transparent materials. By focusing femtosecond laser pulses inside the bulk of a substrate, nonlinear absorption mechanisms confine energy deposition to a microscopic volume, inducing a localized and permanent refractive index modification. This direct laser writing method enables the rapid prototyping of complex photonic circuits, couplers, and splitters with high precision and minimal thermal damage. This report reviews the fundamental principles of laser-matter interaction governing the process, explores various writing geometries and regimes, and highlights key applications in integrated optics, miniature laser sources, and quantum photonics. The unique capability to inscribe waveguides in diverse materials, from glasses to crystalline media, underscores its significance for next-generation photonic devices.



**Biography:** Feng Chen is a Distinguished Professor at Shandong University, China. He received the PhD from Shandong University in 2002. He was a Humboldt Research Fellow at Technical University of Clausthal, Germany, in 2003-2005. His research interests include fabrication of micro-nanoscale photonic structures, ultrafast laser writing, ion beam modification of nanomaterials, lasers, etc. He has more than 500 papers published in peer-reviewed journals, 1 professional book, 5 book chapters, and holds 10 patents. He is a Fellow of Institute of Physics (IOP UK), OPTICA (formerly OSA), and SPIE. He also serves the Editor-in-Chief of Laser and Particle Beams, Associate Editor of ChemPhysMater, Editorial Board Member of Opto-Electronic Science, Scientific Reports, and Journal of Physics: Photonics. a member of committees/subcommittees of CLEO, CLEO-Europe, CIOP etc. He has given invited talks in about 70 international conferences/workshops.

# Ultrafast Lasers in Large-scale Scientific Facilities: Challenges and Opportunities

Wei Liu

Sun Yat-Sen University

**Abstract:** Ultrafast laser systems are integral components of X-ray Free Electron Laser (FEL) facilities, serving critical roles in photo-cathode injection, electron beam heating, seeding, and pump-probe experiments. The Shenzhen Superconducting Soft X-ray Free Electron Laser (S3FEL), currently under construction (2025-2032), operates at a high repetition rate of 1 MHz, posing significant challenges for laser technology. These include the requirement for high average power (100–1000 W), ultrashort pulse widths (<20 fs), broad wavelength tunability (EUV to IR), and attosecond-level synchronization. This presentation highlights the R&D progress at the Institute of Advanced Light Source Facilities, Shenzhen (IASF). We discuss the transition to Yb-based gain media to meet high-power demands. Key breakthroughs include the development of a 200 W Yb-fiber amplifier, multi-pass cell (MPC) post-compression achieving sub-10 fs pulses, and wavelength extension into the VUV/EUV range. These advancements provide a robust technical foundation for the next generation of high-repetition-rate FEL user facilities.



**Biography:** Wei Liu is an Associate Professor of Physics at Sun Yat-Sen University. His research focuses on ultrafast laser physics and engineering, including high-power femtosecond lasers, multi-pass cell post-compression, and vacuum-ultraviolet and extreme-ultraviolet ultrafast light sources. He is actively involved in the development of laser systems for free-electron lasers and large-scale scientific facilities. His current interests also include engineering platforms for advanced scientific instruments and the translation of ultrafast laser technologies into practical applications.

# Mono-cycle Ytterbium Laser-driven Terahertz Generation

Shaobo Fang

Institute of Physics, Chinese Academy of Sciences

**Abstract:** We demonstrated the generation of ultra-broadband terahertz (THz) pulses. To achieve efficient ultra-broadband THz generation, the ytterbium pump laser was efficiently compressed into the mono-cycle regime, with its optimized spectrum covering a wavelength range from approximately 300 nm to 1300 nm. For the first time, this ultra-broadband THz source enables the simultaneous verification of nearly all phonon absorption peaks.



**Biography:** Shaobo Fang received his Ph.D. degree from Hokkaido University, Japan. He once served as an Assistant Research Scientist in the Core Research for Evolutional Science and Technology (CREST) program, Japan Science and Technology Agency (JST). He subsequently worked as a Research Scientist under the Helmholtz Association Young Scientist Program at Center for Free-Electron Laser Science (CFEL), Deutsches Elektronen-Synchrotron DESY. He later joined the Institute of Physics (IOP), Chinese Academy of Sciences (CAS), where he holds the position of Associate Professor. His research interests focus on mono-cycle pulse generation and sub-cycle waveform synthesis for femtosecond terahertz (THz) and attosecond ultraviolet (UV) sources, as well as their relevant applications.

# Yb-fiber laser delivering $\mu\text{J}$ -level femtosecond pulses with tunable repetition rate

Gengji Zhou

Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

**Abstract:** Ultrafast laser delivering microjoule ( $\mu\text{J}$ ) level pulse energy has been widely used in scientific, medical and industrial applications, such as nonlinear frequency conversion, vision correction in ophthalmology, and material precision micro-machining. Take vision correction for example, current commercial laser applied in corneal structural modifications are operated in a fixed repetition rate (rep-rate), such as 500 kHz or 2 MHz for the VisuMax series from Carl Zeiss. Fix the rep-rate helps to reduce the system complexity in constructing femtosecond lasers. However, it is powerless when confronting applications necessitating femtosecond pulse with larger pulse energy at a lower rep-rate, such as performing cataract surgery. Hence, a  $\mu\text{J}$ -level pulse energy ultrafast laser operating in a tunable rep-rate could provide great flexibility in dealing with applications demanding femtosecond pulse with different parameters.



**Biography:** Prof. Gengji Zhou has been conducting research on ultrafast fiber laser since 2013, and worked at several world-renowned academic institutions, including DESY (Deutsches Elektronen-Synchrotron), the University of Michigan, Ann Arbor, and IMRA America, Inc. He has published over twenty scientific papers in international journals such as *Optica*, *Optics Letters*, *Optics Express*; and has delivered several presentations at international conferences, including CLEO, ASSL. He is now working at Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. His current research focuses on high-power Yb fiber laser system, including generation on high average power (kW-level) and large pulse energy (mJ-level) ultrafast pulses.

# Spatiotemporal Structuring of Ultrafast Light Pulses

Qiwen Zhan

Westlake University/University of Shanghai for Science and Technology

**Abstract:** Spatiotemporal sculpturing of light pulses with sophisticated structures on demand is one major goal of the everlasting pursuit of ultrafast information transmission and processing as well as ultra-intense energy concentration and extraction using light. It may hold the key to unlocking new extraordinary fundamental physical effects. Traditionally, spatiotemporal light pulses are treated as spatiotemporally separable wavepackets as a solution to Maxwell's equations. In the past decade, more generalized forms of spatiotemporally nonseparable solution started to emerge with growing importance for their striking physical effects. This talk intends to provide the necessary basics on how to sculpture light in the spatiotemporal domain to realize spatiotemporal structures on demand and highlight some of the recent advances in the creation and characterization of increasingly complex spatiotemporal wave packets. These spatiotemporally separable to complex nonseparable states with diverse geometric and topological structures exhibit unique physical properties during propagation, focusing and interaction with matter.



**Biography:** Dr. Qiwen Zhan is Chair Professor at the Westlake University, Chair Professor in Nanophotonics at the University of Shanghai for Science and Technology (USST) and founder of the Center for Complex Optical Fields and Meta-Optics Structures (COSMOS). He also holds joint appointment with Zhangjiang Laboratory, China, as well as affiliate membership with the International Institute for Sustainability with Knotted Chiral Meta Matter (WPI-SKCM2) at the Hiroshima University, Japan. He received a B.S. in Physics (optoelectronic) from the University of Science and Technology of China (USTC) in 1996 and a Ph.D. in Electrical Engineering from the University of Minnesota in 2002. From 2002 to 2020, he held tenured faculty position (Assistant Professor in 2002, Associate Professor in 2008, and Full Professor in 2012) in the Department of Electro-Optics and Photonics at the University of Dayton, USA. He established the Fraunhofer Research Center at the University Dayton and served as the founding director till 2020. Currently, he serves as Deputy Editor for Optics Express, Associate Editor for Science Bulletin, Advisory Editor-in-Chief for Light Manipulation and Applications, Advisory Deputy Editor for Photonix, Associate Editor for Advanced Photonics, Editorial Board Member for Scientific Reports. Prof. Zhan is elected Senior Member of the IEEE, Fellow of OPTICA (formerly OSA, 2013), and Fellow of the SPIE (2012).

# Generation of spatiotemporal vortex and Skyrimions in the EUV range

Yi Liu

University of Shanghai for Science and Technology

**Abstract:** Rapid advancements in light manipulation technology have enabled the emergence of a variety of novel structured optical fields. In particular, recent studies have achieved the construction of vortex and skyrmionic structures of optical fields in the spatiotemporal domain and demonstrated their significant application potential. Up to now, these structures can currently only be achieved in the visible and near-infrared regime. In this work, we demonstrate the generation and control of spatiotemporal vortex and skyrmions in the EUV region via high harmonic generation (HHG). We demonstrate the generation of attosecond pulse trains featuring a spatiotemporal optical vortex (STOV) structure by a two-color femtosecond light field, with each color carrying transverse OAM. For the generation of spatiotemporal Skyrimions in the EUV range, we found that each spatiotemporal skyrmionic harmonic driven by two-color laser fields exhibits the characteristics of the Bloch-type skyrmion. Other types of EUV spatiotemporal skyrmions, even vector hopfions can also be generated by optimizing and manipulating the driving laser structure parameters.



**Biography:** Yi Liu received his Ph. D degree from Peking University, China in 2006. He worked as a postdoctor at Ecole Polytechnique, France from 2006 to 2009. From 2009 to 2015, he was hired as a permanent researcher of French scientific research center (CNRS), in Laboratoire d'Optique Appliquée. In 2016, he became a professor of University of Shanghai for Science and Technology,

China. His research interests include ultrafast nonlinear optics, light field manipulation, with focus on air lasing, strong field terahertz radiation and its application, high-order harmonic generation, laser micro- and nanofabrication. He has published more than 100 peer-reviewed articles including 14 papers in Physical Review Letters and Optica, with a H-index of 35.

# Terahertz Nanoscopy of Two-Dimensional Material Heterostructures

Fucheng Qiu<sup>1,2</sup>, Chang Wang<sup>3</sup>, Zhiyong Tan<sup>3</sup>, Juncheng Cao<sup>3</sup>, Huabin Wang<sup>1,2</sup>

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**Abstract:** Two-dimensional materials exhibit great potential in high-efficiency modulating and ultrafast detecting at the terahertz (THz) range. However, studying such multilayer heterostructure' local THz photoelectric properties, especially the surface-rough layered systems, is complicated. Here, we performed experimental and theoretical analyses of a PbS-graphene heterostructures via THz scattering scanning near-field optical microscopy (s-SNOM), which can offer nano-imaging below diffraction limits. We note that the THz near-field contrast is closely related to the thickness, surface roughness, and the multilayer nanomaterials' intrinsic properties. Further, we calculate the THz near-field signal of the Pbs-graphene heterostructures by a finite-dipole model for multilayers, yielding consistent contrast with the experimental s-SNOM data. Our results reveal that the THz near-field probing of the multilayer systems is thickness and roughness-dependent, opening up significant possibilities for nanoscale characterization in the field of advanced nanomaterials, nano-photoelectronic and molecular biology.

# A Flexible Multiparameter Terahertz Microdetector Based on Plasmon Polaritons

Shaojing Liu, Huanjun Chen

State Key Laboratory of Optoelectronic Materials and Technologies Guangdong Province Key Laboratory of Display Material and Technology, School of Electronics and Information Technology, Sun Yat-sen University

**Abstract:** The development of wearable devices for terahertz (THz) integrated sensing and communication (ISAC) is pivotal for forthcoming 6G Internet of Things (IoT) and wearable optoelectronics. However, existing THz system suffers from bulkiness, narrow spectral response and limited flexibility constrained by their dependence on external antennas, complex coupling architectures and rigid components. Here, we present a 2D THz smart wristband based on a graphene plasmon polariton atomic cavity (PPAC) array, which integrates sensing and communication within a monolithic microdetector. Operating without any external antenna, the compact and flexible device enables self-powered, polarization-sensitive and frequency selective THz detection across a broad response spectrum from 0.25 to 4.24 THz, with a responsivity of 6 V/W, a response time of 62 ms, and mechanical robustness maintained over 2000 bending cycles. Notably, we further exploit its multi-parameter THz responses for dual-purpose ISAC functionality. For sensing, the polarization- and strain-dependent THz responses are utilized as high-dimensional features for a convolutional neural network (CNN), enabling circuit fault diagnosis with 97% accuracy. For communication, the device implements secure encrypted communication under simulated on-body wearing condition through dualchannel encoding of THz polarization and on-off signals. This 2D ISAC platform paves the way for miniaturized, intelligent wearable systems for advanced human-machine interaction.

# A Reconfigurable Terahertz Neuromorphic Chip for Penetrative Dynamic Vision and Compressed Information Transmission

Huijun Zhao, Fei Fan

Nankai University

**Abstract:** Terahertz (THz) waves have enormous potential for high-penetration imaging and broadband information transmission with high biosafety. However, due to challenges such as non-volatile regulation and construction of high-density mode, there is no THz-based dynamic visual sensing-storage-computing system. Here, we demonstrate a THz neuromorphic chip integrating high-penetration dynamic vision, high-density information transmission, and in-sensor computing. By integrating a specially designed metasurface with a ferroelectric liquid crystal (FeLC) layer to establish a dual-physics layer mechanism, this chip utilizes 6-level states across 16 input ports and triple-frequency multiplexing to dynamically encode  $3 \times 6^{16}$  vortex interference fields (scalable to  $m \times S^n$ ) in the spatiotemporal-frequency domain, achieving a 27-fold performance enhancement over prior works. Using an artificial neural network and Caesar transformation, the device implements a brute-force-attack-resistant high-dimensional encryption transmission scheme with a bit error rate of 0.09%, representing a leading performance in THz wireless communications. Furthermore, via multi-level encoding and two-dimensional complex-amplitude output, the system achieves motion direction recognition under low-visibility environments, with an experimental accuracy of 92.3% and a horizontal visibility range 12-fold that of near-infrared devices. This strategy integrates the superiorities of THz techniques and neuromorphic computing, potentially applicable to dynamic artificial vision with high-penetration, dynamically information processing, compressed and encrypted information transmission abilities.

**Biography:** Huijun Zhao is a recipient of the National Natural Science Foundation of China grant for Basic Research Projects of Young Students (PhD Candidate) and was selected for the Young Talent Support Project PhD Program sponsored by the China Association for Science and Technology. To date, she has published 10 first-author papers in leading optoelectronics journals, including *Advanced Materials*, *Advanced Functional Materials*, *Laser & Photonics Reviews* (2 papers), and *Photonics Research* (2 papers); She also holds one granted national invention patent.

# Denoised terahertz quantum cascade laser spectroscopy based on Unet-based deep learning

Yanan Zhao<sup>1,2,3</sup>, Zejun Ma<sup>1,2,3</sup>, Quanyong Lu<sup>1</sup>

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**Abstract:** Terahertz quantum cascade lasers (THz QCLs) operating in a self-mixing configuration present significant potential for high-resolution imaging and spectroscopy, although their real-world implementation is frequently constrained by the poor signal-to-noise ratio (SNR) and limited accuracy associated with conventional Fourier analysis methods. To overcome these inherent limitations, we introduce a hybrid noise-reduction architecture that integrates wavelet preprocessing with a specially designed peak-aware U-Net model, aiming to restore multimode THz QCL spectra with minimized error factors and superior SNR. Specifically, the wavelet transform is initially applied to filter out high-frequency disturbances, after which the U-Net architecture reconstructs the intricate spectral features and amplifies the target peaks through its unique peak-aware mechanism. Comprehensive experimental evaluations reveal that our proposed strategy yields an SNR improvement of approximately 10 dB, alongside a determination coefficient of 0.979 and an extremely low reconstruction error of  $3.7 \times 10^{-5}$ , which substantially surpasses the raw data quality. Furthermore, practical validation using methanol gas transmission spectra firmly verifies the model's proficiency in precisely retrieving essential characteristic spectral signatures. Ultimately, this research illustrates the capability of deep learning-based signal processing in advancing THz spectroscopic sensing toward higher precision and reliability.

# Quantum Mechanical Simulations of Strong-Field Control of Intralayer Excitons in Van Der Waals Heterostructures

Siyuan Zhu, Xiaoyue Zhou, Jingdi Zhang

The Hong Kong University of Science and Technology

**Abstract:** We present a theoretical investigation into the microscopic mechanisms of strong-field exciton control in van der Waals heterostructures. By performing single-particle simulations based on the time-dependent Schrödinger equation (TDSE) with a Keldysh-Rytova potential, we model the non-perturbative evolution of intralayer excitons under an intense in-plane multi-terahertz drive. Our results reveal that the oscillating field actively modifies the excitonic spectral landscape, generating a ladder of coherent Floquet sidebands spaced by integer multiples of the driving photon energy. We demonstrate that these photon-dressed states effectively bridge the energetic gap between the distinct intralayer resonances, opening a transient resonant tunneling channel that is inaccessible in the perturbative regime. By quantifying the field-dependent spectral overlap integral, we provide a rigorous microscopic explanation for the experimentally observed "uphill" population transfer, establishing Floquet engineering as the dominant driver of sub-cycle excitonic switching.

# Harnessing Van Hove Singularities for Terahertz Photoresponse in RbV<sub>3</sub>Sb<sub>5</sub> Metals

Yingdong Wei<sup>1,2</sup>, Lin Wang<sup>1</sup>, Xiaoshuang Chen<sup>1,2</sup>

<sup>1</sup>State Key Laboratory of Infrared Physics, Shanghai Institute of Technical Physics, Chinese Academy of Sciences,

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**Abstract:** The trihexagonal tiling system exhibits strong electron-electron interactions, positioning it as a key condensed matter platform for studying geometrically frustrated lattices made up of corner-sharing triangles. Its phase-transition-driven lattice modulations enable Fermi surface reconstruction, while emergent van Hove singularities near the Fermi level and correlated band anomalies present critical challenges in understanding electronic interaction mechanisms. By combining temperature-dependent spectroscopy, angle-resolved photoemission, and density functional theory calculations, we demonstrate a 61-fold enhancement in terahertz direct detection mode, ultra-low noise ( $1.38 \times 10^{-25} \text{ A}^2/\text{Hz}$ ) below phase transition temperature; and broadband operation up to 100 GHz in beat-note heterodyne mode. These results are directly correlated with the Fermi surface reconstruction induced by phase transitions. These results position geometrically frustrated lattices as a powerful platform for studying correlated quantum phenomena, offering new pathways for the design of advanced quantum devices.

# Spacetime Imaging of Group and Phase Velocities of Terahertz Plasmon Polaritons in $\text{Bi}_2\text{Se}_3$

Jingwen Yu, Ran Wang, Qiyu Zhang, Zhuocheng Zhang, Xiaoqiuyan Zhang, Min Hu

Terahertz Research Center, School of Electronic Science and Engineering, University of Electronic Science and Technology of China

**Abstract:** The spatiotemporal imaging of polaritons is crucial to understand the light-matter interactions in materials. Recent developments in time-domain near-field imaging and global fitting methods with simple normalization and mathematical model have provided powerful tools for directly extracting the group velocity ( $v_{gr}$ ), phase velocity ( $v_{ph}$ ), and damping of surface plasmon polariton (SPP) in graphene. However, the applicability of this method in topological insulators (TIs) remains to be explored. In this paper, we apply this method to  $\text{Bi}_2\text{Se}_3$  for the first time, and directly visualize and quantify the propagation of plasmon polaritons (PPs) in the time domain. This study not only provides reliable propagation characteristic parameters of PPs in  $\text{Bi}_2\text{Se}_3$ , but also demonstrates the remarkable universality and effectiveness of the proposed time-domain imaging and analysis method for polariton research beyond graphene systems. This breakthrough paves the way for rational design of the next topological quantum devices.

# Nitrogen-doped diamond as a new material for high-power photoconductive THz antenna

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Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia

**Abstract:** Diamond doping has enabled the use of commercially available femtosecond (fs) infrared lasers for optical pumping of photoconductive antennas (PCAs) instead of complex UV fs lasers for generating photocarriers in pure diamond. However, the demonstrated power of the generated terahertz radiation is still far from the maximum achievable level. The main limiting factor is that the electrodes generating the electric field in the diamond substrate are located on the diamond surface, and the bias voltage level is limited by electrical breakdown across the diamond surface (20 kV/cm). Such antennas do not utilize the potential of the diamond substrate to achieve peak power. Their parameters do not exceed those of antennas made of narrow-gap semiconductors. Increasing the peak power requires the implementation of multipole antennas, i.e., antennas containing multiple emitters over a large area. A multiple increase in the THz radiation intensity is achieved by reducing the distance between the electrodes in each dipole and, correspondingly, increasing the intensity of the static electric field. To utilize the full potential of diamond, it is necessary to create conductive structures inside the diamond bulk. This work demonstrates the possibility of embedding conductive structures into the diamond bulk to significantly increase the electric field in the antenna. This research was funded by the Russian Science Foundation, grant number 25-19-00796, <https://rscf.ru/en/project/25-19-00796/>.

# Coherent seeding and controlling dynamical ferroelectricity by phonon anharmonicity

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**Abstract:** Optical manipulation of matter offers a route to engineer non-equilibrium phases and functionalities inaccessible in thermodynamic equilibrium. While light-induced ferroelectricity represents a paradigmatic example, its realization has thus far been confined to quantum paraelectrics residing near the ferroelectric instability. Furthermore, recent time-resolved X-ray scattering results indicate that the driven state within this quantum critical regime is better characterized as a polar-acoustic phase rather than a homogeneous ferroelectric phase. Establishing an unambiguous light-induced ferroelectric state far from criticality thus remains a fundamental outstanding challenge. Here we show that intense terahertz excitation of a soft phonon mode induces a ferroelectric steady state in centrosymmetric PbTe, a thermoelectric with exceptionally strong lattice anharmonicity but no ferroelectric transition at finite temperature. The induced symmetry-broken state is realized up to about 100~K, far away from its equilibrium criticality and in the absence of local dipolar fluctuations. Our polarization-, temperature- and field-dependent measurements identify the anharmonic coupling between the two degenerate transverse optical phonons underpins this ferroelectric induction, which is supported by theoretical simulations. Furthermore, we demonstrate coherent control over the induced polarization by employing a second terahertz pulse with a tunable time delay. These results extend light-induced ferroelectricity beyond near-criticality and establish anharmonic phonon coupling as a general strategy for ultrafast symmetry control in quantum materials.

# Optical modulation of terahertz radiation by ultrathin continuous films of gold via optical pump-terahertz probe spectroscopy

Maksim I. Paukov<sup>1</sup>, Shuang Sun<sup>2,3</sup>, Dmitry I. Yakubovsky<sup>4</sup>, Gennady A. Komanidin<sup>5</sup>, Aleksey V. Arsenin<sup>4</sup>, Yan Zhang<sup>2,3</sup>, Maria G. Burdanova<sup>1,5</sup>

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**Abstract:** The study of ultrathin gold films is highly relevant due to their widespread application in plasmonics and optoelectronics. However, the dynamics of their nonequilibrium conductivity in the terahertz range remain poorly understood. In this work, using optical pump-terahertz probe spectroscopy, we present the first measurements of ultrafast carrier relaxation in continuous Au films with thicknesses ranging from 2 to 8 nm. We observed a non-monotonic dependence of the electron-phonon interaction time on both the pump fluence and the sample thickness. The characteristic modulation depth is on the order of 1% per unit thickness, with modulation speeds reaching approximately 100 GHz. Notably, the films exhibit negative photoconductivity, indicated by a decrease in the transmitted terahertz amplitude following optical excitation. These findings expand the fundamental understanding of relaxation processes in low-dimensional metallic systems and have practical implications for the development of ultrafast modulators and detectors for the terahertz range.

## Polarization-tunable spin-based terahertz emitter by Halbach array

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**Abstract:** The radiation characteristics of spintronic terahertz (THz) emitters (STEs) are highly dependent on the characteristics of the external magnetic field. In conventional studies, the magnetic field is typically restricted to a single linear configuration, which significantly limits the polarization states of the emitted THz pulses. In this work, we design various types of Halbach arrays to provide diverse external magnetic field configurations for STEs. Specifically, the dipole mode provides a uniform linear magnetic field, enabling arbitrary control over the linear polarization direction of the THz pulses by rotating the magnetic field. The quadrupole mode simultaneously provides two orthogonal magnetic field components, thereby facilitating the radiation of THz pulses with dual-directional polarization states. Building upon this, we leverage the THz birefringence properties of the sapphire substrate to introduce a phase shift, achieving the generation of elliptically or circularly polarized THz pulses within the 1-3 THz frequency range. This high-efficiency, highly flexible, and broadband polarization-tunable STE holds immense potential for a wide range of applications, particularly in materials, imaging, THz sensing, and diagnostics.

# Localized in-plane ferroelectric field enabled fast-response visible-to-terahertz photodetection in Graphene/LiNbO<sub>3</sub> heterostructure

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**Abstract:** Fast-response, broadband, and low-power-consumption photodetectors are crucial for optoelectronic applications like optical communication and terahertz (THz) sensing. Employing the direction-controllable and non-volatile localized ferroelectric field is an effective approach to constructing stable, compact, and self-driven photodetectors, but the inherent wide bandgap and low carrier mobility of ferroelectrics limit the detectable wavelength range and response speed of such devices. This work adopts zero-bandgap monolayer graphene as the broadband photosensitive layer on the LiNbO<sub>3</sub>-on-insulator (LNOI) substrate, where a ridge structure is fabricated by etching the LiNbO<sub>3</sub> monocrystal layer to localize the in-plane ferroelectric field, thereby accelerating the device response by directionally propelling carriers to drift in the high-mobility graphene. Thus, the graphene/LNOI hybrid structure achieves self-driven sensitivity across the visible-to-THz spectrum, with response timescales reduced to tens of microseconds or even a single microsecond (21.2 μs for 532 nm, 6.7 μs for 10 μm, and 37.9 μs for 119 μm). The results confirm the feasibility of achieving fast and broad-spectrum photodetection using the in-plane ferroelectric field, providing a new strategy for the development of ferroelectric-based photodetectors.

# Enhanced THz emission signals based on antiferromagnet-heavy metal heterostructures

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**Abstract:** Antiferromagnetic materials (AFMs), have potential to achieve spintronic applications due to their advantages, such as being insensitive to external magnetic fields, the resonance frequency of AFMs being in the terahertz (THz) region. In addition, the zero net magnetization in AFMs makes them easier to design some devices of high-density integration. On the other hand, the insensitivity of AFMs to external magnetic fields makes the manipulation and detection of spin currents or magnetic order in AFMs difficult. It has been reported that the THz spin currents can be generated by a femtosecond laser pumping the AFM film. And the THz spin currents in AFM can be injected to the adjacent heavy metals (HM), as a spin current detector due to inverse spin Hall effect (ISHE), i.e. convert spin current into charge current. However, the injection of the THz spin currents is inefficient in such a process, sometimes we can even not distinguish observation signals from system noise. In this research, a significant improvement of the injection of THz spin currents will be accomplished by us. In order to raise the efficiency, two methods are adopted by us. The results from our research can be conducive to the understanding of the generation, transportation and detection of spin currents in both magnetism and spintronics, especially in antiferromagnetic spintronics. Besides, it can pave a road for the design of spintronic application based on AFMs as well.

## Single femtosecond level jitter ultrashort electron bunch

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Centre for Ultrafast Imaging, Universität Hamburg, Germany.

**Abstract:** The generation of femtosecond electron beams with high timing stability remains a central challenge for ultrafast electron-based measurements, particularly at the keV energy scale where space-charge effects and arrival-time jitter strongly limit performance. A key difficulty is achieving both temporal selection and pulse compression without introducing additional timing sensitivity. Here, we demonstrate a THz-driven scheme that integrates temporal slicing and velocity bunching within a single device, enabling the generation of ultrashort and ultra-stable electron pulses. Because the THz field is derived from the same laser that drives photoemission, the interaction occurs near the THz zero-crossing, rendering the output pulse largely insensitive to arrival-time jitter. Using this scheme, we generate electron pulses with a duration of 50 fs and a rms timing jitter of 1.4 fs sustained over one hour at sub-femtocoulomb charge levels. Further compression to 6 fs is achieved by correcting beam tilt with an additional antenna. In addition, long-term timing jitter is suppressed from several hundred femtoseconds to the few-femtosecond level. This compact THz-driven scheme provides a robust and scalable route to producing ultrashort, ultra-stable electron pulses for ultrafast electron diffraction and other timing-sensitive accelerator applications.

# Multi-parameter Terahertz Micro-detection Enabled by Symmetry-Broken Driven Unidirectional Electron Flow

Tianxiang Yu, Huanjun Chen

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**Abstract:** Effective detection and reconstruction of multiple terahertz (THz) wave parameters— including amplitude, phase, frequency, and polarization—are critical for applications such as future broadband 6G communications and high-resolution stealth imaging. However, current methodologies remain limited, lacking integrated, high-performance solutions. Here, we introduce a multi-parameter THz micro-detector based on patterned graphene integrated with symmetry-broken gold micro-disks. The asymmetric plasmonic heterostructure creates strong local field gradients that drive a tunable unidirectional photocurrent under THz illumination, enabling simultaneous polarization-selective and frequency-selective photodetection in a single device. Crucially, the direction of the photocurrent flow can be tailored by engineering the symmetry-broken orientation of the gold disks, allowing direct detection of different polarization states. At 2.52 THz and under zero-bias conditions, the detector achieves a high responsivity of 25.12 V/W, a fast response time of 1.68 ns, a low noise equivalent power of  $8.58 \times 10^{-9}$  W/Hz<sup>1/2</sup>, and a specific detectivity of  $6.69 \times 10^7$  Jones. Both experiments and simulations confirm its sensitivity to amplitude, frequency, and polarization, with the latter two being tunable via subtle geometric modifications to the gold structures. We furthermore demonstrate its application in free-space THz polarization encrypted imaging and non-destructive identification. Our work provides a versatile platform for high-performance and multi-functional THz detection and paves the way toward on-chip polarization-resolved THz systems.

# A D-Band GCPW-to-SIW Transition on Glass Using TGV Technology for Terahertz Systems

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**Abstract:** This paper presents the design, fabrication, and characterization of a D-band transition from grounded coplanar waveguide (GCPW) to substrate integrated waveguide (SIW), targeting future 6G and terahertz applications. Fabricated on a monolithic 200- $\mu\text{m}$ -thick BF33 glass substrate using through-glass-via (TGV) technology, the transition features an SIW width of 830  $\mu\text{m}$ , yielding a fundamental mode cutoff frequency near 96.5 GHz. The waveguide sidewalls are formed by two rows of copper-filled vias with a diameter of 20  $\mu\text{m}$  and a pitch of 40  $\mu\text{m}$ . A broadband tapered transition enables on-wafer probing and ensures efficient mode conversion. The GCPW launch is optimized for 50  $\Omega$  impedance with a signal width of 50  $\mu\text{m}$  and a gap of 12  $\mu\text{m}$ . The device is fabricated through a dedicated TGV process, which includes laser drilling, wet etching, copper electroplating, and dual-side Ti/Au metallization. Process characterization confirms excellent dimensional control, with TGV diameters of  $20.5 \pm 0.5$   $\mu\text{m}$  and complete metal filling. Electromagnetic simulations show an insertion loss better than 3 dB and a return loss below -6 dB across the 110-170 GHz band. Preliminary on-wafer measurements validate the design, though the measured response shows a frequency shift of approximately 10 GHz towards higher frequencies compared to simulations. The maximum measured insertion loss increases to about 6 dB, while the return loss remains below -6 dB across most of the band. This discrepancy is primarily attributed to fabrication tolerances. Further studies and process optimization are underway to address this issue. This work demonstrates a functional, monolithically integrated D-band GCPW-to-SIW transition on glass using TGV technology, offering a promising low-loss and highly integrated platform for future terahertz circuits and systems.

## A 110-170 GHz Biosensor Using a TGV-Based GCPW-to-SIW Resonator

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**Abstract:** A novel high-frequency biosensor operating from 110 to 170 GHz, based on a Through-Glass Via (TGV) resonator structure, is proposed and analyzed for the first time. The core sensing element is a substrate-integrated waveguide (SIW) resonator, fed by a grounded coplanar waveguide (GCPW) transition fabricated on the TGV platform. Sensing is facilitated by micromachined holes/channels within the substrate itself, which function as a microfluidic passage. This design ensures direct interaction between the electromagnetic field concentrated in the substrate and the analyte flowing through it. The sensor's performance is comprehensively investigated through parametric studies, detailing the critical influence of the aperture's diameter, position, and quantity on key performance metrics such as the resonant frequency shift and sensitivity. Based on this analysis, the final design is optimized to exhibit high sensitivity to changes in the magnetic permeability ( $\mu$ ) of the sample. This characteristic makes the proposed sensor particularly promising for advanced biosensing applications, notably in the detection and quantification of magnetic beads, which are widely used in biomedical assays.

# Terahertz Detection Using Rydberg Atoms and Its Applications

Junnan Wang<sup>1</sup>, Xiyuan Chen<sup>1</sup>, Xiasi Sun<sup>2</sup>, Lei Hou<sup>1</sup>

<sup>1</sup>Xi'an University of Technology, <sup>2</sup>Northwest Engineering Corporation Limited

**Abstract:** Broadband and highly sensitive terahertz (THz) detectors are pivotal for advancing THz technologies across a wide range of applications, including spectroscopy, imaging, communications, and sensing. In recent years, Rydberg atoms have emerged as a promising candidate for THz detection based on the quantum coherence effects. Despite their high intrinsic sensitivity, conventional Rydberg detectors often face practical limitations, particularly in achieving large detection bandwidth. In this paper, we propose a Rydberg atom THz detector that operates in a detuned-field scheme. Through systematic optimization of the atomic transition parameters and the utilization of a tunable THz frequency, both the detection performance and functionality of the system are significantly enhanced. Notably, the detector achieves a minimum detectable electric field of 2.69 V/m, which marks a significant improvement over traditional resonant methods, while simultaneously extending the detection bandwidth to 14 GHz, which enables efficient detection across a broad frequency range. In addition, this Rydberg atom THz detector enables polarization measurement with an angular resolution of  $1.27^\circ$ , and is further applied for the quantitative detection of biological sample concentration. Overall, this study contributes a practical and high-performance Rydberg atom THz detection platform that advances the state of the art in quantum-enhanced sensing, offering a pathway toward integrated, broadband, and highly sensitive THz systems for both scientific and industrial applications.

# Antiferromagnet-topological insulator heterostructure for polarization-controllable terahertz generation

Yu Cheng<sup>1,2</sup>, Faran, Zhou<sup>1,2</sup>, Jing Teng<sup>1,2</sup>, Peiyan Li<sup>3</sup>, Litong Jiang<sup>1,2</sup>, Piming Gong<sup>1,2</sup>, Yongqing Li<sup>1,2</sup>, Xiaojun Wu<sup>3,4,5</sup>, Franz X. Kärtner<sup>6</sup>, Jimin Zhao<sup>1,2,7</sup>

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<sup>2</sup>School of Physical Sciences, University of Chinese Academy of Sciences, <sup>3</sup>School of Electronic and Information Engineering, Beihang University, <sup>4</sup>Zhangjiang Laboratory, <sup>5</sup>Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, <sup>6</sup>Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron, Germany, <sup>7</sup>Songshan Lake Materials Laboratory

**Abstract:** We have designed a novel ultrafast THz emitter (UTE) based on a brand-new category of spintronic heterostructure, antiferromagnet/topological insulator (AFM/TI) heterostructure. By adjusting the pump polarization and sample azimuth, we have achieved unprecedented circularly polarized ultrafast THz emission. Based on previously conducted studies of spintronic UTEs, we find the THz emission from our MnSe/(Bi,Sb)<sub>2</sub>Te<sub>3</sub> is consistent with spintronic THz emission, while no need of external magnetic field. Significantly, two THz emission mechanisms (light-induced transient magnetization and spin-charge conversion) are identified to coexist, which together enables precise control of the polarization of the THz emission.

# High-Precision Characterization of Nanomaterials via On-Chip Waveguide-Coupled Terahertz Time-Domain Spectroscopy

Jiang Peng, Yukang Liang, Yang Liu, Zhaoxin Guo, Lifeng Cao, Degao Zhong, Bing Teng, Dongwei Zhai

College of Physics, Qingdao University

**Abstract:** Waveguide-coupled terahertz time-domain spectroscopy (THz-TDS) provides a high-precision platform for characterizing nanoscale functional materials, effectively overcoming the phase sensitivity limitations of conventional free-space systems. In this work, we investigate nanostructured conductive and semiconducting films integrated with on-chip THz waveguide platforms. Specifically, a silicon-based waveguide featuring surface-etched grating couplers was employed to characterize a 418.8-nm-thick indium tin oxide (ITO) nanostructures. By extracting the complex permittivity with a 3% error margin, Drude–Smith modeling revealed a carrier concentration of  $1.21 \times 10^{19} \text{ cm}^{-3}$  and a carrier lifetime of 41 fs, indicating strong nanostructure-induced carrier localization. Additionally, a 120-nm-thick magnetron-sputtered WS<sub>2</sub> film is well-understood with grating waveguide. It is then integrated in a hybrid Au–WS<sub>2</sub>–Si resonance metamaterial. This configuration yielded an ultra-high Q-factor of 447.4—four times higher than conventional cross-shaped resonators—while enabling mode-selective enhancement and suppression. Field distribution analysis clarified the coupling mechanisms between THz resonances and the WS<sub>2</sub> layer, offering insights into its carrier dynamics and electrical response. These results demonstrate the versatility of waveguide-coupled THz spectroscopy for ultrasensitive sensing and provide a foundation for developing high-performance integrated THz modulators and functional metamaterial devices.

# Quantitative analysis of subsurface optical properties via terahertz scattering-type scanning near-field optical microscopy

Shuchao Yu<sup>1, 2, 3, 4</sup>, Min Hu<sup>1, 2, 3, 4</sup>

<sup>1</sup>Terahertz Research Center, School of Electronic Science and Engineering, University of Electronic Science and Technology of China, <sup>2</sup>Key Laboratory of Terahertz Technology, Ministry of Education, <sup>3</sup>Terahertz Radiation and Application Key Laboratory of Sichuan Province, <sup>4</sup>Tian Fu Jiang Xi Laboratory

**Abstract:** Terahertz scattering-type scanning near-field optical microscopy (THz s-SNOM) has emerged as a powerful non-destructive tool for nanomaterial research, ranging from fundamental topographical characterization to interdisciplinary property analysis. However, while it has evolved into a cornerstone of nanoscience, its potential for subsurface imaging and quantitative measurement remains a largely overlooked terrain. Here, we propose and implement a Generalized Dipole Model (GDM) that accurately and universally resolves the interaction mechanism of the probe in THz s-SNOM measurements. Leveraging this analytical framework, we demonstrate the precise retrieval of local dielectric properties and subsurface layer thickness for S1805G series photoresists, achieving a probing depth extending to hundreds of nanometers. Our experimental findings reveal that this analytical model significantly streamlines the quantitative interpretation of near-field signals without the necessity of complex external calibrations, thereby enhancing the efficiency of detection and reconstruction. These results establish a robust methodology for quantitative THz near-field metrology and provide critical insights for the precise analysis of buried semiconductor structures and subsurface material characterization.

# A Reconfigurable Terahertz Neuromorphic Chip for Penetrative Dynamic Vision and Compressed Information Transmission

Huijun Zhao, Fei Fan

Nankai University

**Abstract:** Terahertz (THz) waves have enormous potential for high-penetration imaging and broadband information transmission with high biosafety. However, due to challenges such as non-volatile regulation and construction of high-density mode, there is no THz-based dynamic visual sensing-storage-computing system. Here, we demonstrate a THz neuromorphic chip integrating high-penetration dynamic vision, high-density information transmission, and in-sensor computing. By integrating a specially designed metasurface with a ferroelectric liquid crystal (FeLC) layer to establish a dual-physics layer mechanism, this chip utilizes 6-level states across 16 input ports and triple-frequency multiplexing to dynamically encode  $3 \times 6^{16}$  vortex interference fields (scalable to  $m \times S^n$ ) in the spatiotemporal-frequency domain, achieving a 27-fold performance enhancement over prior works. Using an artificial neural network and Caesar transformation, the device implements a brute-force-attack-resistant high-dimensional encryption transmission scheme with a bit error rate of 0.09%, representing a leading performance in THz wireless communications. Furthermore, via multi-level encoding and two-dimensional complex-amplitude output, the system achieves motion direction recognition under low-visibility environments, with an experimental accuracy of 92.3% and a horizontal visibility range 12-fold that of near-infrared devices. This strategy integrates the superiorities of THz techniques and neuromorphic computing, potentially applicable to dynamic artificial vision with high-penetration, dynamically information processing, compressed and encrypted information transmission abilities.

**Biography:** Huijun Zhao is a recipient of the National Natural Science Foundation of China grant for Basic Research Projects of Young Students (PhD Candidate) and was selected for the Young Talent Support Project PhD Program sponsored by the China Association for Science and Technology. To date, she has published 10 first-author papers in leading optoelectronics journals, including *Advanced Materials*, *Advanced Functional Materials*, *Laser & Photonics Reviews* (2 papers), and *Photonics Research* (2 papers); She also holds one granted national invention patent.

# Repetition-Rate-Dependent Radiation Dynamics in Femtosecond Laser Filamentation with Pulse Accumulative effect

Chaopeng Yang<sup>1,2</sup>, Tiejun Wang<sup>1,2</sup>, Yaoxiang Liu<sup>1,2</sup>

<sup>1</sup>State Key Laboratory of Ultra-Intense Laser Science and Technology, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, <sup>2</sup>Center of Materials Science and Optoelectronics Engineering, University of Chinese

Academy of Sciences

**Abstract:** High-repetition-rate femtosecond laser filamentation exhibits strong pulse accumulation effects that significantly influence radiation generation in air. In contrast to low-repetition-rate laser, high-repetition-rate pulses lead to residual gas heating and incomplete density recovery, which modify subsequent filament formation. In this work, we investigate the radiation response of femtosecond laser filaments under pulse accumulative effect by systematically varying the laser repetition rate while maintaining consistent single-pulse parameters. Multiple radiations including supercontinuum generation, third-harmonic emission, and molecular fluorescence from excited nitrogen molecules, are examined using independent diagnostic configurations. The experimental results show that increasing the repetition rate leads to concurrent enhancement of spectral broadening, harmonic enhancement, and fluorescence intensity increase. These correlated trends indicate that pulse accumulation reshapes nonlinear propagation and plasma dynamics through cumulative thermal modification of the propagation medium. This unified understanding provides insight into ultrafast laser-matter interactions at high repetition rates and offers guidance for optimizing filament-based radiation sources in atmospheric and nonlinear optical applications.

<b>April 29th Plenary Sessions Room 1016, C1 Conference Center</b>	
<b>Time</b>	<b>Content</b>
Presider: Sheng Meng	
08:45-09:30	<b>Subcycle Analysis of Elementary Fluctuations: Photons, Charges and Spins</b> <b>Alfred Leitenstorfer</b> University of Konstanz, Germany
09:30-10:15	<b>Non-Equilibrium/Nonlinear Terahertz Spectroscopy Study of the Collective Higgs Modes of Superconductors</b> <b>Nanlin Wang</b> Shanghai Jiao Tong University
10:15-10:30	Coffee Break
Presider: Nanlin Wang	
10:30-11:15	<b>Ultrafast Correlated Electron-Lattice Dynamics in Condensed Matter</b> <b>Sheng Meng</b> Institute of Physics, Chinese Academy of Sciences
11:15-12:00	<b>Visualization of Electronic Structures of Quantum Materials</b> <b>Yulin Chen</b> ShanghaiTech University
12:00-13:30	Lunch

# Subcycle Analysis of Elementary Fluctuations: Photons, Charges and Spins.

Alfred Leitenstorfer

University of Konstanz

**Abstract:** Typically, ultrafast phenomena are studied by pump-probe techniques providing the dynamics of averaged system properties after excitation. Recent advances enable a time-domain access also to their elementary fluctuations both in and out of equilibrium. Examples will be featured concerning the quantum noise of the mid-infrared electromagnetic field, electron transport at the atomic spatio-temporal scale and magnonic correlations in magnetic systems.



**Biography:** Alfred Leitenstorfer obtained his PhD in Physics from Technical University of Munich in 1996. Subsequently, he worked as a Postdoctoral Member of the Technical Staff at Bell Laboratories in Holmdel, NJ. After returning to TUM in 1998, he received his Habilitation degree in Experimental Physics in 2000. From 2001 to 2002, he held a non-tenured position as an Associate Professor at LMU

Munich. In 2003, Leitenstorfer was appointed Full Professor of Experimental Physics at University of Konstanz where he also heads the Center for Applied Photonics since 2004. He received the Rudolf Kaiser and Arnold Sommerfeld Prizes in 2000, the Ludwig Genzel Prize in 2010, the Kenneth J Button Prize in 2020 and the DPG Technology Transfer Award in 2023. In 2011, Alfred Leitenstorfer was awarded an ERC Advanced Grant and since 2013, he is a Fellow of the Optical Society (now Optica). His research interests comprise femtosecond technology and optical phase control, ultrafast phenomena in condensed matter as well as fundamental quantum physics at elementary scales of time and space.

# Non-equilibrium/nonlinear terahertz spectroscopy study of the collective Higgs modes of superconductors

Nanlin Wang

Tsung-Dao Lee Institute, Shanghai Jiao Tong University

**Abstract:** The superconducting condensate results in gapped single-particle excitations and collective Higgs mode excitations. While traditional experimental techniques typically focus on single-particle excitations, detecting the collective Higgs mode proves to be quite challenging using conventional spectroscopic methods due to its lack of linear coupling with the electromagnetic field. Recent progress in pulsed laser and strong-field terahertz technologies has enabled the exploration of collective excitations in superconductors using non-equilibrium or nonlinear terahertz spectroscopy. In this talk, I will present our recent findings on identifying collective Higgs modes in NbN and cuprate superconductors. Specifically, we observed a significant coupling effect between the Higgs mode below  $T_c$  and the mode developed above  $T_c$  in cuprate superconductors. Additionally, superconductivity competes with the order that emerges in the normal state. These investigations illustrate how exploring these collective excitations can provide new and valuable insights into the interplay between superconductivity and pseudogap in these materials.



**Biography:** Nan-Lin Wang is a TD Lee chair professor at Tsung-Dao Lee Institute, Shanghai Jiao Tong University. He obtained his PhD in condensed matter physics from the University of Science and Technology of China in 1992. His research focuses on both equilibrium and nonequilibrium infrared and terahertz spectroscopy study of strongly correlated electronic systems, including high temperature superconductors, charge/spin density wave compounds, transition metal oxides/chalcogenides, heavy fermions, quantum magnetic systems, 3D Dirac/Weyl semimetals in both equilibrium and nonequilibrium states. He is an elected fellow of the American Physical Society in 2012.

# Ultrafast correlated electron-lattice dynamics in condensed matter

Sheng Meng

Institute of Physics Chinese Academy of Sciences

**Abstract:** Photoexcitation and the resultant attosecond quasiparticle dynamics is a powerful means in distinguishing different interactions and manipulating the states of matter, especially in complex quantum materials. Here we investigate photoexcitation-induced correlated electron-lattice dynamics at the attosecond timescale with the recently developed new theoretical tools incorporating both nonadiabatic electron-nuclear couplings and nuclear quantum effects. In particular, we uncover the attosecond ultrafast processes of exciton formation, evolution and dissociation in monolayer hexagonal boron nitride, and the subsequent exciton-exciton interference phenomenon, where the resulting oscillatory signals of electron occupation allow us to extract phase information of exciton envelope function. Another example is the attosecond process of high harmonics generation (HHG) in solids. Coherent phonons are revealed to effectively affect HHG via the adiabatic band modulation induced by phonon deformation effects and the nonadiabatic nonequilibrium distribution of photocarriers in multiple valleys. Investigation of these quantities enables the direct probing of the exciton-exciton and electron-phonon interactions in materials



**Biography:** Dr. Sheng Meng is a professor and director of Surface Science Laboratories at Institute of Physics, Chinese Academy of Sciences. He obtained his Bachelor degree in physics from University of Science and Technology of China (USTC) in 2000, and Ph.D. degree in condensed matter physics from Institute of Physics, Chinese Academy of Sciences and applied physics from Chalmers University of Technology, Sweden in 2004. During 2005-2009, he worked at Harvard University's Department of Physics first as a post-doctoral researcher then a research associate. Dr. Meng's research interests focus on excited state quantum dynamics of condensed matter; design of quantum materials; energy conversion mechanism for sustainable society; as well as new algorithms and tools in materials computation. He has published ~200 technical papers in peer-reviewed journals, and has received 18000+ citations. Dr. Meng receives various awards including first-tier prize in science and technology of Beijing municipality, NSFC outstanding youth investigator awards etc. He is an elected fellow of American Physics Society (APS).

# Visualization of Electronic Structures of Quantum Materials

Yulin Chen

ShanghaiTech Univ. / Oxford Univ.

**Abstract:** The discovery of materials with novel properties is one of the most captivating aspects of physics, playing a pivotal role in advancing science and improving human life. The electronic structure of a material is critical information that determines its electrical, magnetic, and optical properties. A precise understanding of this information not only provides insights into the diverse properties and phenomena of quantum materials but also guides the design of their potential applications. Angle-resolved photoemission spectroscopy (ARPES) is a powerful technique for determining the electronic structures of materials. With its energy and momentum resolution, ARPES can directly visualize the dispersions of electronic bands in reciprocal space, providing critical parameters for understanding material behavior. In this talk, I will begin with a brief introduction to ARPES, including its basic principles and the wealth of information it offers. I will then highlight its application on the study of topological quantum materials, low-dimensional systems, and exotic superconductors. Finally, I will discuss recent advancements in ARPES technology and share perspectives on its future directions and applications.



**Biography:** Yulin received his B.S. from the University of Science & Technology of China in 2000 and Ph.D. in Physics from Stanford University in 2008. After working at SLAC National Accelerator Laboratory briefly (2008-2011, postdoc/associate staff scientist/ staff scientist), he joined the University of Oxford since 2012 as a Fellow of the Jesus College and university lecturer/associate professor/professor. Yulin is now jointly appointed in ShanghaiTech University and Oxford University,

He is also an adjunct professor in Tsinghua University during 2014~2023. Yulin's research focuses on understanding the behavior of electrons in unconventional materials, including topological quantum materials, strongly correlated electron systems, and other functional materials. He is also dedicated to developing advanced instrumentation with novel capabilities to push the frontiers of current research. In recognition of his contributions to the field of topological quantum materials, Yulin has received several prestigious awards, including the William E. and Diane M. Spicer Young Investigator Award (2009), the OCPA Outstanding Young Researcher Award (2012), the Nakamura Lecture Award (2017), and the Kai Siegbahn Prize (2021). He is also recognized as a Highly Cited Researcher by the Web of Science.

<b>April 29th Session 1 Terahertz Detector Room 2001, C1 Conference Center</b>	
Presiders: Ziqi Li, Ride Wang	
13:30-13:50	<b>Room-Temperature 2D Material Terahertz Detector Based on the Photothermoelectric Effect</b> <b>Yiming Zhu</b> University of Shanghai for Science and Technology
13:50-14:10	<b>Experimental Realization of a Metasurface-Based Dual-Gate Photoelectric Tunable-Step Thz Detector</b> <b>Ruqiao Xia</b> Cavendish Laboratory
14:10-14:30	<b>Recent Progress on Terahertz Detectors Using Micro/Nanoelectromechanical System Resonators</b> <b>Ya Zhang</b> Tokyo University of Agriculture and Technology
14:30-14:50	<b>Sensitive Thz Quantum Capacitance Detectors with High Dynamic Range</b> <b>Jian Chen</b> Nanjing University
14:50-15:10	<b>Quantum Geometry Effect on Nonreciprocal Quantum Terahertz Sensing</b> <b>Lin Wang</b> Shanghai Institute of Technical Physics, Chinese Academy of Sciences.
15:10-15:30	<b>Ultra-Broadband, Rapid, and Trace Terahertz Fingerprint Detection via Resonance Interaction Enhancement</b> <b>Yuping Yang</b> Minzu University of China
15:30-15:50	<b>Room-Temperature Thz Multiparameter Detection Using Plasmon Polariton Atomic Cavities</b> <b>Huanjun Chen</b> Sun Yat-sen University
15:50-16:05	Coffee Break
Presiders: Ruqiao Xia, Yiming Zhu	
16:05-16:25	<b>Graphene Terahertz Photothermoelectric Detector and Its Array Integration</b> <b>Yingxin Wang</b> Tsinghua University
16:25-16:45	<b>Performance Analysis of Electro-Optic Sampling Detection Technique with Thin Gase Crystal</b> <b>Haiwei Du</b> Nanchang Hangkong University

16:45-17:05	<b>Highly Sensitive Trace Detection Based on Terahertz Metasurfaces</b> <b>Ride Wang</b> National Innovation Institute of Defense Technology
17:05-17:25	<b>Design and Application of Carbon Nanotube Terahertz Metasurface Sensors for Trace Biochemical Detection</b> <b>Yue Wang</b> Xi'an University of Technology
17:25-17:45	<b>Deep-Subwavelength Electromagnetic Modulation for Ultra-Sensitive Integrated Sensing Systems</b> <b>Xuanru Zhang</b> Southeast University
17:45-18:05	<b>Terahertz Resonant Envelope Sensor Based on Sub-Array Integrated Metamaterial with Multimode Resonance</b> <b>Jiusheng Li</b> China Jiliang University
	Dinner

<b>April 29th Session 2 Terahertz Spectroscopy Technology Room 2002, C1 Conference Center</b>	
Presiders: Chuanshan Tian, Heng Zhang	
13:30-13:50	<b>Metatronics for High-Performance Terahertz Integrated Circuits</b> <b>Mohammad Samizadeh Nikoo</b> Nanyang Technological University
13:50-14:10	<b>Terahertz Imaging Technique Based on Terahertz Parametric Wavelength Conversion</b> <b>Kosuke Murate</b> Nagoya University
14:10-14:30	<b>High Resolution and High Performance Thz Frequency-Domain Spectroscopy (Thz-Fds) Systems with Substances Detection and Applications</b> <b>Cunjun Ruan</b> Beihang University
14:30-14:50	<b>Quantum Transport of Strongly Correlated Excitons in Moiré Superlattices</b> <b>Shibin Deng</b> Nankai University
14:50-15:10	<b>Low-Loss Native Ge Platform for Chip-Scale Lwir Photonics</b> <b>Dingding Ren</b> Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
15:10-15:30	<b>Nonlinear Terahertz Spectroscopy Under Magnetic Fields</b> <b>Xinbo Wang</b> Institute of Physics, Chinese Academy of Sciences
15:30-15:50	<b>Research on Plasma Parameter Diagnostics Using Terahertz Time-Domain Spectroscopy</b> <b>Chun Zhou</b> Hefei Institutes of Physical Science, Chinese Academy of Sciences
15:50-16:05	Coffee Break
Presiders: Cunjun Ruan, Shibin Deng	
16:05-16:25	<b>Interface THz Nonlinear Optical Spectroscopy</b> <b>Chuanshan Tian</b> Fudan University
16:25-16:45	<b>Plasma Distribution Charactering by Terahertz Focal Plane Imaging</b> <b>Wenfeng Sun</b> Capital Normal University
16:45-17:05	<b>Ultrafast Charge Transport by Terahertz Spectroscopy</b> <b>Heng Zhang</b> Xiamen University

17:05-17:25	<b>Reference-Free Humidity Sensing Based on Terahertz Time-Domain Spectroscopy</b> <b>Xuequan Chen</b> Aerospace Information Research Institute, Chinese Academy of Sciences
17:25-17:45	<b>Spintronic Terahertz Emission Driven Ultrafast Spectroscopy Ofvan Der Waals Materials</b> <b>Piyush Agarwal</b> Agency for Science, Technology and Research (A*STAR)
17:45-17:55	<b>Scaling Impact on Transmission Performance of TGV-Based CPW Interconnects in Glass Interposers at Terahertz Frequencies</b> <b>Ran Wang</b> Beihang University
17:55-18:05	<b>Probing Carrier Dynamics in Monolayer 2D Materials with Nanoscale Spatial Resolution Through Time-Resolved Thz-Tds Near-Field Microscopy</b> <b>Nicolai Hartmann; Jonas Albert; Andreas Huber</b> Attocube systems GmbH, Nanoscale Analytics
18:05-18:15	<b>Ultrafast Charge Carrier and Thermal Dynamics in Mxenes</b> <b>Wenhao Zheng</b> Aerospace Information Research Institute, Chinese Academy of Sciences
	Dinner

<b>April 29th Session 3 Terahertz Materials, Physics and Applications Room 2003, C1 Conference Center</b>	
Presiders: Tian Jiang, Zhen Tian	
13:30-13:50	<b>Terahertz Surface-Emitting Photonic Devices for Vortex Beam Generations and Wireless Communications</b> <b>Song Han</b> Zhejiang University
13:50-14:10	<b>Probing Spin-Phonon Coupling and Chirped Terahertz Emission in Quantum Materials</b> <b>Zhigao Sheng</b> Hefei Institutes of Physical Science, Chinese Academy of Sciences
14:10-14:30	<b>Spatiotemporal Terahertz Modulation Using Uv-Patterned Conductive Polymer Thin Films</b> <b>Shangzhi Chen</b> University of Electronic Science and Technology of China
14:30-14:50	<b>Ultrafast Ferroelectric Polarization Switching Driven by Optical and Terahertz Pulses in Nbocl<sub>2</sub> Semiconductor</b> <b>Fuhai Su</b> Institute of Solid State Physics, HFIPS, Chinese Academy of Sciences
14:50-15:10	<b>High-Efficiency Optically Controlled Terahertz Modulation in HgTe Semimetal</b> <b>Peng Suo</b> Shanghai University
15:10-15:30	<b>Probing Orbital Polarization via Orbital-to-Charge Conversion</b> <b>Yong Xu</b> Beihang University
15:30-15:50	<b>The New Physics in Coupling of THz Metasurfaces</b> <b>Wei Huang</b> Guilin University of Electronic Technology
15:50-16:05	Coffee Break
Presiders: Yong Xu, Song Han	
16:05-16:25	<b>Emerging Dynamics and Functional Properties of Topological Polar Structures</b> <b>Qian Li</b> Tsinghua University
16:25-16:45	<b>Active Photonic Functional Terahertz Emitters Enabled by Spatial and Temporal Modulations</b> <b>Xueqian Zhang</b> Tianjin University

16:45-17:05	<b>Time Interface and Terahertz Non-Reciprocal</b> <b>Tian Jiang</b> National University of Defense Technology
17:05-17:25	<b>Gradient-Index Self-Focusing of Terahertz Hyperbolic Phonon Polariton in Nanophotonic Waveguide</b> <b>Liaoxin Sun</b> Shanghai Institute of Technical Physics, Chinese Academy of Sciences
17:25-17:45	<b>Strong Coupling and Dissipative Dynamics of Thz Magnons in RfeO<sub>3</sub> Cavities</b> <b>Guohong Ma</b> Shanghai University
17:45-18:05	<b>Terahertz Photoacoustics and Applications</b> <b>Zhen Tian</b> Tianjin University
18:05-18:25	<b>Thz-Energy Molecular and Spin Dynamics Driven by Single-Electron Tunneling</b> <b>Shaoqing Du</b> Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
	Dinner

<b>April 29th Session 4 Ultrafast Spectroscopy and Imaging Technology Room 1016, C1 Conference Center</b>	
Presiders: Xiaodong Cui, Jiaxin Zhao	
13:30-13:50	<b>Nonlinear Optics in 2D Materials</b> <b>Zhipei Sun</b> Aalto University, Finland
13:50-14:10	<b>Topologically Enhanced Giant Broadband Second-Harmonic Generation in Weyl Semiconductor Tellurium</b> <b>Dong Sun</b> Peking University, China
14:10-14:30	<b>Second-Harmonic Generation as a Tool for Studying Antiferromagnets</b> <b>Victor Pavlov</b> Ioffe Institute, Russian Academy of Sciences, St. Petersburg, Russia
14:30-14:50	<b>Thz-Driven Electron Source for Ultrafast Electron Diffraction and Imaging</b> <b>Dongfang Zhang</b> Shanghai Jiaotong University, China
14:50-15:10	<b>Line Shape Relations in Ultrafast Transient Absorption from a Coherent Superposition</b> <b>Peng Peng</b> ShanghaiTech University
15:10-15:30	<b>Integrated Coherent High-Power Terahertz-Wave Generation with Large Frequency Tunability and Applications</b> <b>Wenting Wang</b> Beijing Institute of Technology, China
15:30-15:50	<b>Third Harmonic Generation Imaging for Intraoperative Diagnosis of Tumors</b> <b>Zhiqing Zhang</b> Nankai University, China
15:50-16:05	Coffee Break
Presiders: Dong Sun, Dongfang Zhang	
16:05-16:25	<b>Dynamic Study on Moire Excitons in Twisted <math>Ws_2/Wse_2</math> Heterostructures</b> <b>Xiaodong Cui</b> Hongkong University, China
16:25-16:45	<b>High Pressure Ultrafast Dynamics of <math>LaH_{10\pm\delta}</math> and Emergent Quantum State in 1T-TaS<sub>2</sub></b> <b>Jimin Zhao</b> Institute of Physics, Chinese Academy of Sciences
16:45-17:05	<b>Polariton Nonlinearities in Superlattices for Ultrafast Optical Switching</b> <b>Jiaxin Zhao</b> Nanyang Technological University, Singapore

17:05-17:25	<b>Dynamic Beam Shaping of Switchable Transverse-Mode Mode-Locked Fiber Laser</b> <b>Anting Wang</b> University of Science and Technology of China
17:25-17:45	<b>Large-Scale Timing Synchronization Based on Linear-Optics Timing Detectors</b> <b>Ming Xin</b> Tianjin University, China
17:45-18:05	<b>Self-Assembly Active Nanophotonic Devices</b> <b>Jiangang Feng</b> University of Science and Technology of China
18:05-18:15	<b>From Ultrafast Toggle to Precessional Single Laser Pulse Switching</b> <b>Yi Peng</b> Beihang University
	Dinner

# Room-Temperature 2D Material Terahertz Detector Based on the Photothermoelectric effect.

Yiming Zhu

Terahertz Technology Innovation Research Institute, University of Shanghai for Science and Technology

**Abstract:** High-performance uncooled terahertz (THz) detectors have a wide range of applications in many fields, such as 6G communications, imaging, spectroscopy and sensing. 2D material THz detectors based on the photothermoelectric (PTE) effect are one of the most promising technological routes to realize room-temperature general-purpose THz detectors with high sensitivity, fast response and broadband detection due to the advantages of the hot-carrier effect, zero-bias mode and broadband response. In this report, we present our team's research progress on a room-temperature, high-sensitivity THz detector based on the PTE effect in 2D materials. By introducing metal-2D material interface hot-carrier effects, combined with techniques such as THz resonant antennas and optical microcavities, the fabricated THz PTE detectors achieves a responsivity of 100 V/W at room temperature under zero-bias operation, an equivalent noise power (NEP) of 10 pW/Hz<sup>1/2</sup>, and a response time of 1 ns. This fully demonstrates the advantages and development potential of 2D material PTE THz detectors.



**Biography:** Professor Yiming Zhu is a preeminent leader in terahertz (THz) science, serving as Vice Director of the Shanghai Key Lab of Modern Optical System and Terahertz Technology Innovation Institute, and a "Youth Science and Technology Innovation Leader" at the University of Shanghai for Science and Technology (USST). Holding a Ph.D. from the University of Tokyo,

he has been recognized as a national "Young Yangtze Professor" and honored with prestigious awards including the "Outstanding Youth Foundation of the National Natural Science Foundation of China (NSFC)" and the "Special State Council Allowance." Professor Zhu's research focuses on the development of terahertz-based instruments and radar systems, with cutting-edge applications in detection and sensing fields. He has published over 100 academic papers, more than 40 of which appear in top-tier journals such as Nature Communications, Science Advances, and Light Sci. & Appl.. Nine of his works are listed as ESI highly cited papers, and he has led over 20 national and provincial-level research projects.

# Experimental realization of a metasurface-based dual-gate photoelectric tunable-step THz detector

Ruqiao Xia

Cavendish Laboratory, University of Cambridge

**Abstract:** High-responsivity terahertz (THz) detection remains a significant challenge, as existing enhancement strategies often rely on external coupling schemes rather than optimizing the intrinsic photoresponse mechanism. In this work, we demonstrate a quantum metasurface detector that exploits the in-plane photoelectric effect (IPPE). This dual-gate on top of two-dimensional electron systems (2DEG) layout enables efficient, zero-bias THz detection, offering a fundamentally different route toward high-performance sensing. By embedding a 2DEG within metasurface, we directly enhance the in-plane photoelectric response through strong localization of the incident THz field. Experimental results demonstrate a responsivity of 2.7 A/W at 1.9 THz (10 K), which is 33 times higher than previously reported values for 2DEG-based detection. These findings represent the first experimental realization of a quantum metasurface employing the IPPE for THz applications. Beyond the specific device performance, this work establishes a scalable framework for integrating metasurface physics with IPPE-based detectors, offering a versatile platform that can be extended to a broad class of high-speed, high-efficiency THz optoelectronic devices.



**Biography:** Dr. Xia Ruqiao is a Scientist at IMRE, A\*STAR, Singapore. She earned her Bachelor's degree with first-class honours from the University of Manchester and her PhD in Physics from Cavendish Laboratory, University of Cambridge. Her research focuses on designing and fabricating metasurfaces and nanophotonic structures for wave control in the terahertz and infrared spectral regions. Dr. Xia advances the development of next-generation, highly reconfigurable photonic and optoelectronic systems.

# Recent Progress on terahertz detectors using micro/nanoelectromechanical system resonators

Ya Zhang

Tokyo University of Agriculture and Technology

**Abstract:** Terahertz (THz) detectors based on micro- and nano-electromechanical system (MEMS/NEMS) resonators have emerged as a promising class of uncooled sensors, offering high sensitivity, fast response, and compatibility with microfabrication technologies. In these devices, incident THz radiation is converted into a thermal, electrical, or optomechanical perturbation, which is transduced into a measurable change in the resonance frequency or amplitude of a mechanical resonator. Recent progress has demonstrated significant improvements in key performance metrics, including noise-equivalent power (NEP), thermal responsivity, and response time, through advances in resonator geometry, material platforms, and readout schemes. Integration of THz absorbers such as antennas, metamaterials, and cavity-enhanced structures has further enhanced coupling efficiency and broadband response. This talk report recent advances in MEMS/NEMS resonator-based THz detectors, highlights remaining challenges in stability, scalability, and noise suppression, and outlines future opportunities for high-performance, compact THz sensing systems.

**Biography:** Ya Zhang is an Associate Professor at the Institute of Engineering, Tokyo University of Agriculture and Technology (TUAT). He received his B.E. (2006) and M.E. (2008) degrees from Tsinghua University, and his Ph.D. from the University of Tokyo in 2014, under the supervision of Prof. Kazuhiko Hirakawa. Following his doctoral studies, he conducted postdoctoral research at the Institute of Industrial Science, the University of Tokyo, from 2014 to 2018. He joined TUAT in April 2018, where he currently leads the Laboratory of THz Science and Devices. His research focuses on THz devices, with particular emphasis on uncooled THz detectors based on MEMS/NEMS resonators. His work spans device physics, micro/nanofabrication, and system-level integration, targeting high-sensitivity and fast-response THz sensing for spectroscopy and imaging applications.

## Sensitive THz quantum capacitance detectors with high dynamic range

Jian Chen

Nanjing University

**Abstract:** Superconducting quantum capacitance detectors (QCDs) have emerged as among the most sensitive terahertz (THz) photon detectors, positioning them as promising candidates for next-generation cryogenic telescopes. However, their limited dynamic range (~32 dB) and low saturated power (~0.1 fW) have hindered their broader applications, such as in THz astronomy, high-resolution spectroscopy, and microscopic imaging. Here, we propose a mechanism that enables controllable adjustment of the sensitivity and dynamic range of THz QCDs, validated both theoretically and through experiments. We developed QCDs that features a fork-shaped gate capacitor and a high-efficiency grid absorber. The optimized devices display a noise equivalent power of  $3.7 \times 10^{-20}$  W/Hz<sup>1/2</sup> and a dynamic range of 42 dB, providing a favorable balance between sensitivity and dynamic range and advancing the practical application of QCDs in future THz applications.



**Biography:** Received the B.S. and M. S. degrees in radio physics from Nanjing University (NJU), China, in 1983 and 1986, respectively. From 1986 to 1989, he was an assistant in NJU. He received D.E. degree in Department of Electrical Engineering from Nagaoka University of Technology (NUT), Japan, in 1992. Then, he was an assistant in Research Institute of Electrical Communication (RIEC), Tohoku University, Japan. From 1998, he was an associate professor in RIEC. He has been a professor in NJU since 2003. His research interest includes superconducting devices, terahertz techniques and their applications.

# Quantum Geometry Effect on Nonreciprocal Quantum Terahertz Sensing

Lin Wang

Shanghai Institute of Technical Physics, Chinese Academy of Sciences.

**Abstract:** Quantum geometry consists of quantum metric and Berry curvature, describe the geometric structure of Bloch electronic states. Their measurable effects depend on the P-T symmetry of quantum materials, invoking great interests in exploring nonlinear quantum phenomena among different materials system such as nonlinear Hall effect, higher-order harmonic generation, as well as electromagnetic harvester from microwave and terahertz band. This talk will introduce the recent progresses on Berry-curvature and quantum-metric dipole induced nonreciprocal quantum transport and nonlinear electromagnetic effect, as well as extrinsic mechanisms that lead to the nonreciprocal effect. We will discuss the opportunities for the development of quantum geometry-based diode without incorporating any semiconductor junctions that limit the threshold voltage or transit time for high-frequency electronics, and thus open up a new route towards broadband mixing, rectification, and frequency-comb in a single chip.



**Biography:** Lin Wang, a Professor at Shanghai Institute of Technical Physics, Chinese Academy of Sciences. He received the B. S. degree in Applied Physics (with honors) from Zhejiang University of Science and Technology, Hangzhou, China, in 2008, and the Ph. D. degree in Microelectronics and Solid-State electronics (with honors) from SITP in 2013. He is a member of AAAS, Chinese Physical Society, serving as young Editor's member for Journals such as Research, Exploration, Fundamental Research etc. Wang's research group is dedicated to the physics, nanophotonics and ultrafast phenomena of topological materials, 2D and quantum materials in far-infrared and terahertz band. He has authored approximately 100 peer-reviewed research articles in various journals including Nat. Electronics, Nat. Commun., Sci. Adv., Nano Lett. etc. which have been cited more than 4,000 times.

# Ultra-broadband, rapid, and trace terahertz fingerprint detection via resonance interaction enhancement

Yuping Yang

Minzu University of China

**Abstract:** Enhancing the interaction between light and matters, especially at terahertz band, is pivotal for achieving ultra-broadband trace molecular fingerprint detection. Here, we present several efficient schemes featuring resonance interaction enhancement of molecular fingerprints with long-awaited precision and flexibility. This technique constructs uniform resonant probes across entire spectral range to reveal molecular coupling effects via frequency-selective amplitude attenuation, enabling both qualitative and quantitative detection of trace THz fingerprint. This is an inaugural experimental achievement of quantitative THz trace fingerprint detection with dual capabilities of achieving ultra-broadband and high-efficiency. Significantly, our technology enables direct identification of molecular absorption signatures from the transmitted multiple Fabry-Pérot modes using wavelet denoising algorithms, eliminating cumbersome data post-processing and redundant testing procedures.



**Biography:** Yuping Yang received the B.S. and M.S. degrees from Capital Normal University in 1999 and 2002, and the Ph.D. degree from Institute of Physics, Chinese Academy of Science in 2005. Then, she joined the School of Science, Minzu University of China.

Her main research focuses on state-of-the-art THz spectroscopy and imaging, and she is dedicated to developing novel high-sensitivity biosensing technology based on THz metamaterials and metasurface to elevating the diagnostic utility and accuracy in clinical settings. Till now, Yuping Yang has published more than 100 high-level academic papers in authoritative journals, hosted over 10 national projects (including the National Major Instrument and Equipment Project, National Natural Science Foundation, National Key Research and Development projects, etc), and granted 11 patents, 4 software copyrights, 1 enterprise standard, as well as 2 group standards, and won the first prize for scientific progress from the Chinese Instrumentation Society.

# Room-temperature THz multiparameter detection using plasmon polariton atomic cavities

Huanjun Chen

Sun Yat-sen University

**Abstract:** Polaritons are hybrid modes formed through the coupling of the electromagnetic field with the charged collective excitations in materials. They exhibit remarkable electromagnetic field confinements within or at the surface of a material, positioning them as highly advantageous for the development of nanophotonic and optoelectronic devices. Noble metals, doped semiconductors, and their nanostructures excel at supporting polaritons in the visible and near-infrared regime. However, their field confinement capabilities degrade significantly as the operational frequency shifts into the mid-infrared and terahertz region. This limitation makes them unsuitable for developing high-performance and miniaturized photonic and optoelectronic devices in the specified frequency domain. Recent studies have uncovered the remarkable capability of van der Waals (vdW) two-dimensional atomic crystals and their nanostructures to sustain diverse polaritonic modes across the mid-infrared to terahertz spectral range. In this presentation, we will briefly review the roadmap of polaritonic van der Waals crystals. Subsequently, we will introduce our recent work on the plasmon polariton properties of graphene and its nanostructures. Following that, we will share our recent results on multiparameter THz detection using these graphene plasmonic nanostructures.



**Biography:** Huanjun Chen is a Professor and PhD Supervisor at the School of Electronics and Information Engineering, Sun Yat-sen University. He has long been engaged in research on polaritonic effects and emerging optoelectronic functional materials and devices, with particular focus on polariton phenomena and mechanisms in low-dimensional structures, the design of polaritonic architectures and electromagnetic field manipulation, and optoelectronic detection materials and devices. His work follows a full-chain research paradigm spanning materials synthesis, fundamental physical studies, and device applications. He has published over 140 SCI-indexed papers, with more than 9,000 citations in SCI (over 17,000 on Google Scholar), and an h-index of 64. His research has been cited by leading journals including Nature, Science, Nature Materials, Nature Photonics, Nature Nanotechnology, Nature Communications, Nature Reviews Materials, and Science Advances.

# Graphene Terahertz Photothermoelectric Detector and Its Array

## Integration

Yingxin Wang

Department of Engineering Physics, Tsinghua University

**Abstract:** As the transition band of electronics and photonics in the spectrum, terahertz wave has been investigated and demonstrated to be the suitable carrier in 6G telecommunications and beyond. This carrier frequency enables high-speed wireless transmission at several gigabits per second. Here, we demonstrate several photothermoelectric terahertz detectors based on ion-gel gated graphene and semi-suspended graphene. We exploit a bow-tie antenna and asymmetrically doped contacts for high absorption and efficient carrier transport, respectively. Compared to previously reported graphene-based terahertz detector with high speed and responsivity, our device avoided the complicated dual-gate structure. The ion-gel serve as gate material and encapsulation. Our device achieved a high responsivity of 0.1 A/W at 0.288 THz, and a setup-limited response time of 120 ns, i.e., a 3 dB bandwidth of 1.3 MHz. We also successfully developed a graphene array detector and achieved good real-time imaging results. These high performances show the potential of our graphene detectors for applications in high-speed terahertz wireless communication and imaging.



**Biography:** Prof. Yingxin Wang is from Department of Engineering Physics, Tsinghua University, Beijing, China. His research field is focused on terahertz photonics and optoelectronics, with particular interests in the theory, technology, and applications of terahertz detection, spectroscopy and imaging. He has been the Principal Investigator on over more than 20 scientific research projects, including the National Key R&D Program and the National Natural Science Foundation of China. He has authored/co-authored more than 130 papers in peer-reviewed journals and academic conferences, including Science Advances, Nano Letters, ACS Photonics (cover), etc. He served as a reviewer for several internationally renowned journals, including Nature. He received the first prize for scientific and technological progress in Beijing and the gold medal at the Geneva International Invention Exhibition.

# Performance analysis of electro-optic sampling detection technique with thin GaSe crystal

Haiwei Du

Nanchang Hangkong University

**Abstract:** Electro-optic sampling (EOS) detection technique has been widely used in the terahertz (THz) science, and it also can measure the field time waveform of few-cycle laser pulses. Its frequency response and band limitation are determined by the electro-optic crystal. Here, we investigate the frequency response of EOS with thin GaSe crystal, discuss its detection performance in the THz and mid-infrared bands. The pulse distortions induced by the EOS detection are discussed in detail, including the shift of the central frequency and change of the bandwidth. It is found: (1) In the THz band, the lower the central frequency is, the less the distortion is. When the frequency of THz pulse is higher than 4 THz, the frequency shift and bandwidth change are greatly obvious; (2) in the mid-infrared band (2-10  $\mu\text{m}$ ), the pulse distortions induced by the EOS also have similar properties. This work provides a good reference to evaluate the performance of EOS detection technique with thin GaSe crystal.



**Biography:** Haiwei Du, doctor, associate professor of Nanchang Hangkong University. Dr. Du obtained his doctoral degree from Shanghai Jiao Tong University in 2012 under the guidance of Professor Zheng-Ming Sheng. He visited THz Center of RPI in the group of Professor Xi-Cheng Zhang as a visiting student in 2010-2011. He has worked in RIKEN (Japan) from 2013 to 2015, in Chongqing Institute of Green and Intelligent Technology (CAS, China) from 2016 to 2018. In 2019, he joined Nanchang Hangkong University. His research involves optical terahertz science and technology, ultrafast optics, and laser plasma interaction. Until now, he has published more than 30 peer-reviewed papers as first author or responding author.

# Highly Sensitive Trace Detection Based on Terahertz Metasurfaces

Ride Wang

National Innovation Institute of Defense Technology

**Abstract:** Research on two-dimensional designer optical structures, especially ultra-thin optical elements dubbed ‘metasurfaces’, focused on engineering resonances to enrich the broadband spectral information, catering to the increasing sensing and detection demands. Current designs are constrained by discrete sampling of the spectrum, limiting continuous space-to-spectrum mapping. Here we present an integrated terahertz (THz) plasmonic gradient micro-phonic approach for encoding broadband spectra to observe molecular fingerprints. This innovation utilizes smooth variations in the metasurface’s unit cells to achieve an extraordinary density of resonances, exciting unique optical modes referred to as bound states in the continuum (BICs) in a non-periodic structure. The device covers a spectral width of 0.9 THz with only 19 modes in a compact  $400 \times 125 \mu\text{m}^2$  area. We demonstrate real-time, label-free identification of multiple analytes with enhanced vibrational fingerprints without complex scanning, offering a compact size, broad capabilities, and adjustable resolution to advance portable THz spectroscopy.



**Biography:** WANG Ride is an Associate Researcher at the Institute of Defense Science and Technology Innovation, Academy of Military Sciences. He has served as the principal investigator for 5 projects, including the National Natural Science Foundation for Young Scientists, Key Programs of the Commission of Science and Technology in the Central Military Commission, and Talent Programs of the Academy of Military Sciences. His research focuses on terahertz metasurface-enhanced sensing and detection devices. He has authored 30 SCI-indexed papers, including 20 as first or corresponding author in prestigious journals such as Nature Communications, Advanced Materials, Light: Science & Applications, Small (Top Cited Article), ACS Photonics (Front Cover), Research (Best Paper Award 2024), Applied Physics Letters (Editor’s Pick), Optics Express, and Nanoscale (Front/Back Cover). His work has been recognized as ESI Highly Cited Papers three times, forming a systematic body of high-quality foundational research.

# Design and Application of Carbon Nanotube Terahertz Sensors for Trace Biochemical Detection

Yue Wang

Xi'an University of Technology

**Abstract:** Carbon nanotube terahertz metasurface sensors exhibit both excellent biocompatibility and tunability in the detection of trace biochemical substances. This presentation focuses on a series of studies on carbon nanotube film-based terahertz metasurface sensors. Through chemical modification and physical doping of carbon nanotubes, precise femtomolar-level detection of trace SAA protein was successfully achieved. To address the characteristic absorption bands of different molecules and integrate multimodal fingerprint sensing, a polarization-angle-tunable resonance mode was designed, enabling specific recognition of molecular fingerprint spectra. To further enhance the specificity of substance identification, an antibody interface was integrated with a multi-channel microfluidic system, allowing parallel quantitative detection of multiple tumor biomarkers in complex biological samples. This series of studies advances terahertz metasurface sensing from fundamental exploration toward practical analysis of complex systems, providing a systematic material and device foundation for highly selective, multi-target biosensing.



**Biography:** Yue Wang, Professor, PhD Supervisor, PhD graduated from Harbin Institute of Technology, Leading Talent of Young and Middle-aged Scientific and Technological Innovation in Shaanxi Province; Leader of Young Innovation Team in Universities of Shaanxi Province; High-Level Talent of Xi'an University of Technology. Listed in the World's Top 2% Scientists

List, and recipient of the 2024 Wiley Outstanding Contribution Award for Chinese Authors. His research mainly focuses on photonics of carbon nanomaterials in the terahertz band, physics of functional devices based on artificial metamaterials, and their applications in biochemical sensing. In the past five years, he has presided over and participated in a number of key research projects, including the Key Program and General Program of the National Natural Science Foundation of China, Key Projects of Shaanxi Province, Key Program of Shaanxi Natural Science Foundation, and Shaanxi Provincial Innovation Team Project. He has published more than 80 SCI-indexed papers, including 5 cover/back cover papers and 2 ESI highly cited papers. He has won 2 Second Prizes of Provincial Natural Science Award and been granted 16 national invention patents.

# Deep-Subwavelength Electromagnetic Modulation for Ultra-Sensitive Integrated Sensing Systems

Xuanru Zhang

Southeast University

**Abstract:** Concentrating and modulating electromagnetic energy at deep-subwavelength scales enables high sensitivity and compact integration in next-generation sensing systems. Spoof localized surface plasmons (SLSPs) achieve this from microwave to terahertz frequencies. This talk will discuss recent advances from our team in integrated SLSP sensing. We have realized on-chip SLSP resonators using a 0.18- $\mu\text{m}$  CMOS process, achieving quality factors exceeding 30 in the terahertz range and deep-subwavelength confinement down to 1/865 of the free-space wavelength in the microwave band. Through precise design, we further engineer strong coupling between multiple SLSP modes to induce an exceptional-point (EP) state. This configuration strongly localizes analytes within an intense electromagnetic field, while the EP regime dramatically amplifies sensitivity to minute perturbations caused by analyte interactions. Using these SLSP resonators, we have experimentally demonstrated detection of nanomole-level antigen-antibody binding events. Building upon these deep-subwavelength resonators, we developed an ultra-compact wireless sensing system with a footprint of only 1.8 cm  $\times$  1.2 cm. The system monitors resonance-frequency shifts of an SLSP resonator via a software-defined approach, achieving a 108-fold enhancement in sensitivity and a signal-to-noise ratio of 69 dB. These results offer promising pathways toward highly compact, portable biomedical sensing platforms and may accelerate the translation of deep-subwavelength plasmonic sensing into practical applications.



**Biography:** Xuanru Zhang is an associate professor in Southeast University, Nanjing, China. She received the Ph.D. degree in optics from the University of Science and China, Hefei, China, in 2014. She was an Engineer at China Electronics Technology Group Corporation, Hefei from 2014 to 2016. She began her post-doctoral research at Southeast University, Nanjing, China, in 2016. Then she was a Postdoctoral Research Associate at The University of Arizona, Tucson, AZ, USA, from 2018 to 2019. Her research interests focus on metamaterials in both terahertz and microwave frequencies.

# Terahertz Resonant Envelope Sensor Based on Sub-Array Integrated Metamaterial with Multimode Resonance

Jiusheng Li

China Jiliang University

**Abstract:** We designs and fabricates a metamaterial terahertz broadband envelope sensor integrated with multi-mode resonator arrays. By leveraging localized surface plasmon resonance to enhance the terahertz wave-biosubstance interaction, terahertz multispectral measurements are performed on a metasurface integrated with 12 sets of sub-array units with geometrically tuned dimensions. This approach captures 26 resonance peaks that merge to form a continuous broadband envelope curve, thereby revealing the intrinsic absorption features of the detected biochemical molecules and addressing the challenges of sensitivity and broad-spectrum detection of characteristic peaks in label-free molecular sensing. The scattering multipole moments are calculated through spatial integration of the electromagnetic field intensity, providing microscopic insights into the local field enhancement mechanism under resonance frequency and mode coupling. Concentration differentiation of the tested biochemical substances is achieved via corresponding redshift of absorption peaks, with a sensor sensitivity reaching 20  $\mu\text{g/ml}$ , effectively improving the accuracy of fingerprint identification and quantitative analysis of biochemical substances. This work offers a new strategy for designing sensing chips capable of broadband, high-sensitivity, and multifunctional detection of biomolecules in the terahertz region.



**Biography:** He recieved the Ph.D degree in optical engineering from Tianjin University. From 2010 to 2011, he was a Postdoctoral Research Fellow in Université Paris-Sud. He was appointed as Zhejiang Provincial Outstanding Youth Fund Fellow, Leading Talents in Zhejiang Province's Ten Thousand Talents Plan for Technological Innovation, Leading Talents in Science and Technology Innovation in Zhejiang Province's Universities. Currently, his research interests include terahertz science and technology, metamaterials and metasurfaces, terahertz spectroscopy and nanophotonics. Up to now, he has published more than 120 SCI-index papers and authorize over 100 national invention patents.

# Metatronics for High-Performance Terahertz Integrated Circuits

Mohammad Samizadeh Nikoo

Nanyang Technological University

**Abstract:** Approaching the terahertz band from the electronics side is of great technological importance, with the promise of advancing next-generation wireless communication systems toward 6G and beyond. However, inherent limitations of high-speed transistors, the primary building blocks of monolithically integrated high-frequency circuits, have hindered the realization of high-performance terahertz electronics.

Electrical metastructures offer an alternative paradigm, in which modulation of the conductivity of a semiconducting layer controls collective quasi-electrostatic responses within a lumped structure, enabling electronic functionalities such as switching, mixing, and parametric amplification. Compared with conventional transistors, electrical metastructures enable ultra-low contact resistances, leading to record-high switching cutoff frequencies well beyond 10 THz in a compact device platform, referred to as electronic metadevices.

The first part of this talk highlights recent advances in III-nitride electronic metadevices operating up to 1 THz and introduces a new generation based on quasi-one-dimensional electrical metastructures with enhanced electrical performance. We present theoretical insights into the collective responses governing the operation of electronic metadevices and elucidate their ultimate performance limits. In the second part, we introduce a metastructure-based paradigm for directly realizing high-performance millimeter-wave and terahertz components with ultracompact footprints, demonstrated the compatibility of metatronic devices with commercial silicon processes.



**Biography:** Mohammad Samizadeh Nikoo is a Nanyang Assistant Professor in the School of Electrical and Electronic Engineering (EEE) at Nanyang Technological University (NTU), Singapore. He is the founding director of the Innovative Electronic & Electromagnetic Device Laboratory (i-Lab), which focuses on developing a new generation of semiconductor components for future information technologies. He received his PhD from EPFL, Switzerland, in 2022. In the same year, he joined the Integrated Systems Laboratory at ETH Zurich as a research scientist, before starting his tenure-track appointment at NTU in 2023. Dr. Samizadeh Nikoo is a Fellow of the National Research Foundation, Singapore (Class 2024). He has co-authored more than 50 journal and conference publications, including four

main-author papers in Nature and Nature Electronics, as well as two papers (one invited) presented at the International Electron Devices Meeting (IEDM). He has received several distinctions and awards and currently serves as the lead Principal Investigator (PI) on multiple national research projects and programs, including a Competitive Research Program (CRP) funded by the National Research Foundation, Singapore.

# Terahertz Imaging Technique Based on Terahertz Parametric Wavelength Conversion

Kosuke Murate

Nagoya University

**Abstract:** This presentation reports recent progress in terahertz (THz) imaging based on an injection-seeded THz parametric generator (is-TPG) and THz parametric detection. Owing to its broadband wavelength tunability and high dynamic range, this system is suitable for THz imaging through packaging materials. Various imaging techniques have been developed using this platform. In this talk, particular emphasis is placed on real-time spectroscopy and high-speed spectroscopic identification imaging achieved by combining multi-wavelength THz parametric generation with machine-learning-based analysis. Improving spectroscopic accuracy requires increasing the number of available wavelengths. This was previously limited to approximately five wavelengths because an equal number of injection-seed lasers were required. To overcome this limitation, we recently devised a new scheme that utilizes higher-order Stokes beams generated in a cascade manner under high-intensity pumping in parametric wavelength conversion as injection seeds. This approach enables simultaneous generation of 14 wavelengths. By employing this multi-wavelength system, real-time identification of more than ten different chemical reagents has been achieved, making it suitable for high-speed spectroscopic identification imaging. This talk will also highlight additional imaging modalities enabled by the is-TPG platform and discuss their potential for practical through-packaging THz sensing.



**Biography:** Kosuke Murate received his B.S., M.S., and Ph.D. degrees from Nagoya University, Japan, in 2013, 2015, and 2018, respectively. He served as an Assistant Professor in the Department of Electronics, Graduate School of Engineering, Nagoya University, from 2018 to 2025, and has been an Associate Professor there since 2025. In 2018, he received the Ikushi Prize awarded by the

Emperor of Japan through the Japan Society for the Promotion of Science. His research focuses on the development and application of terahertz parametric sources and detectors, including high-power tunable THz generation, real-time spectroscopy, and imaging technologies.

# High resolution and high performance THz frequency-domain spectroscopy (THz-FDS) systems with substances detection and applications

Cunjun Ruan

School of Electronic and Information Engineering, Beihang University

**Abstract:** Terahertz (THz) waves occupy a special frequency band between microwaves and infrared light. Due to their excellent properties such as low energy, penetration ability, and fingerprint characteristics, THz waves have significant research value and application prospects in various fields, including biological analysis, chemical analysis, non-destructive testing, and national defense and military applications. Among these, THz spectroscopy, which is based on molecular rotational and vibrational transition characteristics, is an important direction in THz scientific research. The technical solutions are mainly divided into THz time-domain spectroscopy (THz-TDS) systems and THz frequency-domain spectroscopy (THz-FDS) systems, each with its own advantages and disadvantages in detection. The THz spectroscopy system used in this paper is a THz frequency-domain spectroscopy system, which has the greatest advantage over THz time-domain spectroscopy in terms of extremely high frequency resolution, providing significant benefits for detecting substances with sharp absorption peaks, such as gases. Based on the constructed THz-FDS detection device, experimental detection and research works have been conducted covering the gas, liquid and solid substance with transmission and reflection layout system. The high resolution, enhanced resonance interaction with good signal-to-noise ratio have been achieved with frequency controlling in 0.1-1.5THz, the Fabry-Pérot cavity etc. The data processing methods have been put forward to obtain the amplitude and phase of the reflected signal using the Hilbert transform and SSKK method etc. Thus, the THz-FDS has been proved as the good devices for the detection, analysis, and distinguish for all kinds of substance in terahertz band, and given good characteristics and wide applications in the future.



**Biography:** Dr. Prof. Cunjun Ruan, born in Aug. 4th, 1974, Professor in School of Electronic and Information Engineering, Beihang University. His main interests focused on the high-power vacuum electron devices e.g. sheet beam klystron (EIK), extended interaction klystron (EIK), travelling wave tube (TWT) in millimeter wave and terahertz band, and integrated semiconductor vacuum tube in

terahertz band. Also, he focuses his research on the interaction processes and physical analysis between terahertz wave and related materials, spectroscopy and imaging in security field. About 300 papers have been published in international academic journals and conferences, and 30 National Invention Patents were authorized.

# Quantum Transport of Strongly Correlated Excitons in Moiré Superlattices

Shibin Deng

Nankai University

**Abstract:** Understanding quantum transport in strongly correlated systems is a central challenge in condensed matter physics. Here we develop a multi-physics-controlled transient optical imaging method to investigate exciton transport in moiré superlattices, which serve as quantum simulators of the Hubbard model with tunable interactions. At a filling of exactly one exciton per moiré site, we observe a striking transport freeze—excitons cease diffusing over  $\sim 70$  nm, despite strong dipole repulsion that would normally accelerate motion. First-principles calculations reveal that long-range dipole interactions create an energy barrier that suppresses diffusion without an external energy reservoir. This behavior highlights the cooperative nature of particle motion with strong correlations. Our results demonstrate a new paradigm of quantum transport where inter-particle interactions dominate, offering insights into possible superfluid or superradiant phases in moiré heterostructures.



**Biography:** Dr. Deng Shibin is a Principal Investigator at Nankai University. His research focuses on ultrafast imaging of carrier dynamics, particularly in strongly correlated quantum systems. Dr. Deng has developed multi-physics-controllable, high-throughput transient absorption microscopy and a multimodal transient optical – ultrafast electron microscopy system, achieving 300 fs/30 nm

spatiotemporal precision under cryogenic and electric field conditions. Using these homebuilt instruments, he directly visualized the formation, freezing, and melting of excitonic Mott insulators in moiré heterostructures, revealing unexpected transport freeze behavior driven by strong correlations. His work has been highlighted by MIT Technology Review and featured as a major advance in the classic textbook Semiconductor Optics (Springer). He has published over 30 papers including in Nature, Nat. Mater., Nat. Chem., Nat Nanotechnol., Nat. Synth., with >3000 citations and 7 ESI highly cited papers. He leads a NSFC General Project and serves as a sub-topic leader for a National Key R&D Program of China. Dr. Deng's innovations provide critical visualization of quantum many-body dynamics and advance domestic ultrafast instrumentation.

## Low-loss native Ge platform for chip-scale LWIR photonics

Dingding Ren

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

**Abstract:** The longwave infrared (LWIR, 6–14  $\mu\text{m}$ ) hosts strong molecular vibrational fingerprints, but integrated photonics in this band has been constrained by the scarcity of material stacks that simultaneously provide high-index guiding and low-loss cladding. We report recent progress on native-germanium (Ge) integrated photonics that enables ultra-low-loss propagation and high-Q resonance in the LWIR. First, using native Ge, we demonstrate LWIR whispering-gallery-mode microresonators coupled to partially suspended Ge waveguides, achieving 0.5 dB/cm loss at 8  $\mu\text{m}$  and intrinsic Q about  $2.5 \times 10^5$ . Second, we develop a germanium-on-zinc selenide (GOZ) platform by bonding high-quality Ge films onto ZnSe, demonstrating wide transparency window from 2 to 14  $\mu\text{m}$  and optical loss of  $\sim 1 \text{ cm}^{-1}$  at 7.8  $\mu\text{m}$ . Finally, we outline how continued loss reduction and dispersion engineering can enable chip-scale frequency conversion, comb sources, and spectroscopy-on-chip in the 6–14  $\mu\text{m}$  band.



**Biography:** Dr. Dingding Ren is currently an associate professor in Shanghai Institute of Microsystem and Information Technology, CAS. He obtained his PhD degree in nanoelectronics and photonics in 2017 from NTNU in Norway. Currently, he focuses on developing low-loss photonic system on chip for longwave infrared and terahertz frequencies, where strong light-matter interactions are crucial for practical sensing applications.

# Nonlinear terahertz spectroscopy under magnetic fields

Xinbo Wang

Institute of Physics, Chinese Academy of Sciences

**Abstract:** Nonlinear terahertz spectroscopy under magnetic fields provides a unique route to probe the non-equilibrium dynamics in strongly correlated systems, topological materials, and spintronic devices. In this talk, I will first introduce the THz spectroscopy platforms developed at the THz unit of the Synergetic Extreme Condition User Facility (SECUF). I will then highlight our recent progress on nonlinear THz response of materials under low temperature and high magnetic field. First, we show that a monolayer Pt film, typically used as a non-emitting reference in THz spintronic studies, can generate highly efficient THz emission via the photo-Nernst effect under cryogenic magnetic fields, with an efficiency comparable to conventional spintronic emitters. Second, by combining a laser-driven tabletop intense THz source with a superconducting magnet, we have developed a THz high-harmonic generation spectrometer operating at 1.5 K and up to 10 T, enabling studies of materials with strongly field-dependent properties. Third, we have established a two-dimensional THz spectroscopy platform based on dual intense THz pulses generated from separate LiNbO<sub>3</sub> crystals, which directly reveals high-order wave mixing processes up to the eleventh order in silicon.



**Biography:** Xinbo Wang is an associate researcher at the Institute of Physics, Chinese Academy of Sciences (IOP, CAS). He received his B.S. degree from Xi'an Jiaotong University in 2011 and his Ph.D. from the IOP, CAS in 2016, followed by postdoctoral research at Nanyang Technological University, Singapore. Since returning to IOP in 2018, he has been responsible for the design and operation of the terahertz spectroscopy unit at the “Infrared and terahertz spectra measurement station under extreme conditions” within the Synergetic Extreme Condition User Facility. His research focus on ultrafast optical spectroscopy under extreme conditions – including low temperature, high magnetic field, high pressure, and intense THz fields – to explore the ultrafast dynamics of condensed matter systems. He has published more than 30 papers in SCI-indexed journals, including 16 as first or corresponding author, including two in Nature Physics, one in Advanced Materials, and one in Nature Communications.

# Research on plasma parameter diagnostics using terahertz time-domain spectroscopy

Chun Zhou

Institute of Plasma Physics, Hefei Institutes of Physical Science, Chinese Academy of Sciences

**Abstract:** In magnetic confinement fusion devices, diagnostics of plasma electron density is very important. Systems such as far-infrared laser interferometers and CO<sub>2</sub> dispersion interferometers can be used to investigate plasma electron density. Terahertz time-domain spectroscopy (THz-TDS) is one of the most common measurement techniques in terahertz research field; it can detect both amplitude and phase information across a frequency range. Using THz-TDS one can study the propagation characteristics of terahertz waves in plasma and identify resonant absorption features induced by the plasma. By comparing the terahertz spectra and phase changes with and without transmission through the plasma, information such as the plasma electron density can be obtained. This talk will report experimental and simulated results of THz-TDS based diagnostics of plasma electron density and THz polarization rotation angles using an inductively coupled plasma (ICP) source, and discusses prospects for extending these methods to tokamak devices.



**Biography:** Chun Zhou, Associate Professor, Institute of Plasma Physics, Hefei Institute of Physical Science, Chinese Academy of Sciences. He earned his undergraduate degree from Nankai University and completed his Ph.D. at Peking University. Following his doctorate, he conducted postdoctoral research in Japan and Germany. Since 2018, he has been affiliated with the Hefei Institute of Physical Science, where his primary research focuses on plasma diagnostics, terahertz technology, and ultrafast lasers, and he has published around 30 papers in high-impact journals such as *Advanced Science* and *Optics Express*.

# Interface THz Nonlinear Optical Spectroscopy

Chuanshan Tian

Department of Physics, Fudan University

**Abstract:** Quantum confinement and proximity effects at material interfaces give rise to a range of novel physical and chemical phenomena, substantially advancing our ability to understand and control material properties. The development of in situ and interface-sensitive characterization techniques is therefore critical for uncovering the microscopic mechanisms governing interfacial systems and for improving device performance. This presentation will outline recent advances in interface nonlinear optical spectroscopic techniques, with a particular focus on their extension into the (multi-)terahertz spectral regime. Applications of these methods in probing interfacial microstructures and dynamic processes will be discussed, highlighting their potential for resolving complex interfacial phenomena with high specificity.



**Biography:** Chuanshan Tian is a professor at the department of physics, Fudan University. He obtained his Ph.D. degree from Fudan University in 2006 and has since dedicated his research to the field of surface science and the development of cutting-edge nonlinear optical spectroscopic

techniques.

# Plasma Distribution Charactering by Terahertz Focal Plane Imaging

Wenfeng Sun

Capital Normal University

**Abstract:** The characterization of electron density distributions in air-ionized plasma using terahertz (THz) focal-plane imaging will be introduced in this talk. Utilizing THz imaging, the electron density distributions of the plasma at different frequencies were revealed. The results indicate that along the length of the plasma filament, the electron density is higher at the initial segment. Furthermore, the evolution of the electron density distributions of plasmas was obtained, revealing that the plasma morphology evolves from a point-like to a strip-like structure as the formation time extends. Additionally, it was found that the peak electron density of the plasma shifts continuously as the laser pulse propagates forward. Other factors, such as the focal length of the focusing lens and the laser pulse power, were also investigated for their influence on the characteristics of the electron density distribution in the plasma. These findings elucidate the spatiotemporal evolution of electron density in air-ionized plasma, offering a valuable tool for plasma diagnostics.



**Biography:** He is currently conducting research at the Key Laboratory of Terahertz Optoelectronics of the Ministry of Education, focusing on terahertz emitters, spectroscopy, and imaging technologies.

His research mainly covers the measurement and characterization of photo-induced plasmas, as well as the development of plasma-based terahertz radiation sources. Concurrently, he carries out research

work at the Beijing Key Laboratory of Metamaterials and Devices, where his studies involve the measurement and characterization of terahertz metamaterial devices, and the exploration of strong-field terahertz-matter interactions based on TPTP, TPOP, and OPTP techniques. His research aims to advance the fundamental understanding and practical application of terahertz technology in related fields.

# Reference-free humidity sensing based on terahertz time-domain spectroscopy

Xuequan Chen

GBA Branch of Aerospace Information Research Institute, Chinese Academy of Sciences

**Abstract:** Humidity sensing is crucial across various applications, yet conventional electrical sensors rely on physical contact, limiting their accuracy, response speed, and spatial flexibility. Water vapor exhibits dense rotational transitions in the terahertz regime, making terahertz spectroscopy an attractive tool for humidity sensing. However, absorption-based spectroscopic sensing demands a frequently measured zero-concentration reference to extract intrinsic absorption spectra, hindering its practical deployment. In this work, we propose a reference-free humidity sensing method based on terahertz time-domain spectroscopy. The method employs a database-comparison strategy empowered by a two-step calibration procedure, which efficiently adapts the database to variations in optical path length, temperature and spectral response. By comparing any newly measured signal with the database, humidity levels can be directly determined from raw signals without reference and absorption models. The method achieved a root mean square error of relative humidity down to 0.62% across various measurement conditions and systems. Furthermore, its contact-free nature enables spatially averaged and real-time response, as demonstrated in the respiration monitoring measurement. Overall, the technique outperforms conventional humidity sensing devices over multiple aspects, showing strong potential for applications in medical diagnosis, extreme industrial environments and advanced scientific instrumentation.



**Biography:** Xuequan Chen received his B.Eng. degree from the University of Electronic Science and Technology of China in 2014 and his Ph.D. degree from the Chinese University of Hong Kong in 2018. He was awarded the Impact Postdoctoral Fellowship for his postdoctoral research during 2018–2021. He has been a research fellow at the GBA Branch of the Aerospace Information Research Institute, Chinese Academy of Sciences (CAS), since 2021. Prof. Chen's research interests include terahertz functional devices, systems, and biomedical applications. He has published over 40 papers in journals such as Nature Communications, ACS Photonics, and Photonics Research.

# Scaling impact on transmission performance of TGV-based interconnects in glass interposers at terahertz frequencies

Ran Wang<sup>1</sup>, Zhaoying Li<sup>2,3</sup>, Yuanze Yan<sup>2</sup>, Pengran Yang<sup>4</sup>, Yanqin Jin<sup>4</sup>, Lianggong Wen<sup>2,3</sup>

<sup>1</sup>Hangzhou International Innovation Institute, Beihang University, <sup>2</sup>School of Integrated Circuit Science and Engineering, Beihang University, <sup>3</sup>Integrated Circuit and Intelligent Instruments Innovation Center, Qingdao Research Institute, Beihang University, <sup>4</sup>National Superior College for Engineers, Beihang University

**Abstract:** Through-glass via (TGV) based vertical interconnects are key enablers for high-density, low-loss 3D glass interposer technologies targeting high-speed digital and RF applications. In this work, a TGV-based coplanar waveguide (CPW) vertical transition is investigated using full-wave electromagnetic simulations. The baseline structure consists of a top-layer CPW connected to a bottom-layer CPW through a copper-filled via, followed by a second via transition to an upper CPW at the output port. The proposed structure achieves an insertion loss better than -1dB over the terahertz band. To study geometric scaling effects, the entire structure is proportionally scaled by factors of 2×, 3×, 4×, and 5×, and their transmission characteristics are compared. Simulation results demonstrate that increased physical length leads to systematic degradation in transmission performance, consistent with previously reported trends for CPW--TGV transitions. The results provide quantitative insight into length-dependent loss mechanisms and offer practical design guidance for compact, low-loss TGV interconnects in glass interposers.

# Probing carrier dynamics in monolayer 2D materials with nanoscale spatial resolution through time-resolved THz-TDS near-field microscopy

Nicolai Hartmann; Jonas Albert; Andreas Huber

attocube systems GmbH, Nanoscale Analytics, Germany

**Abstract:** Terahertz (THz) imaging and spectroscopy enable contact free characterization of free carrier concentrations and ultrafast carrier dynamics in nanoscale electronic materials. Conventional THz microscopy is diffraction limited, whereas scattering type scanning near field optical microscopy (s SNOM) concentrates THz fields at a metallic tip and detects the scattered signal, achieving spatial resolutions below 15 nm ( $\lambda/8000$ ).

We integrated a customized THz TDS spectrometer with a neaSCOPE near-field microscope to investigate nanoscale variations in doped semiconductors and two-dimensional materials. Incorporating a pump-probe scheme extends this approach to femtosecond time resolution. We demonstrate THz TDS based s SNOM, including VIS optical pump/THz probe (OPTP) imaging and spectroscopy of individual MoS<sub>2</sub> crystals and MoS<sub>2</sub>/WSe<sub>2</sub> heterostructures.

Broadband THz pulses illuminate the tip, and near field images of MoS<sub>2</sub> under synchronized optical pumping reveal terrace dependent contrasts related to thickness and photoinduced conductivity changes. VIS excitation increases THz conductivity via photo generated carriers. Extending the method to MoS<sub>2</sub>/WSe<sub>2</sub> heterostructures shows monolayer level sensitivity. Time-resolved local OPTP measurements show distinct relaxation dynamics in individual MoS<sub>2</sub>, WSe<sub>2</sub> layers, and combined MoS<sub>2</sub>/WSe<sub>2</sub> layers. Within an individual domain, nanoscale variations, including faster recombination at edges are observed.

Our results highlight the capability of combining time resolved THz TDS with nanoscale optical resolution to study low energy excitations and ultrafast processes in emerging quantum and nanomaterials, with potential extension to cryogenic investigations.

# Ultrafast charge carrier and thermal dynamics in MXenes

Wenhao Zheng

GBA Branch of Aerospace Information Research Institute, Chinese Academy of Sciences

**Abstract:** Two-dimensional transition metal carbides, nitrides and carbonitrides, known as MXenes, exhibit remarkable electronic, optical, mechanical, and thermal properties. However, a comprehensive understanding of charge carrier and thermal dynamics in MXene remains limited.

Here, we address two central questions concerning charge transport and photothermal effects in MXenes:

- (i) We resolve the distinction between long-range and short-range charge transport and demonstrate the formation of large polarons in MXenes by combining ultrafast terahertz and static electrical transport measurements.
- (ii) We reveal a long-lived, photoinduced suppression of conductivity, which we attribute to efficient lattice heating and slow heat dissipation in metallic MXenes.

Our findings provide integrated insights into the coupled electrical, optical, and thermal responses of MXenes, underscoring their promise for electronic transport devices and photothermal technologies.

# Terahertz surface-emitting photonic devices for vortex beam generations and wireless communications

Song Han

Zhejiang University

**Abstract:** Integrated photonics is increasingly demanded in applications such as large-scale data centers, intelligent sensing, and next-generation wireless communications, where compact, multifunctional, and energy-efficient components are essential. Here, we present two strategies for surface-emitting photonic devices that can convert the in-plane guided THz wave to be beam-engineered free-space THz wave. 1. We develop a staged-annealing topological optimization (SATO) framework tailored for the design of integrated terahertz (THz) beam-shaping devices. 2. We construct topological leaky-wave antennas that can robustly function as highly collimated wireless communication links.



**Biography:** Dr. Han's research focuses on terahertz semiconductor devices and physics, photonic crystals and metamaterials, terahertz chip-integrated devices and systems. He has co-authored or served as a corresponding/first author on over 50 academic papers published in journals such as Nature Photonics (1), Nature Communications (1), Advanced Materials (2), Light: Science & Applications (2), Laser & Photonics Reviews (1), and Advanced Optical Materials (4), including 2 highly cited papers. He holds one authorized international patent and two domestic patents. He has also led several research projects, including the National Key R&D Program Young Scientist Project, the Excellent Young Scientists Fund (Overseas), and a General Program of the National Natural Science Foundation of China.

# Probing Spin-Phonon Coupling and Chirped Terahertz Emission in Quantum Materials

Zhigao Sheng

High Magnetic Field Laboratory, HFIPS, Chinese Academy of Sciences, Hefei 230031, China

**Abstract:** This report presents our recent progress in advancing terahertz (THz) science through active device engineering and novel spectroscopic applications in several quantum materials. We first demonstrate a smart electro-optic THz modulator based on the strongly correlated oxide  $\text{VO}_2$ . Secondly, we leverage THz spectroscopy to probe fundamental interactions in quantum materials. In the frustrated magnet  $\text{NaCrO}_2$ , we directly reveal strong spin-phonon coupling and persistent short-range magnetic order. In  $\text{LaF}_3$ , we report novel chirped THz emission driven by phonon polaritons. Collectively, this work bridges smart THz device development with the exploration of spin-lattice and photon-phonon interactions.



**Biography:** Prof. Zhigao Sheng is the vice director of the Chinese High Magnetic Field Laboratory (CHMFL) of Chinese Academy of Sciences. He got Ph.D from Institute of Solid State Physics, CAS in 2007, and then be a postdoctoral fellow in the University of Hong Kong (07-08), the University of Tokyo (08-10), and the RIKEN in Japan (10-13). He focused on the research of spectrum technology, spectrum materials and spectrum devices under magnetic field, published more than 100 papers (Nature Phys., PRL, Nature Comm., Adv. Mater., etc).

# Spatiotemporal Terahertz Modulation Using UV-Patterned Conductive Polymer Thin Films

Shangzhi Chen

University of Electronic Science and Technology of China

**Abstract:** Broadband and continuously tunable terahertz (THz) modulation remains challenging due to the lack of materials enabling large, spatially programmable transmission control. Here, we present a scalable approach for spatiotemporal THz modulation by integrating ultraviolet (UV) patterning with vapor phase polymerization of PEDOT:Tos thin films. UV exposure enables deterministic control of sheet conductance over more than three orders of magnitude with minimal thickness variation, resulting in broadband THz transmission tunable from ~1% to ~90% across 0.2–1.5 THz. The films exhibit excellent long-term stability and enable applications including programmable neutral-density filters, gradient choppers, beam shaping, and high-dynamic-range THz imaging.



**Biography:** Shangzhi Chen is a Professor at the University of Electronic Science and Technology of China. He received his Ph.D. from Linköping University, Sweden, and conducted postdoctoral research at the University of Cambridge. His research focuses on conductive polymers, organic plasmonics, and terahertz photonics, with an emphasis on dynamically tunable electromagnetic devices and functional materials.

# Ultrafast ferroelectric polarization switching driven by optical and terahertz pulses in NbOCl<sub>2</sub> semiconductor

Fuhai Su

The Hefei Institutes of Physical Science (HFIPS), Chinese Academy of Sciences (CAS)

**Abstract:** Recently, semiconductor NbOCl<sub>2</sub> has emerged as a room-temperature ferroelectric distinguished by weak interlayer coupling and a pronounced nonlinear optical response, making it a promising candidate for ultracompact on-chip photonic devices. Herein, we utilize time-resolved (TR) second-harmonic generation (SHG) spectroscopy to investigate the dynamics of ferroelectric polarization (FP) in NbOCl<sub>2</sub> thin flakes. Upon above-bandgap photoexcitation via optical pulses, we observe a substantial suppression of SHG intensity within sub-picosecond timescales, exhibiting a linear scaling with pump fluence up to 10 mJ/cm<sup>2</sup>. Through complementary TR-reflectivity measurements, we reveal that the FP modulation is predominantly governed by charge screening coupled with electron heating. Moreover, leveraging intense terahertz (THz) pulses as a pump, we achieve a remarkable 40-fold enhancement in SHG intensity, demonstrating nonthermal FP switching driven by the THz electric field. The dependence of SHG modulation on THz field strength exhibits transitions between linear and quadratic regimes, contingent on the light polarization. Our findings underscore the potential of NbOCl<sub>2</sub> for high-speed optically controlled ferroelectric devices and THz detection.



**Biography:** Fuhai Su earned his Ph.D. in Condensed Matter Physics from the Institute of Semiconductors, Chinese Academy of Sciences (CAS) in 2006. He subsequently conducted postdoctoral research at the Max Planck Institute for Solid State Research, Germany (July 2006- November 2007) and the University of Alberta, Canada (March 2008- November 2010). He is currently a researcher at the Institute of Solid State Physics, Hefei Institutes of Physical Science (HFIPS), CAS. His primary research focuses on the ultrafast photophysics of quantum functional materials spanning the visible, infrared, and terahertz spectral ranges, as well as the development of ultrafast spectroscopy under extreme conditions, such as high temperature and high pressure. To date, he has published over 80 papers in international journals, including Physical Review Letters, Physical Review B, and ACS Nano.

# High-efficiency optically controlled terahertz modulation in HgTe semimetal

Peng Suo

Shanghai University

**Abstract:** Low-power and high-speed terahertz (THz) modulators are of significant importance for advancing THz technologies, which demand exceptional functional materials to load. In this work, we investigate the transient THz transmission dynamics in semimetallic mercury telluride (HgTe) films utilizing optical pump-THz probe spectroscopy. Astonishingly, photoexcited pure HgTe exhibits an ultrasensitive transmission response in the THz frequency range at room temperature. Moreover, the photocarrier relaxation remains ultrafast and nearly constant across a wide range of pump fluences. Through detailed analysis of THz photoconductivity spectra, Drude-Smith model fitting, and temperature-dependent transient dynamics, we reveal that HgTe's superior performance stems from its ultrahigh electron mobility, small effective mass, as well as its gapless electronic structure. This study highlights HgTe's immense potential for developing energy-efficient, broadband, all-optically controlled, ultrafast THz modulators.



**Biography:** Dr. Peng Suo obtained his Ph. D. degree in Department of Physics from Shanghai University in 2023. He currently continues his scientific research as a postdoctoral research fellow at Shanghai University. His research interests include ultrafast carrier dynamics and terahertz photonics, especially the ultrafast terahertz spectroscopy in topological materials. He has published over 10 papers (as the first or the corresponding author) in prestigious international journals, including Physical Review Letters, Laser & Photonics Reviews, and ACS Photonics. He is currently hosting 3 research projects, including the National Natural Science Foundation of China, the China Postdoctoral Science Foundation, and the Postdoctoral Fellowship Program of CPSF.

## Probing Orbital Polarization via Orbital-to-Charge Conversion

Yong Xu

Beihang University

**Abstract:** Orbitronics exploits the orbital degree of freedom and paves a new route for developing ultrafast magnetic devices. The orbital source is critical for the performance of ultrafast orbitronic devices. While the orbital generation from Ni upon ultrafast pumping has recently been studied extensively, the application of Ni-based devices is hindered by its low generation efficiency and the low Curie temperature. In our latest findings, we present a more effective method of generating ultrafast light-induced orbital currents using CoPt alloy. The resulting orbitronic terahertz emission from CoPt/Cu/MgO structures exhibits terahertz radiation comparable to benchmark spintronic terahertz emitters. We show that terahertz emission primarily originates from the generation of ultrafast orbital accumulation within CoPt material, which propagates through the Cu layer and achieves orbital-to-charge conversion at the Cu/MgO interface via the inverse orbital Rashba-Edelstein effect. Our work provides a new opportunity for the developing ultrafast orbitronic devices, paving the way to efficient orbital terahertz emitters.



**Biography:** Xu Yong, Associate Professor, PhD supervisor, is the Assistant Director of the National Key Laboratory of Spin Chips and Technology. His research focuses on spintronics. In the past five years, he has published over 40 SCI papers in journals such as Nat. Commun. and Adv. Mater. He has been invited to serve as a reviewer for important international SCI journals, including Phys. Rev. Lett., Nat. Commun., etc. He has also been invited to give invited talks at various international and domestic conferences, including the International Conference on Magnetism and Magnetic Materials and the Annual Meeting of the Korean Physical Society, etc.

## The new physics in coupling of THz metasurfaces

Wei Huang

Guilin University Of Electronic Technology

**Abstract:** In this talk, I will summarize our recent works about some new physics in coupling of THz metasurfaces, such as analogue of many-body physics, anderson localization and the information theory of coupled metasurface. Based on the many-body physics, we propose a transmission dip in a terahertz (THz) metamaterial device by employing the coupling between bright mode and interference of dark modes. We provide the theoretical analysis, analytical calculations, and simulations to present the transmission spectrum of metamaterials. In second study, we demonstrate the Anderson localization effect in coupled metamaterial structures. We introduce the random variables by randomly choosing the geometrical parameter of structures and randomly choosing the distance between structures to reduce the coupling of metamaterial and this decoupling effect is equivalent to Anderson localization effect. At the last, we derive the information theory for metasurfaces by considering ubiquitous near-field coupling effect between the meta-structures and find that an information entropy reduction will be introduced to the upper bound of information for metasurfaces due to such couplings.



**Biography:** Wei Huang obtained PhD degree from Singapore University of Technology and Design (SUTD) with full scholarship in 2018. He was awarded Guangxi Major Talent Project in 2025 and Guangxi oversea 100 talent in 2018. He is currently an associate professor in Guilin University Of Electronic Technology (GUET). His research interests are in quantum optics, applications of quantum optics in multiple (classical and quantum) system and coupling of metamaterials. Currently, he published 45 journal paper with first or corresponding author. Obtained two NFSC funding and received a Special Prize for the Science and Technology Progress Award from the Guangxi Society of Optics (Ranked first) and a second prize in the Guangxi Natural Science Award.

# Emerging Dynamics and Functional Properties of Topological Polar Structures

Qian Li

Tsinghua University

**Abstract:** The discoveries of topological polar structures, such as polar vortices, skyrmions, and dipole waves, have opened a new frontier in ferroelectric studies.  $\text{PbTiO}_3/\text{SrTiO}_3$  superlattices, featuring wide-range tunable lattice strain and boundary conditions, have emerged as an important platform in which various topological structures can be stabilized. These structures generally exhibit polarization vector configurations with nontrivial topology and nanoscale unit sizes, giving rise to emerging dynamics and functional properties distinct from conventional ferroelectrics. Over the last few years, we have systematically explored the functional properties of topological polar structures hosted in  $\text{PbTiO}_3/\text{SrTiO}_3$  superlattices, using optical second-harmonic generation and ultrafast spectroscopy characterizations. In this talk, I will present our findings on the terahertz collective dynamics, nonlinear optical responses, and millimeter-wave dielectric tunability, which suggest the promise of topological polar structures for applications in next-generation terahertz optoelectronic devices.



**Biography:** Prof. Qian Li received his BSc and MSc from Nanjing University of Aeronautics and Astronautics and his PhD from The Australian National University in 2014, followed by postdoctoral research at Oak Ridge National Laboratory and Argonne National Laboratory in the United States.

His research focuses on ferroelectric thin films, integrated photonic devices, nonlinear optics, and ultrafast dynamical characterization. He has published over 130 papers in leading journals such as Nature, Nature Physics, Nature Communications, Light: Science & Applications, and Advanced Materials, and has been recognized with several prestigious national talent programs, grants and awards.

# Active photonic functional terahertz emitters enabled by spatial and temporal modulations

Xueqian Zhang

Tianjin University

**Abstract:** Active terahertz (THz) generation and control are critical for advancing communication, imaging, and sensing. Traditional THz emitters often face limitations in dynamic modulation speed, bandwidth, and spatial programmability. This report introduces two synergistic approaches: one enables ultrafast temporal modulation of THz generation using optically pumped indium tin oxide films, achieving sub-picosecond amplitude and spectral tuning. The other realizes a programmable photonic THz phased array via selective excitation of nonlinear metasurfaces, enabling dynamic beamforming, imaging, and vortex beam generation. The temporal modulation approach demonstrates 80% amplitude and 15% frequency shift modulations. The spatial approach achieves broadband 2D wavefront control with 2-bit phase coding over 0.8–1.4 THz, supporting reconfigurable THz beam steering and structured emission. These works highlight the potential of integrating spatial and temporal modulation strategies to create versatile, high-speed, and programmable THz sources, paving the way for next-generation THz technologies in communications, radar, and compact spectral systems.



**Biography:** Xueqian Zhang, Professor and Doctoral Supervisor at the Center for Terahertz Waves, School of Precision Instrument and Opto-electronics Engineering, Tianjin University. His research focuses on terahertz manipulation. He has published over 110 papers with over 10,000 Google Scholar citations and an H-index of 51. Among them, more than 50 papers have been published as first or corresponding author in journals such as Nature Communications, Science Advances, Advanced Materials, Advanced Photonics, and Optica. He has led Key, General, and Young Scientists projects supported by the National Natural Science Foundation of China, and has received honors including the First Prize in Natural Science from the Ministry of Education, the Second Prize in Natural Science from Guangxi Zhuang Autonomous Region, selection into the China Association for Science and Technology's "Young Talents Supporting Project", the Jin Guofan Young Scholar Scholarship from the China Instrument and Control Society, the National Excellent Doctoral Dissertation in Optics from the Chinese Optical Society, nomination for the National Excellent Doctoral Dissertation in Optical Engineering from the Chinese Society for Optical Engineering, the "Climbing Program" for Leading Scientific and Technological Talents at Tianjin University, and the Peiyang Scholar–Young Backbone Teacher award.

# Time Interface and Terahertz Non-reciprocal

Tian Jiang

National University of Defense Technology

**Abstract:** Non-reciprocity refers to the breaking of wave transmission symmetry guaranteed by time-reversal symmetry, constituting the fundamental basis for controlling light flow and developing optical isolating and circulating devices. Also, the development of non-reciprocal components is indispensable for ensuring the stable and flexible operation of terahertz photonic systems, yet conventional magneto-optic approaches face limitations such as bulkiness, high insertion loss, and incompatibility with highly integrated platforms. Meanwhile, recent advances have explored magnetic-free strategies for photonic non-reciprocity, such as nonlinear metasurfaces, optomechanical interactions, and temporal modulations. However, extending such schemes to terahertz waves has always been challenging due to limited modulation speed and weak light-material interaction. Here, we propose and experimentally realize non-reciprocal terahertz light transmission at 0.73 THz with a time-varying metasurface compatible well with on-chip semiconductor-technology. This work establishes a compact, integrable, and ultrafast-response platform for exploring non-reciprocal terahertz photonics.



**Biography:** Professor Jiang Tian, Doctoral Supervisor at the College of Science, National University of Defense Technology, holds the Cheung Kong Scholars Professor program, and is a recipient of the Special government allowances of the State Council. He also serves as Deputy Director of the Youth Editorial Committee of the Chinese Laser Press. Professor Jiang has authored two academic monographs and published over 50 papers as first or corresponding author in leading international journals including Nature Nanotechnology, Nature Communications, Physical Review Letters and Advanced Materials. Among these, three papers are ranked in the top 1% of ESI, one in the top 1%.

# Gradient-Index Self-Focusing of Terahertz Hyperbolic Phonon Polariton in Nanophotonic Waveguide

Liaoxin Sun

Shanghai Institute of Technical Physics, ACS

**Abstract:** Controlling the propagation of polaritons is paramount for developing next-generation on-chip hybrid photonic devices. While refractive index engineering is a cornerstone of conventional optics, its application to deeply subwavelength polaritonic systems remains a significant challenge. In our study, we demonstrate a novel platform for manipulating THz hyperbolic phonon polaritons (HPhPs) using a gradient refractive index (GRIN) landscape. By creating a precisely tailored air gap with a thickness gradient beneath a van der Waals  $\alpha$ -MoO<sub>3</sub> film, we establish a GRIN environment that forces HPhPs into a periodic, self-focusing trajectory within a nanophotonic waveguide. This phenomenon is highly controllable, with the number and position of the focal spots tunable by adjusting the waveguide geometry and excitation wavelength. We further show that this self-focusing mechanism is robust and adaptable to various excitation boundary conditions. Our findings introduce a powerful paradigm for GRIN optics at the nanoscale, opening avenues for creating adaptive polaritonic devices, ultra-compact optical interconnects, and platforms for enhanced light-matter interactions.



**Biography:** Liaoxin Sun is an associate researcher at the Shanghai Institute of Technical Physics, Chinese Academy of Sciences. He earned his Ph.D. from Fudan University and conducted postdoctoral research at the University of Pennsylvania from 2011 to 2014. His work focuses on investigating the physical properties of semiconductors using various spectroscopic techniques. He

has carried out systematic research in three closely related areas: preparation of novel microstructures and optical field manipulation, strong light-matter coupling, and strain engineering for modulating electronic states. He has published 50 SCI papers, including 30 as first or corresponding author. In addition, he has led the development of an innovative spectroscopic system capable of simultaneous spatial and angular resolution, addressing the limitations of existing commercial and macro-angle-resolved spectroscopy systems. The system covers a broad spectral range from ultraviolet and near-infrared to THz, integrating functionalities such as photoluminescence, reflection, transmission, and near-field probe spectroscopy. Notably, its angle-resolved capability utilizes the area-array characteristics of a CCD to simultaneously capture spectra at different angles, achieving fast, convenient, non-destructive, and multi-functional measurements. He also holds three authorized invention patents.

# Strong Coupling and Dissipative Dynamics of THz Magnons in RFeO<sub>3</sub> Cavities

Guohong Ma

Shanghai University

**Abstract:** The pursuit of faster, less dissipative information technologies has driven significant interest in strongly coupled photon-magnon systems within electromagnetic cavities, especially at THz frequencies. In this talk, I will discuss our experimental demonstration of THz magnon-polaritons in the canted antiferromagnetic crystal RFeO<sub>3</sub>. We realized strong coupling through two different Fabry-Pérot (FP) resonator approaches. Firstly, we utilized the high-quality RFeO<sub>3</sub> crystal as its own FP cavity. By tuning the magnon frequency with an external magnetic field and temperature, we demonstrated strong coupling between the cavity and magnon modes. Secondly, we implemented a high-Q FP cavity formed by two parallel silicon wafers. Introducing an RFeO<sub>3</sub> slab into this cavity and tuning the FP modes revealed pronounced anticrossing at room temperature. In both configurations, the vacuum Rabi splitting exceeded the polariton linewidths, confirming strong light-matter interaction. Finally, I will also demonstrate the observation of level attraction in RFeO<sub>3</sub> in a high magnetic field and low temperature, resulting from dissipative magnon-magnon coupling.



**Biography:** Prof. Dr. Guohong Ma obtained his Ph. D degree in Optics from Fudan University in 2001. He had been a Research fellow in National University of Singapore during 2001 to 2005. He joined Shanghai University and worked there since 2005. He was honored as “Pujiang talent” in 2006 and “Eastern Scholar” in 2008. Dr. Ma is the member of Optical Society of America (OSA) as well as the member of Singapore Materials Research (SMR). Dr. Ma’s research interests cover ultrafast

photonics, terahertz photonics and terahertz spintronics, he pays special attention on the control and optical manipulation of electronic spin in semiconductor and ordered magnetic system. With magnetic components of THz pulses, he led ultrafast photonics group investigating the spin wave excitation, coherent control, and spin reorientation phase transition in RFeO<sub>3</sub> magnets schematically. He published more than 200 peer-reviewed papers, and he gave more than 50 oral presentations including 30 invited talks at international conferences.

## Terahertz photoacoustics and applications

Zhen Tian

Tianjin University

**Abstract:** The application of terahertz waves in biomedicine faces the challenge of strong absorption by biological systems, which represents the major bottleneck for further utilization of terahertz waves in the field of bioelectromagnetics. To overcome these limitations, we have developed a series of terahertz radiation sources and terahertz photoacoustic technologies. These approaches enable biomedical detection and testing without invasive sampling or chemical labeling, thereby providing an *in vivo* method to measure the concentrations of biomolecules—particularly in blood—in real time, while simultaneously allowing for real-time *in vivo* determination of protein chirality (L-/D-proline). This method offers a new potential solution for terahertz biomedical applications.



**Biography:** Zhen Tian, Chair Professor, Doctoral Supervisor, and Optica Fellow, currently serving as the Director of the Degree Office at Tianjin University and the Head of the Optical Engineering discipline at Tianjin University. He has presided over projects such as the National Natural Science Foundation of China (NSFC) Excellent Young Scientists Fund and Key Program, as well as the Tianjin Outstanding Youth Fund. His research focuses on terahertz photonics, micro/nano photonics, and photoacoustic optics. He has published over 100 papers in journals including *Nature Communications* and *Advanced Materials*, with an h-index of 48. Related achievements have been awarded the First Prize of Natural Science by the Ministry of Education and the Tianjin Youth Science and Technology Award.

# THz-Energy Molecular and Spin Dynamics Driven by Single-Electron Tunneling

Shaoqing Du

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

**Abstract:** Single-molecule transistors offer a controlled setting for exploring low-energy molecular and spin dynamics driven by electron tunneling. Here we report recent transport-spectroscopy studies revealing molecular and spin excitations at the terahertz (THz) energy scale in single-molecule transistors. In the tunneling regime, electron transport couples sensitively to internal molecular degrees of freedom, enabling the identification of rotational and vibrational excitations at the single-molecule level. Furthermore, we demonstrate that single-electron tunneling can induce ortho–para conversion of a water molecule encapsulated in a C60 cage. Analysis of tunneling spectra establishes selection rules governed by energy and angular-momentum conservation among tunneling electrons, molecular rotations, and nuclear spins. A distinct excitation at approximately 9.3 meV is identified as a higher-order conversion process involving simultaneous changes in nuclear spin, electron spin, and molecular rotation. These results reveal electrically driven nuclear-spin dynamics and highlight single-molecule transistors as a platform for studying THz-energy molecular and spin phenomena.



**Biography:** Shaoqing Du, Ph.D., is an Associate Professor at the Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences. He received his Ph.D. in Electrical Engineering from the University of Tokyo in 2017. From 2017 to 2022, he conducted collaborative research at the Institute of Industrial Science, the University of Tokyo, serving as a Project Researcher during the first two years and as a Project Research Associate during the following three years. He joined SIMIT in 2022 as an associate professor. His research focuses on terahertz (THz) spectroscopy, nanoelectronics, and molecular-scale electron transport, with current interests in light–matter interaction, sub-nanometer electron transport, and on-chip THz spectroscopy. His work has been supported by the National Natural Science Foundation of China and the Chinese Academy of Sciences.

## Nonlinear Optics in 2D Materials

Zhipei Sun

Aalto University, Finland

**Abstract:** Nonlinear optics plays an essential role in various photonic and optoelectronic applications, such as wavelength conversion and information processing. Recently, the extraordinarily large nonlinear optical properties of 2D materials have attracted significant attention. However, the conversion efficiency of 2D materials is typically limited by the atomically thin light-matter interaction length. Here, I will discuss the strategies to enhance optical nonlinearities of two-dimensional layered materials (e.g., graphene, transition metal dichalcogenides) for various integrated photonic and optoelectronic applications, such as high-purity quantum emitters, wavelength converters, and ultrafast lasers. I will also present our recent results of employing hybrid structures, such as mixed-dimensional heterostructures, plasmonic structures, and silicon/fibre waveguides integrated).



**Biography:** Zhipei Sun is Professor of Photonics at the Department of Electronics and Nanoengineering of Aalto University, Finland. He earned his PhD from the Institute of Physics, Chinese Academy of Sciences. Currently, he is actively involved with the European Research Council advanced grant, European quantum flagship, Academy of Finland Photonics Flagship, and Academy of Finland Centre of Excellence on quantum materials. His research interests include nonlinear optics, nanophotonics, and ultrafast photonics.

# Topologically Enhanced Giant Broadband Second-Harmonic Generation in Weyl Semiconductor Tellurium

Dong Sun

Peking University & Zhengzhou University

**Abstract:** The talk will present our efforts in studying the topological Weyl semiconductor tellurium (Te), which exhibits giant second-harmonic generation (SHG) across an ultrabroadband infrared range (1.2–5.0  $\mu\text{m}$ ), including the challenging mid-infrared (MIR) region. We demonstrate that the conversion efficiency of Te nanoflakes is two orders of magnitude greater than that of GaSe in the MIR region. The extracted second-order nonlinear susceptibility  $\chi^{(2)}$  spectrum reveals a prominent peak of  $5.0 \pm 0.4 \text{ nm V}^{-1}$  at 2.2- $\mu\text{m}$  excitation and two shoulders, attributable to three two-photon resonances with interband transitions near three different Weyl cones, indicating topological enhancement of SHG. The giant, anisotropic, ultrabroadband SHG in Te nanoflakes promises unprecedented versatility for MIR frequency conversion and advanced MIR nonlinear optical devices.



**Biography:** Professor Dong Sun is currently Boya distinguish professor of the International Center for Quantum Materials (ICQM) at Peking University and joint professor of Physics Department of Zhengzhou University. He graduated with a bachelor's degree from USTC, and a Ph.D degree from University of Michigan. Since 2012, he worked in ICQM of Peking University as associated professor and full professor. He was recruited by the national overseas talent program in 2012 and received distinguished young scholars awards from both the National Science Fund of China and Beijing Nature Science Foundation, respectively. His main research direction is optical spectroscopy studies of quantum materials, novel optoelectronic devices based on quantum materials and related device physics.

## Second-harmonic generation as a tool for studying antiferromagnets

Victor Pavlov

Ioffe Institute, Russian Academy of Sciences, St. Petersburg, Russia

**Abstract:** This talk focuses on optical second-harmonic generation in a number of antiferromagnets with different symmetries: magnetoelectrics, a classic example is  $\text{Cr}_2\text{O}_3$ ; ordinary antiferromagnets, which retain the inversion center, e.g.  $\text{NiO}$ ; altermagnets, which represent a new class with unique features in their electronic structure, such as  $\text{CoF}_2$ . In the electric dipole (ED) approximation, SHG is allowed only in materials without an inversion center. However, in centrosymmetric media, it can arise due to contributions from higher multipoles, such as a magnetic dipole (MD) or an electric quadrupole (QD). In the magnetoelectric  $\text{Cr}_2\text{O}_3$ , inversion symmetry is broken below the Néel temperature, allowing the observation of ED-SHG in the antiferromagnetic phase. In the centrosymmetric  $\text{NiO}$ , SHG is due to the MD-type susceptibility, allowing the study of a magnetic structure that does not violate spatial inversion. In the altermagnet  $\text{CoF}_2$ , a new nonlinear optical susceptibility of the QD-type is also predicted and observed, reflecting the specific symmetry of this state.



**Biography:** Victor Pavlov graduated in 1986 from Leningrad Polytechnic Institute as engineer-physicist. He has got PhD in 1993 and the degree as Doctor of Physical and Mathematical Sciences in 2008 at Ioffe Institute of the Russian Academy of Sciences, St. Petersburg.

From 1986 to the present, he has worked successively as a junior researcher, a researcher, a senior researcher, a leading researcher, and the head of laboratory on optical phenomena in ferroelectric and magnetic crystals at Ioffe Institute.

In 2011, he was awarded the Bessel Prize by the Alexander von Humboldt Foundation in Germany.

From 2001 up to now, he was a principle coordinator of several Projects supported by the Russian Foundation for Basic Research and the Russian Science Foundation.

Victor Pavlov specializes in the following research areas and scientific topics: linear and nonlinear magneto-optics; optics of semiconductor nanoscale magnetic structures; optics of nanoscale layered magnetic structures; optics of thin-film and bulk ferroelectric structures; dielectric studies of magnetic structures and bulk materials; ultrafast time-resolved spectroscopy; magnetic phase transitions.

# THz-Driven Electron Source for Ultrafast electron diffraction and Imaging

Dongfang Zhang

Shanghai Jiao Tong University

**Abstract:** The growing demand for compact ultrafast electron and X-ray sources has motivated strong interest in terahertz (THz) acceleration techniques, which can generate high-brightness, ultrashort electron bunches at high repetition rates. This talk presents recent advances in strong-field THz electron sources using spatiotemporally confined pulses and a tip cathode. We integrated cascaded acceleration and temporal compression within a single cavity, producing an ultrashort electron beam of 167 fs. Using a ridged cavity and dual 24  $\mu\text{J}$  THz pulses, a peak surface field of 23 GV/m was achieved, yielding electron bunches with energies up to 46 keV and a stable charge of 2 pC per bunch. By coupling the source with time-resolved shadowgraphy, we demonstrate real-time observation of transient field dynamics. This work provides a critical foundation for compact electron sources suited to ultrafast imaging and spectroscopy.



**Biography:** Dongfang Zhang is an Associate Professor at Shanghai Jiao Tong University. His research focuses on strong-field terahertz lasers, THz-driven electron sources, and ultrafast imaging. He has authored over 50 peer-reviewed publications, including first- or corresponding-author papers in high-impact journals such as Nature Photonics (featuring 2 cover articles), Physical Review X (2), Physical Review Letters (1), Optica, Science Advances, Nature Communications, and ACS Photonics.

# Line Shape Relations in Ultrafast Transient Absorption from a Coherent Superposition

Peng Peng

ShanghaiTech University

**Abstract:** Ultrafast laser pulses with broad bandwidth can simultaneously excite multiple quantum states, forming coherent superpositions. The phases of the associated optical transitions evolve in time, giving rise to spectral line profiles that range from symmetric Lorentzian to asymmetric Fano-like forms. Yet, the line shape relations between different transitions within such superpositions remain largely unexplored. Here, we use transient absorption spectroscopy to probe transitions from coherent superpositions. While each transition's line profile evolves over time, the relative line shape relations between different transitions remain fixed. We identify four fundamental types of line shape relations, each producing distinct spectral signatures. These relations naturally arise from second-order perturbation processes and can be actively tuned via the laser-matter interaction strength. Our findings establish a pathway for line-shape-engineered control across atomic and molecular systems.



**Biography:** Peng Peng is a tenure-track assistant professor at ShanghaiTech University, specializing in strong-field laser physics, femtosecond ultrafast spectroscopy, high-harmonic generation, attosecond science, and light-matter interactions involving intense optical/infrared laser pulses and high-harmonic radiation.

# Integrated coherent high-power terahertz-wave generation with large frequency tunability and applications

Wenting Wang

Beijing Institute of Technology

**Abstract:** High-spectral-purity and high-power frequency-agile room-temperature sources in the terahertz spectrum are foundational elements for imaging, sensing, metrology, and communications. Here we present a chip-scale tunable terahertz parametric synthesizer based on an integrated nonlinear microresonator and a plasmonic nanoantenna array without optical spectral shaping and utilizing nonlinear processes. Coherent terahertz radiation spanning 2.7-octaves from 330 GHz to 2.3 THz and terahertz frequency combs are generated and characterized. By properly controlling the intracavity optical power and pump-resonance detuning, terahertz frequency combs are also generated by beating the pump laser and the generated localized sub-comb lines. Thirdly, with active feedback stabilization of the microresonator intracavity power and pump wavelength, sub-Hertz linewidth of the terahertz wave, along with 10-15 frequency instabilities are observed.



**Biography:** Wenting Wang received his PhD from the Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China, and Deutsches Elektronen Synchrotron, Hamburg, Germany, in 2017. From 2017 to 2022, he was a postdoctoral fellow at the University of California, Los Angeles. He is currently a professor at the Beijing Institute of Technology. His research interests include ultralow-noise microwave/terahertz generation, optical frequency combs, optical signal processing, integrated microwave photonics, high-speed optoelectronic devices and integration and high-precision time and frequency transfer.

## Third harmonic generation imaging for intraoperative diagnosis of tumors

Zhiqing Zhang

Nankai University

**Abstract:** Third harmonic generation (THG) microscopy is a label-free imaging technique that shows great potential for intraoperative diagnosis of tissue during tumor surgery. In this talk, I will talk about the latest application of THG imaging in the clinic, from the perspective of signal generation mechanism, instrumental development, mouse and human tissue imaging, AI and clinical challenge.



**Biography:** Dr. Zhang obtained his bachelor and master's degree of Mathematics from Beijing Normal University in 2008 and 2011, respectively. After two years in industry, Dr. Zhang joined the group of Prof. Marloes Groot at VU Amsterdam in 2013, where he completed his PhD's study of Biophysics in 2017. From 2017 to 2021, Dr. Zhang worked as a postdoc at VU Amsterdam and KU Leuven. Since 2022, Dr. Zhang has been working as an associate professor

at the Institute of Modern Optics of Nankai University. In his lab (named ACLight Lab), nonlinear imaging technique has been developed for intraoperative imaging of tissue.

## Dynamic study on moire excitons in twisted WS<sub>2</sub>/WSe<sub>2</sub> heterostructures.

Xiaodong Cui

University of Hong Kong

**Abstract:** Van der Waals (vdW) heterostructures provide a versatile platform for manipulating multiple electronic and excitonic degrees of freedom and for engineering artificial lattices. Their stacking flexibility enables the creation of tunable moiré superlattices that host a variety of emergent quantum states. Among these systems, moiré excitons in transition metal dichalcogenide (TMD) heterostructures have attracted particular interest due to the direct bandgap of monolayer TMDs and their rich internal degrees of freedom. In this talk, I will present our dynamical study of moiré excitons in twisted WSe<sub>2</sub>/WS<sub>2</sub> superlattices. We observe that exciton relaxation dynamics vary significantly across different moiré filling states. I will also discuss measurement artifacts encountered in pump–probe spectroscopic studies of moiré superlattices.



**Biography:** Prof. Xiaodong Cui, chair professor at physics department, the University of Hong Kong. Prof. Cui got his B.S. in physics at University of Science and Technology of China and PhD at Arizona State University. After his PhD, he did a joint postdoctoral research at Columbia University and IBM. He has been working as assistant/associate/full/chair professor at University of Hong Kong since 2004. His research interests and expertise cover various subjects on experimental condensed matter physics. His recent research focuses on 2D semiconductors with semiconductor optics techniques.

# High Pressure Ultrafast Dynamics of $\text{LaH}_{10\pm\delta}$ and Emergent Quantum State in $1\text{T-TaS}_2$

Jimin Zhao

Institute of Physics, Chinese Academy of Sciences

**Abstract:** I will talk present our recent works on high-pressure ultrafast spectroscopy. We innovated an on-site in situ high pressure pump-probe ultrafast spectroscopy instrument, enabling precision measurements of both the amplitude and lifetime, with independent tuning and precise control of pressure and temperature. Using this instrument, we found pressure-induced phonon-bottleneck effect. Then, I will address the time-resolved low temperature ultrafast spectroscopy of  $\text{LaH}_{10\pm\delta}$  under an ultrahigh pressure. This first ultrafast dynamics investigation of superhydrides provides direct experimental evidence that strong EPC is responsible for the near-room-temperature superconductivity in clathrate superhydrides. Finally, I will also present another work, whereby we use ultrafast collective dynamics discovered an emergent quantum state in a charge density wave material  $1\text{T-TaS}_2$ .



**Biography:** Professor Jimin Zhao is a group leader at the Institute of Physics, Chinese Academy of Sciences. He obtained his BS and MS degrees from Tsinghua University and PhD degree from the University of Michigan (Ann Arbor). His research interest is ultrafast spectroscopy and ultrafast dynamics of correlated quantum materials. He delivered more than 80 invited talks on international conferences and renowned organizations, including the plenary talk on the Ultrafast dynamics conference (Crete), discussion leader on GRC, invited talks on APS, PIPT, Phonons, M2S, SPIE, etc. He is an Optica Fellow, and he also served as the vice chair of the Technical Group of Ultrafast Optical Phenomena, OPTICA. He is on the board of the Academic Committee of Light Scattering, Chinese Physical Society. He is the project leader of the National Key Research and Development Program of China, the Key Project of National Natural Science Foundation of China, the CAS Interdisciplinary Innovation Team, and the Key Project of Beijing Natural Science Foundation.

# Polariton Nonlinearities in Superlattices for Ultrafast Optical Switching

Jiixin Zhao

Nanyang Technological University - NTU Singapore

**Abstract:** Monolayer group-VI transition-metal dichalcogenides (TMDs) have emerged as a promising class of 2D semiconductors, owing to their sizable direct bandgap and exceptional optical and electronic properties. The tightly bound excitons in monolayer TMDs, with their large oscillator strength, make these materials ideal for exploring light–matter interactions in the strong-coupling regime when integrated with optical cavities. In addition, their layered structure enables the fabrication of van der Waals heterostructures through vertical stacking, offering new strategies for controlling strong light–matter interactions. In this talk, I will present tunable control of the exciton–photon coupling strength by embedding multiple WS<sub>2</sub> monolayers into a planar microcavity. Building on this platform, we explore polarization-dependent interactions by incorporating a WS<sub>2</sub> superlattice into the microcavity, and demonstrate all-optical polariton spin switches operating at room temperature. These devices exploit spin-anisotropic nonlinearities to enable ultrafast switching between polarization states, with sub-picosecond response times and minimal device footprints. This functionality highlights the potential of TMD-based systems for integrated photonic and spintronic applications. As a proof of concept, I will show different spin-switch geometries that operate reliably under ambient conditions, illustrating the practicality and scalability of this approach.



**Biography:** Jiixin is a Presidential Postdoctoral Fellow at Nanyang Technological University, where she also earned her PhD. Her research focuses on light–matter interactions in two-dimensional materials. She has authored 27 peer-reviewed journal articles; as first or co-first author, her publications include Nature Photonics, Nature Nanotechnology, Nature Communications, and Light: Science & Applications. She delivers invited talks at international conferences and serves as a peer reviewer for Nature Communications and ACS journals.

# Dynamic beam shaping of switchable transverse-mode mode-locked fiber laser

Anting Wang

University of Science and Technology of China

**Abstract:** With the development of switchable transverse mode all-fiber lasers, their unique advantages in phase, polarization, and intensity distributions have attracted increasing attention in fields such as ultrafast optics and beam shaping. A mode-locked all-fiber laser capable of transverse-mode switching is experimentally demonstrated by combining dual multi-mode fiber Bragg grating configuration with a LiNbO<sub>3</sub> Mach-Zehnder intensity modulator. The laser system achieves stable mode-locking operation across four linearly polarized modes and five orbital angular momentum (OAM) modes, enabling arbitrary switching among these transverse modes. Additionally, high-order transverse modes exhibit unique intensity distributions, and their incoherent superposition states can generate diverse structured light fields, offering novel approaches to beam shaping. Furthermore, the laser supports controllable incoherent superposition of any two transverse modes, flexibly realizing 12 distinct structured light fields. These switchable transverse mode all-fiber lasers, featuring mode diversity and switching flexibility, have significant potential for applications in nonlinear optics, laser material processing, and beam shaping.



**Biography:** Wang Anting, received the B.S. degree in Physics and the Ph.D degree in optics from University of Science and Technology of China (USTC) in 1999 and 2004, respectively. He worked as visiting scholar in UCI and UCSD from Aug. 2005 to Nov. 2007. He is an associate professor in school of physical sciences, USTC. His research interest includes fiber optics, optical vortex, and advanced display.

## Large-scale timing synchronization based on linear-optics timing detectors

Ming Xin

Tianjin University

**Abstract:** Over the past decades, the pulse-based BOC timing synchronization method has benefited several extreme laser facilities such as SULF, ELI, European XFEL, FERMI, SwissFEL and LCLS II. Currently, the primary challenge facing BOC-based timing synchronization systems lies in the inherent contradiction between optical power and synchronization precision. To ensure sub-fs synchronization precision while simultaneously suppressing additional timing jitter induced by fiber nonlinear effects, the optical power transmitted through the link must be constrained within the range of 10 to 20 mW. Taking transmission losses into account, this constraint limits the link length to under 5 kilometers. And since the output power of an MLL oscillator is usually 100~200 mW, the maximum number of synchronization terminals is also limited to ~10. To improve the scalability of these large facilities and ensure their continued operation with remarkable stability over the forthcoming decades, we have proposed a novel timing synchronization technology based on linear-optics timing detectors. Each timing link can be stabilized to sub-fs precision with <1 mW optical power, therefore, the additional timing jitter induced by fiber nonlinear effects can be neglected. Remarkably, the system is capable of maintaining sub-femtosecond precision even at optical power levels as low as 240 nW (for 5.2-km link length), or the link length as long as 20 km (with 1  $\mu$ W optical power), respectively.



**Biography:** Ming Xin received the bachelor's and doctor's degrees in electronic engineering from Tsinghua University, Beijing, China, in 2005 and 2010, respectively. From 2010 to 2011, he was a Project Manager with China Mobile Research Institute of China Mobile, Beijing. In July 2011, he joined the CFEL Ultrafast Optics and X-rays Group of DESY, Hamburg, Germany, as a Team Leader. From 2015 to 2018, he was a Visiting Scientist with the Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, USA. Since 2018, he has been a full professor at Tianjin University, China. His research interests include attosecond photonics, integrated photonics and gravitational wave detection.

# From Ultrafast Toggle to Precessional Single Laser Pulse Switching

Yi Peng<sup>1,2,3</sup>, G. Malinowski<sup>3</sup>, B. Kunyanguyen<sup>3</sup>, D. Salomoni<sup>4</sup>, J. Igarashi<sup>3</sup>, J. X. Lin<sup>3</sup>, W. Zhang<sup>2,3</sup>, J. Gorchon<sup>3</sup>, J.

Hohlfeld<sup>3</sup>, L. D. Buda-Prejbeanu<sup>3</sup>, R. C. Sousa<sup>3</sup>, I. L. Prejbeanu<sup>3</sup>, D. Lacour<sup>3</sup>, S. Mangin<sup>3</sup>, and M. Hehn<sup>3</sup>

<sup>1</sup>Beihang University, School of Integrated Circuit Science and Engineering, <sup>2</sup>Hangzhou International Innovation

Institute of Beihang University, <sup>3</sup>Universite de Lorraine, CNRS, France

**Abstract:** With the advent of nanotechnologies, it has been possible to extend the number of stimuli that can be used to control the state of a magnetic nanostructure. Among those stimuli, single laser pulse excitation allows, under certain conditions, to obtain energy-efficient ultrafast magnetization reversal. With this respect, two different types of single pulse switching mechanisms have been reported. The first one consists in a sub-picosecond ultrafast toggle switching, which was observed mainly in Gd based alloys. The second type relies on sub-nanosecond precessional switching occurring in rare earth–transition metal alloys/multilayers. Here, we demonstrate that single pulse all optical switching is achieved in  $\text{Co}_{68}\text{Tb}_{32}/\text{Co}_{100-x}\text{Gd}_x/\text{Co}_{68}\text{Tb}_{32}$  trilayers in which the behavior can be tuned from toggle to precessional by changing the composition of the  $\text{Co}_{100-x}\text{Gd}_x$  alloy. In order to promote toggle switching,  $\text{Co}_{100-x}\text{Gd}_x$  alloy needs to keep PMA. Furthermore, the spin current coming from the demagnetization of Gd has to be large enough and remains the key ingredient to promote the toggle switching. This behavior stands until a multidomain state is observed, which is a sign that  $F_{\text{SW}} > F_{\text{MD}}$ . On the other hand, precessional switching occurs for low Gd concentration. In this case, the spin current generated by the Gd demagnetization is strongly decreased, while the net magnetization increases and so does the demagnetization field, favoring the in-plane reorientation of the magnetization. This work emphasizes the role of magnetic anisotropy on the laser induced ultrafast magnetization reversal in complex magnetic multilayers, which is fore seen as a candidate for magneto-photonic memory applications.

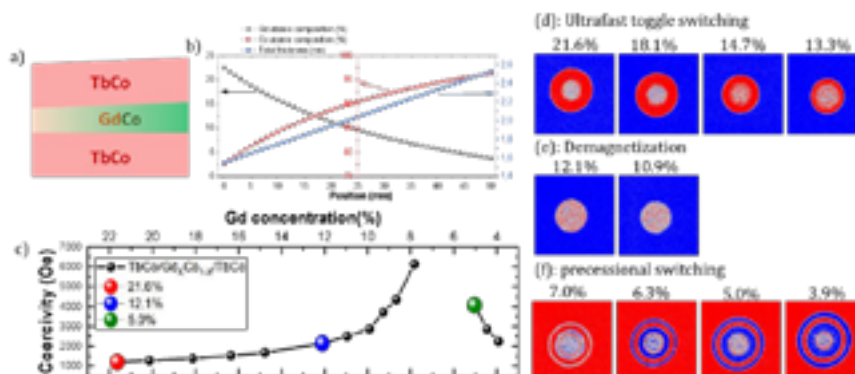


FIG 1. Single pulse reversal behavior in TbCo/GdCo/TbCo trilayers with different Gd concentration in GdCo.

<b>April 30th Plenary Sessions Room 1016, C1 Conference Center</b>	
<b>Time</b>	<b>Content</b>
Presider: Hartmut Roskos	
08:45-09:30	<b>Push HHG Toward Sub-50 as Isolate Attosecond Pulse and Frequency Comb at XUV Range</b> <b>Zhiyi Wei</b> Institute of Physics, Chinese Academy of Sciences
09:30-10:15	<b>Coherent Magnonics in Canted Antiferromagnets</b> <b>Rostislav Mikhaylovskiy</b> Lancaster University
10:15-10:30	Coffee Break
Presider: Zhiyi Wei	
10:30-11:15	<b>Towards Real-Time All-Electronic THz Fourier Imaging Augmented by Artificial Intelligence</b> <b>Hartmut Roskos</b> Physikalisches Institut, Goethe-University Frankfurt am Main, Germany
11:15-12:00	<b>Biomedical Applications of Terahertz Technology</b> <b>Vince Wallace</b> The University of Western Australia
12:00-13:30	Lunch

# Push HHG toward sub-50 as isolate attosecond pulse and frequency comb at XUV range

Zhiyi Wei

Institute of Physics, Chinese Academy of Sciences

**Abstract:** In this presentation I will report our recent research works on HHG for isolate attosecond pulse generation and frequency comb at XUV range. By using MID femtosecond laser of central wavelength at 2 $\mu$ m as driven pulse, continuum spectra beyond cut-off 400 eV were obtained. All Optical-FROG measurement and retrieval shown that pulse duration as short as 48 as was realized. In addition to, by driven HHG with a home-made 20 W femtosecond fiber laser at 200MHz repetition rate and an enhancement resonator, we realized a XUV frequency comb of spectra covered from 49 to 148 nm, corresponding to the harmonic from 7 to 21 orders, photon energy from 8 to 25eV



**Biography:** Professor Wei Zhiyi has been working on ultrafast and ultraintense laser technology since 1984. He has made remarkable progresses in the generation, compression, amplification, synchronization, and frequency conversion of femtosecond pulses, such as the world records on 1.16 PW peak power and sub 5 fs pulse duration. He also conducted research on optical frequency comb in China firstly and generated the first attosecond pulse domestically. For his contributions, he was

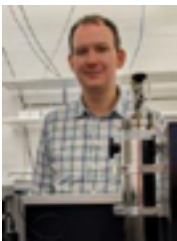
elected as fellow of Optica, COS and CSOE. He has served as the Chair and co-Chairs of several important international conferences. Currently, he serves as the platform director of the "Synthetic Extreme Conditions User Facility" and the chief scientist of the "Advanced Attosecond Laser Infrastructure", the member of the Asian High Power Laser Committee and Max Planck Center for Attosecond and X-ray Science

## Coherent Magnonics in Canted Antiferromagnets

Rostislav Mikhaylovskiy

Lancaster University, UK

**Abstract:** Magnonics aims to employ quanta of spin waves, magnons, to carry, transport and process information, avoiding the dissipation of energy inherent to electronics. The antiferromagnetic order leads to high spin wave propagation velocities and might enable devices operating at terahertz (trillion of hertz) clock-rates. However, the absence of the net magnetisation also makes antiferromagnets magnetically ‘invisible’: it is very hard to detect and influence the antiferromagnetic order. Yet, in some antiferromagnets strong spin–orbit coupling results in canting of the spins, thereby producing net magnetization. The canted antiferromagnets combine antiferromagnetic order with phenomena typical for ferromagnets and hold a great potential for spintronics and magnonics. In this way they can be identified as closely related to the recently proposed novel class of magnetic materials, called altermagnets. In my talk I will discuss a new functionality of canted antiferromagnets and altermagnets for magnonics and show that these materials facilitate mechanisms allowing to generate, detect and convert propagating magnons at the nanoscale.



**Biography:** Rostislav Mikhaylovskiy is a Reader (Associate Professor) in Ultrafast Physics at Lancaster University. He did his PhD in Physics at University of Exeter (2013) and then worked as a postdoc and later as a junior sub-group leader at Radboud University, Nijmegen. In 2019 he joined Lancaster University to develop and lead an independent research programme on THz phenomena in magnetically ordered materials, supported by highly prestigious ERC Starting grant and Green Future Fellowship of Royal Academy of Engineering. Throughout his career, Rostislav has pioneered THz spectroscopy of ultrafast spin dynamics in a broad class of magnets ranging from metallic spintronic heterostructures to insulating transitional metal oxides.

# Towards Real-Time All-Electronic THz Fourier Imaging Augmented by Artificial Intelligence

Hartmut Roskos

Physikalisches Institut, Goethe-University Frankfurt am Main, Germany

**Abstract:** Three-dimensional imaging with sub-terahertz radiation ( $< 1$  THz) has considerable potential for (i) the recognition of hidden objects in use cases such as the inspection of THz-transparent materials, packages and containers, (ii) remote sensing in robotic, automotive and security applications, and (iii) gesture recognition. All of these require real-time imaging which is not possible with present-day technology in a cost-effective, robust way. In order to overcome the hurdles, we develop electronic components for such imaging systems, including III-V RTD emitter arrays with increased emission power and Si CMOS detectors and detector arrays, but also explore digital Fourier imaging as a novel approach to 3D THz imaging. To reduce complexity and costs and to achieve real-time capability, we avoid heterodyne detection and instead record only intensity data. The phase information is reconstructed computationally, which is a notoriously ill-posed inverse problem to solve. To address it, we employ physics-informed deep learning frameworks. We have developed these first for the simpler imaging modality of in-line holography, successfully addressing the three problems of phase retrieval, position (depth) estimation, and occlusion reconstruction by integrating physical modeling with supervised, unsupervised, and self-training strategies. This presentation will give an overview of the status quo and will discuss our route to extend this work to Fourier Imaging with scalable agentic A.I. technologies.



**Biography:** Hartmut Roskos is Goethe Research Professor and a retired Full Professor of Physics of Johann Wolfgang Goethe-University, Frankfurt am Main, Germany. He studied Physics at the Technical Universities of Karlsruhe and Munich. From the latter, he also obtained the PhD degree in 1989. He was a post-doc at AT&T Bell Laboratories, Holmdel, USA, where THz phenomena became the focus of his research. From 1991-1996, he was with the Institute of Semiconductor Electronics of RWTH Aachen, where he received the Habilitation degree in Physics. He became a Full Professor at Goethe-University in 1997. He spent sabbatical semesters at the University of California at Santa Barbara, the University of Rochester, and was an Invited Guest Professor at Osaka University. In 2009, OC Oerlikon AG awarded his group jointly with the Ferdinand-Braun-Institute (FBH) in Berlin a 5-year endowed professorship which led to the establishment of a Joint Lab for THz Photonics. His research team is the winner of the 2025 Goethe Innovation Prize and he is the 2026 recipient of the Kenneth J. Button Prize of the IRMMW-THz Society. Current main fields of work are time-resolved solid-state spectroscopy, the development of novel THz emitters, detectors, and sensors, and especially A.I.-augmented THz imaging.

# Biomedical Applications of Terahertz Technology

Vince Wallace

The University of Western Australia

**Abstract:** Terahertz radiation shows promise for biomedical imaging and diagnostics due to its sensitivity to tissue water content, which can indicate disease states. Key biomedical applications include skin cancer detection, breast tumour margin identification during surgery, and burn assessment. The presentation covers three interconnected research areas: molecular-scale interactions with proteins, cellular-level effects, and tissue-level imaging capabilities. While THz technology has demonstrated significant potential for in vivo medical imaging and real-time surgical guidance, challenges remain in penetration depth, speed, and clinical translation. As THz systems become increasingly common in medical and industrial environments, understanding their biological interactions is crucial for safety considerations and advancing their potential in niche applications.



**Biography:** Vincent Wallace has a PhD in Physics Applied to Medicine from the Institute of Cancer Research in London, UK. He is currently Professor and Head of the Department of Physics at the University of Western Australia, Perth. He specialised in the interaction of light with tissues and has focused on developing technology for diagnosis and treatment of disease. This has resulted in a very broad and multidisciplinary research career, working with biochemists, biologists, engineers, and clinicians. His work spans the whole electromagnetic spectrum from UV to far infrared where he has been involved with the development of multiphoton microscopy for deep tissue imaging, novel spectroscopy methods for the pharmaceutical industry and tools to determine tumour margins during surgery.

<b>April 30th Session 1 Terahertz Materials, Physics and Applications Room 2001, C1 Conference Center</b>	
Presiders: Chang Wang, Fangrong Hu	
13:30-13:50	<b>Thz Manipulation of Quantum Materials</b> <b>Liang Cheng</b> University of Electronic Science and Technology of China
13:50-14:10	<b>Interfacial Cherenkov Radiation</b> <b>Xiao Lin</b> Zhejiang University
14:10-14:30	<b>Autocorrelation Terahertz Optical Rectification Generation in Reflection from Nonlinear Crystals</b> <b>Mathias H. Kristensen</b> University of Savoie
14:30-14:50	<b>Gate-Tunable Nanomaterial Devices: Pathways to Terahertz Applications</b> <b>Maria Burdanova</b> Moscow Institute of Physics and Technology
14:50-15:10	<b>Broadband Absorption Limit of Terahertz Waves in 2d Nanomaterials and Its Applications</b> <b>Tao Zhao, Gaohui Ge, Hao Xu</b> University of Electronic Science and Technology of China
15:10-15:30	<b>Optical Modulation of Terahertz Radiation by Ultrathin Continuous Films of Gold via Optical Pump-Terahertz Probe Spectroscopy</b> <b>Maksim I. Paukov</b> Moscow Center for Advanced Studies
15:30-15:50	<b>Thz S-Snom Technique and Its Applications in Materials Science</b> <b>Shu Chen</b> University of Shanghai for Science and Technology
15:50-16:05	Coffee Break
Presiders: Xiao Lin, Liang Cheng	
16:05-16:25	<b>Terahertz Quantum Cascade Laser and Imaging Application</b> <b>Chang Wang</b> Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
16:25-16:45	<b>Terahertz Functional Materials: from Ultrafast Dynamic to Terahertz Optical Field Manipulation</b> <b>Jiang Li</b> China Academy of Engineering Physics (CAEP)
16:45-17:05	<b>Terahertz Micro Mano Sensors and Their Biomedical Applications</b> <b>Fangrong Hu</b> Guilin University of Electronic Technology

17:05-17:25	<b>Compact Terahertz Devices Based on Semiconductor Superlattice Materials and Its Applications</b> <b>Zhiyong Tan</b> Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
17:25-17:45	<b>Interwoven Magnetic Kagome Metal Overcoming Geometric Frustration</b> <b>Zhongkai Liu</b> ShanghaiTech University
17:45-18:05	<b>Spatiotemporal Terahertz Emission Nanoscopy of Spintronic Photocurrents</b> <b>Felix Paries</b> RPTU University Kaiserslautern-Landau, Fraunhofer Institute for Industrial Mathematics ITWM, Leipzig Institute of Photonic Technology IPHT
18:05-18:15	<b>Ultrasensitive Terahertz Superconducting Kinetic Inductance Detectors with Photon-Noise-Limited Performance</b> <b>Runfeng Su</b> Nanjing University
	Dinner

<b>April 30th Session 2 Terahertz Imaging and Biomedicine Room 2002, C1 Conference Center</b>	
Presiders: Xurong Li, Liao Chen	
13:30-13:50	<b>Research on the Application in the Diagnosis of Glioma Based on Terahertz Technology</b> <b>Yuye Wang</b> Tianjin University
13:50-14:10	<b>All-Fibre-Coupled Terahertz Single-Pixel Imaging for Biomedical Applications</b> <b>Sen Mou</b> Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences
14:10-14:30	<b>Machine Learning-Assisted Terahertz Metasurface Design</b> <b>Shan Yin</b> Guilin University of Electronic Technology
14:30-14:50	<b>Terahertz Detection of Single Proteins</b> <b>Huabin Wang</b> Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences
14:50-15:10	<b>Terahertz Spectroscopy in Ultrafast Photoelectric Conversion Process</b> <b>Zeyu Zhang</b> Hangzhou Institute of Advanced Study, University of Chinese Academy of Science
15:10-15:30	<b>Inverse Design of Diffusion-Absorption Hybrid Metasurfaces</b> <b>Zicheng Song</b> Harbin Institute of Technology
15:30-15:50	<b>Coherent Control of the Functionality of Quantum Materials by Thz Light</b> <b>Tao Dong</b> Shanghai Jiao Tong University
15:50-16:05	Coffee Break
Presiders: Pei-Chao Cao, Huabin Wang	
16:05-16:25	<b>Superradiant Smith-Purcell Radiation with Ultra-Narrow Linewidth</b> <b>Fang Liu</b> Tsinghua University
16:25-16:45	<b>A Gap-Free Real-Time Broadband Spectrum Analyzer by Overlapping Optical Short-Time Fourier Transform</b> <b>Liao Chen</b> Huazhong University of Science and Technology

16:45-17:05	<b>Next-Generation Terahertz Time-Domain Spectroscopy System: from Terahertz Focal-Plane Array to Integrated Femtosecond Laser</b> <b>Xurong Li</b> Zhejiang University
17:05-17:25	<b>Broadband Thz Airy-Beam Phase Imaging Through Scattering Media</b> <b>Xiong Wang</b> ShanghaiTech University
17:25-17:45	<b>Sub-Thz Interlayer Phonons and Novel Raman Scattering in Layered Semiconductors</b> <b>Miao-Ling Lin</b> Institute of Semiconductors, Chinese Academy of Sciences
17:45-18:05	<b>Reconfigurable Phase-Programmable Spintronic Terahertz Emitter</b> <b>Shaojie Liu</b> The Hong Kong University of Science and Technology
18:05-18:15	<b>Ultrafast Real-Time Nano-Imaging of a Single Terahertz Metamolecule via Nano Time-Domain Spectroscopy</b> <b>Yuxuan Zhuang<sup>1</sup>, Xiaoqiuyan Zhang<sup>1*</sup>, Zhuocheng Zhang<sup>2</sup>, Min Hu<sup>2*</sup></b> 1.University of Electronic Science and Technology of China, 2.University of Electronic Science and Technology of China
	Dinner

<b>April 30th Session 3 Terahertz Communication Technology and Other Applications Room 2003, C1 Conference Center</b>	
Presiders: Yifei Fang, Qiwu Shi	
13:30-13:50	<b>Broadband and Scalable Terahertz Programmable Metasurfaces</b> <b>Jingbo Wu</b> Nanjing University
13:50-14:10	<b>A Portable 220-GHz-Band Prototype for Terahertz Integrated Sensing and Mobile Communications</b> <b>Chong Han</b> Shanghai Jiao Tong University
14:10-14:30	<b>Photoinduced Picosecond-Scale Radial Current for Generating and Converting Spin Textures</b> <b>Pierre Vallobra</b> Hangzhou International Innovation Instit
14:30-14:50	<b>Terahertz Time-Resolved Nonlinear Optics of Discrete Media: from Gas and Liquid to the Surface</b> <b>Alexander Shkurinov</b> Lomonosov Moscow State University
14:50-15:10	<b>Terahertz Modulation Devices Based on Topological Photonic Crystals for Communication Applications</b> <b>Yaxin Zhang</b> University of Electronic Science and Technology of China
15:10-15:30	<b>Communications for Unmanned Aerial Vehicles Drones</b> <b>David Lopez Perez</b> Beihang University
15:30-15:50	<b>THz photonics for integrated communication and sensing</b> <b>Xianbin Yu</b> Zhejiang University
15:50-16:05	Coffee Break
Presiders: Chong Han, Jingbo Wu	
16:05-16:25	<b>Investigation of Modulation Mechanism in Advanced Polar Crystal Modulators</b> <b>Yifei Fang</b> Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences
16:25-16:45	<b>Dielectric Engineering in Polymer Composites for Low-Loss Sub-Terahertz Fiber</b> <b>Qiwu Shi</b> Sichuan University

16:45-17:05	<b>Silicon-Based Terahertz Radar and Imaging Chips</b> <b>Kaixue Ma</b> Tianjin University
17:05-17:15	<b>Dynamical Modeling of Terahertz Smith–Purcell Radiation via the Current-Transient Approach in Hexagonal Metasurfaces</b> <b>Suguo Chen<sup>*</sup>, Pengtao Wang</b> Xi'an University of Technology
17:15-17:25	<b>Deep Farey Tree Locking in Terahertz Semiconductor Laser Frequency Combs</b> <b>Guibin Liu<sup>1,2</sup>, Xuhong Ma<sup>1</sup>, Binbin Liu<sup>1</sup>, Ziping Li<sup>1</sup>, Wenjian Wan<sup>1</sup>, Hua Li<sup>1,2*</sup></b> 1Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China 2Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences, China
17:25-17:35	<b>Enhanced terahertz generation from air plasma via three-color mid- and near-infrared pumping</b> <b>Vasily Kostin<sup>1,2*</sup></b> 1.Gaponov-Grekhov Institute of Applied Physics of the Russian Academy of Sciences, Russia; 2.Lobachevsky State University of Nizhny Novgorod, Russia
17:35-17:45	<b>Low-Frequency Terahertz Spectral Features for Apparent Amylose Content Assessment in Rice and Corn Starches</b> <b>Han Guo<sup>*</sup></b> Kyoto University
	Dinner

<b>April 30th Session 4 Other Ultrafast Optical Applications Room 1016, C1 Conference Center</b>	
Presiders: Haiming Zhu, Huang Zhou	
13:30-13:40	<b>Phonon-Driven Spin Dynamics in Rare-Earth Orthoferrites Across Spin Reorientation Temperatures</b> <b>Madeleine Hales<sup>1*</sup>, Oleksandr Kovalenko<sup>1</sup>, Alexey Kimel<sup>2</sup>, Dymtro Afanasiev<sup>2</sup>, Rostislav Mikhaylovskiy<sup>1</sup></b> 1.Lancaster University, 2.Radboud University
13:40-14:00	<b>Switching of an Antiferromagnet Controlled by Spin Canting in a Laser-Induced Hidden State</b> <b>Alexandra Kalashnikova</b> Ioffe Institute, St. Petersburg, Russia
14:00-14:20	<b>Ultrafast Magnetization Switching Induced by Femtosecond Laser Pulse</b> <b>Wei Zhang</b> Beihang University, China
14:20-14:40	<b>Ultrafast Magnetization Switching</b> <b>Pierre Vallobra</b> Beihang University, China
14:40-15:00	<b>Ultrafast Terahertz Magnetism in Ferrimagnetic Iron Garnets</b> <b>Evgeny A. Mashkovich</b> Institute of Physics II, University of Cologne, Germany
15:00-15:20	<b>Ultrafast Dynamics of Spin Polarons in Europium Chalcogenides</b> <b>Pavel A. Usachev</b> Ioffe Institute, St. Petersburg, Russia
15:20-15:30	<b>Ultrafast Light Application in Neuroimaging and Modulation</b> <b>Wang Xi</b> Zhejiang University, China
15:30-15:40	<b>Signature of Jahn-Teller-Like Magnetic Instability in YbFeO<sub>3</sub> and Dynamical Strong Coupling of Fe Spins and Yb Orbitals</b> <b>Oleksandr Kovalenko<sup>1*</sup>, Nikolay Vovk<sup>1</sup>, Rostislav Mikhaylovskiy<sup>1</sup>, Anhua Wu<sup>2</sup></b> 1.Lancaster University, 2.Shanghai Institute of Ceramics
15:40-15:55	Coffee Break

Presiders: Pierre Vallobra, Wei Zhang	
15:55-16:15	<b>Ultrafast Electronic and Structural Dynamics in 2D Metal Halide Semiconductors</b> <b>Haiming Zhu</b> Zhejiang University, China
16:15-16:35	<b>Shine Bright Like a Diamond to Generate Ultrashort THz Pulses</b> <b>Yudan Su</b> Zhangjiang Laboratory
16:35-16:55	<b>Electro-Optic Frequency Comb Based Fast and Precise Lidar</b> <b>Guanhao Wu</b> Tsinghua University, China
16:55-17:15	<b>High Power Kilohertz Thin Disk Amplifier with 600mJ Pulse Energy and 600fs Pulse Duration Developed for Opcpa</b> <b>Huang Zhou</b> Songshan Lake Material Laboratory, China
17:15-17:35	<b>Ultra-Large Field-of-View Mesoscopic Two-Photon Imaging and Its Applications</b> <b>Hong Ye</b> Suzhou Institute of Biomedical Engineering and Technology CAS, China
17:35-17:45	<b>Ultrafast Control of Valley Polarization</b> <b>LingJie Lv</b> JiaXing University
17:45-17:55	<b>Ultrafast Laser High-Aspect-Ratio Extreme Nanostructuring of Optical Materials</b> <b>Guanghua Cheng<sup>1</sup>, Guodong Zhang<sup>1</sup>, Razvan Stoian<sup>2</sup></b> 1.northwest Polytechnical university, 2.Universit� Jean Monnet - Saint-Etienne
17:55-18:05	<b>Novel Barium Sulfides and Selenides for Efficient Narrowband Terahertz Generation</b> <b>Dina Suleimanova<sup>1*</sup>, Ekaterina Migal<sup>1</sup>, Dmitrii Badikov<sup>2</sup>, Fedor Potemkin<sup>1</sup></b> 1.Faculty of Physics, M.V. Lomonosov Moscow State University, 2.High Technologies Laboratory, Kuban State University
18:05-18:15	<b>Rapidity-Based Relativistic Modeling of Electron Dynamics in Ultrafast Terahertz Photonic Fields</b> <b>Nikolai Akintsov</b> Research Center for Intelligent Information Technology, Nantong University
	Dinner

## THz Manipulation of Quantum Materials

Liang Cheng

University of Electronic Science and Technology of China

**Abstract:** While intense terahertz (THz) pulses can transiently break inversion symmetry in the quantum paraelectric SrTiO<sub>3</sub>, the microscopic mechanism driving this phenomenon remains debated. Using fields up to ~1.1 MV/cm, we demonstrate that THz-field-induced second harmonic generation (TFISH) is spatially inhomogeneous, governed by a competition between lattice dynamics and defect effects. In oxygen-vacancy-rich regions, short-lived coherent antiferrodistortive (AFD) modes suppress dipole correlations within ~5 ps, and a defect-induced low-frequency mode (~0.1–0.3 THz) further quenches long-range ferroelectric order. Conversely, in defect-sparse regions, collective modes exhibit softening followed by hardening below  $T^* \approx 28$  K, confirming the formation of transient ferroelectric domains. These findings reconcile conflicting interpretations, identify defect-mediated competition as the key regulator of light-induced ferroelectricity, and provide a pathway for the ultrafast control of quantum materials.



**Biography:** Dr. Liang Cheng is a Professor at the University of Electronic Science and Technology of China (UESTC). He obtained his Bachelor's degree from Wuhan University and his Ph.D. in Physics from Nanyang Technological University. His research interests lie in ultrafast and terahertz (THz) spectroscopy within condensed matter physics. In recent years, his research has focused on THz nonlinear optics, ultrafast spintronics, and the applications of THz technology, with related findings published in journals including Nature Physics and Science

Advances.

## Interfacial Cherenkov radiation

Xiao Lin

Zhejiang University

**Abstract:** Cherenkov radiation occurs only when a charged particle moves with a velocity exceeding the phase velocity of light in that matter. This radiation mechanism creates directional light emission at a wide range of frequencies and could facilitate the development of on-chip light sources except for the hard-to-satisfy requirement for high-energy particles. Here, we report a mechanism to create the interfacial Cherenkov radiation from photonic crystals, namely by exploiting the constructive interference of light emission from sequential particle-interface interactions with specially designed (umklapp) momentum-shifts. Due to the umklapp scattering for the excited high-momentum Bloch modes, the resulting interfacial Cherenkov radiation is intrinsically threshold-free and is uniquely featured with spatially-separated apexes for its wave cone and group cone. Moreover, , we will discuss in this talk the possibility about achieving achromatic interfacial Cherenkov radiation from photonic crystals.



**Biography:** Dr. Xiao Lin is a professor in Zhejiang University (ZJU), China. He received B.S. and Ph.D. degrees both from ZJU in 2011 and 2016, respectively. He was the recipient of the First Prize of Chinese Society of Optical Engineering (CSOE) Natural Science Award (ranked the first) in 2024, the First Prize of Zhejiang Provincial Natural Science Award (ranked the second) in 2021, and the National Natural Science Fund for Excellent Young Scientists Fund Program (Overseas) of China in 2021. Ever since February 2025, he served as the associate editor of Applied Physics Reviews, which

has a five-year impact factor over 15. He published over seventy papers as the first or corresponding author, including Nature Physics, PRL, PNAS, Science Advances, and Nature Communications. Particularly, his paper about Superlight Inverse Doppler Effect has been selected as the editors' favourite paper in the area of Optics, from all papers published between 2005-2020 in Nature Physics [see “15 years of Nature Physics”, Nature Physics 16, 999 (2020)].

# Autocorrelation Terahertz Optical Rectification Generation in Reflection from Nonlinear Crystals

Mathias H. Kristensen

CROMA, Université Grenoble Alpes, Université Savoie Mont Blanc, Le Bourget du Lac, France.

**Abstract:** Optical rectification in reflection enables generation of ultrabroadband terahertz (THz) fields at crystal surfaces, avoiding bulk propagation or phase-matching constraints. We present a combined experimental–theoretical study of THz and second-harmonic generation (SHG) driven by a pair of time-delayed femtosecond pulses. This double-pulse scheme enables interferometric control of the nonlinear response and simultaneous detection of THz and SHG signals using sensitive, slow detectors with broad spectral response, such as bolometers and photomultiplier tubes. By scanning the inter-pulse delay, we extract time-domain waveforms encoding the crystal’s ultrafast THz and SHG responses. We introduce an analytical model accounting for susceptibility dispersion, detector sensitivity, and the relation between linear and nonlinear optical constants. The model reproduces key waveform and spectral features across ZnTe, GaSe, GaP, and LiNbO<sub>3</sub>, while deviations at higher pump powers reveal effects of two-photon absorption and free-carrier dynamics. These findings highlight reflection-based THz optical rectification as a sensitive probe of ultrafast surface nonlinearities.



**Biography:** Mathias Hedegaard Kristensen received his Ph.D. in nonlinear optics and terahertz physics from Aalborg University, Denmark, in 2023. He subsequently joined the Laboratoire Ondes et Matière d’Aquitaine (LOMA), Université de Bordeaux, France, as a Postdoctoral Researcher, where he worked on terahertz-driven nonlinear light–matter interactions in disordered materials, and generation and characterization of terahertz vortex beams. He is currently a Postdoctoral Researcher at CROMA, Université Savoie Mont Blanc and Université Grenoble Alpes, France. His ongoing work focuses on terahertz optical rectification in reflection geometry, with applications in surface-sensitive THz spectroscopy and imaging. Dr. Kristensen’s broader research interests include ultrafast and nonlinear optics, terahertz generation and detection, and machine-learning-assisted terahertz sensing. He has been involved in international collaborations across Denmark, France, and Japan, contributing to interdisciplinary research at the interface of nonlinear optics, materials science, and data-driven spectroscopy.

# Gate-tunable Nanomaterial Devices: Pathways to Terahertz Applications

Maria Burdanova<sup>1,2</sup>, Dmitry Krasnikov<sup>3</sup>, Albert G. Nasibulin<sup>3</sup>, Kirill Zaytsev<sup>2</sup>, Yan Zhang<sup>4,5</sup>, Aleksey Arsenin<sup>1</sup>,  
Valentyn Volkov<sup>6</sup>

<sup>1</sup>Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Russia. <sup>2</sup>Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia, <sup>3</sup>Skolkovo Institute of Science and Technology, Russia,

<sup>4</sup>Beijing Key Laboratory for Metamaterials and Devices, Key Laboratory of Terahertz Optoelectronics, Ministry of Education of China, China, <sup>5</sup>Beijing Advanced Innovation Center for Imaging Technology, Department of Physics,

Capital Normal University, China, <sup>6</sup>Emerging Technologies Research Center, XPACEO, Dubai, United Arab Emirates

**Abstract:** Terahertz (THz) radiation is rapidly being integrated into various fields, including biomedical imaging, sensing, security, and communications. The investigation into the optical and terahertz (THz) properties of nanomaterials is essential for advancing optoelectronic devices. Our recent research highlighted the unique properties of single-walled carbon nanotube (SWCNT) and MXenes, such as high electrical conductivity and mechanical flexibility, which make them ideal candidates for tunable optical elements in the THz frequency range. The implementation of a home-made THz time-domain system as well as THz continuous-wave imaging system allowed for detailed characterization of both charge carrier and developing of device performance.

Susceptibility of nanomaterials to the charge injection caused by doping makes them attractive for various terahertz applications due to the easily tunable conductivity by means of electrochemical gating. In our research we showed that adjustable and high electrical conductivity of titanium carbide, coupled with its absorption capabilities in the THz range, is utilized in the development of electrochemically and optically controlled devices, making them ideal for dynamic electro-magnetic shielding control. The sufficient shielding effectiveness of  $2.5 \times 10^4$  dB g<sup>-1</sup> cm<sup>2</sup> can be enhanced through electrochemical doping, reaching levels as high as  $4 \times 10^4$  dB g<sup>-1</sup> cm<sup>2</sup> (at +2 V).

We also employed the tunable optical response of ionic-liquid-gated SWCNT films to address a major challenge in THz optics – the limited range of materials with suitable optical properties. In this study, we demonstrated a high-performance THz intensity modulator combined with a focusing Fresnel zone plate (FZP) integrated in electro-chemical cell. We introduce a new approach for designing and fabricating the FZP, based on pre-measured dielectric properties of SWCNT films under applied voltage. The superior shielding effectiveness (up to  $8 \times 10^8$  dB cm<sup>2</sup>g<sup>-1</sup>) of SWCNT films enables the creation of an ultrathin terahertz lens. Electrical gating doubled the minimum refractive index, enhancing lens performance. This also enabled in situ tunability of the intensity modulation depth, from +15 to –20 %, with an applied voltage of +2 to –2 V. Although the current switching time is 3.6 seconds, our work presents the first demonstration of an electrochemically gated SWCNT FZP, offering distinct advantages in tunability and thin-film design.

In summary, the integration of both SWCNTs and MXenes in the design of optical elements, combined with a deeper understanding of their optical and electronic properties, sets the stage for significant advancements in THz technology, aligning with the ongoing pursuit of enhancing the functionality and applicability of nanomaterials in cutting-edge optoelectronic devices.

# Broadband absorption limit of terahertz waves in 2D nanomaterials and its applications

Tao Zhao, Gaohui Ge, Hao Xu

University of Electronic Science and Technology of China

**Abstract:** The broadband absorption limit of electromagnetic waves by nanoscale thin-film materials is the foundation for achieving high-performance optoelectronic devices across broad frequency ranges. There are two absorption limits for electromagnetic waves by nanofilms: 50% and 100%. The first limit, 50%, represents the intrinsic absorption limit of suspended nanofilms, while the second limit of 100% is achieved through resonant cavity enhancement. Under specific conditions, nanofilms can achieve both limits, but realizing broadband absorption limits remains a significant challenge, particularly for the terahertz band. We discovered that a two-dimensional transition metal carbon nitride (MXene) self-assembled film with a thickness of 10.2 nm (approximately  $\lambda/30,000$ ) can reach the intrinsic absorption limit across the entire terahertz band. Furthermore, we designed a broadband terahertz-infrared resonant cavity that enhances the absorption of two-dimensional MXene nanofilms in the 0.9–20 THz range to near-perfect levels. This structure significantly improves broadband response of detectors to terahertz-infrared radiation. These findings will advance research on broadband terahertz-infrared technologies involving MXene and other materials, while also providing a feasible pathway for developing compact, ultra-wideband terahertz-infrared photothermal or photothermal-electric devices.



**Biography:** Tao Zhao, Professor at the University of Electronic Science and Technology of China, specializes in research on the interaction between two-dimensional materials and broadband terahertz waves as well as related devices. He has published over 50 papers, including academic articles as the first or corresponding author in renowned international journals such as Nature Photonics, InfoMat, Small, Photonics Research, and Applied Physics Letters. He has led projects including National Key R&D Program topics, National Natural Science Foundation of China (General/Youth Fund), Sichuan Provincial Natural Science Foundation, and Central University Fund projects.

# Optical modulation of terahertz radiation by ultrathin continuous films of gold via optical pump-terahertz probe spectroscopy

Maksim I. Paukov<sup>1</sup>, Shuang Sun<sup>2,3</sup>, Dmitry I. Yakubovsky<sup>4</sup>, Gennady A. Komanidin<sup>5</sup>, Aleksey V. Arsenin<sup>4</sup>, Yan Zhang<sup>2,3</sup>, Maria G. Burdanova<sup>1,5</sup>

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<sup>2</sup>Beijing Key Laboratory for Metamaterials and Devices, Key Laboratory of Terahertz Optoelectronics, Ministry of Education of China, China

<sup>3</sup>Beijing Advanced Innovation Center for Imaging Technology, Department of Physics, Capital Normal University, China

<sup>4</sup>Emerging Technologies Research Center, XPANCEO, United Arab Emirates

<sup>5</sup>Prokhorov General Physics Institute of the Russian Academy of Sciences, Russia

**Abstract:** The study of ultrathin gold films is highly relevant due to their widespread application in plasmonics and optoelectronics. However, the dynamics of their nonequilibrium conductivity in the terahertz range remain poorly understood. In this work, using optical pump-terahertz probe spectroscopy, we present the first measurements of ultrafast carrier relaxation in continuous Au films with thicknesses ranging from 2 to 8 nm. We observed a non-monotonic dependence of the electron-phonon interaction time on both the pump fluence and the sample thickness. The characteristic modulation depth is on the order of 1% per unit thickness, with modulation speeds reaching approximately 100 GHz. Notably, the films exhibit negative photoconductivity, indicated by a decrease in the transmitted terahertz amplitude following optical excitation. These findings expand the fundamental understanding of relaxation processes in low-dimensional metallic systems and have practical implications for the development of ultrafast modulators and detectors for the terahertz range.

## THz s-SNOM technique and its applications in materials science

Shu Chen

Terahertz Technology Innovation Research Institute, University of Shanghai for Science and Technology, Shanghai

**Abstract:** Terahertz (THz) spectroscopy owns great advantages in the studies of electron, phonon and chemical information of molecules and materials. Because of the limitation of diffraction, however, the far-field THz techniques don't allow the studies at the nanoscale, significantly limiting the wide applications of THz spectroscopy and imaging. The emergence of THz scattering-type scanning near-field optical microscopy (THz s-SNOM) provides the solution to this issue, benefiting from the capabilities of breaking through the diffraction limitation. However, it is still suffering the difficulties (e.g. low signal to noise), thus hindering its wide applications. In this talk, I will discuss the issues of THz s-SNOM and provide the corresponding solutions. I will further discuss our recent works related on the applications of THz s-SNOM in the field of Nanophotonics.



**Biography:** Shu Chen, Professor, PhD supervisor. She obtained her PhD degree from Xiamen University in 2016.10. After her PhD, she moved to CIC nanoGUNE in Spain and worked at Prof. Rainer Hillenbrand's group. She was awarded the title of "Excellent Young Scientists Fund", "Shanghai Dawn Scholar Program" and "high-level Talent oversea" of Shanghai and joined in Terahertz (THz) technology innovation research institute of Shanghai for Science and Technology.

Her current researcher lines are near-field optics, nanophotonics and their applications of optoelectronic devices and surface enhanced spectroscopies. In these fields, she has published ~ 50 papers in first author and collaborating authors on the top-level journals including Nature, Nature Mater, Nature Nanotech, Nat. Energy, Nat. Commun., J. AM. Chem. Soc., Nano Lett. et al. These papers have been widely cited by Science, Nature, Nature Nanotech, Nature Photonics, Phys. Rev. Lett et al. The total citation is around 4600 from google scholar, 8 papers with the citations over 100 and ~ 8 papers are selected as ESI highly cited papers.

## Terahertz quantum cascade laser and imaging application

Chang Wang

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

**Abstract:** Terahertz (THz) quantum cascade lasers (QCLs) based on the inter-subband transition of electrons in quantum wells are important radiation sources in the THz frequency band, typically operating in the 2-5 THz frequency range with the advantages of high energy conversion efficiency and easy integration. They have significant application prospects in fields such as super-resolution imaging and large capacity communication system. The lasing frequency of THz QCL and the peak detection frequency of THz QWP can be achieved by adjusting the width of quantum wells, doping concentration, and potential barriers. The dynamic behaviors of QCLs under optical injection and optical feedback are carefully studied. The results give a deep insight into the physics of QCL and is helpful to optimize device active region. The fabricated THz QCLs can realize a maximum peak power of 1.40 W in pulse mode. Using THz QCL as the source and THz quantum well photodetector as the detector, a scattering-type scanning near-field optical microscope has been developed with a high spatial resolution.



**Biography:** Wang Chang received the Doctorate degree in in microelectronics and solid-state electronics from Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences in 2007. Currently he is Professor with the State Key Laboratory of Materials for Integrated Circuits, SIMIT. His research interests include terahertz semiconductor optoelectronic devices and their applications. He has undertaken projects such as the National Key Research and Development Program and the National Natural Science Foundation.

# Terahertz functional materials: from ultrafast dynamic to terahertz optical field manipulation

Jiang Li

Institute of Fluid Physics, China Academy of Engineering Physics

**Abstract:** Terahertz (THz) technology has emerged as a frontier interdisciplinary field with profound implications for communications, sensing, imaging, and other related areas. However, the development of high-performance THz functional materials and precise manipulation of THz optical fields remain core challenges restricting its practical application. In this work, we systematically investigate the ultrafast dynamic behaviors (including charge carrier relaxation, photoinduced phase transition, etc.) in representative THz functional materials (such as VO<sub>2</sub>, MXene, and GST) using optical pump-THz probe spectroscopy. By clarifying the intrinsic physical mechanisms underlying the ultrafast response of these materials to optical stimuli and their modulation effects on THz optical fields, an efficient approach for THz optical field manipulation tailored to near-field single-pixel imaging is proposed. Furthermore, deep sub-wavelength THz imaging with a spatial resolution of ~6.5 μm is achieved based on an optically controlled THz near-field coding method.



**Biography:** Jiang Li obtained his joint Ph.D. degree from the China Academy of Engineering Physics (CAEP) and Helmholtz-Zentrum Dresden-Rossendorf (HZDR, Germany), and currently serve as a Professor at the Institute of Fluid Physics, China Academy of Engineering Physics, his research interests include ultrafast terahertz spectroscopy, high-resolution terahertz spectral imaging, and terahertz non-destructive testing applications. He has published over 50 peer-reviewed journal papers, including *Light: Science & Applications*, *Small*, *Angewandte Chemie International Edition*, etc.

Professor Li was selected as the Provincial-Ministerial Talent Program and awarded the Second-Class Prize of Military Science and Technology.

# Terahertz Micro Nano Sensors and Their Biomedical Applications

Fangrong Hu

College of Electronic Engineering and Automation, Guilin University of Electronic Technology

**Abstract:** The application of terahertz science and technology in the biomedical field is a technological revolution, which brings more precise, accurate, and safe detection methods, and has enormous potential for application. This report includes four parts:

- (1) Characteristics and application status of terahertz waves.
- (2) The sensing mechanism of terahertz frequency micro nano sensors. The LC equivalent circuit model will be used to explain the absorption peak frequency shift principle and sensing mechanism of terahertz sensors.
- (3) Design methods and preparation techniques for high sensitivity and high specificity terahertz micro nano sensors. This section first introduces the key technical indicators of terahertz sensors: sensitivity  $S$ , quality factor  $Q$ , and selectivity. Then, introduce the design, processing, and characterization methods of terahertz micro nano sensors.
- (4) Biomedical applications of terahertz micro nano sensors. This includes three parts: using terahertz sensors to distinguish cancerous tissues from normal tissues, specifically detecting liquid tumor markers, and specifically detecting gaseous tumor markers.



**Biography:** Hu Fangrong: Professor, PhD, Doctoral Supervisor, Second Level Candidate of Guangxi New Century "Ten Hundred Thousand Talents Project", Vice Dean of the School of Electronic Engineering and Automation at Guilin University of Electronic Science and Technology, and Leader of the First Class Discipline Direction of Instrument Science and Technology in Guangxi. Currently serving as a member of the Micro Nano Device and System Technology Branch of the

Chinese Instrument and Meter Society, and a member of the Physics Teaching Guidance Committee of undergraduate universities in Guangxi. In 2010, he obtained a doctor's degree in optical engineering from the Graduate School of the Chinese Academy of Sciences. From May 2011 to July 2013, I conducted postdoctoral research at the Key Laboratory of Optical Physics, Institute of Physics, Chinese Academy of Sciences. From January 2015 to January 2016, I was a visiting scholar in the Department of Electronic and Computer Engineering at Oklahoma State University in the United States. I have published over 140 SCI indexed journal articles and have won the Guangxi Science and Technology Award three times.

My research interests include: Novel terahertz functional devices; Micro nano sensors and their biomedical applications; Terahertz radar technology and applications.

# Compact terahertz devices based on semiconductor superlattice materials and its applications

Zhiyong Tan

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, China

**Abstract:** Terahertz radiation sources based on semiconductor superlattice structure mainly include terahertz quantum-cascade laser (THz QCL) and photoconductive antennas (THz PCAs). They are two very important devices in the terahertz region and have been widely used in materials science, biomedicine and other fields. This report develops high-power THz QCL device and light source module based on the "four well resonant phonon" structure. The maximum pulse power of the laser exceeds 1 W, and the maximum pulse power of the laser with a liquid nitrogen dewar is more than 400 mW. The developed THz QCLs have been applied to the real-time imaging system and the near-field microscopic imaging system. The real-time imaging can achieve wavelength resolution, and the near-field microscopic imaging resolution is 95 nm. Using Be doping technology, high resistivity InGaAs/InAlAs materials were acquired, and a parallel line antenna electrode structure was fabricated. A pair of PCAs with a dynamic reach of 80 dB and a working spectral width of about 4 THz was developed. Finally, a sNOM system based on terahertz PCA was constructed, and third-order scattering signals were detected.



**Biography:** Prof. Dr. TAN Zhiyong is from State Key Laboratory of Materials for Integrated Circuits, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, Shanghai, China. Prof. TAN's research activities are focused on far-infrared/terahertz superlattice semiconductor devices, photoelectric measurement technology, spectroscopy, and application systems. He has published over 50 EI/SCI papers in journals such as *iScience* and *Optics Letters* etc., authored the monograph "Terahertz Photoelectric Measurement Technology", holds 26 patents. His research achievements won the first prize of Shanghai Technology Invention Award in 2023 (2/10), the first prize of Science and Technology Award of China Communications Society in 2024 (3/8).

## Interwoven magnetic Kagome metal overcoming geometric frustration

Zhongkai Liu

ShanghaiTech University

**Abstract:** Magnetic kagome materials provide a unique platform for exploring magneto-transport phenomena, symmetry breaking, and charge ordering driven by the intricate interplay among electronic structure, topology, and magnetism. Herein, we introduce a new design strategy for interweaving quasi-1D magnetic Tb zigzag chains with nonmagnetic Ti-based kagome bilayers in  $\text{TbTi}_3\text{Bi}_4$ . Neutron diffraction, spin-polarized scanning tunneling spectroscopy, and angle-resolved photoemission spectroscopy analyses confirm that the interwoven structure exhibits a coexistent elliptical spiral magnetic order, a spin-density wave, and an unusually large band-folding gap. The combined unique magnetic and electronic state leads to a giant anomalous Hall conductivity of  $10^5 \Omega^{-1} \text{cm}^{-1}$ . These results establish  $\text{TbTi}_3\text{Bi}_4$  as a model system of magnetic kagome metals with strong electron–magnetic interactions.



**Biography:** Zhongkai Liu received B.S. in physics from Tsinghua University and Ph. D in Stanford University under the supervision of Prof. Zhi-Xun Shen. After one year working as a postdoc in I05, DLS, he started as an assistant/associate professor at ShanghaiTech University. His research interests lie in the photoemission study of topological quantum materials, low dimensional materials and development of synchrotron based spatial resolved ARPES.

# Spatiotemporal Terahertz Emission Nanoscopy of Spintronic Photocurrents

Felix Paries

RPTU University Kaiserslautern-Landau, Fraunhofer Institute for Industrial Mathematics ITWM, Leibniz Institute of Photonic Technology IPHT

**Abstract:** Capturing ultrafast spin and charge photocurrents on nanoscopic scales is essential for fundamental research in physics and engineering, as well as for future applications, such as novel spinorbitronic devices. Accessing the fundamental dynamics driven by changes in electronic energy, linear momentum, and angular momentum requires probing that simultaneously resolves their native spatiotemporal scales: femtoseconds and nanometers. However, experimental approaches achieving this simultaneous resolution remain scarce and instrumentally demanding.

While near-field probing offers promising platforms to combine ultrafast and nanometer resolution, a major challenge is the observation of in-plane propagation dynamics, required for studying many application-relevant, high-speed phenomena – from carrier transport in 2D materials to spin-to-charge conversion in spintronic terahertz emitters (STEs). However, near-field scanning probes are primarily sensitive to out-of-plane electric fields.

In this talk a solution to this challenge by performing terahertz (THz) emission nanoscopy (TEN) of a photoexcited fiber-coupled STE using a scanning-probe microscope is presented. A counterintuitive, dipolar evolution of the near-field THz signal is uncovered, which is shown to originate from the scanning-probe's inherent sensitivity to local out-of-plane electric fields that emerge in our case from spatially confined in-plane charge currents. The findings resolve ambiguities regarding the sensitivity of near-field probes to ultrafast in-plane charge transport and establish TEN as a fully vectorial probe for the spatiotemporal imaging of coupled nanoscale THz charge and spin dynamics.

**Biography:** Felix Paries is a physicist specializing in ultrafast photonics and field-resolved spectroscopy. He earned a German Diplom/M.Sc. in 2020 with a thesis on attosecond-precision timing-jitter metrology, and completed a Ph.D. in 2025, during which he captured the nanoscale spatiotemporal evolution of in-plane terahertz spintronic photocurrents and developed interferometric delay calibration for optical sampling systems. Both degrees were awarded by RPTU University Kaiserslautern-Landau.

His current research advances field-resolved spectroscopy toward biomedical use. At present, he dedicates the majority of his lab-time to two key pillars: interferometric delay tracking of high-end optical sampling systems, enabling ultraprecise measurement of electric-field signatures, and increasing FRS-system compactness and robustness to transfer the technology from the lab to clinical and industrial environments. Additionally, he continues his research in spatiotemporal terahertz emission nanoscopy.

Felix Paries serves as postdoctoral researcher at the Laboratory for Lightwave Metrology and is affiliated with RPTU University Kaiserslautern-Landau, Fraunhofer ITWM, and Leibniz Institute of Photonic Technology. His dissertation received the Springer Theses Award.

# Ultrasensitive terahertz superconducting kinetic inductance detectors with photon-noise-limited performance

Runfeng Su<sup>1</sup>, Rui Tan<sup>1</sup>, Junhua Chen<sup>1</sup>, Yuwei Zhu<sup>1</sup>, Tianyuan Chi<sup>1</sup>, Siming Zang<sup>1</sup>, Jingbo Wu<sup>1,2</sup>, Xuecou Tu<sup>1,2</sup>, Jian Chen<sup>1,2</sup>, and Peiheng Wu<sup>1,2</sup>

<sup>1</sup>Research Institute of Superconductor Electronics (RISE), School of Electronic Science and Engineering, Nanjing University, <sup>2</sup>Purple Mountain Laborator

**Abstract:** Ultrasensitive detectors play a key role in astronomical observations, particularly in the terahertz (THz) bands. The THz spectrum contains abundant information about the universe that is invisible in other spectral ranges. Superconducting kinetic inductance detectors (KIDs), which can be easily fabricated into large arrays with intrinsic frequency-multiplexing readout, are among the most promising candidates for THz astronomy. We report two terahertz superconducting KIDs designed for operating frequencies of 4.3 and 15 THz, respectively. The KIDs are lumped-element resonators, each comprising a tantalum interdigitated-capacitor and an aluminum inductor. The capacitor and coplanar waveguide feedlines are fabricated from a 150-nm-thick tantalum (Ta) film, while the inductor is composed of a 40-nm-thick aluminum (Al) film and also acts as an absorber. At a bath temperature of 100 mK in a dark environment, the KIDs exhibit an intrinsic quality factor on the order of  $10^5$ . For the 4.3 THz KID, the absorber consists of periodic hairpin units with individual linewidths of 100 nm and a volume of  $\sim 4.3 \mu\text{m}^3$ , yielding a simulated polarization-averaged absorption efficiency of  $\sim 68\%$  at the operating frequency. For the 15 THz KID, the absorber uses periodic dipole units with individual linewidths of 400 nm and a volume of  $\sim 58 \mu\text{m}^3$ , with a simulated efficiency of  $\sim 76\%$ . We measured the optical noise equivalent power (NEP) using a cryogenic blackbody source with the bath temperature fixed at 100 mK. The 4.3 THz KID shows photon-noise-limited performance for absorbed powers above  $\sim 10$  aW, while the 15 THz KID reaches this regime above  $\sim 1$  fW. The lowest optical NEP is  $\sim 1.9 \times 10^{-19}$  W/ $\sqrt{\text{Hz}}$  for the 4.3 THz KID and  $\sim 2.9 \times 10^{-18}$  W/ $\sqrt{\text{Hz}}$  for the 15 THz KID. These results demonstrate that Ultrasensitive THz KIDs show great potential for astronomical observations on ground-based, balloon-borne, and space platforms.

# Research on the application in the diagnosis of glioma based on terahertz technology

Yuye Wang

School of Precision Instruments and Optoelectronics Engineering, Tianjin University

**Abstract:** Glioma is the most common primary intracranial tumor with high mortality rate. Rapid and high-sensitive diagnosis is an important prerequisite for the precise treatment in neurosurgery. Terahertz (THz) wave can reflect the change of dipole moment caused by the asymmetric vibration/rotation in molecules and polar groups. It has the advantages of label-free and fingerprint spectrum, and has great potential in the field of biomedical detection. In our group, the high-resolution and high sensitivity THz attenuated total reflection (ATR) imaging system was established, which can break through the limitations of low sensitivity, low resolution, and small imaging area. The imaging resolution reached  $120\ \mu\text{m} \times 140\ \mu\text{m}$ . Based on this system, the accurate identification of glioma regions in mice models with different genotypes and clinical glioma tissues was realized. The automatic identification method of glioma regions in THz images was constructed. This study can provide a new method for the rapid, high-sensitive and label-free accurate diagnosis of glioma.



**Biography:** Yuye Wang, female, the distinguished professor and doctoral supervisor in the School of Precision Instrument and Optoelectronic Engineering in Tianjin University. She is the visiting scientist at RIKEN in Japan, the deputy secretary-general of Tianjin Laser Technology Society, and the deputy secretary-general of Tianjin Intelligent Science and Technology Society. Currently, her research group mainly engaged in the research fields of all-solid-state laser and nonlinear optical frequency conversion technology, THz photonics source, THz application in biomedical diagnostics and Raman spectral detection technology. She has undertaken more than 20 projects such as the National Basic Research Program of China (973), National Natural Science Foundation of China (NSFC). She has published more than 200 papers in academic journals and conferences, such as *ASC Photonics*, *Photonics Research*, *Applied Physics Letters*. She has also authorized 20 national invention patents and compiled 4 Chinese and English monographs. She was awarded the First Prize of Chongqing Science and Technology Progress Award in 2019. She was selected as the first batch of young scientific and technological talents in Tianjin, and the young scientific and technological talents of Tianjin Innovation Talent Promotion Plan.

# All-fibre-coupled terahertz single-pixel imaging for biomedical applications

Sen Mou

Xi'an Institute of Optics and Precision Mechanics, CAS

**Abstract:** Terahertz (THz) radiation is a promising non-destructive and non-ionising spectroscopic and imaging approach for biomedical applications, owing to its low photon energy (few meV) and strong sensitivity to water content in biological tissues. In particular, THz imaging shows significant potential for differentiating cancerous from normal tissues by exploiting their distinct hydration levels. Real-time, non-invasive imaging techniques are essential for practical biomedical applications. Yet existing THz imaging systems often suffer from limited speed, bulky designs, and poor adaptability to in situ environments. Hereby, we proposed a fully fibre-coupled THz attenuated total internal reflection single-pixel imaging system to overcome these challenges. The all-fibre architecture enables seamless integration for in situ biomedical applications, including measurements directly on patients. Central to the design is a THz spatial light modulator based on an unpassivated silicon wafer, facilitating high-speed modulation and enabling video-rate imaging with a spatial resolution down to 360  $\mu\text{m}$ . The system achieves an imaging throughput exceeding 30,000 pixels per second for 64-by-64 images - over five-fold higher than the state of the art - representing a substantial improvement in real-time THz imaging capabilities.



**Biography:** Dr. Sen Mou, researcher (full professor) at Xi'an Institute of Optics and Precision Mechanics, CAS, obtained his Ph.D. degree in 2018 at the University of Naples Federico II. Then he worked at INFN (National Institute for Nuclear Physics) in Italy, ICFO (The Institute of Photonic Sciences) in Spain and the University of Warwick in the UK as a postdoctoral researcher. He won a 2-year INFN Postdoctoral Fellowship in 2020. He joined Xi'an Institute of Optics and Precision Mechanics as a researcher in 2025. His research interests focus on ultrafast optics, THz photonics,

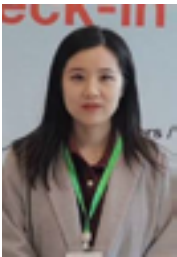
THz single-pixel imaging, vortex beams, hybrid organic-metal perovskite materials, 2D materials, etc. He has extensive experience in regenerative chirp-pulse-amplification laser systems, optical parametric amplifiers, and optical parametric chirped-pulse amplification laser systems. He built setups for THz generation with laser-induced plasma and optical rectification in nonlinear crystals, optical-pump THz-probe, THz single-pixel imaging, z-scan, etc. He published more 30 peer-reviewed articles in journals such as Nature Communications, Photonics Research, APL Photonics, etc.

# Machine Learning-Assisted Terahertz Metasurface Design

Shan Yin

Guilin University of Electronic Technology

**Abstract:** Data-driven paradigm provides a powerful engine for the research and development of next-generation, high-performance, and customizable metasurface devices. Here, we will introduce how we employ deep learning frameworks such as visual attention networks, conditional generative adversarial networks (CGANs), and variational autoencoders to build efficient forward prediction and inverse design models, fundamentally revolutionizing the traditional simulation-based design workflow. Through specific case studies, we will demonstrate the successful applications of these intelligent methods in the design of terahertz high-Q devices, chiral metasurfaces, and inverse design of patterned structures, achieving orders-of-magnitude improvements in both accuracy and efficiency.



**Biography:** Shan Yin received the B.S. degree in optical information science and technology from Minzu University, Beijing, China, in 2010 and the Ph.D. degree in optics from the Institute of Physics, Chinese Academy of Sciences, Beijing, China, in 2016. She is currently a Professor with Guilin University of Electronic Technology, Guilin, China. She has got the Major Talent Project in Guangxi, and led more than 10 research projects, including the National Natural Science Foundation, Guangxi Natural Science Foundation and the Central Guidance Fund for Local Science and Technology Development. Her current research interests include optoelectronic detection technology, machine learning, and metasurface functional devices.

## Terahertz Detection of Single Proteins

Huabin Wang

Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences

**Abstract:** Terahertz (THz) technology has attracted increasing interest worldwide. In the past years, much progress has been made in THz biomedical research. However, it is a challenge to detect biomolecules at the single-molecule level with THz, which is crucial for single-molecule biophysics. In this presentation, the speaker will share the work made by his group in the study of biomolecules with a super-resolution THz spectral imaging instrument, termed THz s-SNOM. The presentation mainly includes the background of THz bio-detection, the principle of THz s-SNOM, THz nanoscopy of single proteins, and the morphology reconstruction of individual proteins, protein networks and protein layers from their THz images. Finally, a perspective will be given on the direction of single-biomolecule detection with THz.



**Biography:** Prof. Wang received his Ph.D. degree in Inorganic Chemistry from Shanghai Institute of Applied Physics, Chinese Academy of Sciences in 2008. After graduation, he worked for 6 years at the School of Chemistry, University of Melbourne, Australia. In 2014, he took a professor position at Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences. In 2021, he established the Center of Super-resolution Optics and has been appointed as the director for this center. His major research areas include THz near-field instruments, THz spectroscopy and imaging, and atomic force microscopy. He presided over more than ten important scientific research projects including the National Key Research and Development Program of China and the National Natural Science Foundation of China. He has authored/co-authored ~100 scientific articles published in PNAS, ACS Nano, Biotechnology Advances, etc. He has been honored as an Excellent Scientist for THz Biophysics of China (2021) and the China's State Council Special Allowances Expert (2023).

# Terahertz Spectroscopy in Ultrafast Photoelectric Conversion Processes

Zeyu Zhang

Hangzhou Institute of Advanced Study, University of Chinese Academy of Science

**Abstract:** Terahertz (THz) spectroscopy has emerged as an effective tool for investigating the key physical processes of photoelectric conversion in novel materials and devices owing to its unique material fingerprinting property and ultrafast time resolution. Using time-resolved terahertz spectroscopy, we have determined the large polaron mobilities that are affected by the A-site cation substitution in  $\text{MA}_x\text{FA}_{1-x}\text{PbI}_3$  perovskite solar cells and demonstrated that MA cations can reduce polaron mobility through anisotropic electron-phonon coupling. Furthermore, by combining terahertz spectroscopy and terahertz emission spectroscopy, we have achieved real-time observation of polaron formation in  $\text{FAPbI}_3$ , verifying a new polaron mode ( $\sim 0.4$  THz) associated with the rotational mode of A-site cations. These results provide critical insights into the formation and functional mechanisms of polarons in perovskite materials and devices. Recently, in the study of 2D-3D interfacial charge transport in organic-inorganic hybrid perovskites, we have identified vertical interfacial transport currents at the 2D-3D perovskite interface via terahertz emission spectroscopy. The results indicate that vertically stacked phase distributions and grain orientations can significantly enhance the vertical transport of carriers, clarifying the key role of this process in improving photoelectric conversion efficiency.



**Biography:** Zeyu Zhang, Professor at Hangzhou Institute of Advanced Study, University of Chinese Academy of Science. His main research fields focus on the applications of time-resolved spectroscopy and terahertz spectroscopy in advanced optoelectronic materials. He has published more than 50 papers in journals such as Nature Communications, ACS Energy Letters, Advanced Science, J. Energy Chem., ACS Photonics, J. Phys. Chem. Lett., and Appl. Phys. Lett.

# Inverse Design of Diffusion–Absorption Hybrid Metasurfaces

Zicheng Song

Harbin Institute of Technology

**Abstract:** Random metasurfaces have demonstrated significant potential in radar-signature control applications, but their ability to manipulate scattering-field reduction is limited by relying solely on the diffusion mechanism. To achieve flexible and arbitrary designs for scattering-field reduction, a diffusion–absorption hybrid metasurface is proposed based on the Babinet principle. This hybrid metasurface adopts complementary bilayer metasurfaces to satisfy the impedance matching condition and employs a hybrid absorption and diffusion mechanism. Such complementary designs' intralayer resonances and interlayer couplings are tailored by multi-objective optimization, achieving the precise and wideband design of absorptive elements with a specific reflection phase. By optimizing the spatial distributions of elements, diffusion is introduced and designs are achieved with a continuous scattering-field reduction. The proposed high-freedom metasurface and the implementation multi-objective optimization strategy collectively empower flexible wavefront manipulation, offering a viable solution for designing hybrid meta-devices that incorporate multiple mechanisms.



**Biography:** Song Zicheng is an associate research fellow and master's supervisor at Harbin Institute of Technology. His research focuses on metamaterials and electromagnetic stealth, and he has published over ten papers as first/corresponding author in journals such as Nat. Commun..

## Coherent control of the functionality of quantum materials by THz light

Tao Dong

Shanghai Jiaotong University

**Abstract:** Coherent light-matter interaction is now emerging as a new route to control the functionality of quantum materials that are otherwise inaccessible by thermodynamical tuning methods. Terahertz light is particularly important for probing and controlling exotic states through resonant collective-mode excitation or nonresonant Floquet engineering without inducing parasitic hot electrons. In this talk, I will present two examples of how to use THz light to control the functionality of PbTe and MnPSe<sub>3</sub> via phonon excitation and lightwave dressing.



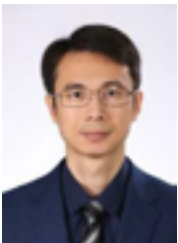
**Biography:** Tao Dong is now an associate professor at the Tsung Dao Lee Institute (TDLI), Shanghai Jiaotong University (SJTU). He received his Ph.D. from the Institute of Physics (IOP), Chinese Academy of Sciences, in January 2014, and then worked at IOP as a research associate. One year later (2015.01), he moved to Peking University. From 2018.07-2020.03, he conducted postdoctoral research in Prof. Jure Demsar's lab at Johannes Gutenberg University in Mainz as a Humboldt postdoctoral fellow. From Feb. 2026, he moved to TDLI, SJTU, as an associate professor.

## Superradiant Smith-Purcell radiation with ultra-narrow linewidth

Fang Liu

Tsinghua Univ.

**Abstract:** Free electron lasers have unique advantages of high power, wide frequency tunability and et al, however, they face challenge in narrowing the spectral linewidth. Here we proposed and realized the pump-induced stimulated superradiant Smith-Purcell radiation (PIS-SPR) and achieved an ultra-narrow spectral linewidth of 0.3 kHz at  $\sim 0.3$  THz in a compact device. The mechanism and technique provides a way to further narrow the spectral linewidth of free electron radiation and broaden its applications. This work provides the possibilities of not only realizing compact, narrow linewidth radiation sources in different frequency region which would promote the applications of S-SPR in different fields, but also generating frequency-locked/-tunable free electron bunches for interaction with different materials and micro-/nano-structures. And the proposed stimulated effect to enhance the light field might also be considered for on-chip electron acceleration to achieve a higher electron acceleration gradient.



**Biography:** Fang LIU received the B.S.degree from Beijing Institute of Technology, China, in 2003, and Ph. D degree from Tsinghua University, China, in 2008. In July 2008, he joined the Electronic Engineering Department, Tsinghua University, China, and was promoted as an Associate Professor and Professor in 2011 and 2021, respectively. His current research interests is free electron devices, plasmonic optoelectronic devices and their applications. He published more than 100 peer-review journal papers, including Nature Photonics, Nature Communications, eLight, Science advances, Optica, Nanophotonics, and Applied Physics Letters. He proposed and realized the first on-chip free-electron light source in the world, hybrid plasmonic-dielectric coupler, integrated plasmonic bio-sensor, plasmonic enhanced thin-film solar cells, and two SPP absorption based nano-lithography.

# A Gap-Free Real-Time Broadband Spectrum Analyzer by Overlapping Optical Short-Time Fourier Transform

Liao Chen

Wuhan National Research Center for Optoelectronics, Huazhong University of Science and Technology

**Abstract:** Real-time analysis of the microwave and terahertz spectrum continuously is essential for the observation and analysis of high-speed random events and short-duration transient events. However, most current schemes perform real-time spectrum analysis in a gapped manner, inevitably losing some critical information. A gap-free real-time microwave spectrum analyzer based on temporal convolution is demonstrated experimentally. Leveraging the temporal overlapping of stretched pulses, the analyzer achieves a high frame rate of 233 MHz, a frequency resolution of ~500 MHz, an instantaneous bandwidth of ~130 GHz, a 100% signal capture ratio. Owing to the good system performance, the real-time dynamic frequency identification for different types of microwave signals covering 110 GHz is demonstrated, and the frequency can be accurately identified at any given time. Furthermore, the real-time capturing of transients is also demonstrated in a continuous manner. Besides, we developed an intergrated BTO optical modulation with over 100 GHz bandwidth to improve the analyzer. The high-performance analyzer can open a new horizon for real-time analysis and processing of high-speed time-domain waveforms in communication, imaging, and sensing applications.



**Biography:** Chen Liao is an Associate Professor at Huazhong University of Science and Technology (HUST). He is currently a member of Professor Zhang Xinliang's research group, where his work focuses on terahertz photonic integrated chips and spectrum measurement technologies. He takes the lead in a number of research projects, including key and sub-projects under the Ministry of Science and Technology's Key Research and Development Program, the National Natural Science Foundation for Young Scientists, as well as collaborative projects with Huawei Technologies Co.,

Ltd. Besides, he served as the second principal investigator for a National Major Instrument Development Project, which has been successfully accomplished. To date, he has published more than 20 academic papers in top-tier international journals such as Nature Communications and Laser & Photonics Reviews, and holds 8 granted invention patents.

## Next-generation terahertz time-domain spectroscopy system: from terahertz focal-plane array to integrated femtosecond laser

Xurong Li

College of Information Science and Electrical Engineering, Zhejiang University

**Abstract:** Terahertz (THz) waves have attracted broad interests for numerous applications, such as security screening, industrial nondestructive evaluation, and biomedical imaging. Among various THz instrumentation platforms, terahertz time-domain spectroscopy (THz-TDS) is particularly powerful, as it simultaneously provides amplitude, phase, and spectral information of the object. For widespread adoption in industrial settings, however, THz-TDS systems must achieve high imaging throughput while remaining compact and cost-effective. Current state-of-the-art systems typically rely on single-pixel THz emitters and detectors, where raster scanning of either the sample or the system severely limits the imaging speed. Here, I present a terahertz focal-plane array consisting of approximately 0.3 million plasmonic nanoantennas, capable of generating hyperspectral THz images with a bandwidth exceeding 3 THz and a signal-to-noise ratio of 60 dB. Leveraging the rich spectral information provided by the focal-plane array, a deep convolutional neural network is trained to perform super-resolution imaging. As a proof of concept, a 16-fold resolution enhancement with an effective pixel count exceeding 1,000 is demonstrated on etched silicon samples with subwavelength thickness variations. This platform further enables, to our knowledge, the first video-rate THz time-domain imaging at 16 frames per second. In addition, I will present a photonic integrated femtosecond mode-locked laser based on an erbium-doped silicon nitride platform, delivering optical pulses as short as 300 fs at a repetition rate of 1.2 GHz. This integrated laser offers a promising route toward replacing bulk solid-state or fiber-based femtosecond sources, paving the way for portable and cost-effective THz-TDS systems.

# Broadband THz Airy-Beam Phase Imaging Through Scattering Media

Xiong Wang

ShanghaiTech University

**Abstract:** Imaging through scattering media in the terahertz band is often limited by severe distortion and contrast loss when conventional spherical beams are used. This presentation introduces a phase-centric solution based on a broadband THz Airy beam, leveraging its propagation-invariant and self-healing properties to maintain wavefront integrity in complex paths. We implement Airy Beam Phase Imaging (ABPI) over 190–210 GHz using a compact set of three 3D-printed dielectric lenses to synthesize a high-quality Airy beam. Experiments on printed dielectric targets demonstrate that phase maps preserve object boundaries and region uniformity more reliably than amplitude images, particularly when a glass-bead scattering layer is inserted. Beyond single-frequency operation, we show that aggregating multi-frequency phase reconstructions reduces artifacts and yields more stable results than selecting any individual frequency. By linking recovered phase to optical path length, the method enables accurate thickness estimation and straightforward 3D reconstruction of dielectric structures under both clear and scattering conditions. The proposed ABPI framework provides a practical route to robust THz inspection in highly turbid scenarios and is well-suited to nondestructive evaluation, biomedical screening, food quality assessment, and security-related imaging.



**Biography:** Professor Wang earned his Ph.D. in Electrical Engineering from the University of Arizona, USA in 2014. Since 2015, he has been working at the School of Information Science and Technology, ShanghaiTech University. His current research interests include microwave-induced thermoacoustic tomography, noninvasive microwave hyperthermia, terahertz imaging, and metasurfaces. He has published over 90 journal papers in the fields of microwaves, terahertz, and biomedical engineering, and currently serves as an Associate Editor for the IEEE JERM journal. He has secured and led research projects such as those funded by the National Natural Science Foundation of China, and has been selected for the Shanghai Eastern Scholar Program and the Shanghai Pujiang Talent Program.

# Ultrafast Real-Time Nano-Imaging of a single Terahertz metamolecule via nano Time-Domain Spectroscopy

Zhuang Yuxuan, Zhang Xiaoqiuyan, Zhang Zhuocheng, Hu Min

Terahertz Research Center School of Electronic Science and Engineering, University of Electronic Science and Technology of China

**Abstract:** Terahertz scattering-type scanning near-field optical microscopy (THz s-SNOM) has enabled nanoscale studies of resonances in individual structures; however, it is still predominantly confined to steady-state (frequency-domain) spectroscopy. Consequently, the real-time resonant response of a terahertz metamolecule—where a nanoantenna and its dielectric environment can coherently hybridize into coupled eigenmodes—remains largely unexplored. Here, we implement nano-THz time-domain spectroscopy (nano-TDS) on a THz s-SNOM platform to record the full temporal near-field response of single gold bowtie antennas fabricated on a silicon-on-insulator substrate, using a dielectric probe to suppress spurious tip resonances. Ultrafast near-field movies directly visualize the geometry-dependent redistribution of resonant energy within a single metamolecule, revealing coherent hotspot switching and geometry-dependent temporal peak slip that emerge only within an optimal size regime. Our work establishes nano-TDS-enabled THz s-SNOM as a route to time-domain nanophotonics of metamolecules, opening opportunities to interrogate and engineer ultrafast near-field dynamics beyond steady-state spectra.

## Broadband and Scalable Terahertz Programmable Metasurfaces

Jingbo Wu

Nanjing University

**Abstract:** Programmable terahertz (THz) devices are becoming essential for advanced sensing, imaging, and communication systems. However, current solutions remain limited in bandwidth, scalability, and pixel-level control. In this talk, I summarize recent progress on THz programmable metasurface based on VO<sub>2</sub>. We used a wet-transfer technique to fabricate an ultrathin, transmissive VO<sub>2</sub>-based programmable metasurface. This device achieves broadband amplitude modulation and supports stacked configurations. We further developed a substrate-free transmissive THz spatial light modulator covering 0.3–10 THz, enabling spatial encoding and time-of-flight imaging. Last, we introduce a scalable crossbar architecture integrated with VO<sub>2</sub> selectors. This design effectively suppresses crosstalk and enables pixel-level programmability. These developments highlight versatile pathways toward next-generation THz photonic systems.



**Biography:** Jingbo Wu is a Professor at the School of Electronic Science and Engineering, Nanjing University. He received his Ph.D. from Nanjing University in 2012 and subsequently worked as a Postdoctoral Research Fellow at the University of Leeds and the University of Cambridge from 2012 to 2016. His research focuses on terahertz metasurfaces, terahertz spectroscopy, and superconducting electronics. He has published more than 80 papers in leading journals, including Nature Communications, Science Advances, Light: Science & Applications, and Optica. He has received several honors, such as the Xi-Cheng Zhang's Award (ISUPTW 2023) and the Xiaomi Young Scholar-Science and Technology Innovation Award.

# A Portable 220-GHz-Band Prototype for Terahertz Integrated Sensing and Mobile Communications

Chong Han

Terahertz Wireless Communications (TWC) Laboratory, Shanghai Jiao Tong University

**Abstract:** Terahertz integrated sensing and communications (THz-ISAC) has attracted increasing interest as a key enabler for beyond-6G systems. In this work, we present a portable 220-GHz prototype, with a compact size of  $20 \times 20 \times 10 \text{ cm}^3$ , that demonstrates integrated sensing and mobile communications using a unified hardware architecture. The prototype incorporates an HTCC-based phased-array RF frontend with a shared waveform and baseband processing framework, enabling full hardware and waveform reuse between the two functionalities. Experimental results show that a data rate of 64 Gbps can be achieved over a 38 m link with user equipment moving at 2 m/s. Meanwhile, using the same OFDM waveform, millimeter-level sensing accuracy is demonstrated through free-trajectory scanning. This work highlights the system architecture, prototype implementation, and representative experimental demonstrations, and most importantly, provides a tangible device-level realization of THz-ISAC.



**Biography:** Chong Han is currently a tenured Associate Professor with Shanghai Jiao Tong University, Shanghai 200240, China, where he joined as an Assistant Professor in 2016. He is also affiliated with Cooperative Medianet Innovation Center (CMIC), School of Information Science and Electronic Engineering, Shanghai Jiao Tong University. He obtained the Ph.D. and the Master of Science degrees in Electrical and Computer Engineering from Georgia Institute of Technology, USA, in 2012 and 2016, and received the Bachelor of Engineering degree in Electrical Engineering and Telecommunications from The University of New South Wales (UNSW), Australia, in 2011. He is the director of the Terahertz Wireless Communications (TWC) laboratory. He is a co-founder and vice-chair of IEEE ComSoc Special Interest Group (SIG) on Terahertz Communications, since 2021. He is the recipient of 2024 IEEE ComSoc Radio Communications Committee (RCC) Early Achievement Award, 2024 Bessel Research Award from Alexander von Humboldt Foundation in Germany, 2023 IEEE ComSoc Asia-Pacific Outstanding Young Researcher Award, among others. He is a (guest) editor with IEEE Trans. Wireless Communications, IEEE JSAC, etc.

# Photoinduced picosecond-scale radial current for generating and converting spin textures

Pierre Vallobra, Xiaoqiang Zhang, Yong Xu, Xiaoyang Lin, Weisheng Zhao

State Key Laboratory of Spintronics, Hangzhou International Innovation Institute, Beihang University

**Abstract:** Magnetic skyrmions are topologically protected spin textures characterized by their whirling structure, high stability, and potential for next-generation magnetic devices. However, their practical implementation has been hindered by the absence of methods for ultrafast and energy-efficient skyrmion writing and erasure. We demonstrate the generation of a picosecond-scale photoinduced radial current that produces an azimuthally polarized spin-orbit torque in a heavy-metal/ferromagnet heterostructure and finally generates skyrmionic topological spin textures. To achieve this, we propose a novel device architecture based on a cylindrical low-temperature-grown GaAs (LT-GaAs) photoconductive layer excited by a femtosecond laser. Micromagnetic simulations reveal that a focused 50-fs laser pulse under a radial bias voltage generates a picosecond radial photocurrent in the LT-GaAs, which in turn generates an azimuthally polarized SOT (Spin Orbit Torque) in the HM/FM bilayer. This SOT is characterized by a radial polarization vector that triggers the creation of skyrmionic quasiparticles. This unique torque geometry enables the ultrafast (<50 ps) generation of all four quasiparticle types and facilitates controlled transitions between their topological states.

# Terahertz Time-Resolved Nonlinear Optics of Discrete Media: From Gas and Liquid to the Surface

Alexander Shkurinov

Department of Physics, Lomonosov Moscow State University

**Abstract:** We present theoretical modeling of nonlinear optical processes together with experimental results on the generation and interaction of THz radiation with discrete nanocomposite media. The polarization dependence of the THz radiation intensity in nanodispersed media demonstrates sensitivity to the characteristic subwavelength scale of the medium. We investigate the interaction of THz radiation with discrete dielectric and magnetoelectric media in both gas and liquid phases. In addition, we consider nanoscale discrete media located near dielectric surfaces.

Such media are usually described electro-dynamically within the linear approximation using the Maxwell–Garnett (MG) effective medium model. In this work, we discuss the application of a nonlinear optical extension of the effective medium model to the analysis of nonlinear effects in discrete media, including the use of pump–probe techniques.



**Biography:** Alexander P. Shkurinov is a Professor at the Department of Physics, Lomonosov Moscow State University and a Member of the Russian Academy of Sciences. He earned his BS, MS, and PhD degrees in Physics from Lomonosov Moscow State University and completed his Doctor of Sciences at the General Physics Institute of the Russian Academy of Sciences. Professor Shkurinov’s research focuses on laser physics, terahertz science and technology, and advanced optical systems. He has authored or co-authored over 350 peer-reviewed scientific

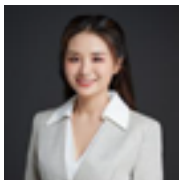
publications in leading international journals and serves on the editorial boards of several scientific publications, including IEEE Transactions on Terahertz Science and Technology. He has held leadership positions in academia and research institutions, including Director of the Institute of Laser and Information Technologies of the Russian Academy of Sciences (2017–2024). His contributions have been recognized with national honors, including the Medal «For Services to the Fatherland» and distinguished scientific awards in optics and photonics. Currently, Professor Shkurinov continues his scientific and educational work at Moscow State University and plays an active role in multiple councils and committees of the Russian Academy of Sciences, supporting the development of nanotechnology, information technology, and interdisciplinary physical sciences.

# Terahertz modulation devices based on topological photonic crystals for communication applications

Yaxin Zhang

University of Electronic Science and Technology of China

**Abstract:** Topological edge states, supported by photonic topological insulators, enable robust wave transport with suppressed backscattering and low bend loss. Among them, valley photonic crystals (VPCs) are especially attractive because they realize chip-scale topological guiding without magnetic bias, inspiring dynamic devices such as cavities, lasers, and phased arrays. However, most reported tuning approaches rely on bulky or hard-to-integrate mechanisms (e.g., optical pumping, thermo-optics, or MEMS), limiting practical on-chip terahertz (THz) systems. Here we report two complementary VPC-enabled THz components. First, we demonstrate an ultrafast on-chip amplitude modulator based on dispersion engineering of a topological boundary mode using voltage-controlled Schottky diodes. Switching the diode state induces a pronounced spectral contraction of the edge dispersion and opens a new stopband, enabling near-perfect intensity gating with a measured on/off ratio of 40 dB. Back-to-back link tests validate high-speed operation up to 20 GHz modulation. Second, we experimentally demonstrate a reconfigurable silicon VPC integrated antenna combining a VPC waveguide, resonant units, and a Luneburg-lens-inspired gradient-index radiator. Optical pumping reconfigures multimode transport and enhances modulation depth, while the graded permittivity aperture delivers high gain and controlled beamwidth. These results provide a compact, system-oriented path toward reconfigurable THz front ends for on-chip links and 6G high frequency terminals.



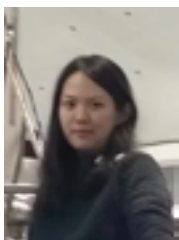
**Biography:** Dr. Lan Wang is an Associate Professor at the School of Physics, University of Electronic Science and Technology of China. Her research is dedicated to overcoming critical bottlenecks in terahertz modulators for communication systems. Her primary research interests focus on THz on-chip tunable devices and their applications in communications, as well as THz topological photonics. She has demonstrated digitally driven high-speed amplitude modulators, high-precision phase modulators, and time-encoded meta-chips, providing new technical pathways for advancing THz RF devices and system-level integration. Her work has been published in *Nature Photonics*, *Science Advances*, *Light: Science & Applications*, and other journals. She has led projects funded by the National Natural Science Foundation of China, was selected for the CAST Young Talent Support Program, and received the Second Prize of the Natural Science Award from the Chinese Institute of Electronics.

# Investigation of Modulation Mechanism in Advanced Polar Crystal Modulators

Yifei Fang

Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

**Abstract:** The coherent control of phonon polaritons (PhPs) in holds transformative potential for nonlinear photonics. We demonstrate terahertz-driven excitation of low-frequency PhPs in zinc oxide (ZnO) crystals, with their nonlinear dynamics resolved via time-resolved second harmonic generation (SHG) spectroscopy. By achieving phase matching via nine sequential reflections within a millimeter-scale crystal, we observe sustained SHG oscillations with 3–4 THz modulation frequencies, achieving optimal extinction ratios of ~18 dB that persist for 90 picoseconds—a temporal span directly governed by polariton propagation dynamics. This work establishes a dual-functionality platform enabling spectral-temporal resolved mapping of quasiparticle interaction dynamics while simultaneously advancing polariton-engineered nonlinear optical modulators through symmetry-broken frequency conversion architectures.



**Biography:** State Key Laboratory of High Field Laser Physics and CAS Center for Excellence in Ultra-intense Laser Science, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. Research focuses on interactions between intense terahertz (THz) fields and solids and the resulting nonequilibrium dynamics. Current efforts emphasize selective strong-field THz driving of lattice and electronic degrees of freedom, coherent generation, propagation, and control of elementary excitations such as phonons and phonon polaritons, and the development of time-

frequency-resolved characterization based on ultrafast nonlinear spectroscopy, linking fundamental mechanisms with device concepts.

# Dielectric engineering in polymer composites for low-loss sub-terahertz fiber

Qiwu Shi

Sichuan University

**Abstract:** Sub-terahertz wired transmission is fundamental for the next generation of high-speed communications. Nevertheless, the existing sub-terahertz fibers have limitations in terms of transmission loss, constraint capacity, and device size. Consequently, the exploration of high-performance materials for sub-terahertz fiber has emerged as a significant challenge. Here, we propose a solution for engineering the dielectric characteristics of polymer composites to achieve a high dielectric constant ( $D_k$ ) and a low loss tangent ( $D_f$ ) simultaneously. In turn, the flexible sub-terahertz fiber with high signal constraint capability and low transmission loss was designed and experimentally demonstrated. This study would provide a foundation for the advancement of the sub-terahertz wired transmission system.



**Biography:** Prof. Qiwu Shi works at the College of Materials Science and Engineering, Sichuan University. He obtained his Ph.D. degree from Sichuan University in 2013. Subsequently, he had a post-doctoral position at Sichuan University from 2013 to 2015 and served as a visiting scholar at UC Berkeley from 2019 to 2020. His research focuses on functional materials and devices for wired sub-THz transmission. He has been awarded 5 NSFC grants and has published more than 60 papers in interdisciplinary journals, such as Nature Communications, Trends in Biotechnology, Laser & Photonics Reviews, ACS Applied Materials & Interfaces, etc.

# Dynamical modeling of terahertz Smith–Purcell radiation via the current-transient approach in hexagonal metasurfaces

Pengtao Wang<sup>1,2</sup>, Suguo Chen<sup>1,2</sup>

<sup>1</sup>Department of Applied Physics, Xi'an University of Technology,

<sup>2</sup>Key Laboratory of Ultrafast Photoelectric and Terahertz Science in Shaanxi, Xi'an University of Technology

**Abstract:** Terahertz (THz) technologies show great application potential in radar, remote sensing, homeland security, medical imaging and high-speed communications, yet their practical implementation is limited by the lack of high-performance THz sources. Smith–Purcell radiation-based THz sources have drawn extensive attention for their frequency tunability and wide-angle radiation in the electron-skimming plane, while beam width modulation is essential for radar stealth applications. Conventional one-dimensional grating-based Smith–Purcell THz sources fail to adjust the beam width in the plane perpendicular to the electron-skimming plane. To solve this problem, we design a two-dimensional hexagonally patterned grating for Smith–Purcell THz generation, which realizes dynamic beam width adjustment in the elevation plane and is optimized for grazing-incidence excitation by an electron beam with a velocity of  $0.6c$ . Comparative results show that the hexagonal structure achieves a narrower beam width than conventional, square and circular grating structures. In addition, we propose a current transient model to clarify the Smith–Purcell radiation mechanism in two-dimensional periodic structures, which provides a theoretical basis for understanding the radiation properties of such sources and accurate prediction guidance for the design of advanced device structures.

# Enhanced terahertz generation from air plasma via three-color mid- and near-infrared pumping

Vasily A. Kostin<sup>1,2</sup>

<sup>1</sup>Gaponov-Grekhov Institute of Applied Physics of the Russian Academy of Sciences, Russia

<sup>2</sup>Lobachevsky State University of Nizhny Novgorod, Russia

**Abstract:** A theoretical and experimental study is presented on the generation of terahertz (THz) radiation from air plasma driven by three-color femtosecond fields composed of the three lowest harmonics of a fundamental pulse in the near-infrared (1.7  $\mu\text{m}$  and 0.8  $\mu\text{m}$ ) and mid-infrared (3.9  $\mu\text{m}$ ) ranges [Opt. Express 33, 22610 (2025)]. An inline optical setup with relative phase control enabled demonstration of strong THz pulse energy enhancement upon addition of the third harmonic (up to six-fold compared to conventional two-color excitation) depending on the fundamental pulse energy and wavelength. For 3.9  $\mu\text{m}$  driving pulses, the THz pulse energy reaches 39.4  $\mu\text{J}$ , with a conversion efficiency of approximately 1%. To investigate the underlying mechanisms, we employ a plasma current model to simulate THz generation with three-color fields, successfully reproducing the observed yield enhancement and its intensity dependence. Our analysis reveals two distinct enhancement modes: The first mode features high enhancement factors ( $\geq 3$ ) that decrease rapidly with pulse intensity (observed with 1.7 and 3.9  $\mu\text{m}$  fundamental pumps); here, the optimal phases correspond to an asymmetric three-color waveform. The second mode displays lower enhancement factors with weak intensity dependence (as seen with a 0.8  $\mu\text{m}$  fundamental pump); here, the optimal phase arrangement corresponds to a symmetric (sawtooth-like) field, as proposed previously. These observations suggest that the THz enhancement arises from two additional ionization wave mixing channels enabled by the third harmonic. Our method offers a straightforward and robust approach to enhancing THz pulse energy and conversion efficiency in air plasma pumped with femtosecond laser pulses.

## Low-frequency terahertz spectral features for apparent amylose content assessment in rice and corn starches

Han Guo<sup>1</sup>, Lin Wang<sup>2</sup>, Sihui Li<sup>3</sup>, Jungbin Kim<sup>1</sup>, Shiraga Keiichiro<sup>1</sup>, Naoshi Kondo<sup>1</sup>

<sup>1</sup>Graduate School of Agriculture, Kyoto University, Japan

<sup>2</sup>Graduate School of Horticulture, Chiba University, Japan

<sup>3</sup>Department of Material Chemistry, Graduate School of Engineering, Kyoto University, Japan

**Abstract:** Apparent amylose content (AAC) critically determines the functional and nutritional properties of starch, yet its routine determination still relies on destructive and time-consuming wet-chemical assays. In this study, terahertz (THz) spectroscopy is explored as a rapid and nondestructive approach for AAC assessment in rice and corn starches by exploiting its sensitivity to low-frequency collective molecular vibrations.

THz spectra were analyzed in the frequency range associated with starch molecular organization, and calibration models were constructed using controlled mixtures of waxy starches and isolated amylose fractions, with AAC values determined by the iodine colorimetric method. Among multiple spectral features examined, absorption peaks near 9.0 and 10.5 THz exhibited strong and consistent correlations with AAC while showing limited sensitivity to crystallinity-related variations. Validation using native starch samples demonstrated that the 9.0 THz feature provides the most robust predictive performance.

The observed AAC sensitivity is attributed to collective vibrational modes related to starch chain architecture, particularly molecular features associated with branching structure and chain length distribution. These results highlight the capability of THz spectroscopy to probe structurally meaningful signatures in complex biopolymer systems and establish its potential as a quantitative tool for starch characterization. This work also illustrates the broader applicability of THz techniques in food and biological materials where molecular organization plays a critical role.

# Phonon-Driven Spin Dynamics in Rare-Earth Orthoferrites Across Spin Reorientation Temperatures

Madeleine Hales<sup>1</sup>, Oleksandr Kovalenko<sup>1</sup>, Alexey Kimmel<sup>2</sup>, Dymtro Afanasiev<sup>2</sup>, Rostislav Mikhaylovskiy<sup>1</sup>

<sup>1</sup>Department of Physics, Lancaster University, United Kingdom

<sup>2</sup>Institute for Molecules and Materials, Radboud University, Nijmegen, Netherlands

**Abstract:** The pursuit of energy efficient alternatives to conventional electronic devices has become a central focus of scientific research. One promising approach employs spin waves (magnons) as a means of information transfer to avoid Joule-heating. Additionally, all-optical magnetization switching holds the potential to enhance magnetic data-storage technology, offering high speed operation and improved efficiency.

Spin dynamics in rare-earth orthoferrites have been extensively studied due to their canted antiferromagnetic structure, strong spin-lattice coupling and very high magneto-optics. Also of interest is a phase transition during which the antiferromagnetic vector undergoes a spin reorientation. For thulium and erbium orthoferrites,  $\text{TmFeO}_3$  and  $\text{ErFeO}_3$ , this occurs from about 80K to 90K. Recently, a phononic pathway to excite spin dynamics has been discovered in rare-earth orthoferrites, while phonon-driven switching was observed in an iron garnet.

To study phonon-driven responses in a single crystal, 60  $\mu\text{m}$ -thick sample of  $\text{TmFeO}_3$  we performed a time-resolved pump-probe spectroscopy experiment. Mid-infrared pump pulses were tuned at resonance with optical phonons, distorting the crystal lattice which induced a torque on the spins, thereby driving them into precessional motion. The spin dynamics were measured by polarization rotation of an 800 nm probe as a function of time-delay with respect to the pump pulse.

Polarization rotation signals reveal the quasi-ferromagnetic magnon mode over the spin reorientation temperature region. A complementary experiment performed on the  $\text{ErFeO}_3$  sample provided similar evidence for phonon-driven excitation by an observed increase in the magnitude of magnon oscillations approaching resonant excitation of infrared phonons. While the frequency dependence in  $\text{TmFeO}_3$  agrees with prior experimental results which used another non-thermal excitation, the pump polarization dependence differs from expectation. Further investigation into the interesting behavior of phonon-driven spin dynamics will yield a better understanding of how the mechanism differs between rare-earth orthoferrites.

## Switching of an antiferromagnet controlled by spin canting in a laser-induced hidden state

Alexandra KALASHNIKOVA

Ioffe Institute, St. Petersburg, Russia

**Abstract:** Kinetics of phase transitions triggered by femtosecond laser pulses plays a key role in many areas of physics and chemistry. For 1st order phase transitions, the transition between two equilibrium states may include hidden phases persisting on time scales from subpicoseconds to milliseconds. It is challenging to identify them and establish a connection with the properties of the final phase. Antiferromagnets are of particular interest in this context, where switching the magnetic state through a spin-reorientation transition is considered as the basis for promising THz memory technologies. We experimentally investigated laser-induced 1<sup>st</sup> order spin-reorientation transition in a canted antiferromagnet Fe<sub>3</sub>BO<sub>6</sub>. A crucial role in the transition is played by a net magnetization decrease during the first picoseconds, achieved through a laser-induced change in the Dzyaloshinsky-Moriya interaction, leading to the appearance of a hidden phase. After this phase occurs, laser-induced heating activates a precessional 90-degree spin switching. The final spin configuration, consisting of two coexisting phases, is determined by the combined effect of the altered spin canting and heating. Our study demonstrates the possibility of dynamically control phase transition by transferring the material to a laser-controlled hidden phase and shows a spin switching in a canted antiferromagnet above room temperature.



**Biography:** Alexandra Kalashnikova received her PhD degree in 2009 from Radboud University Nijmegen, The Netherlands. Since 2010 she works at the leading Russian research institute – Ioffe Institute in St. Petersburg, where she is currently a head of the Ferroics Physics Laboratory. She is a lecturer at ITMO University where she also co-supervises a Master program “Photonics and Spintronics.” Main research interests of Dr. Kalashnikova lie in the field of experimental studies of ultrafast spin, lattice, and electronic kinetics and includes laser-induced magnetization switching,

opto-magnonics, nonequilibrium phase transitions. Among the main scientific results are the demonstration of an ultrafast inverse Cotton-Mouton effect, novel nonequilibrium path for all-optical magnetization switching, spin switching through spin-reorientation phase transition in various iron oxides, optical driving and controlling magnetostatic waves and zone-edge magnons. She is a co-author of 83 papers, which include publications in Physical Review Letters, Nature Physics, Nature Communications, Science Advances, Advanced Materials, Physics Reports, with a total citation of about 3000. H-index is 24.

# Ultrafast magnetization switching induced by femtosecond laser pulse

Wei Zhang

State Key Laboratory of Spintronics, Hangzhou International Innovation Institute, Beihang University, Hangzhou

**Abstract:** Magnetic memory based on traditional electrical methods has encountered a bottleneck where high storage speed and low power consumption cannot be simultaneously achieved. On the one hand, when the electrical pulse width is less than 1 ns, the power required for reading and writing processes in magnetic tunnel junctions and spin valve devices increases drastically; on the other hand, due to the limitations of the 'precessional' switching mechanism, the time for magnetic reversal is difficult to break through the hundred-picosecond scale. Therefore, finding a new magnetic switching method that can achieve faster magnetic reversal speeds while also maintaining lower power consumption has become one of the urgent tasks in the field of spintronics.

Compared to traditional spin manipulation methods, such as magnetic and electric fields, light offers a faster triggering speed. This report will introduce the development and current research status of spintronics, particularly the interaction between light and magnetic materials. In particular, it will focus on all-optical induced magnetic switching. For example, in CoTb/Cu/CoPt multilayer spin valve structures, by controlling material thickness, composition, interfaces, and other factors, we have achieved ultrafast spin-current-induced deterministic all-optical magnetization reversal. This expands the range of material systems capable of all-optical magnetic switching and lays the foundation for the development of future ultrafast spintronic devices.



**Biography:** Zhang Wei is an associate professor at the State Key Laboratory of Spintronics, Beihang University (Hangzhou). He obtained his Ph.D. in 2018 from the State Key Laboratory of Magnetism at the Institute of Physics, Chinese Academy of Sciences. From 2018 to 2023, he conducted postdoctoral research at the Nano-Spin Electronics group at the University of Lorraine in France and at Beihang University. His research primarily focuses on ultrafast spin dynamics induced by femtosecond pulsed lasers, including optically induced magnetic damping, magnetic switching, and magnetic phase transitions. He has published over 30 SCI journal papers, including 15 papers as first or corresponding author in journals such as *Adv. Mater.*, *Adv. Funct. Mater.*, and *Phys. Rev. B*. He has received the Second Prize of the Sichuan Provincial Science and Technology Progress Award and has led several projects, including a key project of the Zhejiang Provincial Natural Science Foundation, the National Natural Science Foundation of China for Young Scientists, the Beijing Natural Science Foundation general project, and a postdoctoral general project.

## Ultrafast magnetization switching

Pierre Vallobra

State Key Laboratory of Spintronics, Hangzhou International Innovation Institute, Beihang University, Hangzhou

**Abstract:** An important parameter of functioning magnetic memories is the operation frequency, otherwise called magnetization switching speed. In this talk, I will exhibit through experimental and simulation methods results indicating magnetization switching between saturated states and between metastable states using femtosecond and picosecond laser pulses. Such laser pulses can be efficiently used to manipulate the magnetization in ferromagnetic, ferrimagnetic, antiferromagnetic states. Picosecond transitions between both saturated states and skyrmionic states will be demonstrated in those different materials. Interestingly, the same laser excitation can trigger different physical phenomenon depending on the magnetic material itself.



**Biography:** Pierre Vallobra obtained his Ph.D in Physics in 2019 from Lorraine University, France. He joined the Hefei innovation laboratory of Beihang University the same year and obtained the position of associate professor in the Hangzhou International Innovation Institute of Beihang University in 2024. His research interest encompasses several aspects of spintronics such as femtomagnetism, skyrmions, domain wall motion, exchange bias or skyrmions. His research methods include the use of various experimental and simulation tools.

# Ultrafast Terahertz Magnetism in Ferrimagnetic Iron Garnets

Evgeny A. Mashkovich

Institute of Physics II, University of Cologne, Germany

**Abstract:** Ferrimagnetic iron garnets combine terahertz (THz)-scale eigenfrequencies with feasible ground-state control, making them ideal for ultrafast magnonics. Using THz-pump/infrared-probe spectroscopy, we address several key aspects of their magnetization dynamics. We demonstrate resonant excitation of exchange modes near magnetic compensation points, regardless of whether compensation occurs between iron sublattices or involves rare-earth ions. High-intensity THz pulses further enable nonlinear excitation of quasi-ferromagnetic modes via the inverse Cotton–Mouton effect. Furthermore, the broad temperature tunability of the exchange frequency—spanning an entire octave—is utilized to realize a recurrent magnon-pumping effect. Finally, we employ a 10 T superconducting magnet to investigate the dynamics of the noncollinear (canted) magnetic phase. It is shown that the dynamics are highly sensitive to the orientation of the net magnetic moment, the external field magnitude, and the temperature.



**Biography:** PD Dr. Evgeny A. Mashkovich is a Senior Researcher at the University of Cologne (Institute of Physics II), where he leads the Terahertz Sub-group. His research focuses on ultrafast magnetism, superconductivity, and terahertz photonics. In particular, his work utilizes 2D terahertz spectroscopy to reveal nonlinear coupling mechanisms in ultrafast magnetic dynamics.

He earned his PhD in 2013 from the University of Nizhny Novgorod, Russia. From 2017 to 2021, he worked as a postdoctoral researcher at Radboud University, The Netherlands. He joined the University of Cologne in 2021, where he established his research program and completed his Habilitation in 2025. His work is currently supported by the German Research Foundation (DFG).

## Ultrafast dynamics of spin polarons in europium chalcogenides

Pavel A. Usachev

Ioffe Institute, St. Petersburg, Russia

**Abstract:** We report on an experimental study of ultrafast dynamics of photo-induced spin polarons (SP) in europium chalcogenides. Detailed analysis uncovers complex, multistage relaxation of photo-induced magnetization from picoseconds to microseconds, involving several distinct metastable states. The theory of SP, developed for the entire family of europium chalcogenides  $\text{EuX}$  ( $X=\text{O}, \text{S}, \text{Se}, \text{Te}$ ), successfully predicts key features like the temperature-dependent magnetic moment across these compounds. However, its application to the case of  $\text{EuO}$  highlights some specific limitations of the theory. We compare the experimental data with the predictions of the effective mean-field model and show that for  $\text{EuO}$  – the compound with the strongest f-d exchange – the theory systematically underestimates the magnitude of the magnetic moment and cannot adequately describe the full range of dynamic behavior. This fundamental discrepancy points to the specific role of the f-d exchange interaction and, possibly, the excitonic nature of the SP in  $\text{EuX}$ , with dynamics unfolding across a manifold of discrete levels. Taken together, the results establish that a deeper understanding of the  $\text{EuX}$  family is the key prerequisite for transforming fundamental insights into applied breakthroughs.



**Biography:** Dr. Pavel Usachev from the Ioffe Institute, St. Petersburg, Russia is a leading researcher in experimental solid-state physics. His work focuses on ultrafast laser interaction with matters on timescales down to femtoseconds. He earned his Ph.D from the Ioffe Institute in St. Petersburg in 2001. At the Royal Institute of Technology (KTH, Stockholm, Sweden), his postdoctoral work delivered key demonstrations of single-photon nonlocality via experimental Bell tests. At Radboud University (Nijmegen, The Netherlands), Dr. Usachev demonstrated the first non-thermal, ultrafast optical control of magnetization via the inverse Faraday effect. This discovery was published in a groundbreaking Nature paper (2005) and has since been cited over 800 times. He further advanced the field with work on inertia-driven spin switching in antiferromagnets. Dr. Usachev has continued this research with collaborative engagements with the University of São Paulo (Brazil) and Dortmund University (Germany). His recent studies explore the complex dynamics of photo-induced magnetic polarons and ultrafast light switching of ferromagnetism in intrinsic magnetic semiconductors. In his talk, he will synthesize a decade of research, presenting a comprehensive experimental picture of ultrafast spin dynamics in europium chalcogenides, and discussing the critical interplay between theory and experiment in this transformative field.

# Ultrafast Light Application in Neuroimaging and Modulation

Wang Xi

School of Brain Science and Brain Medicine, Zhejiang University

**Abstract:** For neuroimage, we developed third-harmonic generation (THG) imaging as a robust platform for long-term cerebellar observation. By employing low-power second near infrared (NIR-II) 1300 nm excitation, we achieved real-time in vivo THG imaging of mouse cerebellar gray matter, revealing its three-layer structure and histological morphology. Then we combined THG signal with fluorescence signal to identify the unique structure signals from erythrocytes and myelin sheath in different layers. Furthermore, we successfully longitudinal quantitatively monitored pathological progression in cuprizone-induced demyelination over 9 weeks, and tracked post-ischemic recovery dynamics in photo-thrombosis models. We also employ a 1070 nm ultrafast laser with spiral scan for producing RB-induced microvessel occlusion, which is described as precision ultrafast laser-induced photothrombosis (PLP). Combine with two-photon microscopy imaging, this PLP displays highly precise and fast occlusion induction of various vessel types, sizes, and depths, which enhances the precision and power of the photothrombosis protocol.



**Biography:** Wang Xi, Associate professor in school of brain Science and Brain Medicine, Zhejiang University. He received his Bachelor's degree from Nanjing University and Doctor's degree from the Institute of Neuroscience, Chinese Academy of Sciences (CAS). His primary research interest lies in investigating the neurovascular coupling mechanism via in vivo imaging of the neural and vascular systems using multiphoton imaging technology. He has also developed a series of imaging technologies with deeper penetration, higher acquisition speed and multimodal integration, which provide novel technical approaches for further research on neurovascular coupling, stroke and other cerebrovascular diseases across models ranging from mice to rhesus monkeys. He has published more than 40 high-impact SCI papers, and presided over or participated in a number of research projects including the National Natural Science Foundation of China, key special projects of the Ministry of Science and Technology, and the Natural Science Foundation of Zhejiang Province.

# Signature of Jahn-Teller-like magnetic instability in $\text{YbFeO}_3$ and dynamical strong coupling of Fe spins and Yb orbitals

Oleksandr Y. Kovalenko<sup>1</sup>, Nikolay R. Vovk<sup>1</sup>, Anhua Wu<sup>2</sup>, Rostislav V. Mikhaylovskiy<sup>1</sup>

<sup>1</sup>Department of Physics, Lancaster University, Bailrigg, Lancaster, United Kingdom

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TBD

**Abstract:** A strong coupling between photons and atoms may lead to light-matter hybridization, the formation of polaritons, quantum entanglement, and phase transitions, offering applications in quantum information science. We show that a magnetically ordered material with rare-earth dopants can mimic the effects of quantum optics. Notably, we demonstrate that antiferromagnetic orthoferrite  $\text{YbFeO}_3$  exhibits ultra-strong coupling between magnons of iron spins, being analogues of photons, and the low-energy doublet states of  $\text{Yb}^{3+}$  ions, which play the role of 2-level atoms. This coupling gives rise to magnetic phase transitions of the Jahn-Teller type.

The magnetization in  $\text{YbFeO}_3$  mainly arises from the spins of the  $\text{Fe}^{3+}$  ions, with the magnetic configuration governed by two competing anisotropy energies: crystalline anisotropy and the Fe-Yb exchange interaction. The crystalline anisotropy energy dominates at high temperatures. However, as the temperature decreases, the exchange interaction increases, leading to a change in dominance at  $\sim 8$  K, followed by a spin-reorientation transition (SRT) of the Jahn-Teller type. The SRT involves rotations of both Fe spins and the Yb orbital moment. These unique properties of  $\text{YbFeO}_3$ , including its energy anti-crossing, make it a promising platform for THz applications.

To reveal the character of Fe-Yb coupling and hybridization, this work employs ultrashort terahertz pulses to resonantly excite the magnetic dynamics in the Fe sublattice and atomic-like transitions in  $\text{Yb}^{3+}$  ions. Using the time-resolved pump-probe technique, the subsequent magnetic dynamics were measured across the SRT.

With a frequency analysis, four well-distinguished modes were identified as: quasi-antiferromagnetic (q-FM), quasi-antiferromagnetic (q-AFM), and two orbital rare-earth modes ( $R_1$ ,  $R_2$ ). The q-FM and  $R_2$  show a strong coupling, which is reflected in the kink-like behavior of q-FM and softening of the  $R_2$  mode.

We believe that our findings represent a major step in understanding quantum effects and dynamical driving of phase transitions in ultrafast magnetism.

## Shine bright like a diamond to generate ultrashort THz pulses

Yudan Su

Zhangjiang Laboratory

**Abstract:** Ultrashort energetic THz pulses have created an exciting new area of research on light interactions with matter. Widely tunable femtosecond THz pulses with peak field strength close to MV/cm can be acquired by optical rectification and difference frequency generation in crystals without inversion symmetry. They had a stable and controllable carrier-envelop phase. However, most materials containing heavy atoms, polyatomic molecules and biomolecules have phonon modes and vibrations in the range of ~5-15 THz. Yet reliable light sources for this important range was a challenge for most laboratories using second order nonlinear process. In this talk a brief review of utilizing resonance Raman excitation process to generate gapless ultrashort THz pulses from diamond, especially in the frequency range of 5 -15 THz, will be given. The talk will include the basic idea, technical challenge and outlook of this new scheme.



**Biography:** Yudan Su obtained his Ph.D. in Physics from Fudan University in 2018. He carried out postdoctoral research under Professor Yuen-Ron Shen at the University of California, Berkeley from 2020 to 2023. He joined Zhangjiang Laboratory in 2023 and was promoted to professor in 2025. He is a recipient of National and Shanghai overseas young talents programs. His research focuses on the development and application of terahertz light sources and nonlinear spectroscopy, covering the development of novel high-field terahertz light sources, terahertz-band and surface nonlinear spectroscopy techniques and their applications. He has published a series of original findings in *Light: Science and Applications*, *Nano Letters*, *JACS*, *Small*, *Ultrafast Science* etc., and holds 5 authorized Chinese invention patents.

## Electro-Optic Frequency Comb based fast and precise LiDAR

Guanhao Wu

Tsinghua University

**Abstract:** Frequency-Modulated Continuous Wave (FMCW) LiDAR is a high-sensitivity 3D ranging technology. The resolution, acquisition rate, and accuracy of FMCW systems are limited by the laser's tuning range, Fourier transform processing, and lack of frequency traceability, respectively. Here, based on the unique advantages of electro-optic frequency combs (EOFCs), such as high sideband power, broad bandwidth, and fast tunable repetition rate, we optimize the FMCW system. This is achieved by using a pair of frequency-shifted EOFCs for swept lasers nonlinearity calibration, employing EOFCs with slightly different repetition frequencies for equivalent large bandwidth, and enabling absolute distance measurement at a gigahertz acquisition rate through an EOFC with high modulation depth.



**Biography:** Guanhao Wu is currently an Associate Professor in the Department of Precision Instrument, Tsinghua University. He received Ph.D degree in optical engineering from Tsinghua University in 2008. He used to be a visiting scholar in National Metrology Institute of Japan (NMIJ) from 2011 to 2012. His research interests include frequency comb, comb-based distance measurement and light detection and ranging (Lidar). In recent years, he has published more than sixty international refereed journal papers, and he is the holder of more than thirty Chinese patents. He won the Special Prize of Chinese Machinery Industry Science and Technology Award in 2020, and won the First Prize of Science and Technology Progress Award of Chinese Society for Measurement in 2021. He is also the winner of Mao Yisheng Beijing youth science and technology award.

# High Power Kilohertz Thin Disk Amplifier with 600mJ Pulse Energy and 600fs Pulse Duration Developed for OPCPA

Huang Zhou

Songshan Lake Materials Laboratory

**Abstract:** In recent years, thin disk lasers have experienced rapid development in the field of ultrafast lasers thanks to their extremely thin laser gain medium, which provide high heat dissipation efficiency. With their outstanding beam quality and ultra-high peak power, they play significant roles in both industrial and scientific research applications such as laser processing, terahertz generation, and high-order harmonic generation. Our team have independently developed two key pumping modules for thin disk laser heads with 32-pass/64-pass configurations and maximum pump powers of 1 kW and 3 kW, respectively. We have also developed large-aperture disk crystal packaging technology. With those key components and disk crystals, we have developed a kHz thin-disk Yb:YAG amplifier system. The broadband seed laser integrating a solid-state oscillator and a spectrum-shaped Yb:CALGO pre-amplifier (>5 nm BW) feeds sequential amplification stages: a thin disk regenerative amplifier and three thin disk multi-pass amplifiers, achieving pulse energy of >600 mJ. Grating compression (1740 l/mm) yields 600-fs pulse length with PW-scale applicability.



**Biography:** Zhou Huang, Associate Researcher, who was graduated from Changchun University of Science and Technology in 2009 with a Bachelor's degree in Science; graduated from Changchun University of Science and Technology in 2011 with a Master's degree in Engineering; graduated from City University of Hong Kong in October 2016 with a Master's degree in Science; graduated from Czech Technical University in Prague in 2023 with a Doctorate in Science. From 2011 to 2014, he served as an Assistant Researcher at the Fujian Institute of Material Structure, Chinese Academy of Sciences. From 2016 to February 2023, he worked at the HiLASE Centre, Institute of Physics, Czech Academy of Sciences, as a Senior R&D Engineer. Since March 2023, he joined in Songshan Lake Materials Laboratory, primarily engaged in research on high-power, high-energy ultrafast thin disk lasers and the key components.

## Ultrafast Control of Valley Polarization

LingJie Lv

JiaXing University

**Abstract:** Valleytronic devices based on all-optical ultrafast control are expected to increase the speed of information processing to petahertz and serve a new generation of quantum computers. However, the current difficulty in realizing this vision is the lack of a non-damaging means suitable for ultrafast lasers. We propose a robust scheme to control the valley polarization of monolayer materials, achieved through the quantum interference between 1- and 2-photon transition pathways. The scheme reveals that conventional circularly polarized light is unnecessary for resonantly induced valley polarization and, instead, only a parallel-polarized 2-color field is required. The interference dynamics enables the switch of valley to be manipulated within few femtoseconds without the necessity for extremely strong or single-cycle pulses. The disclosure of this interference scheme enables repetitive operations in valley devices for signal processing at petahertz clock rates without causing material damage. It sheds light on the practical manufacture of high-speed valleytronic devices.

# Ultrafast laser high-aspect-ratio extreme nanostructuring of optical materials

Guanghua Cheng<sup>1</sup>, Guodong Zhang<sup>1</sup>, Razvan Stoian<sup>2</sup>

<sup>1</sup>School of Artificial Intelligence, Optics and Electronics, Northwestern Polytechnical University, China

<sup>2</sup>Laboratoire Hubert Curien, UMR 5516 CNRS, Université Jean Monnet, France

**Abstract:** A capacity to substantially exceed optical limits and to structure below 100 nm is essential to advance ultrafast processing into the field of metamaterials. Using ultrafast nondiffractive Bessel beams, we demonstrate unprecedented feature sizes down to 7 nm, result from self-generated near-field light components initiated by cavities induced by far-field radiation in a back-surface illumination geometry. This sustains the generation of more confined near-field evanescent components along the laser scan with a nanometer pitch, perpendicular to the incident field direction, driving a super-resolved laser structuring process via local thermal ablation. The near-field pattern is replicated with high robustness, advancing toward a 10-nm nanoscribing tool with a millimeter-sized photolithography. The nondiffractive irradiation develops evanescent fields over the focusing length, resulting in high-aspect-ratio trenching with a nanometer section and a micrometer depth. A predictive multi-pulse simulation method validates the far-field-induced near-field electromagnetic scenario of void nanochannel growth and replication, indicating the processing range and resolution on the surface and in the depth. We conducted in situ reconstruction of thermodynamic states over the entire matter relaxation path in bulk fused silica irradiated by ultrafast nondiffractive laser beams using time-resolved optical phase microscopy. The dispersion and time design of the optical beam to picosecond durations increases the spatial confinement and triggers an extreme nanostructuring process based on nanocavitation. This allows for structural and morphological nanoscale material features under 3D confinement that can engineer optical materials.

# Novel barium sulfides and selenides for efficient narrowband terahertz generation

D. Z. Suleimanova<sup>1</sup>, E. A. Migal<sup>1</sup>, D.V. Badikov<sup>2</sup>, F. V. Potemkin<sup>1</sup>

<sup>1</sup>Faculty of Physics M.V. Lomonosov Moscow State University, Russia

<sup>2</sup>High Technologies Laboratory, Kuban State University, Russia

**Abstract:** Narrowband terahertz (THz) radiation sources are in great demand for a variety of applications ranging from high-resolution spectroscopy and imaging to resonant control over the functional properties in quantum materials. However, development of the compact and robust sources of THz pulses, characterized by bandwidths of the order of 0.1 THz, remains quite challenging and demands for the search of novel materials. Here, we report on our recent advances in generation of quite strong (of up to 0.1 MV/cm) narrowband THz pulses in 1.9 – 3.5 THz frequency range in a table-top scheme using the novel barium-based chalcogenides ( $\text{BaGa}_4\text{Se}_7$ ,  $\text{BaGa}_2\text{GeSe}_6$  and  $\text{BaGa}_2\text{GeS}_6$ ) excited by high-power femtosecond Cr:forsterite laser. In particular, the generation of THz radiation at the frequencies of 1.9 THz, 2.05 THz, 2.55 THz, 2.83 THz, 2.91 THz and 3.36 THz is reported. The relative bandwidths of generated THz pulses reached the values of 2 – 4%. The sufficient optical-to-THz conversion efficiency values of  $0.3 \times 10^{-5}$  –  $0.8 \times 10^{-5}$  are maintained within the entire frequency tuning range. To clarify the main mechanism, responsible for generation of intrinsically narrowband THz radiation, comprehensive investigation of the properties of these phonon-rich materials and generated THz radiation, involving the Raman scattering, infrared and THz time-domain spectroscopy, was performed. As a result, it was shown that narrowband THz radiation generation is governed by optical rectification process, that occur in the narrow frequency regions of perfect phase matching between THz and optical pulses, determined by strong dispersion near the phonon resonances within the limited bandwidth of the 100-fs pump pulse. Thus, the frequency range of generated THz radiation can be further expanded up to 6 THz by using the broad-bandwidth pump pulses. Moreover, the efficient control of the THz field polarization state was also demonstrated, which is important for further applications of the developed source.

# Rapidity-based relativistic modeling of electron dynamics in ultrafast terahertz photonic fields

Nikolai Akintsov

Research Center for Intelligent Information Technology, Nantong University

**Abstract:** Ultrafast terahertz (THz) photonics enables the control of electron motion on sub-picosecond time scales, where relativistic effects can influence charge transport and radiation emission. We present a theoretical model for electron dynamics in intense THz fields based on a hyperbolic-function formalism of special relativity with coupled parameters. In this approach, Lorentz spacetime coordinates are redefined in terms of rapidity-dependent variables, allowing for a compact and invariant description of charge motion in strong, time-varying electromagnetic fields. By applying the rapidity-based Lorentz framework to ultrafast THz pulses interacting with nanoscale materials, we derive analytical expressions for the Hamiltonian, kinetic energy, and frequency modulation of relativistic electrons. The model predicts non-linear acceleration regimes and field-induced rapidity oscillations that correspond to experimentally observable THz harmonics and spectral sidebands. The rapidity-dependent decomposition also provides an intuitive tool for analyzing the transition between classical and relativistic motion in femtosecond-to-picosecond regimes. This work connects relativistic electrodynamics with THz photonics, offering a novel theoretical perspective for interpreting and designing ultrafast experiments involving strong-field excitation, relativistic plasmonics, and THz-driven electron nanobunching.

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ISUPTW2026-0122-6	<p><b>Achieving Nearly Diffraction-Limited Focal Spots in the Lithium Niobate Terahertz Source</b> Deyin Kong<sup>1,2,3</sup>, Xiaojun Wu<sup>1,2,3</sup> 1. Hangzhou International Innovation Institute, Beihang University, Hangzhou, 2. School of Electronic and Information Engineering, Beihang University, Beijing, 3. Zhangjiang Laboratory, 100 Haike Road, Shanghai</p>

ISUPTW2026-0122-7	<p><b>Shift Current-Based Terahertz Emission Properties of <math>\gamma</math>-InSe</b> Mingcong Dai<sup>1,2</sup>, Xiaojun Wu<sup>1,2*</sup></p> <p>1. Hangzhou International Innovation Institute, Beihang University, 2. School of Electronic and Information Engineering, Beihang University</p>
ISUPTW2026-0122-8	<p><b>High-Intensity Spintronic Terahertz Emitters for Large-Area Imaging</b> Zehao Yang<sup>1,2</sup>, Xiaojun Wu<sup>1,2*</sup></p> <p>1. School of Electronic and Information Engineering, Beihang University, 2. Hangzhou International Innovation Institute, Beihang University</p>
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ISUPTW2026-0130-4	<p><b>THz Spatial-Temporal Diagnostic for THz Gun Accelerator</b> Junhao Zhang<sup>1,2*</sup>, Kroh Tobias<sup>1</sup>, Reza Bazrafshan<sup>1</sup>, Mikhail Pergament<sup>1</sup>, Nicholas Matlis<sup>1</sup>, Franz Kärtner<sup>1, 3, 4</sup></p> <p>1. Deutsches Elektronen-Synchrotron, 2. Hamburg University, 3. University of Hamburg, 4. The Hamburg Center for Ultrafast Imaging</p>
ISUPTW2026-0130-6	<p><b>Active MEMS RF Probe for sub-THz Characterization via Flip-Chip Heterogeneous Integration</b> Li Zefeng, Ma Dinghao, Zhang Boyu<sup>*</sup>, Bai Tianhao Beihang University</p>
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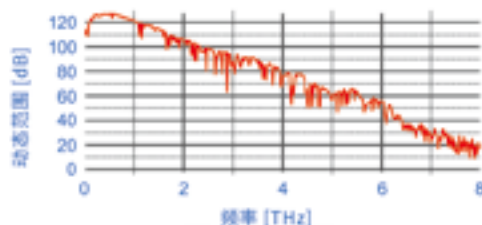


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自动随形太赫兹无损检测系统

应用领域: 非极性材料的无损检测

航空航天、军工、文物保护等材料的无损检测



自动随形太赫兹无损检测系统可以对复杂曲面的物体成像,例如航天隔热层、飞机、发动机涂层、天线罩、整流罩、管材等,利用六轴机械臂 360°均可调的特点,将太赫兹探头安装在机械臂执行末端,通过离线编程、在线示教等方式实现随形无损检测。

QT-PTS1000

便携式太赫兹测厚系统

整机系统结构紧凑、便携、移动灵活、单人操作、简单方便;手持测厚探头定位定焦快捷、显示信息丰富、一键触发采集、一键保存;便携式主机高度集成、尺寸小、低功耗、续航能力强、延迟范围广、光纤长度长;上位机软件功能丰富,信息显示、参数设置、后台运行等一应俱全;算法实现方式多变、信号模型及寻峰处理方案成熟。



应用领域: 适用于非金属涂层测厚

汽车制造领域

航空航天领域





# MenloSystems

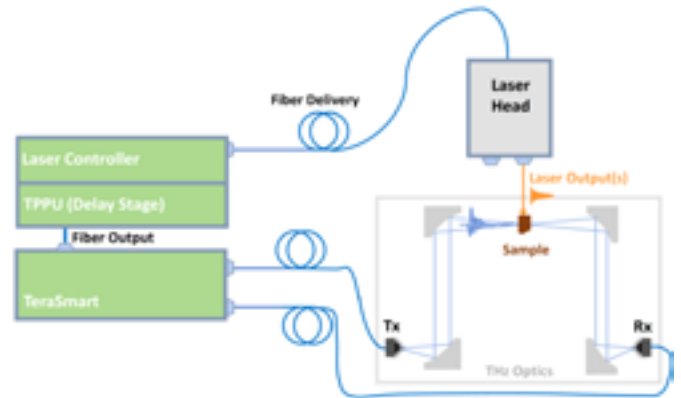
## 太赫兹高功率泵浦-探测解决方案

### 太赫兹参数

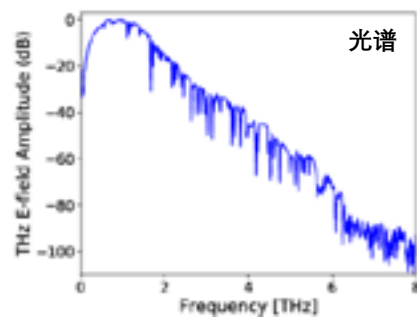
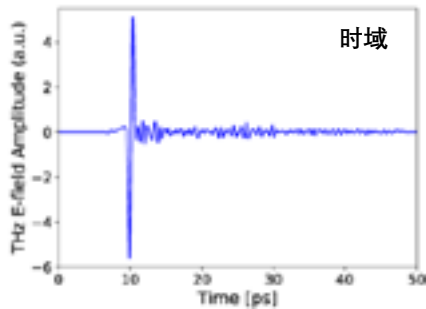
- 光谱范围: >6 THz
- 动态范围: >100 dB
- 太赫兹功率: >300  $\mu$ W
- 扫描速度: 125 Hz @ 50 ps (最高>300 Hz)
- 扫描范围: 最大1700 ps, 其它可定制
- 常见选项: 反射模块, 多通道, 定制天线长度, 成像模块

### 激光器参数

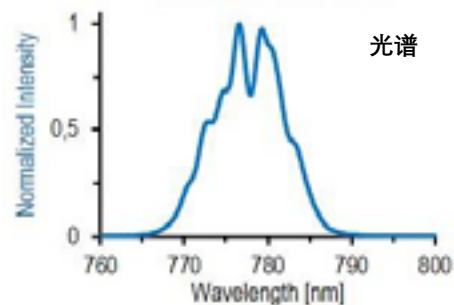
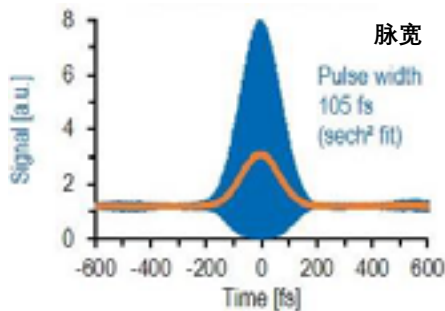
- 输出功率: 780 nm \1560 nm >1 W
- 可选配 390 nm >200 mW
- 脉冲宽度: 780 nm <150 fs (典型值120 fs)
- 重复频率: 100 MHz
- 功率控制: AOM 快速幅度调制
- 色散预补偿: 最高至 -30.000 fs<sup>2</sup>



太赫兹:



泵浦激光:  
(780 nm)



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# LBTEK 麓邦

麓邦创立于2018年，是一家专注于光学元件、光学模组、光学系统和光学仪器的集研发、生产、销售于一体的国家级专精特新“小巨人”企业，致力于为光学领域研发人员提供高端产品和解决方案，并不断推进光学技术的民用化和前沿技术的平民化。

麓邦非常注重研发，来自一流高校的硕博、海外留学技术人员占公司员工总数的40%，累计研发投入近2亿，已发布上万款标准产品。目前麓邦业务范围已覆盖全国及部分海外国家与地区，服务200余所高校及科研院所，300余家创新型企业的30,000多名科研人员。



2<sup>亿</sup>

近2亿研发投入

40,000<sup>m<sup>2</sup></sup>

研发生产基地

2<sup>↑</sup>

研发基地

500<sup>+</sup>

员工总数

200<sup>+</sup>

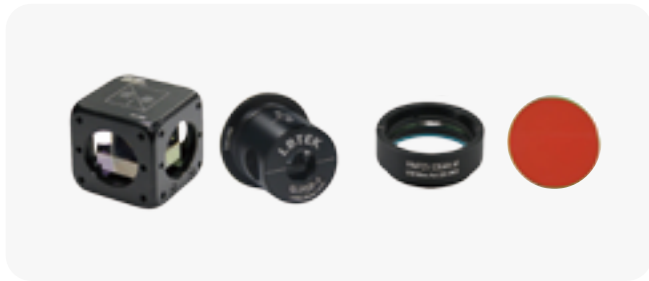
服务科研院所

30,000<sup>+</sup>

服务科研人员

## 量子光学

### 偏振光学



### 高性能光机械件



### 光电探测器件



### 光电调制



### 光学平台



### 激光器





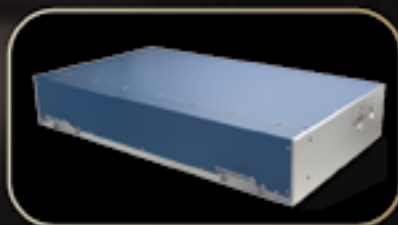
大族激光科技产业集团股份有限公司于1996年在中国深圳创立，于2004年在深圳证券交易所上市（股票简称：大族激光，深市代码：002008）。

大族激光致力于智能制造装备及其关键器件的研发、生产和销售，具备从基础器件、整机设备到工艺解决方案的垂直一体化优势，是全球领先的智能制造装备整体解决方案服务商。截止到2024年12月，大族激光通过国内外100多个分支机构及16,900多名员工，为4万个规模以上的工业客户提供智能制造解决方案。2024年实现营业收入147.71亿元，研发费用占营业收入比例12.32%，多项技术及财务指标名列全球前列。

## 激光器及通用元器件-核心产品



皮秒激光器



飞秒激光器



碟片超快激光器

- 诚聘光学工程师若干
- 硕士及以上学历，激光/光电子/物理光学相关专业；
- 3年以上项目经验，有激光器研发经验者优先；
- 专业基础知识扎实，有较强的动手能力，了解并掌握一定激光器相关研发技术；
- 熟练掌握zemax等光学仿真软件，有项目经验者优先。
- 联系方式：[lir113715@hanslaser.com](mailto:lir113715@hanslaser.com) 或会议现场交流。



Topics may include, but are not limited to:

### **Symposium I: Terahertz Science and Technology**

- Terahertz Sources
- Terahertz Detectors
- Terahertz Functional Devices
- Terahertz Materials and Physics
- Terahertz Spectroscopy and Imaging
- Other Applications of THz Technology

### **Symposium II: Ultrafast Phenomena**

- Ultrafast Laser Technology and Facility
- Ultrafast Laser Interaction with Matters
- Ultrafast Spectroscopy and Imaging
- Ultrafast Laser Filamentation and Application
- EUV/X Ray Source and Attosecond Science
- Other Applications of Ultrafast Optics



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