ISUPTW | International Symposium on Ultrafast Phenomena and Terahertz Waves

ISUPTW 2024

International Symposium on Ultrafast Phenomena and Terahertz Waves

Host

- Aerospace Information Research Institute, CAS

Organizer

- GBA branch of AIR CAS

Co-Organizers

- State Key Laboratory of Optoelectronic Materials and Technologies, Sun Yat-sen University
- Faculty of Information, Sun Yat-sen University
- Light: Science & Applications

NOV. 15-18 | GUANGZHOU, CHINA

X-C Zhang Award

About the Award

The X-C Zhang Awards established in 2023, are in recognition of the outstanding contributions of researchers to THz wave science, technology and applications. The recipients of the awards for 2024 will be announced at the 12th International Symposium on Ultrafast Phenomena and THz Waves (ISUPTW 2024), which will be held in Guangzhou, China in November 2024. Up to four potential recipients will receive a cash prize of ￥10,000 (pretax) and a certificate of recognition.

The potential award winner applicants may directly apply for the award or be noninated by the award committee.

Eligibility Requirements for Applicants:

1. Application for the Award is open to scientists worldwide with a PhD in Physics, Electrical and Electronic Engineering, Chemistry, and Biology or any other relevant research field engaging in the Terahertz wave science, technology and applications.
2. Applicants must be at the age of 50 or younger on the closing date of the application.
3. The applicants must be the principal researcher of the relevant scientific and technological achievements.
4. The selection committee members are ineligible for the award.

The X-C Zhang Award is sponsored by Qingdao Quenda Terahertz Technology Co.,Ltd.

青源峰达 QUENDA | 太赫兹 T H z

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Organizations

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Faculty of Information, Sun Yat-sen University

Light | Science & Applications

Light: Science & Applications

Conference Chairs

Yirong Wu
Aerospace Information Research Institute, Chinese Academy of Sciences

X.-C. Zhang
University of Rochester, USA

Conference Co-Chairs

Guangyou Fang
Aerospace Information Research Institute, Chinese Academy of Sciences

Zhiyi Wei
Institute of Physics, Chinese Academy of Sciences

General Conference Chair

Tianwu Wang
Aerospace Information Research Institute, Chinese Academy of Sciences

Symposium Chairs

Min Hu
University of Electronic Science and Technology of China

Hua Li
Shanghai Institute of Microsystem and Information Technology

Jianing Chen
Institute of Physics, Chinese Academy of Sciences

Conference Chairs:
Yirong Wu, Aerospace Information Research Institute, Chinese Academy of Sciences
X.-C. Zhang, University of Rochester, USA

Conference Co-Chairs:
Guangyou Fang, Aerospace Information Research Institute, Chinese Academy of Sciences
Zhiyi Wei, Institute of Physics, Chinese Academy of Sciences

General Conference Chair:
Tianwu Wang, Aerospace Information Research Institute, Chinese Academy of Sciences

Symposium Chairs of THz Science and Technology:
Min Hu, University of Electronic Science and Technology of China
Hua Li, Shanghai Institute of Microsystem and Information Technology, CAS

Symposium Chair of Ultrafast Phenomena:
Jianing Chen, Institute of Physics, Chinese Academy of Sciences

Advisory Committee:
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Peixiang Lu, Huazhong University of Science and Technology
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Shenggang Liu, University of Electronic Science and Technology of China
Harald Schneider, Helmholtz-Zentrum Dresden-Rossendorf, Germany
Perry Shum, Southern University of Science and Technology
Shengcai Shi, Purple Mountain Observatory, CAS
Alexander Shkurinov, Lomonosov Moscow State University, Russia
Xuechu Shen, Shanghai Institute of Technical Physics, CAS
Li Wang, Institute of Physics, CAS
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Jianquan Yao, Tianjin University
Jianmin Yuan, National University of Defense Technology
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Olga G. Kosareva, M. V. Lomonosov Moscow State Univ., Russia
Weiwei Liu, Nankai University
Tani Masahiko, University of Fukui, Japan
Xiaoyu Peng, Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences
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Wei Shi, Xi'an University of Technology
Masayoshi Tonouchi, Osaka University, Japan
Tianwu Wang, Aerospace Information Research Institute, Chinese Academy of Sciences
Xiaojun Wu, Beihang University
Degang Xu, Tianjin University
Dongwen Zhang, National University of Defense Technology
Yan Zhang, Capital Normal University
Yaxin Zhang, University of Electronic Science and Technology of China
Zengxiu Zhao, National University of Defense Technology
Li-Guo Zhu, China Academy of Engineering Physics
Yiming Zhu, University of Shanghai for Science and Technology

Sponsors

General Information

Conference Venue: NARADA GuangZhou（广州黄埔君澜酒店）
Address: No. 129 Wenjian Road, Huangpu District, Guangzhou（广州市黄埔区温涧路 129 号）

Speaker Preparation

Time of an keynote talk will be 30 min, invited talk will be 20 min and an oral talk will be 15 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.**

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: Sunday, Nov. 17, 17:00-18:00
Poster board size: 0.95 m (length) * 2.47 m (height), **recommended poster size:0.8m*1.2m**
Set-uptime: Saturday, Nov. 16, 08:00-18:20，Nov. 17, 08:00-18:00，
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

11:30-13:30, Nov 16-18, Lan Tian Restaurant (2F) 二楼澜天自选自助餐厅

Dinners

17:30-20:00, Nov 15-16, Lan Tian Restaurant (2F) 二楼澜天自选自助餐厅

Banquet and Award Ceremony

Location: HuangPu Hall A+B, 2F, 17: 30-20:00
The banquet and award ceremony of the International Symposium on Ultrafast Phenomena and THz Waves (ISUPTW) will be held on Sunday, Nov. 17, 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

This Award is sponsored by Qingdao Quenda Terahertz Technology Co.,Ltd, and The winners will be selected by The Award Committee and presented on site.

Best Student Paper Award

The winner will be selected by reviewers on site during the best student paper session.

Best Poster Award

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

Program at a Glance

	Friday Nov.15	Saturday Nov.16	Sunday Nov.17	Monday Nov.18	Address
Registration	9:30-22:30	08:00-19:00	08:00-18:30		Hotel lobby
Opening Ceremony		08:30-12:00			Huang Pu Hall A+B 黄埔厅 A+B
Plenary Session		09:00-12:00	09:30-12:00		Huang Pu Hall A+B 黄埔厅 A+B
Symposium I: Terahertz science and technology		13:30-18:00	13:30-17:00	08:30-12:00	Huang Pu Hall A+B+Kai Fang Hall 黄埔厅 A+B+ 开放厅
Symposium II: Ultrafast Phenomena		13:30-18:00	13:30-17:00	08:30-12:00	Huang Pu Hall C 黄埔厅 C
Best Student Award Session		13:30-16:30			Kai Yuan Hall 开源厅
Corporate Reporting Session				10:15-12:15	Huang Pu Hall C 黄埔厅 C
Terahertz super-resolution technology and applications		16:45-17:45			Kai Yuan Hall 开源厅
Poster Session			17:00-18:00		Huang Pu Hall Lobby 黄埔厅序厅
Banquet			18:30-20:30		Huang Pu Hall A+B 黄埔厅 A+B

Special Event

Terahertz super-resolution technology and applications

为帮助研究生提升专业能力，讲好学术报告，现面向所有参会学生开设公益讲座，欢迎感兴趣的学生参加。

For helping postgraduates improve their professional abilities and deliver good academic reports, now we offer public lectures to all participating students. Interested students are welcome to attend.

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

时 间：2024 年 11 月 16 日 16:45-17:45

地 点：NARADA GuangZhou（广州黄埔君澜酒店）Kai Yan Hall（开源厅）

主讲人：胡 旻，中国电子科技大学

语言：中文

Time: 16:45-17:45, 16 November, 2024

Venue: NARADA GuangZhou（广州黄埔君澜酒店）Kai Yan Hall（开源厅）

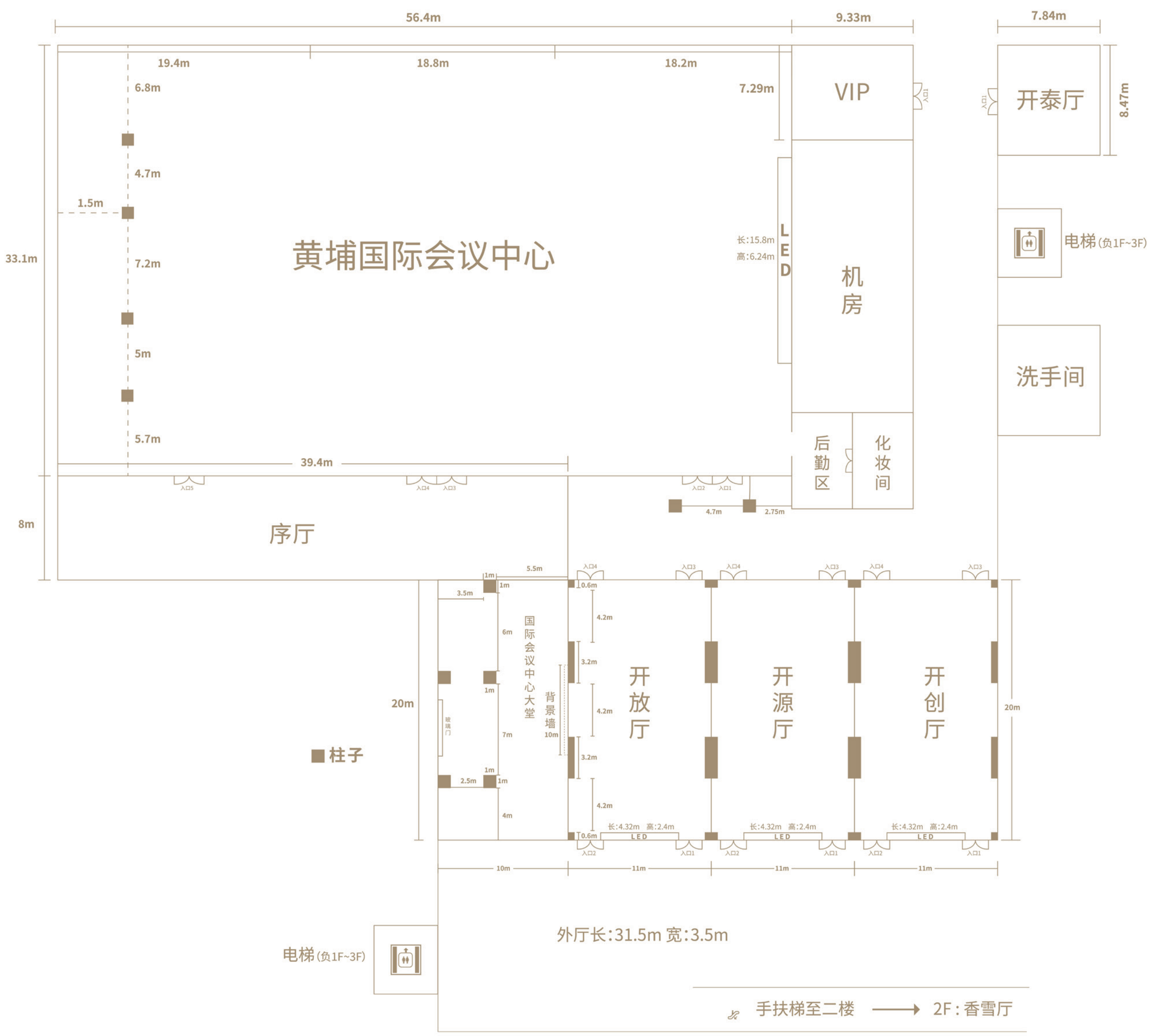
Lecturer: Min Hu, University of Electronic Science and Technology of China

Language: Chinese

Conference Map

广州黄埔君澜酒店
Guangzhou · China
NARADA

广州黄埔君澜酒店一楼平面示意图



地址:中国 广东省广州市黄埔区温润路129号
Add: No.129 Wenjian Road, Huangpu District, Guangzhou 510700, Guangdong Province, P.R.China

Opening Ceremony & Plenary Sessions

November 16th, Huang Pu Hall A+B (黄埔厅 A+B)

Time	Title/Speaker
Presider: **Tianwu Wang,** Aerospace Information Research Institute, Chinese Academy of Sciences, China	
08:30-08:50	The Opening Ceremony
08:50-09:00	Group Photo
Presider: **Peter Uhd Jepsen,** Danish Technical University, Denmark	
09:00-09:40	**Recent development of China's terahertz astronomy** **Shengcai Shi** Purple Mountain Observatory, Chinese Academy of Sciences
09:40-10:20	**Ultrafast intersubband relaxation in III-V semiconductors: from mode-locked THz quantum cascade lasers to ultrabroadband mid-infrared quantum-well photodetectors** **Stefano Barbieri** IEMN Laboratory, France
10:20-10:40	Coffee Break
Presider: **Shengcai Shi,** Purple Mountain Observatory, Chinese Academy of Sciences	
10:35-11:15	**Recent progress of THz air photonics** **Peter Uhd Jepsen** Danish Technical University, Denmark
11:15-11:55	**Title: TBD** **Ranjan Singh** Nanyang Technological University, Singapore
12:00-13:30	Lunch

November 17th, Huang Pu Hall A+B (黄埔厅 A+B)

Time	Title/Speaker
Presider: **Zengxiu Zhao,** National University of Defense Technology	
09:30-10:10	**A microscopic approach to describing terahertz stimulated emission in correlated systems: from past to present** **Alexander Shkurinov** Lomonosov Moscow State University, Russia
10:10-10:50	**Terahertz Near-field Optics under Multiple Physical Fields** **Yalin Lu** University of Science and Technology of China
10:50-11:10	Coffee Break
Presider: **Alexander Shkurinov**, Russia	
11:10-11:50	**Quantum dynamics probed from picoseconds to attoseconds** **Zengxiu Zhao** National University of Defense Technology
11:50-13:30	Lunch

Recent development of China's terahertz astronomy

Sheng-Cai Shi
Purple Mountain Observatory, Chinese Academy of Sciences

Abstract: Terahertz astronomy has long been regarded as a killer application in the field of terahertz sciences and technologies, with scientific breakthroughs such as the first black hole image and transformative understanding of protoplanetary disk structures made recently. China has developed state-of-the-art superconducting mixers and detectors at terahertz wavelengths. And the first THz astronomical instrument will be put into space soon. Given the fact that Qinghai-Tibet plateau and Dome A in Antarctic provide extremely good condition for ground-based terahertz astronomy, we are constructing a 15-m submillimeter-wave telescope named XSMT in Qinghai and carrying out some pilot experiments at Dome A in Antarctic. This talk will mainly present the recent progress of terahertz astronomy developed in China from space to Qinghai-Tibet plateau to Antarctic.

Sheng-Cai Shi
Purple Mountain Observatory, Chinese Academy of Sciences

Prof. Sheng-Cai Shi received his B.S. degree in 1985 from Southeast University (China), M.S. degree in 1988 from Purple Mountain Observatory (PMO, China), and Ph.D. degree in 1996 from the Graduate University for Advanced Studies (Japan). He has been a Professor at PMO since 1998 and is currently serving as the Chair of the Advisory Committee of PMO. His research interests include the physics of superconducting devices, THz mixers and detectors, and THz applications. He is a recipient of HLHL Award in 2019 and was elected as an Academician of CAS in 2021.

Ultrafast intersubband relaxation in III-V semiconductors: from mode-locked THz quantum cascade lasers to ultrabroadband mid-infrared quantum-well photodetectors

Stefano Barbieri
Centre National de la Recherche Scientifique, France

Abstract: Energy relaxation between two-dimensional electronic states in the conduction band of III-V semiconductor heterostructures is ruled by optical phonon emission and unfolds on the ps time scale. This property deeply impacts the operation and dynamics of quantum cascade lasers and quantum-well photodetectors, by far the most successful unipolar optoelectronic devices. In the first part of the talk I will review our experimental studies on the dynamics of THz quantum cascade lasers, from active mode-locking operation via coherent electro-optic sampling, to free-running multi-mode operation using real-time microwave self-detection. In the second part I will present our latest results on the development of ultrafast mid-infrared quantum well photodetectors operating at ~10um wavelength. The devices architecture is based on a 2D-array of subwavelength patch antenna resonators, electrically connected to a monolithically integrated coplanar line. By characterizing their frequency response up to 1THz we demonstrate 3dB-bandwidths of 100GHz at 300K, limited by electron's capture.

Stefano Barbieri
Centre National de la Recherche Scientifique, France

Stefano Barbieri received his PhD in Physics in 2000 at Scuola Normale Superiore (Pisa, Italy). In 2000, he joined as research scientist, Orbisphere SA (Geneva, Switzerland), where he focused on the development of gas-sensing systems based on laser photo-acoustic spectroscopy. In 2002, he joined TeraView Ltd (Cambridge, UK) where he led an R&D activity focused on THz QCLs in collaboration with the Cavendish Laboratory, of Cambridge University. In 2004, he was awarded a three-year Industry-Fellowship from the Royal Society aimed at promoting technology transfer between industry and academic institutions. In December 2005, he was recruited by CNRS in France. From 2005 to 2016 he has been in charge of THz research at the MPQ Laboratory at the University of Paris Diderot (Paris, France). In 2016 he joined the THz-Photonics group at IEMN Laboratory (Lille, France). Presently, his main research interests focus on III-V semiconductor ultrafast detectors, photomixers and modulators operating in the mid-infrared range. He has co-authored more than 70 publication in peered-reviewed journals.

Recent progress of THz air photonics

Peter Uhd Jepsen
Technical University of Denmark, Denmark

Abstract: I will present recent advancements in THz air photonics, where gases like air or nitrogen serve as nonlinear media to convert femtosecond laser pulses into coherent, broadband THz radiation. Unlike photoconductive materials and nonlinear crystals, air offers advantages in damage resilience and phase matching. THz generation here takes place in a plasma channel formed by femtosecond laser pulses, enabling peak THz field strengths in the MV/cm range, with spectral coverage extending from 1 to over 30 THz. Using accessible mJ-class laser setups, we achieve broad bandwidth and high signal-to-noise ratios. I will detail the mechanisms of THz generation, beam propagation, and detection, with practical insights for maximizing bandwidth and achieving precise, ultra-broadband THz spectroscopy.

Peter Uhd Jepsen
Technical University of Denmark, Denmark

Peter Uhd Jepsen is a distinguished professor specializing in Optical Terahertz Science and Technology. He earned his Ph.D. in Physics and Chemistry from Aarhus University in 1996. Currently, he serves as Deputy Head of the Department of Electrical and Photonics Engineering at the Technical University of Denmark (DTU). With over 164 peer-reviewed articles and more than 11,500 citations, Jepsen's research focuses on generating, propagating, and detecting ultrashort pulses of coherent THz radiation. He has chaired several international conferences and workshops and supervised numerous graduate students and postdoctoral researchers, contributing significantly to THz technology.

A microscopic approach to describing terahertz stimulated emission in correlated systems: from past to present

Alexander Shkurinov
Lomonosov Moscow State University, Russia

Abstract: The first maser developed by J. P. Gordon, H. J. Zeiger and C. H.Townes radiated microwaves at 24 GHz from ammonia, just below the THz range. Then, following A.M.Prokhorov, several papers addressed the theoretical possibility of sub-millimeter masers. In my lecture I will give a brief overview of the history of science and technology of millimeter and sub-millimeter waves, also called the far-infrared or more trendy the TeraHertz (THz) domain and its role in the further discoveries in the terahertz stimulated emission sources based on the solid state correlated systems. The generation of far-infrared radiation through nonlinear or stimulated optical processes requires powerful pump optical beams, and thus it was developed after the invention of lasers. The theoretical foundations of laser generation involve the analysis of the properties of stimulated emission, while maser generation can be interpreted in terms of oscillation theory. In my lecture, I will discuss how correlated oscillatory systems under pulsed photoexcitation can emit coherent maser-like radiation in the terahertz frequency range. Modern molecular crystals successfully demonstrate the feasibility of the ideas of the classics of quantum electronics and laser physics.

Alexander Shkurinov
Lomonosov Moscow State University, Russia

Alexander Shkurinov in 1985 graduated with honours from the M.V. Lomonosov Moscow State University (MSU), Moscow, Russia. He received his Ph.D. degree in Physics from MSU in 1988. Since 2004 he is a full-time Professor at the Department of Physics of the MSU where he is Head of the Laboratory of terahertz optoelectronics. The research interests of Alexander Shkurinov are mainly centered around the development and application of femtosecond laser techniques, time-resolved spectroscopy of molecules in liquid phase, nonlinear optics and THz techniques and spectroscopy. The results obtained by Alexander Shkurinov have been published in more than 350 scientific papers in peer-reviewed journals.

Terahertz Near-field Optics under Multiple Physical Fields

Yalin Lu
University of Science and technology of China

Abstract: Near-field Terahertz (THz) microscopy exploits evanescent field confined by a nanotip to access light-matter interactions at the nano-scale, orders of magnitude below the diffraction limit. Current reported nano THz near-field systems are mainly built in ambient environments, lack of the ability of being operating under multiple physical fields, e.g. magnetic field, cryogenic temperatures, and variuious optical field, which will be critical to the development of next generation quantum materials.
This talk will give a brief review over the near-field THz optics, and present an advanced near-field THz system which can be operated in a 9T+5T vector magnet, at low temperature below 3K, and meanwhile coupling multiple types of light sources for both excitation and pumping, including a compact FEL-type THz light source. With this system, high-quality THz-driven atomic images have been obtained at the room temperature, well above the previous record of around 100K. Other phenomena such as charged density waves were also displayed. Our effort resulted in a submission of over 20 patents and many significant publications on PNAS, Nat.Phy, Nat.Matter, PRL, etc.

Yalin Lu
University of Science and technology of China

Yalin Lu is now a distinguished chair professor in the University of Science and technology of China (USTC) and a distinguished researcher in Hefei National Laboratory. Before joining USTC, he was a professor in AFA, Tufts University and Lawrence Berkeley National Laboratory. Dr. Lu is the recipient of China National Award for Natural Science (first class) in 2006 and many international awards, is the Member of International Eurasian Academy of Sciences and the Correspondence Member of the Slovenia Academy of Engineering. He was the Director of National Synchrotron Radiation Laboratory of China (2014-2019), and currently serves as the Assistant to the USTC President, and the Director of Anhui Laboratory of Advanced Photon Science and Technology.
His research focuses on quantum functional materials, nanophotonics, new energy materials and THz technologies. He is highly noted for the past inventions on transparent electro-optical PMN-PT ceramics, quasi-phase matched PPLN crystal, nonlinear microwave scanning tip microscope, quantum functional complex oxides, and terahertz compact FELs. He is also an expert on giant scientific infrastructures such as Synchrotron light Sources. Dr. Lu has ~ 550 publications, ~ 110 US and Chinese patents and applications, and 6 books/chapters.

Quantum dynamics probed from picoseconds to attoseconds

Zengxiu Zhao
National University of Defense Technology

Abstract: The generation of new light sources as terahertz waves and attosecond pulses allows to probe the nonstationary atomics states and nonequilibrium matter phases in time-domain. While the timescales can be different by 6 orders, the motion of electrons and atoms under intensive light pumping are connected and concerted which can be revealed by terahertz time-domain spectroscopy or attosecond absorption/emission spectroscopy or both in combination. In this talk, we will present our recent advances on the probing of ionic dynamics induced by strong laser field in attoseconds, and the probing of thermalization of Au film irradiated by intense pump in picoseconds. Also we will present the spectroscopy study on the joint measurement of harmonic and terahertz spectra from gas phase or solid phase. We show that combing terahertz and attosecond science would allow a deeper look into the quantum dynamics in the two extremes.

Zengxiu Zhao
National University of Defense Technology

Professor Zengxiu Zhao obtained Ph. D degree from Kansas State University, US, in 2005. He was currently a full professor in National University of Defense Technology. His research interests includes: attosecond physics and attosecond pulse generation, and multielectron aspects of ionization and radiation in strong fields from terahertz wave to high harmonics. Dr. Zhao has published more than 100 refereed papers (with 15 publications in Nature communications and Physical Review Letters).

Symposium I: Terahertz science and technology

November 16th, Huang Pu Hall A（黄埔 A 厅）

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

Time	Title/Speaker
13:30-14:00	**Title:TBA** **Jiaguang Han** *Keynote* Tianjin University
14:00-14:30	**Metasurfaces based on the bound states in the continuum and their THz applications** **Longqing Cong** *Keynote* Southern University of Science and Technology
14:30-14:50	**Electrically Driven Thermal Infrared Emission from Graphene Metasurfaces** **Jianfa Zhang** *Invited* National University of Defense Technology
14:50-15:10	**Deep Learning-Empowered Terahertz Sensing Applications** **Jinfeng Zhu** *Invited* Xiamen University
15:10-15:25	**Research on terahertz metasurface devices for wavefront manipulation** **Zhiyu Tan** *Invited* University of Shanghai for Science and Technology
15:25-15:40	**Theoretical study of THz and high-order harmonic generation in liquids** **Xuebin Bian** *Oral* Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences
15:40-15:55	Coffee Break

Presider: **Longqing Cong,** Southern University of Science and Technology

Time	Title/Speaker
15:55-16:25	**Realization and application of nano-resolved terahertz near-field spectroscopy** **Min Hu** *Keynote* University of Electronic Science and Technology of China
16:25-16:55	**Application of terahertz technology in biomedical study** **Huabin Wang** *Keynote* Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences
16:55-17:15	**THz s-SNOM nanoimaging ultra-confined in-plane anisotropic THz polaritons in real space** **Shu Chen** *Invited* University of Shanghai for Science and Technology
17:15-17:35	**Title:TBA** **Zebo Zheng** *Invited* Sun Yat-sen University

17:35-17:55	**Terahertz scattering-type scanning near-field optical microscopy of collective excitations for quantum technologies** **Xiao Guo** *Invited* The University of Queensland
17:55-18:10	**Crystal Growth and Design of Indolium-based Nonlinear Optical Materials for Terahertz-wave Generation and Detection** **Xinyuan Zhang** *Oral* Tianjin University of Technology
18:10-18:25	**Theoretical physical properties of some nonlinear optical crystals in the THz range** **Rukang Li** *Oral* Technical Institute of Physics and Chemistry, Chinese Academy of Sciences

November 17th, Huang Pu Hall A（黄埔 A 厅）

Presider: **Zhen Tian,** Tianjin University	
Time	**Title/Speaker**
13:30-14:00	**Magnon and electromagnon excitation in RFeO3 crystal probing with THz magnetooptical spectroscopy** **Guohong Ma** *Keynote* Shanghai University
14:00-14:30	**Title:TBA** **Qiye Wen** *Keynote* University Of Electronic Science And Technology Of China
14:30-14:50	**Terahertz ultrafast physics, device and transient dynamics** **Zuanming Jin** *Invited* University of Shanghai for Science and Technology
14:50-15:10	**Title:TBA** **Qiwu Shi** *Invited* Sichuan University
15:10-15:25	**The Influence of Multidomain Stress on the Insulator-Metal Phase Transition of VO2 Driven by Strong Field Terahertz** **Hao Chen** *Oral* Institute of Physics, Chinese Academy of Sciences
15:25-15:40	**Coffee Break**
Presider: **Qiye Wen,** University Of Electronic Science And Technology Of China	
15:40-16:10	**Generation of terahertz structured beams using tri-layered** **Yan Zhang** *Keynote* Capital Normal University
16:10-16:40	**Title:TBA** **Zheng Tian** *Keynote* Tianjin University

16:40-17:00	**Carbon Nanotube metasurface for THz sensing applications** **Yue Wang** *Invited* Xi'an University of Technology
17:00-18:30	**Poster Session**
18:30-20:30	**Banquet**

November 18th, Huang Pu Hall A（黄埔 A 厅）

Presider: **Weiwei Liu,** Nankai University

Time	Title/Speaker
08:30-09:00	**Title:TBA** **Liguo Zhu** *Keynote* China Academy of Engineering Physics
09:00-09:30	**Coherent Control of Terahertz Wave Generation in Semiconductors** **Xinlong Xu** *Keynote* Northwest University
09:30-09:50	**Application of Terahertz Spectroscopy in Gas Detection and Analysis** **Xiaojiao Deng** *Invited* Tsinghua University
09:50-10:10	**Title:TBA** **Jiaojiao Ren** *Invited* Changchun University of Science and Technology
10:10-10:30	**Surface-state-related carrier dynamics of GaAs determined by UV-visible pump-probe terahertz spectroscopy** **Dongwei Zhai** *Invited* Qingdao University
10:30-10:45	**Coffee Break**

Presider: **Liguo Zhu,** China Academy of Engineering Physics

10:45-11:15	**Title:TBA** **Weiwei Liu** *Keynote* Nankai University
11:15-11:35	**Title:TBA** **Junpeng Lyu** *Keynote* Southeast University
11:35-11:55	**Multi-level organization of carbon nanotubes for advanced THz optics** **Dmitry V. Krasnikov** *Invited* Skolkovo Institute of Science and Technology, Russia
11:55-12:05	**Ultrafast Dynamics of Liquid Water Induced by Strong Terahertz Field** **Yanyu Wei**[1, 2], **Jieya Ruan**[1, 2], **Guoqian Liao**[1, 2, 3*], **Yutong Li**[1, 2, 3*] *Oral* 1.Institute of Physics, Chinese Academy of Science; 2.University of Chinese Academy of Sciences, China; 3.Songshan Lake Materials Laboratory

Metasurfaces based on the bound states in the continuum and their THz applications

Longqing Cong
Southern University of Science and Technology

Abstract: We will report the recent results of dielectric metasurfaces based on the bound states in the continuum (BIC). BIC is capable of reducing the radiative loss to zero and, therefore, has been applied in nonlinear photonics, ultrasensitive sensors, and nanolasing. In practical scenarios, nonradiative losses inherited from material absorption are inevitable, which will deteriorate the resultant resonant quality factors (Q) to a finite value, and infinite Q is impractical. We move to probe the correlated phase spectrum and observe the infinite value of group delay in a practical metasurface where the phase singularity condition is reached with the assistance of nonradiative losses. The phase singularity enabled by BIC physics reveals better sensing performance whose spectral linewidth and field enhancement can be engineered. This system operates with an external pump which could function as a tuning knob to control the operating condition. In the second part, we will report the results of single-pulse THz sensing and imaging enabled by the BIC metasurfaces.

Longqing Cong
Southern University of Science and Technology

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, and photonic crystals and their applications in terahertz communications, imaging, and sensing. He has published over 50 peer-reviewed journal papers with more than 6400 citations. He serves on the editor board of the journal Ultrafast Science (Science Partner Journal) and Chinese Laser Press. He was awarded the gold medal of "MRS Singapore best PhD thesis" in 2018, the World's Top 2% Scientists by Elsevier, Best Young Scientist by IEEE Photonics Society, and the WuSi Medal of Shenzhen Government.

Electrically Driven Thermal Infrared Emission from Graphene Metasurfaces

Jianfa Zhang,
National University of Defense Technology

Abstract: Thermal emission is a fundamental and ubiquitous phenomenon. It plays a key role in physics and has various applications. Graphene, a two-dimensional material with excellent electrical properties, high-temperature stability and broadband emission, has been demonstrated as a promising material for thermal emitters, but its low emissivity has limited the efficiency. In this talk, we combine monolayer graphene with metasurfaces and demonstrate electrically driven narrowband thermal infrared emitters with near unity emissivity. Our work provides a new avenue for the application of thermal infrared radiation emitters in the fields of gas sensing, infrared communication, active thermal camouflage and so on.

Jianfa Zhang
National University of Defense Technology

Jianfa Zhang is currently an associate professor at the National University of Defense Technology. He obtained his PhD from the Optoelectronics Research Centre, University of Southampton in 2013. His research mainly focuses on nanophotonics, metamaterials and graphene. He has filed >20 patents and published >100 peer-reviewed journal papers in Nature Nanotechnology, Light: Science & Applications, Advanced Materials, Laser & Photonics Reviews, Optics Express etc.

Deep Learning-Empowered Terahertz Sensing Applications

Jinfeng Zhu,
Xiamen University

Abstract: Terahertz (THz) molecular fingerprint sensing technology, which implies structural details including inter- or intra-molecular vibrational modes, has emerged as a non-destructive label-free detection technique for trace sample analysis. In recent years, researchers have developed metasurfaces with strong localized near-field enhancement to amplify the interaction between THz wave and trace samples, leading to the utilization of various meta-optics mechanisms for THz molecular fingerprint detection. However, traditional metasurface design requires extensive parameter optimization based on the given fingerprint frequency ranges of samples, which depends on complex computational resources. In order to overcome this barrier, we propose a series of rapid on-demand design methods for THz metasensors. Particularly, we introduce the schemes of spectrum splitting and multi-head attention to boost design accuracy, and provide deep physics insights by the explainable deep learning of metasensor design. These studies indicate that one can accomplish rapid on-demand design of metasensors for trace THz molecular fingerprint sensing by deep learning. Evidently, the use of artificial intelligence will speed the development of THz metasurface design in sensing applications.

Jinfeng Zhu
Xiamen University

Jinfeng Zhu received the B.S. degree in electronic communication science and technology and the Ph.D. degree in physical electronics from the University of Electronic Science and Technology of China, Chengdu, China, in 2006 and 2012, respectively. From November 2009 to November 2011, he was a Visiting Researcher with the Device Research Laboratory and Department of Electrical Engineering, University of California, Los Angeles, CA, USA. From July2017 to 2018, he was a Visiting Professor with the Optoelectronics Research Centre, University of Southampton, Southampton, U.K. Since July 2012, he has been with Xiamen University, Xiamen, China, where he is currently the Dean and a Professor with the Institute of Electromagnetics and Acoustics. His research interests include nanophotonics, plasmonics, metamaterials, and related sensing applications. Jinfeng Zhu is the Director of the Fujian Provincial Key Laboratory for Electromagnetic Wave Science and Detection Technology. He is a Fellow of the International Advanced Materials Society (IAAM) and a Senior Member of IEEE/OPTICA.

Research on terahertz metasurface devices for wavefront manipulation

Zhiyu Tan
University of Shanghai for Science and Technology

Abstract: Controlling the wavefront of terahertz (THz) waves is essential for advancing applications like 6G wireless communication and sensing, as well as for pioneering emerging technologies such as augmented reality (AR) and optical neural networks (ONNs). However, effective manipulation of THz wavefronts is still challenging due to limitations in current material systems and functional devices. In this study, we have integrated artificial metasurface technology with unique materials and structures to develop highly effective and multifunctional THz devices for wavefront manipulation. By incorporating the magneto-optical semiconductor material InSb into artificial metasurfaces, we have created several THz nonreciprocal active wavefront manipulation devices. Some fundamental magneto-optical manipulation mechanisms have been established, including spatiotemporal symmetry breaking, control of nonreciprocal spin chirality, and universal "chirality-wavevector-magnetic field" dispersion relations. Leveraging these mechanisms, we designed, fabricated, and experimentally characterized devices such as THz magneto-optical nonreciprocal wavefront controllers, achieving significant advancements in isolation, insertion loss, bandwidth, and driving magnetic field. Additionally, we developed an all-optical diffractive neural network with high signal-to-noise ratio (SNR) with polarization-rotated metasurface, experimentally demonstrating its capability to classify multiple handwritten digits, fashion items, and hybrid targets. These works may advance the theory and technology of THz wavefront manipulation and have great potential in designing THz functional devices.

Zhiyu Tan
University of Shanghai for Science and Technology

Zhiyu Tan received his M. S. degree in optoelectronic information science and engineering, and Ph. D. degree in optical engineering, from Nankai University in 2018 and in 2024, respectively. Since 2024, he has been with the Terahertz Technology Innovation Research Institute, University of Shanghai for Science and Technology. His current research involves terahertz science and technology, metasurface, magneto-optics and the applications of artificial neural network networks. He has been published several papers as the first author in the journals such as Laser & Photonics Reviews, Advanced Science and Advanced Optical Materials.

Theoretical study of THz and high-order harmonic generation in liquids

Xue-Bin Bian
Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, China

Abstract: The mechanism of laser-induced THz and high-order harmonic generation (HHG) in bulk liquids is investigated theoretically.
The structure of bulk liquid systems is long-range disordered, and the mechanism of THz and HHG in liquids is difficult to be interpreted by the existing models in gases and solid crystals. For the THz emission in liquids, we developed a shift-current model. It comes from the transition of localized bound states in disordered liquid systems. The energy difference of them is in the THz range. This model can quantitatively reproduce the THz yield dependence on the laser pulse duration and intensity measured in the experiments. It can also interpret the origin of unmodulated THz signals in the two-color laser fields. Nuclear quantum effect is found to play key roles.
For the HHG in liquids, we developed a new model by introducing the statistical methods. It is found that the finite coherence distance of bound states plays a very important role in liquid HHG. Dephasing is naturally included, which will filter the long trajectories. It can be used to explain the linear dependence of maximum harmonic photon energy Ω as a function of laser field strength. The prediction of the wavelength-independent Ω by our theory is also confirmed recently by experiments. It provides us a new method to measure the degree of disorder in the liquid system.
In summary, the dynamics of bound states determines the main features of the HHG and THz spectra.

Realization and application of nano-resolved terahertz near-field spectroscopy

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.

Min HU
University of Electronic Science and Technology of China

Min HU, University of Electronic Science and Technology of China (UESTC), PhD, Professor. Head of the Terahertz Science Research Center, UESTC, Deputy Director of the Key Laboratory of the Ministry of Education, China, Deputy Director of the Key Laboratory of Sichuan Province, China, Member of IOC of IRMMW-THz. Engage in the work of new terahertz radiation sources and applications of terahertz science and technology. Hosted and undertaken several national terahertz projects, including the “973” project of the Key Research and Development Program of the Ministry of Science and Technology of China, key projects of the National Natural Science Foundation of China, surface projects and youth funds. Published 100+ SCI papers including the Nature Photonics, Physical Review Letters, and other academic journals.

Application of terahertz technology in biomedical study

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

Abstract: Terahertz (THz) spectroscopy and imaging are important areas of THz science and technology. In this presentation, first I will introduce the background of THz bio-detection. Second, I will demonstrate the application of some conventional THz far-field spectroscopy and imaging techniques in biological studies. Third, I will show three advanced THz near-field methods, including THz time-domain attenuated total reflection spectroscopy which was employed to investigate the effects of bioactive chemicals on living cells in aqueous media, a home-developed THz near-field microscopy for the study of tissue slices and single cells at the micron level, and a THz scattering-type scanning near-field optical microscopy with a nanometer resolution by which single protein molecules have been successfully observed. Finally, a brief summary and some perspectives are given. Collectively, our results manifest that despite facing challenges THz technology is holding a promising future in biomedical field.

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

Prof. Huabin Wang is the Deputy Secretary-general of Terahertz Biophysics, Biophysical Society of China, and the State Council Special Allowances Expert. He presided over important and competitive projects such as the National Key Research and Development Program, and the National Natural Science Foundation. His research is focused on terahertz instrumentation and application. He has authored/co-authored ~100 scientific articles published in PNAS, ACS Nano, Biosensors and Bioelectronics, etc.

THz s-SNOM nanoimaging ultra-confined in-plane anisotropic THz polaritons in real space

Shu Chen
University of Shanghai for Science and Technology

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, we will show our home-made THz s-SNOM systems, discuss the issues and provide the corresponding solutions. By using the THz s-SNOM, we recently imaged Ag2Te thin layered platelets and achieved the very first real-space nanoimaging of in-plane anisotropic plasmon polaritons(PPs), that is, electromagnetic waves formed by strong coupling between light and dipolar matter excitations. We further found that hybridization of the PPs with their mirror image - by placing the platelets above a Au layer - increases the direction-dependent relative polariton propagation length, while increasing the polariton confinement. This allows for verifying a linear dispersion and elliptical isofrequency contour in momentum space, revealing in-plane anisotropic acoustic PPs.

Shu Chen
University of Shanghai for Science and Technology

Shu Chen 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. After five years, she was awarded the title of "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 ~ 40 papers in first author and collabrating authors on the top-level journals including 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 3400 from google scholar, 8 papers with the citations over 100 and ~ 8 papers are selected as ESI highly cited papers.

Terahertz scattering-type scanning near-field optical microscopy of collective excitations for quantum technologies

Xiao Guo
The University of Queensland

Abstract: Terahertz (THz) waves are particularly sensitive to probing intraband transitions, making them versatile electromagnetic probes for investigating exotic phenomena resulting from electronic structure tunability in condensed matter systems. However, conventional THz far-field techniques are limited by the diffraction limit since the long wavelengths of THz waves, preventing direct microscopic observations of these phenomena. Recently, advancements in THz near-field detection methods, such as scattering-type scanning near-field optical microscopy (s-SNOM), have enabled to resolve THz light-matter interactions due to permittivity heterogeneity down to tens of nanometres. In this talk, I will demonstrate how THz s-SNOM allows a direct probing of evanescent THz electromagnetic modes and localised vibrational excess by harnessing s-SNOM deep sub-wavelength spatial resolution (< 100 nm). The results presented here underscore the versatility of THz s-SNOM as a non-destructive and label-free technique for studying condensed matter systems relevant to quantum technologies at the nanoscale. The demonstrated method can be extended to investigate novel THz fingerprints in nanoscale confined systems that deviate from the typical Drude response, which is crucial for advancing our understanding of microscopic THz-matter interactions in complex systems in the future.

Xiao Guo
The University of Queensland

Dr. Xiao Guo currently is a Postdoctoral Research Fellow in the University of Queensland (Brisbane, Australia). He obtained his Bachelor of Science in Physics from Northeastern University in 2017. He then received his Master and PhD in Electrical Engineering from the University of Hong Kong in 2018 and the University of Queensland in 2022 respectively.
His research focuses on terahertz near-field optics and light-matter interactions in nanomaterials and nanostructures. He contributes to develop quantitative nanoprobe methods for scattering-type scanning near-field optical microscopy (s-SNOM) and to further study nanoscale heterogeneity in semiconductor nanodevices and biological materials.
Dr. Guo has delivered oral presentations and invited seminars at leading conferences, including IRMMW-THz 2024, NFO-17, the 2nd International Nanoscale Analytics Workshop, and COMMAD 2022 / 24th AIP Congress. Since 2022, he has been independently invited to peer-review over 20 times for prestigious journals, such as *Nature Communications, ACS Photonics*, and *IEEE Transactions on Terahertz Science and Technology*.

Crystal Growth and Design of Indolium-based Nonlinear Optical Materials for Terahertz-wave Generation and Detection

Xinyuan Zhang
Tianjin Key Laboratory of Functional Crystal Materials, Institute of Functional Crystals, Tianjin University of Technology, China

Abstract: Nonlinear optical (NLO) crystals are promising candidates in generating and detecting coherent terahertz (THz)-waves. At present, NLO crystals meeting the requirement of optical technology are rare. Herein, we presents the indolium-based ionic-type NLO crystals which exhbit large second harmonic generation (SHG) response (~ 0.8×OH1, d33(OH1) = 120 pm/V at 1.9 μm). Through evaporation method with optimal growth conditions, millimetre-sized single crystals are obtained. Remarkably, efficient output energy among 0.1 ~ 20 THz region is realized by OHI-T. Moreover, by use of the obained indolium-based OH5Cl-BS crystals as both the THz-wave emitter and detector, a widely tunable (from 2.23 to 33.54 THz) and monochromatic THz system with high effectiveness and sensitivity was demonstrated. This work indicates that indolium-based NLO crystals are promising future material for terahertz technology with high-level performance.

Theoretical physical properties of some nonlinear optical crystals in the THz range

Rukang Li
Beijing Centre for Crystal Research and Development, Key Laboratory of Functional Crystals and Laser Technology, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences. China and Center of Materials Science and Optoelectronics Engineering, University of Chinese Academy of Sciences. China.

Abstract: Direct measurements of the physical properties of the nonlinear optical crystals in the terahertz (THz) range are challenging and confusions may arise from different measurements using various methods and apparatus, which hindered the effective utilizations of those materials in THz generations. For example, for the well-known nonlinear optical (NLO) crystal LBO, two different sets of orders in the refractive indices with corresponding crystallographic axes were reported by different groups. Our recent theoretical and experimental confirmation also reveal that BBO crystal becomes optically positive in the THz range reversing from negative in the optical range, in contradicting to all the previous reports by many groups. On the other hand, the ever-growing power of theoretical calculation makes it possible nowadays to accurately predict physical properties of condensed matter systems. High accurate ab initio calculation can touch the practical field of linear and nonlinear optical effects, as present author and others described. It is shown that using a linear combination of atomic orbitals (LCAO) type quantum chemistry calculation package and the coupled perturbed Kohn-Sham (CPKS) method, material properties like the band gaps, static refractive indices and full matrix elements of the nonlinear optical and electro-optic coefficients with unprecedented accuracy can be achieved for borate and mid-IR nonlinear optical crystals. In this report, I will try to extend the calculations to the properties of the practical materials related to the THz applications. The studied materials range from known borate NLO crystals such as BBO, LBO, CBO (CsB_3O_5), BiBO (BiB_3O_6), YCOB ($YCa_4O(BO_3)_3$), LCB ($La_2CaB_{10}O_{19}$), to mid-IR NLO crystal $BaGa_4Q_7$ (Q=S, Se) and organic THz crystal DAST. The mechanisms govern their properties in the THz range will be discussed and potential favorable crystals for THz applications will be proposed.

Magnon and electromagnon excitation in RFeO3 crystal probing with THz magnetooptical spectroscopy

Guohong Ma
Shanghai University

Abstract: Within the domain of spintronics, antiferromagnetism was once thought to be interesting but useless. Recently, antiferromagnetic materials have garnered significant attention since the pioneering work by Jungwirth. In contrast to ferromagnetic materials, antiferromagnetic materials exhibit a zero net magnetic moment, endowing them with an inherent immunity to external magnetic perturbations. The spin excitations within antiferromagnetic materials, exemplified by magnons, typically reside in the THz frequency spectrum, offering promising avenues for high-speed data processing.
With THz magnetooptical spectroscopy in time domain, we have investigated the temperature and magnetic field dependent excitation of magnon and electromagnon in a rare-earth orthoferrite crystal, DyNdFeO3. Our experimental results demonstrate that the R3+-Fe3+ anisotropic energy as well as the R3+-R3+ interactions can be modified by rare earth element doping, which results in a change in the spin reorientation temperature and coupling strength of the magnetoelectric effect of the compound. By altering the temperatures and applied magnetic field, we have successfully presented the magnon and electromagnon tuning in Dy0.9Nd0.1FeO3 single crystal probing with THz spectroscopy. We anticipate that our findings will contribute to the understanding of magnetoelectric coupling mechanisms and pave the way for the development of novel multiferroic materials with tailored properties.

Guohong Ma
Shanghai University

Professor 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 investigate the spin wave excitation, coherent control, and spin reorientation phase transition in RFeO3 magnets schematically.

Terahertz ultrafast physics, device and transient dynamics

Zuanming Jin
University of Shanghai for Science and Technology

Abstract: We investigated the spintronics terahertz emitters. Firstly, a non-contact accurate measurement of spin-dependent densities and momentum scattering time on the sub-picosecond timescale is realized to solve the problem that the fundamentals of magneto-transport cannot be measured. Secondly, by demonstrating and using the ultrafast anomalous Nernst effect, ultrafast demagnetization effect and inverse spin Hall effect, the all-optical ultrafast manipulation of spins on sub-picosecond timescale is realized and further used to induce broadband terahertz radiation. Thirdly, a cascaded ferromagnetic multilayer heterojunction with large size is adopted to realize a strong terahertz emitter with low cost, nanometer thickness, and flexible control of its optical field parameters.

Zuanming Jin
University of Shanghai for Science and Technology

Zuanming Jin is an associate 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 and Chen Guang Project by Shanghai Municipal Education Commission etc.

The Influence of Multidomain Stress on the Insulator-Metal Phase Transition of VO2 Driven by Strong Field Terahertz

Hao Chen[1,2] Guo-Qian Liao[1,2,3,*] Yan-Yu Wei[1,2] Ran Yan[1,2] Hong-Yuan Wu[1,2] Si-Jia Li[1,2] and Yu-Tong Li[1,2,3,*]

1.Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, China

2.School of Physical Sciences, University of Chinese Academy of Sciences, China

3.Songshan Lake Materials Laboratory, China

Abstract: The ultrafast phase transition control of quantum materials through terahertz radiation is an emerging method for manipulating material properties. Vanadium dioxide (VO2) is a strongly correlated-electron material, where the presence of multiple insulating and metallic domains results in complex stress between the domains. The first step of the strong field terahertz-induced insulator-metal phase transition in VO2 involves the charge-carrier itinerancy and localization; however, the relaxation processes on the picosecond scale are often overlooked. Here, we report on the rebound phenomenon caused by stress during the phase transition relaxation of VO2 under strong terahertz pump fields. Investigating this novel phenomenon can enhance our understanding of the microscopic phase transitions in VO2.

Generation of terahertz structured beams using tri-layered

Yan Zhang
Capital Normal University

Abstract: Terahertz radiation has many advanced characteristics. It has potential applications in wireless communication, non-destructive testing, and biological imaging. A structured beam is a light field in which the amplitude, phase, and polarization state of light have a special distribution in time and space. In the terahertz band, our home-build terahertz focal plane imaging system can simultaneously obtain the spatial distribution of frequency, amplitude, phase, and polarization state of a terahertz wavefront, providing an excellent tool for characterizing structured beams. We proposed to simultaneously control the amplitude, phase, and polarization state of terahertz wavefronts with tri-layered metasurfaces , providing an effective tool for the generation of terahertz structured beams. This presentation introduces the structural beams generated using tri-layered metasurface devices, including vector beams, spiral vector beams, and special holography. The preparation of these terahertz structured beams provides a new approach to improve the resolution of terahertz imaging, increase the channels for terahertz wireless communication, and enhance the interaction between terahertz waves and matter.

Carbon Nanotube metasurface for THz sensing applications

Yue Wang
Xi'an University of Technology

Abstract: Terahertz (THz) metasurface sensor plays an important role in environmental monitoring, biomedical diagnostics, and materials science. However, most traditional THz metasurfaces for trace biological substance detection either suffer from high ohmic loss, or cannot achieve ultra-low concentration detection at the femtomolar level, which limits the application range of THz metasurfaces. We propose a novel metasurface based on modifed single-walled carbon nanotubes (SWCNTs) flm for specifc detection of SAA protein in femtomolar concentration. We experimentally demonstrated that the sensitivity of this THz metasurface sensor for SAA protein detection is 37.5 GHz/fM. In contrast to conventional metal or dielectric metasurfaces, this new modifable metasurface can achieve the lowest detection limit of 0.1 fM, which has increased by an order of magnitude. Our results provide a new and promising method for THz metasurfaces to realize high-performance biosensors.

Yue Wang
Xi'an University of Technology

Professor Wang graduated from Harbin Institute of Technology in 2011. From 2015 to 2016, he was a Research Scholar with the College of Engineering, Boston University, Boston, MA, USA. He is currently a Professor with the Department of Applied Physics, and a Highlevel Talent, Xi'an University of Technology. From 2020, he served as the Director of the Youth Innovation Team for Terahertz Micro Nano Materials, Device Physics and Applications. He has authored 100 articles in international peer-reviewed journals. His research interests include the terahertz pulse spectroscopy of carbon-based nano-materials, antenna and propagation, surface plasmon polaritons, terahertz metamaterial and applications, and BICs at Terahertz region. He was selected as one of World's top 2% of scientists in 2023 and 2024.

Coherent Control of Terahertz Wave Generation in Semiconductors

Xinlong Xu
Northwest University

Abstract: Coherent control under two-color femtosecond laser excitation plays a significant role in atomic, molecular, and semiconductor materials. Recently, terahertz (THz) emission spectroscopy has been employed to characterize the coherent ultrafast photocurrent from semiconductor materials under two-color light excitation. However, distinguishing the contributions of various optical effects to THz radiation under normal and oblique incident excitations with two-color light remains a challenge. In this talk, we choose zinc selenide as a model semiconductor to study the THz radiation at normal and oblique incidences with two-color light excitation. Based on the dependence of the THz signal on the relative phase difference between the fundamental wave (800 nm, ω) and the second harmonic wave (400 nm, 2ω), the contribution ratio of optical rectification (OR) and four-wave mixing (FWM) to THz radiation is calculated at normal incidence. Under oblique incidence, the contribution ratio of FWM, OR, and surface depletion field (SDF) to THz radiation are also calculated. This work reveals the interplay among OR, SDF, and FWM in the coherent control of ultrafast photocurrent under femtosecond excitation.

Xinlong Xu
Northwest University

Professor Xinlong Xu received his PhD degree from Institute of Physics, Chinese Academy of Sciences. He is a professor of Optics and Condensed Matter Physics in Institute of Photonics & Photon-Technology, School of Physics, Northwest University, Xi'an, China. He is also a vice dean of the School of Physics at Northwest University. His research interest focuses on ultrafast physics, especially terahertz photonics and devices based on ultrafast laser.

Application of Terahertz Spectroscopy in Gas Detection and Analysis

Xiaojiao Deng
Tsinghua University

Abstract: A terahertz spectrometer based on frequency multiplier chain and heterodyne detection was presented. The rotational spectra of acetonitrile gas were measured with 100 kHz spectral resolution. The spectrometer demonstrated excellent spectral specificity and the extrapolated limit of detection for acetonitrile of 1.4 ppm. In addition, a spectroscopy system for gas detection based on a terahertz parallel-plate waveguide leaky-wave antenna is presented. The directional patterns of the leaky-wave antenna are demonstrated to map the absorption characteristic peaks of the acetonitrile, thus enabling an extension of the detection range. Furthermore, novel quantification and qualitative analysis method of trace gas were proposed based on broadening mechanisms.

Xiaojiao Deng
Tsinghua University

Xiaojiao Deng received the Ph.D. degree in physical chemistry from the Institute of Chemistry, Chinese Academy of Sciences, Beijing, China, in 2015. From 2016 to 2019, she was a Post-Doctoral Research Fellow with the Department of Automation, Tsinghua University, Beijing. She joined the Department of Automation, Tsinghua University, in 2019, where she is currently an Assistant Researcher. Her current research interests include the development and application of terahertz spectroscopy.

Surface-state-related carrier dynamics of GaAs determined by UV-visible pump-probe terahertz spectroscopy

Dongwei Zhai
Qingdao University

Abstract: Intrinsic electronic surface states exist at the surface of semiconductors, resulting either from the asymmetry of the electronic wavefunction at the surface, dangling bonds of the surface semiconductor atoms, or, if so, bonds between such atoms and those of an adsorbed layer. Several techniques are now available to characterize such surface electronic states. In principle, those techniques can give the absolute value of the surface state energy. However, understanding the properties of electron dynamics within the surface states is significant for semiconductors study and the development of related devices. In this work, the surface velocity and the bulk lifetime of photo-excited free carriers in GaAs were measured using an optical-pump and THz-probe time-domain technique. By varying the pump laser photon energy from 1.56 to 4.15 eV, we observe that the surface velocity drops abruptly from 0.7*106 cm/s down to 0.2*106 cm/s at 2.5 eV, while the bulk lifetime remains almost constant. We tentatively explain this step-like behavior of the surface velocity vs the photon energy by a trapping of the free carriers at surface states, whose density of states shows a maxi- mum at 2.5 eV.

Dongwei Zhai
Qingdao University

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, etc. He has given 12 talks on international conferences and published 10 articles on APL, OE, IEEE journals. Now, he is an Assis. prof in Qingdao University, working on ultra-broadband THz spectroscopy.

Multi-level organization of carbon nanotubes for advanced THz optics

Dmitry V. Krasnikov
Skolkovo Institute of Science and Technology, Russia

Abstract: The unique set of mechanical, electrical, and optical features of carbon nanotubes has inspired scientists and engineers for several decades to create new materials and devices in various fields of our civilization: from medicine to aerospace, from telecommunications to construction technologies. Significant progress in the field of functional materials ensures the gradual introduction of nanotubes into such scientific and technological products as antistatic coatings, lithium-ion batteries and polymer composites; nevertheless, the development of carbon nanotube-based devices in optoelectronics and biomedicine lacks in performance. This is mostly related to insufficient control on nanotube properties. Here we report our recent advances on tuning carbon nanotubes to create an element base in the THz range. By identifying five levels of material organization ("individual nanotubes", "nanotube agglomerates", "network of agglomerates", "structured assembly", "system of assemblies"), we transform the polyphony of properties of carbon nanotubes to THz create modulators, sensors etc. The authors thank the joint Skoltech-MIPT-ITMO program "Clover".

Dmitry V. Krasnikov
Skolkovo Institute of Science and technology, Russia

Prof. Krasnikov graduated from Novosibirsk State University (2012) and got his PhD in Chemistry (kinetics and catalysis) at Boreskov Institute of Catalysis (2016). Since 2017 he has been working in the Laboratory of Nanomaterials at Skoltech; he joined Aalto University as a visiting researcher (2019, 2021, 2022 (cancelled)). Dmitry is a specialist in the field of physical chemistry, aerosol science, and catalysis, with extensive experience in the synthesis and characterization of carbon nanomaterials (h-index=25; 88 articles; 2 books and 6 patents). He has teaching experience on the topics of applied physics of aerosol science, catalysis, and chemical kinetics). He has been distinguished with numerous professional awards and stipends: Alferov award, RF president stipend, Moscow Government priz award, European Council of Catalysis, etc. Dmitry has extensive experience in the successful (co-)supervision of students and postgraduates: 2 BSc diplomas, 18 MSc and 6 PhD theses. Dr. Dmitry V. Krasnikov is an Assistant Professor at the Center for Photonic Science and Engineering of Skolkovo Institute of Science and Technology.

Ultrafast Dynamics of Liquid Water Induced by Strong Terahertz Field

Yanyu Wei[1,2], Jieya Ruan[1,2], Guoqian Liao[1,2,3*] and Yutong Li[1,2,3*]
1.Institute of Physics, Chinese Academy of Science, China;
2.University of Chinese Academy of Sciences, China;
3.Songshan Lake Materials Laboratory, China

Abstract: Liquid water at room temperature exhibits ultrafast molecular motions and complex dynamic behavior. The hydrogen bonds connecting water molecules have characteristic energies and intrinsic motion frequencies that fall within the terahertz(THz) frequency range.THz radiation is a unique tool for probing and manipulating the ultrafast dynamics of water molecules. We developed an experimental platform based on a strong THz field pump-weak THz field probe setup driven by intense ultrashort laser pulses, along with a dual-filament-guided continuous liquid film generation system. Using single-shot THz nonlinear spectroscopy, we investigated the ultrafast dynamics of the interaction between intense THz pulses and water. Experimental results reveal distinct relaxation evolution patterns in the THz dielectric properties of water under varying THz pump field strengths, reflecting a synergistic competition between solvated electron behavior and water molecular motions induced by the strong THz field. Based on the Drude-Lorentz theory and the Clausius-Mossotti relation, we simulated and analyzed the frequency-domain absorption characteristics, delocalization radius, and scattering rate of solvated electrons, based on models involving strong THz-field-induced water molecule dynamics and local solvated electrons, effectively explaining the experimental phenomena. This study provides insight into the ultrafast dynamics of liquid water molecules, presenting a new approach through THz pump-THz probe technology.

November 16th, Huang Pu Hall B（黄埔 B 厅）

Presider: **Chang Wang,** Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

Time	Title/Speaker
13:30-14:00	**Generation and applications of strong terahertz bursts with ultraintense laser pulses** **Yutong Li** *Keynote* Institute of Physics, Chinese Academy of Sciences
14:00-14:30	**Intense terahertz wave generation from air plasma induced by femtosecond laser** **Liangliang Zhang** *Keynote* Capital Normal University
14:30-14:50	**Title:TBA** **Yanping Chen** *Invited* Shanghai Jiao Tong University
14:50-15:10	**Probing the Higgs modes in superconductors by Nonlinear Terahertz Spectroscopy** **Tao Dong** *Invited* Peking University
15:10-15:30	**The interdigitated THz metamaterial sensors and high-power THz resonant-tunneling-diode (RTD) oscillator arrays** **Fanqi Meng** *Invited* Goethe University Frankfurt
15:30-15:45	**Enhancement of Terahertz Emission in Gallium Telluride Under Pressure** **Kai Zhang[1], Fuhai Su[2*], Tianwu Wang[1*]** *Oral* 1.GBA branch of Aerospace Information Research Institute, Chinese Academy of Sciences; 2.Key Laboratory of Materials Physics, Institute of Solid State Physics, HFIPS, Chinese Academy of Sciences
15:45-15:55	Coffee Break
Presider: **Liangliang Zhang,** Capital Normal University	
15:55-16:25	**GW-TW terahertz radiation interactions with matter** **Guoqian Liao** *Keynote* Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences
16:25-16:55	**Material insights enabled by ultra-broadband THz spectroscopy** **Binbin Zhou** *Keynote* Technical University of Denmark
16:55-17:15	**Semiconductor terahertz photonics devices and their imaging applications** **Chang Wang** *Invited* Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
17:15-17:35	**All-Optical Attoclock Based on Terahertz Emission** **Zhihui Lyu** *Invited* National University of Defense Technology

17:35-17:55	**Sub-wavelength Terahertz Imaging based on a Cross-Filament** **Xinke Wang** *Invited* Capital Normal University
17:55-18:10	**Tunable terahertz BIC resonance based on the 3D Dirac semimetal elliptical resonators** **Xiaoyong He, Hao Zhang** *Oral* Mathematics & Science College, Shanghai Normal University
18:10-18:25	**Gate-tunable Fresnel zone plate based on single-wall carbon nanotubes for terahertz frequency applications.** **Arina Radivon[1*], Gleb Katyba[2,3], Nikita Raginov[4], Aleksey Chernykh[5], Aleksei Ezerskii[5], Elizaveta Tsiplakova[5], Ignat Rakov[4], Maksim Paukov[1], Vladimir Starchenko[1], Aleksey Arsenin[1], Igor Spector[2], Kirill Zaytsev[2], Dmitry Krasnikov[4], Nikolay Petrov[5,6], Albert Nasibulin[4], Valentyn Volkov[1], Aram Mkrtchyan[4], Maria Burdanova[1,3]** *Oral* 1.Moscow Institute of Physics and Technology; 2.Prokhorov General Physics Institute of the Russian Academy of Sciences; 3.Institute of Solid State Physics of the Russian Academy of Sciences; 4.Skolkovo Institute of Science and Technology; 5.ITMO University; 6.Qingdao Innovation and Development Center

November 17th, Huang Pu Hall B（黄埔 B 厅）

Presider: **Jianqiang Gu,** Tianjin University

Time	Title/Speaker
13:30-14:00	**Title:TBA** **Aleksandar D. Rakic** *Keynote* The University of Queensland, Australia
14:00-14:30	**Probing spatiotemporal beating of van der Waals hyperbolic polaritons** **Peining Li** *Keynote* Huazhong University of Science and Technology
14:30-14:50	**Reaching the atomic scale with sub-cycle terahertz microscopy** **Tom Siday** *Invited* University of Birmingham, U.K.
14:50-15:10	**Passive terahertz near-field nanoscopy of hot electrons in working devices** **Qianchun Weng** *Invited* Shanghai Institute of Technical Physics, Chinese Academy of Sciences
15:10-15:25	**Terahertz imaging identifies characteristics of cariogenic microbia in the oral cavity** **Aopeng Zhang[1], Lei Lei[1], li Cheng[1], Haowei Yin[2], Chenchen Zhang[1], Jingjing Luo[1], Fanglong Wu[1], Min Hu[2*], Ran Cheng[1*], Tao Hu[1*]** *Oral* 1.West China School of Stomatology, Sichuan University; 2.Terahertz Research Center, School of Electronic Science and Engineering, Key Laboratory of Terahertz Technology of Ministry of Education, University of Electronic Science and Technology of China
15:25-15:40	**Coffee Break**

Presider: **Tom Siday,** University of Birmingham, U.K.

15:40-16:10	**Enhancement and Manipulation of Terahertz Emission from a Meta-Photoconductive-Antenna** **Jianqiang Gu** *Keynote* Tianjin University

16:10-16:30	**Terahertz scanning tunneling microscopy for locally generating excited states and surface nano-manufacturing** **Ikufumi Katayama** *Invited* Yokohama National University, Japan
16:30-16:50	**Study of glioma detection based on terahertz wave and Raman spectroscopy tech-nology** **Yuye Wang** *Invited* Tianjin University
16:50-18:30	**Poster Session**
18:30-20:30	**Banquet**

November 18th, Huang Pu Hall B（黄埔 B 厅）

Presider: **Heyuan Guan,** Jinan University

Time	Title/Speaker
08:30-09:00	**Title:TBA** **Tian Jiang** *Keynote* National University of Defense Technology
09:00-09:20	**THz imaging array based on glow discharge detectors** **Lei Hou** *Invited* Xi 'an University of Technology
09:20-09:40	**Title:TBA** **Zhensheng Tao** *Invited* Fudan University
09:40-10:00	**Heterogeneous integrated optical modulators** **Junjia Wang** *Invited* Southeast University
10:00-10:20	**THz Applications in Crystallography and Exploration of THz-generation Inorganic Crystals** **Feng Zhang** *Invited* Xinjiang Technical Institute of Physics and Chemistry, Chinese Academy of Sciences
10:20-10:35	**Coffee Break**

Presider: **Lei Hou,** Xi 'an University of Technology

10:35-11:05	**Title:TBA** **Heyuan Guan** *Keynote* Jinan University
11:05-11:25	**Plasma-based Terahertz Modulation** **Yindong Huang** *Invited* National Sciences Institute of Innovation
11:25-11:45	**Terahertz Chiral Metasurfaces: Fundamentals and Applications** **Jie Li** *Invited* Chengdu University of Information Technology
11:45-12:00	**Spectral Characteristics of Nucleotides and Terahertz Sensing of Uridine Nucleotide Solutions** **Guozhong Zhao** *Oral* Capital Normal University

Generation and applications of strong terahertz bursts with ultraintense laser pulses

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 have systematically studied strong THz radiation from solid targets driven by ultraintense laser pulses. The experiments were performed with femtosecond and picosecond laser facilities respectively. The energetic MeV fast electron beams accelerated by the high intensity laser pulses are the origin for the THz radiation. When the forward electrons reach the target rear surface, THz radiation can be induced due to transition radiation. We have demonstrated the total energy of THz pulses emitted from the target rear is up to ~200 mJ, giving a peak power upto ~Terawatt, when using 60J ps driving laser beam. We have tried to use the laser-plasma interactions based THz radiation to study the fast electron dynamics, water and protein dynamics.

Yutong Li
Institute of Physics, Chinese Academy of Sciences

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.

Intense terahertz wave generation from air plasma induced by femtosecond laser

Liangliang Zhang
Capital Normal University

Abstract: Terahertz (THz) sources generated using an air-excited plasma have been extensively studied because of their high performance and extensive applications. We propose a THz emission system using three-color lasers with adjustable near-infrared wavelengths obtained using an OPA, its SH, and an additional 800 nm ultrafast pulse. We demonstrate a large stable THz enhancement of the near-infrared two-color fields after the addition of the 800 nm laser. Moreover, we obtained the variation trends of the THz strengthening effect with important parameters in the system such as the polarizations and energies of the lasers, and then analyzed the optimal conditions for the maximum THz enhancement. The modulation of the THz spectral energy distribution and central frequency shifting after the addition of an 800 nm pulse could provide valuable insights for the generation of THz radiations with specific frequency distributions for certain purposes.

Liangliang Zhang
Capital Normal University

Liangliang Zhang is a professor of Capital Normal University, China. Her research interests include strong terahertz aqueous and air photonics. She has published over 100 papers in scientific journals, including the top journals such as Physical Review Letters and Light. She won the award of National Excellent Doctoral Dissertation of China and the First Prize of Scientific Research Excellence Award from the Chinese Ministry of Education. She took charge of the Beijing Science Foundation for Distinguished Young Scholars, the Youth Beijing Scholar Program of the Beijing Government, etc. She is now a topical editor for Journal of the Optical Society of America B (JOSA B).

Probing the Higgs modes in superconductors by Nonlinear Terahertz Spectroscopy

Tao Dong
Peking University

Abstract: The superconducting (SC) state can be described by a complex order parameter with spontaneously broken U(1) symmetry, whose free energy is given by the Mexican hat potential. The Higgs collective mode corresponds to the amplitude oscillation of the order parameter, while the phase mode corresponds to the longitudinal fluctuation of the order parameter. The advent of a strong field terahertz (THz) source enables the detection of the Higgs mode of the superconductivity order parameter either with a free oscillation in a monocycle THz quenching or with a forced oscillation in a multicycle driving. The Higgs modes of superconductivity also can serve as a sensor for studying the interaction between the superconductivity and exotic orders in unconventional superconductors. In this talk, I will present our recent work on the Higgs mode detection and its interaction with pseudogap phase in cuprate superconductors by nonlinear THz spectroscopy.

Tao Dong
Peking University

Tao Dong is now a research associate professor at the International Center for Quantum Materials, Peking University. He got his Ph.D. from the Institute of Physics (IOP), Chinese Academy of Science, in January 2014. Then he worked in Prof. Nanlin Wang's group as a research associate. One year later (2015.01), he moved to Peking University and worked as a research assistant professor. During 2018.07-2020.03, he did this postdoc research in Prof. Jure Demsar's lab at the Johannes Gutenberg University in Mainz as a Humboldt postdoctoral fellow.

The interdigitated THz metamaterial sensors and high-power THz resonant-tunneling-diode (RTD) oscillator arrays

Fanqi Meng[1], Lei Cao[2], Yannik Loth[3], Merle Richter[3], Anna Katharina Wigger[3], Maira Pérez Sosa[4], Alaa Jabbar Jumaah[4], Shihab Al-Daffaie[4], Zhenling Tang[5], Jahnabi Hazarika[1], Petr Ourednik[6], Michael Feiginov[6], Safumi Suzuki[5] Peter Haring Bolívar[3], and Hartmut G. Roskos[1]

1.Physikalisches Institute, Goethe University Frankfurt, 60438 Frankfurt am Main, Germany
2.State Key Laboratory of Advanced Electromagnetic Engineering and Technology, Huazhong University of Science and Technology, Wuhan, China
3.University of Siegen, Institute for High Frequencies and Quantum Electronics, Siegen, Germany
4.Department of Electrical Engineering, Eindhoven University of Technology, 5612 AE Eindhoven, Netherlands
5.Department of Electrical and Electronic Engineering, Tokyo Institute of Technology, Tokyo, Japan
6.Department of Electrical Engineering and Information Technology, TU Wien, Vienna 1040, Austria

Abstract: In the first part of this contribution, we present a strategy to design metamaterial sensors in detecting small amounts of dielectric materials and trace molecules. The amount of frequency shift depends on intrinsic properties (electric field distribution, Q-factor, and mode volume) of the bare resonator, as well as the overlap volume of its high-electric-field zone(s) and the analyte. Guided by the simplified dielectric perturbation theory, we designed interdigitated electric split-ring resonators (ID-eSRR) to significantly enhance the detection sensitivity compared to eSRRs without interdigitated fingers [1]. The measurements demonstrate a remarkable 33.5~GHz frequency shift upon depositing a 150~nm SiO_2 layer, with a figure of merit (FOM) improvement of over 50 times compared to structures without interdigitated fingers. This rational design offers a promising avenue for highly sensitive detection of thin films and trace biomolecules.

In the second part of the abstract, we will discuss the high-power THz emission from resonant-tunneling-diode (RTD) oscillator arrays. The RTD oscillators possess the highest oscillation frequency among all electronic THz emitters. However, the emitted power from RTD oscillators remains limited. Here, we demonstrate a novel linear RTD oscillator arrays and achieve high power coherent emission [2]. Both in-phase and anti-phase coherent emission from the 11-RTD oscillators array were observed. The anti-phase mode oscillates at approximately 450 GHz with maximum power of about 400 μW, while the in-phase mode oscillates at around 750 GHz with maximum power of about 1 mW. Moreover, certain RTD oscillator arrays demonstrate dual-frequency band oscillation under different biases, allowing for controllable switching between two coherently coupled modes. Our linear RTD oscillator array represents a significant step forward in the realization of high-power large RTD oscillator arrays at high frequencies, and enables large-scale applications of high-power, high-frequency electronic THz emitters.

Enhancement of Terahertz Emission in Gallium Telluride Under Pressure

Kai Zhang[1,2,3], Fuhai Su[3], and Tianwu Wang[1,2*]

1. GBA branch of Aerospace Information Research Institute, Chinese Academy of Sciences, Guangzhou 510700, China
2. Guangdong Provincial Key Laboratory of Terahertz Quantum Electromagnetics, Guangzhou, 510700, China
3. Key Laboratory of Materials Physics, Institute of Solid State Physics, HFIPS, Chinese Academy of Sciences, Hefei 230031, China

Abstract: Transient terahertz responses and terahertz emission performances for the GaTe under pressure are examined by timeresolved terahertz spectroscopy. The terahertz emission strength rockets with increasing pressure whereas rapidly declines above 10 GPa, implying the insulator-metal transition. Decay time of the pumped hot carriers also shows incontinuity at the corresponding pressure.

GW-TW terahertz radiation interactions with matter

Guoqian Liao
Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences

Abstract: Recently, GW-TW THz radiation has been demonstrated experimentally by high-power laser pumping nonlinear crystals or via high-intensity laser interactions with plasmas, offering a unique platform for the study of strong-field few-cycle THz wave – matter interactions. In this talk, we report some recent progresses on the GW-TW THz interactions with different media including solids, liquids, gases and plasmas. For solid materials, the THz-field-induced ultrafast insulator-to-metal transition in vanadium dioxide is achieved without metamaterials for the local field enhancement. For liquid samples, the THz field-induced ultrafast heating and electron solvation of water are observed. For gases, the THz ionization-induced self-action focusing at a power much lower than the well-known critical power for Kerr self-focusing is studied. Such extreme THz - matter interactions exhibit distinct behaviors or features from the conventional near-infrared cases.

Guoqian Liao
Institute of Physics, Chinese Academy of Sciences

Guoqian Liao is currently an Associate Professor at the Institute of Physics, Chinese Academy of Sciences. His recent research interest focuses particularly on the ultraintense laser-driven terahertz radiation and its applications. He has authored and co-authored more than 50 papers, including 5 first-authored papers published in PRL, PNAS and PRX.

Material insights enabled by ultra-broadband THz spectroscopy

Binbin Zhou
Technical University of Denmark

Abstract: This presentation will discuss recent advances in our femtosecond laser-induced air-plasma-based ultra-broadband THz platform. We will begin by introducing the fundamental principles of this unique THz spectroscopy platform, followed by some of our latest developments. The focus will then shift to key spectroscopy applications on different material systems with the advantageous THz platform, showcasing how this powerful platform can probe the intrinsic optoelectronic properties of thin-film selenium and uncover the complex carrier-phonon coupling dynamics in strongly correlated materials.

Binbin Zhou
Technical University of Denmark

Binbin Zhou is an Associate Professor at the Technical University of Denmark (DTU), specifically within the Department of Electrical and Photonics Engineering. With a background in ultrafast infrared and terahertz science, Dr. Zhou's research focuses on advanced spectroscopy techniques and their applications.

Semiconductor terahertz photonics devices and their imaging applications

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

Abstract: Terahertz (THz) quantum cascade lasers (QCLs) and quantum well detectors (QWPs) developed based on the inter-subband transition mechanism of quantum wells are important radiation sources and detection devices 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, space communication, and spectral detection. 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 rate equations are developed to study the QCL dynamics under optical injection and optical feedback. The results give a deep insight into the physics of QCL and can be used to optimize device designs. The fabricated THz QCLs can realize a maximum peak power of 1.40 W in pulse mode. Using THz QCL as the source and QWP as the detector, a scattering-type scanning near-field optical microscope has been developed with a spatial resolution of about 95 nm.

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

Wang Chang received the Bachelors degree in microelectronics from East China Normal University in 2002 and the Doctorate degree in in microelectronics and solid-state electronics from the 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.

All-Optical Attoclock Based on Terahertz Emission

Zhihui Lyu
National University of Defense Technology

Abstract: The contentious debate over whether tunneling ionization requires time significantly impacts the development of attosecond and strong-field physics, as well as other specialized fields, while challenging the foundational theories of quantum mechanics. Attoclock, a technique that obtains time delays by measuring the electron momentum distributions during strong-field ionization, provides a critical tool for studying ultrafast electron dynamics in atoms.

This report, based on precise measurements of terahertz emission from atoms in strong fields, investigates tunneling ionization of atoms in two-color fields. We have achieved all-optical measurements of this fundamental physical process with temporal precision down to 10^-17 seconds. A more precise, non-invasive experimental method for studying tunneling ionization has been introduced. This method integrates terahertz technology with precision measurements in atomic and molecular physics, deepening the understanding of tunneling phenomena.

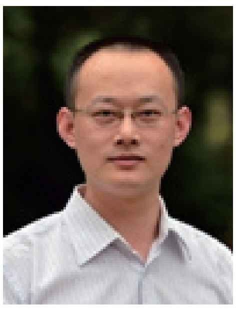
Zhihui Lyu
National University of Defense Technology

His primary research emphasis is on terahertz technology and strong-field physics. Over the past five years, he has spearheaded five national and ministerial-level projects, and contributed to three major national initiatives. With 24 publications and four invention patents to his name, his work has made substantial contributions to fields including terahertz radiation, high harmonic generation, terahertz polarization detection, and single-shot measurement techniques. His achievements have been recognized with the prestigious First Prize for Natural Science in Hunan Province.

Sub-wavelength Terahertz Imaging based on a Cross-Filament

Xinke Wang
Capital Normal University

Abstract: Because of the unique advantages of terahertz (THz) near-field techniques, the imaging technology has attracted considerable attention. However, in traditional THz near-field techniques, it has been necessary to approach the sample surface with a THz detector or source, such as a metallic aperture, scattering tip, film photo-modulator, spintronic THz emitter, or micro-structured photo-conductive antenna. This problem has restricted the wider applications of THz near-field microscopy in some fields, e.g., biomedical sensing and chemical inspection. Here, a new approach was developed for THz near-field microscopy based on a cross-filament. The cross-filament was formed by two crossed air-plasmas, which opened a micron-scale dynamic aperture to modulate the intensity of a THz beam on a sample surface. By using this technique, THz near-field information can be acquired without approaching the sample surface. To demonstrate the feasibility of this technique, sub-wavelength THz imaging of different materials was achieved, such as metallic, semiconductor, plastic, and biological samples. The advantages of the technique are expected to accelerate the advancement of THz microscopy.



Xinke Wang
Capital Normal University

Prof. Dr. WANG Xinke is from Department of Physics, Capital Normal University, Beijing. Prof. WANG's research activities are focused on THz imaging technology and THz metasurface. Prof. WANG has published more than 30 peer reviewed papers, including Light: Science & Applications, Advanced Optical Materials, Optics Letters, Optics Express, Applied Physics Letters etc. His researches received the support from National Natural Science Foundation of China and Beijing Natural Science Foundation etc. In addition, he has received 4 patents and 3 research awards.

Tunable terahertz BIC resonance based on the 3D Dirac semimetal elliptical resonators

Xiaoyong He[1,2,*], Hao Zhang[1]
1.Department of Physics, Mathematics & Science College, Shanghai Normal University, No. 100 Guilin Road, China;
2.Shanghai Key Lab for Astrophysics, No. 100 Guilin Road, Shanghai, China

Abstract: Nowadays, terahertz (THz) waves show potential applications in the fields of high-speed 6G wireless communication, sub-millimeter astronomical observation and medical imaging. However, due to the relatively long wavelength and large carrier absorption, it is highly difficulty to manipulate THz waves conveniently. Artificially made of subwavelength resonators, metasurfaces are capable of effectively regulating the electro-magnetic properties of incident waves, which provides a good platform to design tunable functional devices with fine performances. Inhibiting the peculiarity of linear dispersion, high carrier velocity, and dynamical control of conductivity, 3D Dirac semimetals (DSM) acts as an efficient tunable medium. Based on the elliptical resonators, the tunable quasi-bound in continuum (BIC) resonant curves with high Q-factors have been investigated in the THz region. The results shows that with the tilted elliptical resonators, a sharp transmission resonant dip with a Q-factor of more than 60 is excited. At large Fermi level, the refection contributes more to the transmission dip. When the Fermi level changes in the scope of 0.01-0.15 eV, the amplitude and frequency modulation depths reach more than 92% and 40%, respectively. Additionally, with the modified configurations of elliptical resonators, another transmission dip resonance is excited and indicates a red shift with the increase of the permittivity of the dielectric filling material. The results are very useful to design novel tunable plasmonic devices, e.g. modulators, filters and sensors.

Gate-tunable Fresnel zone plate based on single-wall carbon nanotubes for terahertz frequency applications.

A.V.Radivon[1], G.M.Katyba[2,3], N.I.Raginov[4], A.V.Chernykh[5], A.S.Ezerskii[5], E.G.Tsiplakova[5], I.I.Rakov[4], M.I.Paukov[1], V.V.Starchenko[1], A.V.Arsenin[1], I.E.Spector[2], K.I.Zaytsev[2], D.V.Krasnikov[4], N.V.Petrov[5,6], A.G.Nasibulin[4], V.S.Volkov[1], A.A.Mkrtchyan[4] M.G.Burdanova[1,3]
1.Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Dolgoprudny, Russia
2.Prokhorov General Physics Institute of the Russian Academy of Sciences, Moscow, Russia
3.Institute of Solid State Physics of the Russian Academy of Sciences, Chernogolovka, Russia
4.Skolkovo Institute of Science and Technology, Moscow, Russia
5.ITMO University, St. Petersburg, Russia
6.Qingdao Innovation and Development Center, Harbin Engineering University, Qingdao, China

Abstract: Fresnel zone plates (FZP) made of thin films of single-walled carbon nanotubes (SWCNT) are proposed as tunable diffraction elements in the terahertz frequency range. This thin-film lens is made by the dry transfer method, which allows any picture to be obtained from carbon nanotubes using a pattern. Signal modulation of about 30% at a frequency of 327 GHz by gating from -2 to +2 V was demonstrated. The obtained results will help to solve the problem of the lack of tunable devices in the terahertz frequency range.
Authors acknowledge the Russian Science Foundation project No. 24-79-00143 and ITMO-MIPT-Skoltech Clover initiative.

Probing spatiotemporal beating of van der Waals hyperbolic polaritons

Peining Li
Huazhong University of Science and Technology

Abstract: Polaritons, collective excitations formed by the coupling of photons with oscillating charges, in anisotropic materials provide a new way to manipulate light at nanoscale. Polaritons waves propagates in anisotropic material display a number of characteristic features. The ray-like propagation is one of the most important features of hyperbolic phonon polaritons since it can lead to out-of-plane hyper-focusing. These features are due to polaritons in anisotropic materials exhibit hyperbolic dispersion that in such materials the real-part dielectric permittivity tensor along orthogonal principal axes have opposite signs. Hyperbolic media support large-k hyperbolic polaritons and the superposition of these modes form ray. Here, we used infrared nanoimaging to study the ray like propagation in Boron nitride which is one of the hyperbolic materials in spatiotemporal domain. Our results deepen the understanding of the ray-like propagation of HPs that are vital to rich phenomena in nanophotonic applications.

Reaching the atomic scale with sub-cycle terahertz microscopy

Tom Siday
University of Birmingham, U.K.

Abstract: Measuring the interactions between light and matter over the smallest possible length- and timescales has been a long-sought goal across condensed matter physics and optics. By exploiting evanescent fields confined to miniscule objects, near-field microscopy can access light-matter interaction on nanometer length scales and with femtosecond time resolution [1]. In this talk, I will first discuss several recent applications of terahertz near-field microscopy for sampling ultrafast dynamics in quantum materials. Then, I will discuss a fundamentally new paradigm for ultrafast microscopy which exploits strong atomic nonlinearities within optical near-fields. In doing so, simultaneous atomic-scale spatial resolution and subcycle time resolution become possible for the first time [2]. This emergent nonlinear response originates from electromagnetic radiation emitted by tunnelling currents flowing in response to the THz electric field [3,4]. This fundamentally new imaging mechanism - near-field optical tunnelling emission (NOTE) - provides the first subcycle videography of atomic-scale quantum dynamics.

[1] M. Plankl et al., “Subcycle contact-free nanoscopy of ultrafast interlayer transport in atomically thin heterostructures”, Nat. Photonics, 15, 594 (2021).
[2] T. Siday et al., “All-optical subcycle microscopy on atomic length scales”, Nature, 629, 329 (2024).
[3] T. L. Cocker et al., “An ultrafast terahertz scanning tunnelling microscope”, Nat. Photonics, 7, 620 (2013).
[4] T. L. Cocker et al., “Tracking the ultrafast motion of a single molecule by femtosecond orbital imaging”, Nature, 539, 263 (2016).

Tom Siday
University of Birmingham

Dr Tom Siday received a Master of Physics degree from the University of York (2015) and completed his PhD in Electronic & Electrical Engineering at University College London (2020). After his PhD, Tom spent 3 years (2019-2022) as a Postdoctoral Researcher at the University of Regensburg, Germany, then returned to the UK as a Postdoctoral Researcher and Junior Research Fellow at the University of Oxford and Somerville College (2023-2024). Now, Tom is an Assistant Professor at the School of Physics and Astronomy, University of Birmingham.

Passive terahertz near-field nanoscopy of hot electrons in working devices

Qianchun Weng
Shanghai Institute of Technical Physics, Chinese Academy of Sciences

Abstract: Hot electrons, which accelerate, scatter, and dissipate energy at the nanoscale, play a crucial role in modern microelectronic and optoelectronic devices. Despite recent advances in infrared and terahertz (THz) near-field microscopes and sensitive nanothermometry techniques, direct real-space imaging of hot electrons in working devices remains challenging. In our group, we developed an ultrasensitive passive terahertz near-field microscope that does not rely on external light excitation for imaging. This specific near-field microscope, now referred to as the scanning noise microscope (SNoiM), can visualize hot electrons in nanoscale devices by detecting evanescent fields generated by ultrahigh frequency current fluctuations. I will describe the uniqueness and general significance of this method, as well as our recent efforts to develop a cryogenic version of SNoiM (Cryo-SNoiM) for low-temperature imaging applications.

Qianchun Weng
Shanghai Institute of Technical Physics, the Chinese Academy of Sciences

Qianchun Weng is currently a full professor at the Shanghai Institute of Technical Physics (CAS) and the deputy director of Key Laboratory for Infrared Physics. From 2016 to 2019, he was a JSPS Research Fellow at the University of Tokyo. From 2019 to 2022, he served as a Special Postdoctoral Research Fellow at RIKEN. Starting in 2022, he become an independent PRESTO researcher at Japan Science and Technology Agency (JST). He was a recipient of several awards including the Encouragement Award from Kao Foundation for Arts and Sciences, and R&D Encouragement Award from NF Foundation (Japan). He is an expert in infrared photon detection and passive super-resolution imaging.

Terahertz imaging identifies characteristics of cariogenic microbia in the oral cavity

Aopeng Zhang[1], Lei Lei[1], Li Cheng[1], Haowei Yin[2], Chenchen Zhang[1], Jingjing Luo[1], Fanglong Wu[1], Min Hu[2], Ran Cheng[1], Tao Hu[1]

1.State Key Laboratory of Oral Diseases & National Center for Stomatology & National Clinical Research Center for Oral Diseases, West China Hospital of Stomatology, Sichuan University, China.

2.Terahertz Research Center, School of Electronic Science and Engineering, Key Laboratory of Terahertz Technology of Ministry of Education, University of Electronic Science and Technology of China, China.

Abstract: The characterization differences among Streptococcus, Streptococcus mutans, and Streptococcus mutans-Candida albicans co-cultures were investigated using terahertz-scattered scanning near-field optical microimaging. Methods: A 0.1-0.3 terahertz octave module served as the emission source, scanning point by point via the nanoprobe tip to interface with the sample. Further noise reduction was implemented on the raw images with a dual-core Gaussian filter. Results: Terahertz s-SNOM yields terahertz near-field microscopy pictures and bacterial signature spectra. The near-field microscopic pictures align with those obtained from the SEM. There are minor variations in the typical spectra of various streptococcal strains and genetically altered strains. Enhanced noise reduction on the raw image facilitates the acquisition of information regarding the internal structure of the strain (e.g., cell wall thickness). Conclusion: Terahertz s-SNOM can provide characteristics of oral microorganisms, including sample size, extracellular matrix, ultrastructural images of internal structures (e.g., cell wall thickness), and distinctive spectra of the samples.

Enhancement and Manipulation of Terahertz Emission from a Meta-Photoconductive-Antenna

Jianqiang Gu
Tianjin University

Abstract: Photoconductive antennas (PCAs) are the most significant and widely applied terahertz (THz) sources which significantly advance the development of THz technology. However, the relatively low power of PCAs have consistently hindered the extension of THz applications. This report conducts an in-depth analysis of the propagation laws of various THz modes radiated by a PCA, pointing out that the dissipation of THz waves along the coplanar lines leads to a significant waste of PCA radiation efficiency. In a recent achievement of the speaker, the wasted THz energy in a H-dipole antenna is collected by integrating metallic meta-atoms onto the coplanar lines. The presented Meta-PCA exhibits a 17-fold increase in radiation power and achieves power enhancement across the entire THz band of interests. This research provides new insights for the R&D of next-generation THz sources.

Jianqiang Gu
Tianjin University

Jianqiang Gu received his Ph.D. from Tianjin University in 2010 and is a professor at the Center for Terahertz Waves, Tianjin University. His research is mainly focused on terahertz spectroscopy, terahertz metasurface, and photoconductive antenna. He has achieved highly original accomplishments in the fields of near-field terahertz combs, liquid crystal elastomer metasurfaces, meta-photoconductive THz sources, THz spatial mode division multiplexing, and high-Q THz devices.

Terahertz scanning tunneling microscopy for locally generating excited states and surface nano-manufacturing

Ikufumi Katayama
Yokohama National University, Japan

Abstract: Terahertz (THz) spectroscopy is widely utilized due to its ability to visualize dynamical properties of materials, such as plasma responses, phonon absorptions, and magnetic properties. However, investigating and controlling nanoscale material properties using THz waves is challenging because the diffraction limit of THz waves is on the order of sub-millimeter scales. Here, by combining THz time-domain spectroscopy with scanning tunneling microscopy (STM), we demonstrated nanoscale spatial resolution of THz-induced luminescence spectroscopy and surface nano-manufacturing. In the experiment, we generated intense THz waves using a LiNbO3 prism excited by pulse-front tilted femtosecond pulses. The generated THz waves were directed onto an STM, and the resultant tunneling current, luminescence, and changes in surface morphology were investigated. When applied to metallic substrates, the tunneling current was successfully induced by the terahertz irradiation, indicating the possibility of electron injection and/or extraction to/from the material surface. Furthermore, plasmonic luminescence from the metal surface was observed, indicating electron-induced photon emission. In the case of phase change materials, we demonstrated nanoscale surface modification and subsequent phase change. The results demonstrate the promising capability of the THz-STM system for investigating and controlling nanoscale material dynamics.

Study of glioma detection based on terahertz wave and Raman spectroscopy technology

Yuye Wang
Tianjin University

Abstract: Glioma is the most common primary intracranial tumor. Rapid and high-sensitive diagnosis is an important prerequisite for precise treatment in neurosurgery. In this work, the THz attenuated total reflection (ATR) imaging system based on solid immersion lens (SIL) was proposed. The imaging resolution can be up to 120 μm×140 μm by designing and optimizing the structure of SIL and THz imaging window. Compared with the visual and H&E-stained images, the accurate identification of glioma tissue boundary was realized. Moreover, the THz and low-wavenumber theoretical spectra of the glioma biomarker γ-aminobutyric acid (GABA) were simulated with solid-state density function theory, respectively. The calculated results were in good agreement with the experimental observations. On the basis of calculated result, the low-frequency characteristics of GABA was analyzed by combining the THz and low-wavenumber Raman spectroscopy . It is beneficial for the structural information analysis and quantitative identification of biomarker GABA in early-stage diagnosis of glioma.

Yuye Wang
Tianjin University

Yuye Wang is currently a professor in Tianjin University, China. She also serves as a visiting scientist at RIKEN, Japan. She has published 4 books, and is the author and coauthor of more than 140 refereed journal articles in terahertz technology, nonlinear optics, and high-power laser. Her current research interests include optical terahertz-wave source, terahertz-wave imaging and spectroscopy application, and Raman spectroscopy application.

THz imaging array based on glow discharge detectors

Lei Hou
Xi 'an University of Technology

Abstract: Terahertz (THz) detector arrays are very rare and have the shortcomings of high prices, limited sensitivity now. We have optimized and enhanced the performance of single glow discharge THz detector. Based on the previous research, glow discharge detector arrays that can be used for THz focal plane imaging are developed.

The dimensions, power supply, and pickup circuit of the detector array were investigated, and it was found that the responsivity increases with the decrease of electrode size. When the electrode gap is reduced to several hundred microns, a high responsivity and a stable discharge can still be obtained. A power supply with a buffer absorption circuit was designed, which can effectively suppresses the high-frequency noise and improves the signal-to-noise ratio. AC operation mode was developed, and it can effectively reduce power consumption and extend the lifetime of the detector array. A differential amplification circuit has been designed to directly detect and amplify the output current signal, and the acquisition time and distortion of the signal were reduced. A integrated 8×8 neon lamp detector array and a 32×32 detector array manufactured by microfabrication technology were developed, and the images of THz beams were successfully obtained.

Lei Hou
Xi'an University of Technology

Prof. HOU Lei is from Xi'an University of Technology. His research activities are focused on high excited state discharge gas terahertz wave detectors. He has published more than 60 academic papers indexed by SCI; hosted nearly 20 scientific research projects, including 6 national level projects; won two second prizes of the Shaanxi Provincial Science and Technology Award. He was elected as leading talent in scientific and technological innovation under the Shaanxi Provincial Special Support Plan, leader of a key scientific and technological innovation team in Shaanxi Province and recipient of the Xi'an Youth Science and Technology Talent Award.

Heterogeneous integrated optical modulators

Junjia Wang
Southeast University

Abstract: Integrated optoelectronic devices can break through the bottleneck of conventional optical systems, and meet the requirements of super large capacity and super high-speed information systems and data centers. Heterogeneous integration have the potential to build high-performance optoelectronic devices. In this regard, we demonstrated (1) a heterogeneous integrated microscale graphene thermo-optic modulator with a compact area of 7.54 μm2 and high heating performance of up to 67.4 K μm3•mW-1; (2) a graphene electro-absorption Mach-Zehnder interferometer modulator with a high modulation efficiency up to 5.3 dB/V and a high-speed data transmission rate up to 32 Gb/s; (3) a BTO modulator with modulation efficiency of 1.6 v•cm. Our work paves the way for compact optoelectronic system.

Junjia Wang
Southeast University

Junjia Wang received the B.Asc. degree in electrical and computer engineering from University of Toronto, Toronto, ON, Canada, in 2009 and the M.Eng. and Ph.D. degrees in electrical and computer engineering from McGill University in 2012 and 2016, respectively. He was with Optoelectronics Research Centre at University of Southampton from mid 2015 to end of 2016 under the Photonic HyperHighway project as a Research Fellow. Then he joined University of Cambridge and was working on Graphene Flagship project. He is now a professor with the School of Electronic Science and Engineering at Southeast University. He is IEEE senior member, Shuangchuang Talent of Jiangsu and Purple Scholar of Huawei. His research interests are in integrated photonics.

THz Applications in Crystallography and Exploration of THz-generation Inorganic Crystals

Feng Zhang
Xinjiang Technical Institute of Physics and Chemistry, Chinese Academy of Sciences

Abstract: This report discusses the application of high-resolution THz spectroscopy in crystallography. By integrating this technique with solid-state DFT methods, the feasibility of using THz spectroscopy for precise structural analysis of functional materials is preliminarily explored. Specifically, this project includes the analysis of hydrogen atoms and the identification of element pairs such as C/N, F/O, and F/OH in inorganic and organic functional materials. A potential framework for establishing "THz crystallography" is proposed. Preliminary results on the exploration of novel inorganic terahertz source materials are presented. The focus is on how structural alternation can be used to modulate the terahertz emission properties. A comprehensive evaluation of various potential inorganic compounds is provided, considering their nonlinear optical coefficients in the THz range, THz absorption, phase matching, and laser damage thresholds. Compared to traditional lithium niobate crystals, these materials may exhibit superior terahertz emission performance.

Feng Zhang
Xinjiang Technical Institute of Physics and Chemistry, Chinese Academy of Sciences

Feng Zhang is a researcher and doctoral advisor. He also serves as a visiting researcher at Kobe University and a visiting associate professor at Shizuoka University in Japan. He has dedicated his career to the study of terahertz spectroscopy and its application to crystalline materials.

Plasma-based Terahertz Modulation

Yindong Huang
National Sciences Institute of Innovation

Abstract: Air-plasma is a convenient and table-top source for the broadband and coherent terahertz (THz) wave generation. Here we report our recent results on generating and modulating of THz emissions using the laser-induced air-plasma. Laser-induced air-plasma is full of dense electrons and ions, whose plasma frequency and damping are locating in the THz frequency range. Our results highlight the importance of laser chirp during the THz wave generation and demonstrate the possibility of modulating the THz yields and spectrum through chirping the incident laser pulse. Meanwhile, we realize the enhancement of THz waves by a factor of 7 when using two temporally overlapped spatially crossed air-plasmas. Furthermore, we use the laser-induced air-plasma to enhance or eliminate the input THz waves.

Yindong Huang
National Innovation Institute of Defense Technology

Yindong Huang received the B.S. degree in physics from Nanjing University in 2011 and Ph.D degree in physics from National University of Defense Technology in 2017. He is currently an Associate Professor with National Innovation Institute of Defense Technology. He has authored or co-authored 28 papers in refereed journals such as PRL, PNAS, APL, Ultrafast Science, PRA, OE, et. al. His citation count is more than 800 and his H-index is 15. His current research interests include the strong field interaction between laser and matters,THz ultrafast switch and sensors, the ultrafast generation and manipulation of terahertz wave.

Terahertz Chiral Metasurfaces: Fundamentals and Applications

Jie Li
Chengdu University of Information Technology

Abstract: Chiral substances will undergo interactions with chiral electromagnetic waves due to the magneto-electric coupling effect. The excellent chirality of meta-devices not only enables spin dependent optical field manipulations such as circularly polarized absorption, anomalous reflection, and wavefront design with multiplexing, but also has potential application value in fields such as biochemical sensing, holographic display, and particle manipulation. In the terahertz band, in addition to the aforementioned functions, new multifunctional meta-devices with dynamic tunable performance can also be developed, greatly expanding the research in the field of metasurfaces. In addition, the chiral fingerprint spectrum in the terahertz band can characterize the low-energy movement of macromolecules, which cannot be achieved in other electromagnetic bands, and it can be enhanced using metasurfaces. This report will introduce some important advances in chiral metasurfaces in terahertz band, including tunable performance using external physical fields, and the potential applications of these devices. This includes strong circular dichroism excitation based on reflective or transmissive metasurfaces, spin selective wavefront design induced by chiral geometric phases, and racemic metasurfaces. In addition, it also includes dynamic polarization and wavefront modulation of chiral devices using graphene and photosensitive semiconductors. These devices will provide important foundations for the new terahertz technology.

Jie Li
Chengdu University of Information Technology

Jie Li obtained his doctoral degree from Tianjin University in 2022, under the guidance of Academician Jianquan Yao. He is currently a full-time researcher in the “Micro-Nano Optics and Intelligent Sensing” team at Chengdu University of Information Technology. In recent years, he has been focusing on the research of terahertz metasurfaces. He has applied for more than 10 national invention patents and published over 20 articles as the first or corresponding author in SCI journals such as Laser&Photonics Reviews, Photonics Research, Science China Physics Mechanics&Astronomy, with more than 3000 citations.

Terahertz Sensing on Biochemical Substancies Based on Terahertz Metasurfaces

Guozhong zhao[1,2], Mingming An[1,2], Weiling shi[1,2] , and Xinli zhou[1,2]
1Department of Physics, Capital Normal University, Beijing 100048, China
2Key Lab for terahertz optoelectronics, Minstry of education, China

Abstract: Terahertz sensing of biochemical substances based on the terahertz metasurfaces are presented. The design, fabrication and characteristics of terahertz metasurfaces are introduced. The resonance mechanism of terahertz metasurface is investigatied. The research significance and importance of terahertz sensing technology is emphasized. Finally, we mainly report our progress on the terahertz sensing and testing on four kinds of biochemical substances, that is, amino acid, Polysaccharides, nucleic acid, and protein. By exploring the methods and routes for achieving highly sensitive terahertz sensing technology for biochemical substances, the way for developing terahertz sensing technology is discussed.

November 16th, Kai Fang Hall（开放厅）

Presider: **Pu Li,** Guangdong University Of Technology

Time	Title/Speaker
13:30-14:00	**Terahertz Sensing on Biochemical Substancies Based on Terahertz Metasurfaces** **Guozhong Zhao** *Keynote* Capital Normal University
14:00-14:30	**Hybrid locking of terahertz quantum cascade laser dual-comb sources** **Hua Li** *Keynote* Shanghai Institute of Microsystem and Information Technology, CAS, China
14:30-14:50	**Terahertz SPR Sensing Method Based on InSb Grating Coupler** **Zhi-mei Qi** *Invited* State Key Laboratory of Transducer Technology, Aerospace Information Research Institute, Chinese Academy of Sciences
14:50-15:10	**Spoof Surface Plasmons for Sensing Applications** **Xuanru Zhang** *Invited* Southeast University
15:10-15:25	**Terahertz selective sensing of ctDNA based on different aggregation states of nanoparticles** **Shuting Fan** *Invited* Shenzhen University
15:25-15:40	**Terahertz metasurface with switchable multifunction based on graphene and vanadium dioxide** **Yi Zhao, Yan Wang, Xin Jue, Yunting Bai** *Oral* North China Electric Power University
15:40-15:55	**Coffee Break**
Presider: **Xiaoyu Peng,** University of Chinese Academy of Sciences	
15:55-16:25	**THz photonics-enabled ultrafast communication and high-resolution sensing** **Xianbin Yu** *Keynote* Zhejiang University
16:25-16:55	**Title:TBA** **Weidong Hu** *Keynote* Beijing Institute Of Technology
16:55-17:15	**Photonics-Inspired Terahertz Components and Systems Advancing 6G Communications** **Weijie Gao** *Invited* Osaka University, Japan
17:15-17:35	**Ultra-wideband photonic terahertz noise source up to 390 GHz** **Pu Li** *Invited* Guangdong University Of Technology

17:35-17:55	**Multi-color Terahertz Spatial Light Modulator for Single-pixel Imaging** **Xudong Liu** *Invited* Shenzhen University
17:55-18:10	**Terahertz perfect absorption enabled by bound states in the continuum with a flexible metasurface** **Guizhen Xu, Longqing Cong** *Oral* Southern University of Science and Technology
18:10-18:25	**THz sampling electron oscilloscope with simutaneous high temporal resolution and large temporal window** **Xie He** *Oral* Shanghai Jiao Tong University

November 17th, Kai Fang Hall（开放厅）

Presider: **Dongwen Zhang,** National University of Defense Technology

Time	Title/Speaker
13:30-14:00	**Title:TBA** **Yaxin Zhang** *Keynote* University of Electronic Science and Technology of China
14:00-14:30	**Bioeffects of high-field terahertz waves on breast cancer cells** **Xiaoyu Peng** *Keynote* University of Chinese Academy of Sciences
14:30-14:50	**Title:TBA** **Xuecou Tu** *Invited* Nanjing University
14:50-15:10	**Terahertz channel propagation and sensing characteristics** **Jianjun Ma** *Invited* Beijing Institute of Technology
15:10-15:25	**Distinguishing linear optical effect and nonlinear effects in coherent control of terahertz generation in ZnSe under normal and oblique incidence** **Xueqin Cao, Leidong Xing, Fan Wang, Yuanyuan Huang, Xinlong Xu** *Oral* Northwest University, China
15:25-15:40	Coffee Break

Presider: **Yaxin Zhang,** University of Electronic Science and Technology of China

15:40-16:10	**Title:TBA** **Cunjun Ruan** *Keynote* Beihang University
16:10-16:40	**Conductivity measurement of warm-dense gold with single-shot THz TDS** **Dongwen Zhang** *Keynote* National University of Defense Technology
16:40-17:00	**Terahertz spectroscopy of low-dimensional materials** **Maria G. Burdanova** *Invited* Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Russia

17:00-18:30	**Poster Session**
18:30-20:30	**Banquet**

November 18th, Kai Fang Hall（开放厅）

Presider: **Yiwen Sun,** Shenzhen University

Time	Title/Speaker
08:30-09:00	**Reliability analysis of a multistage depressed collector and output window for G-band Traveling Wave Tube** **Wenxin Liu** *Keynote* Aerospace Information Research Institute, Chinese Academy of Sciences
09:00-09:20	**Terahertz gyro-devices and their applications** **Diwei Liu** *Invited* University of Electronic Science and Technology Of China
09:20-09:40	**THz High-integration front-end SiP System Solution Using Novel Multi-layer Inter-connection Technology** **Peng Wu** *Invited* Aerospace Information Research Institute, Chinese Academy of Sciences
09:40-10:00	**195 – 215 GHz Transmitter and Receiver in 40 nm CMOS** **Ruibing Dong** *Invited* GBA Branch of Aerospace Information Research Institute, Chinese Academy of Sciences
10:00-10:20	**Towards Arbitrary Polarization Control of Broadband Terahertz Waves** **Xuequan Chen** *Invited* GBA Branch of Aerospace Information Research Institute, Chinese Academy of Sciences
10:20-10:35	**Coffee Break**

Presider: **Wenxin Liu,** Aerospace Information Research Institute, Chinese Academy of Sciences

10:35-11:05	**Title:TBA** **Yiwen Sun** *Keynote* Shenzhen University
11:05-11:25	**Title:TBA** **Tunan Chen** *Invited* Southwest Hospital, Third Military Medical University
11:25-11:45	**Multicontact Photoconductive Antennas for Polarization-Sensitive THz-TDS** **Huiliang Ou** *Invited* The University of Warwick
11:45-12:05	**Probing negative refraction of van der Waals hyperbolic polaritons** **Tianning Zhang[1,2], Peining Li[1,2], Xinliang Zhang[2,3,4*]** *Oral* 1.Huazhong university of science and technology, China; 2.Optics Valley Laboratory, China; 3.Huazhong University of Science and Technology, China; 4.Xidian University, China

Terahertz Sensing on Biochemical Substancies Based on Terahertz Metasurfaces

Guozhong Zhao
Capital Normal University

Abstract: Terahertz sensing of biochemical substances based on the terahertz metasurfaces are presented. The design, fabrication and characteristics of terahertz metasurfaces are introduced. The resonance mechanism of terahertz metasurface is investigatied. The research significance and importance of terahertz sensing technology is emphasized. Finally, we mainly report our progress on the terahertz sensing and testing on four kinds of biochemical substances, that is, amino acid, Polysaccharides, nucleic acid, and protein. By exploring the methods and routes for achieving highly sensitive terahertz sensing technology for biochemical substances, the way for developing terahertz sensing technology is discussed.

Guozhong Zhao
Capital Normal University

Prof. Dr. Guozhong Zhao is engaged in long-terms work on terahertz spectroscopy, terahertz imaging, terahertz sensing and teraherta functional materials and devices. He is graduated from Institute of Physics, Chinese Academy of Sciences in China. After three years of postdoctor work from TU Delft and TU/e in Netherlands, he enter into Key Lab of Terahertz Optoelectronics, Ministry of Education, in Capital Normal University, Beijing. In recent years, he is working on the terahertz sensing technologies of biochemical substances based on the terahertz metasurfaces.

Hybrid locking of terahertz quantum cascade laser dual-comb sources

Hua Li
Shanghai Institute of Microsystem and Information Technology, CAS, China

Abstract: Frequency combs show various application potentials in high precision spectroscopy, imaging, communications, and so on. In the terahertz (THz) region, semiconductor-based quantum cascade lasers (QCLs) are good candidates for frequency comb and dual-comb operations. THz dual-comb sources can be obtained by beating two THz QCL combs with a slight difference in the repetition frequencies. Different approaches, e.g., digital algorithms, active phase locking of one dual-comb line, self-reference techniques, etc., have already been employed to stabilize THz dual-comb sources. Up to now, a complete locking of a THz dual-comb source using hardware locking elements has never been demonstrated. Here, we propose a hybrid locking method to simultaneously stabilize both dual-comb offset and repetition frequencies of a THz QCL dual-comb source. Experimental results demonstrate that the stability of all dual-comb lines is improved significantly when the proposed hybrid locking is applied to the dual-comb source. Under the hybrid locking condition, the measured "maxhold" dual-comb line width can reach a record of 5.7 kHz. Furthermore, the recorded time trace of the dual-comb signal shows pulse-like behavior during a large time scale of 100 μs, which verifies that the proposed method functions well for an active locking of a THz QCL dual-comb source.

Hua Li
Shanghai Institute of Microsystem and Information Technology, CAS, China

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 frequency combs. He has published more than 90 peer-reviewed papers, delivered more than 30 invited talks at international conferences, and obtained more than 22 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, etc.

Terahertz SPR Sensing Method Based on InSb Grating Coupler

Zhi-mei Qi
State Key Laboratory of Transducer Technology, Aerospace Information Research Institute, Chinese Academy of Sciences

Abstract: Grating coupled THz-SPR chips on InSb substrates were designed and fabricated for chemical and biological detection. The resonance characteristics of the THz-SPR chip are simulated, and the results show that the resonance frequency and quality factor of the chip are strongly dependent on the height of the grating ridge but almost independent of the duty cycle of the grating. By comparing the analytical and simulated values of the resonant frequency of the SPR chip, the variation of the perturbation of the surface plasma wave vector by the grating coupler with the height of the grating ridge is obtained. The resonance frequency of the THz-SPR chip was measured at different incident angles by using a terahertz time-domain spectroscopy system, which is in good agreement with the simulation data. The response of the SPR chip to the solid-state medium overlying it was achieved. To suppress the water interference on the measured results with the SPR chip, a novel method that combing the filtering of porous membrane and the THz-SPR sensing was proposed.

Zhi-mei Qi
State Key Laboratory of Transducer Technology, Aerospace Information Research Institute, Chinese Academy of Sciences

Prof. Qi received his Ph.D. from Yokohama National University, Japan, in 2001. Subsequently, he joined National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan, where he worked on optical waveguide sensing technology. In April 2007, he returned to Aerospace Information Research Institute (former Institute of Electronics), CAS and worked as a professor and team leader on the development of integrated optical sensors, miniature Fourier spectrometers, Vis-NIR and terahertz SPR sensors, and optical microphones. He has published more than 100 papers on peer-reviewed Journals such as Nature Communications and Optics Letters.

Terahertz selective sensing of ctDNA based on different aggregation states of nanoparticles

Shuting Fan
Shenzhen University

Abstract: We developed a detection strategy for selective sensing of ctDNA based on the transformation of aggregation states of nano particles. Specifically, when Fe nanoparticles and DNA hybridize with i-Motif scaffolds, Fe forms a more dispersed state with the increasing concentration of i-Motif. The difference in aggregation state will cause a correspondingly different frequency response to the resonant frequency of THz metamaterials. We used this strategy for tumor biomarker sensing and have achieved good sensitivity and specificity.

Shuting Fan
Shenzhen University

Shuting Fan received her Bachelor's degree from Tianjin University in 2011, and a Ph.D degree from the Hong Kong University of Science and Technology in 2015. She worked as a research fellow in the school of physics at the University of Western Australia for two years before joining Shenzhen University. She is now an Associate Professor at the College of Physics and Optoelectronics, Shenzhen University. Her research interests include Terahertz technologies and its biomedical applications. She has co-authored more than 30 peer-reviewed journal papers. She also serves as a editorial advisory board member for APL photonics, and is the associate editor for Biomedical Optics Express.

Terahertz metasurface with switchable multifunction based on graphene and vanadium dioxide

Xi Zhao, Yan Wang, Xin Jue, and Yunting Bai

Department of Electronicand Communication Engineering, North China Electric Power University, China

Abstract: Multifunctional metasurfaces have attracted remarkable attention since they provide solutions for developing integrated systems and applications. Although notable past efforts, linear-to-circular and linear polarization conversion switchable devices particularly in terahertz (THz) regime remain a challenge due to the intense competitions among transmission, reflection, and absorption. Here, we propose a function switchable metasurface by employing graphene and vanadium dioxide (VO2), which possess tunable and diversified functionalities in THz frequencies. When VO2 is in the insulating state, the metasurface operates as a transmissive linear-to-circular polarization converter (LTC PC) across a frequency range near 1 THz with a bandwidth exceeding 0.3 THz. The 3-dB axial ratio relative bandwidth approaches 30% when the Fermi level (Ef) of graphene is approximately 1 eV. Upon transitioning VO2 to the metallic state, the metasurface transforms into a reflective linear-to-linear polarization converter (LTL PC), achieving a polarization conversion rate (PCR) greater than 90% within a frequency range close to 0.95 THz around 1 THz if Ef around 1 eV. At this point, inversing the incident direction of the linearly polarized (LP) waves enables the metasurface to transform into a broadband high-efficiency absorber with over 90% absorption within a frequency range of above 2THz bandwidth. Additionally, the metasurface is capable of absorbing the incident CP waves and realize the cross-polarization conversion between the left-handed circularly polarized (LHCP) wave and the right-handed circularly polarized (RHCP) wave. And this design strategy provides valuable insights for the exploration of metasurface across various frequency bands.

THz photonics-enabled ultrafast communication and high-resolution sensing

Xianbin Yu
Zhejiang University

Abstract: THz photonics provides a promising solution for ultrafast wireless communication with high data rates, and non-destructive sensing with high resolution. In this talk, I will present our recent academic achievements on THz photonic-wireless communicaiton towards Tbit/s, millimeter-scale resolution THz sensing, as well as the convergence of THz communication and sensing for future. In addition, some technical challenges to further developemtn of THz systems will be discussed.

Xianbin Yu
Zhejiang University

Xianbin Yu is currently a full professor at Zhejiang University. His research interests are in the areas of ultrafast millimeter-wave/THz photonic information processing, ultrahigh frequency photonic wireless communication systems, as well as emerging new applications of millimeter-wave/THz technologies, etc. He has (co-)authored 3 book chapters and 200+ peer-reviewed international journal and conference papers and given 50+ invited talks in prestigious international conferences within the area of optical communications and RF photonics technologies.

Photonics-Inspired Terahertz Components and Systems Advancing 6G Communications

Weijie Gao
Osaka University, Japan

Abstract: The advancement of terahertz communication faces critical challenges, particularly in developing high-performance chipsets and fully integrated on-chip systems. Traditional semiconductor materials in the terahertz frequency range suffer from low energy conversion efficiency, nonlinear effects, and limited micro-fabrication compatibility, hindering the scalability of terahertz devices. Additionally, the lack of an effective integration platform complicates hybrid or heterogeneous integration of terahertz devices using different fabrication processes. This work presents cutting-edge developments in terahertz communications, focusing on pioneering new paradigms for integrated device design. Central to these innovations is the adoption of terahertz micro-photonic integrated waveguide technology, providing an efficient, scalable platform for device integration. The introduction of novel photonic/electric devices, such as ultra-low-noise lasers, Fermi-level-managed barrier diodes, high-sensitivity resonant-tunneling diodes, and high-power uni-traveling carrier photodiodes, has driven breakthroughs in terahertz transceivers. These technologies deliver large bandwidth, low noise, high sensitivity, and high output power, essential for next-generation wireless communication systems. This presentation will also demonstrate terahertz wireless communication systems showcasing the practical application of these advances. These systems are poised to significantly impact 6G communications, enabling ultra-high-speed, low-latency wireless networks for emerging technologies such as radar, imaging, and sensing.

Weijie Gao
Osaka University

Weijie Gao received his PhD in Electrical and Electronic Engineering from The University of Adelaide, Australia, in 2022. He is currently a Specially Appointed Researcher at Osaka University, Japan. His research primarily focuses on the development of photonics-based terahertz integrated devices and communication systems, including terahertz micro-photonic integrated waveguides, filters, multiplexers, and the development of wideband, high-gain integrated terahertz antennas. In addition, he is working on the development of an ultra-low-noise wireless communication system at 300 GHz, which includes the study of Fermi-level managed barrier diodes (FMBD) for detectors and mixers, high-power uni-traveling carrier photodiodes (UTC-PD) chips, and terahertz transceivers based on resonant tunneling diodes (RTD).

Ultra-wideband photonic terahertz noise source up to 390 GHz

Pu Li
Guangdong University Of Technology

Abstract: Noise source is a fundamental instrument for noise figure measurement. By measuring the noise figure, the performance of components can be evaluated and the component design can be guided. Therefore, the research on terahertz noise generation is of vital importance to the development of terahertz components. It is extremely difficult to generate terahertz noise with flat power spectrum in a large frequency range for traditional noise generation technique based on electrical technology. Photonic technology has been proved to be the best option for terahertz noise generation. Here, we report a series of terahertz photonic noise sources with photo-mixing multiple Gaussian-shaped noise slices from a super luminescent diode. Experimental results demonstrate that 90~140 GHz, 140~220 GHz, 220~390 GHz terahertz noise can be successfully generated with excess noise ratios of more than 35 dB and flatness of less than ±2.8 dB. Furthermore, our proposed noise sources have been applied for measuring the noise figure of mature mixer products.

Pu Li
Guangdong University of Technology

Pu Li received the M.S. degree in physical electronics from the Taiyuan University of Technology (TYUT), Taiyuan, China, in 2011, and the Ph.D. degree in circuits and systems from the Key Laboratory of Advanced Transducers and Intelligent Control System, Ministry of Education of China, TYUT, in 2014. Since 2022, he joined the Institute of Advanced Photonics Technology, Guangdong University of Technology, Guangzhou, China. His research interests include nonlinear dynamics of semiconductor lasers and its applications including lidars, random number generators and terahertz noise sources.

Multi-color Terahertz Spatial Light Modulator for Single-pixel Imaging

Xudong Liu
Shenzhen University

Abstract: In contrast to existing electronically controlled terahertz (THz) spatial light modulators (SLMs) that rely on the resonant effect of metamaterials with narrow operation bandwidth, we present a novel approach in this work. We have designed, fabricated, and demonstrated a broadband electronically controlled 10×10 THz SLM. Each pixel of this SLM consists of a Schottky diode structure formed by metal microslits and an n-doped epitaxial GaAs layer. This configuration serves as real-time tunable, spectrally sensitive spatial masks for terahertz imaging, requiring only a single-pixel detector. To showcase the potential of our THz SLM, we have developed a single-pixel THz camera capable of spatial imaging of objects without any moving components.

Xudong Liu
Shenzhen University

Dr. Liu Xudong obtained his Ph.D. from the Department of Electronic Engineering at The Chinese University of Hong Kong in 2017. He has been recognized as a High-Level Talent Category "C" by Shenzhen and a Leading Talent Category "C" by Nanshan District. Dr. Liu is the principal investigator for one National Natural Science Foundation of China (NSFC) Youth Project, one Guangdong Provincial Medical Project, and one Shenzhen Municipal Project. He has published more than ten papers in high-impact journals classified as Q1 by the Chinese Academy of Sciences.

Terahertz perfect absorption enabled by bound states in the continuum with a flexible metasurface

Guizhen Xu[1], and Longqing Cong[1,2*]

1. State Key Laboratory of Optical Fiber and Cable Manufacture Technology, Department of Electrical and Electronic Engineering, Southern University of Science and Technology, China

2. Guangdong Key Laboratory of Integrated Optoelectronics Intellisense, Southern University of Science and Technology, China

Abstract: High-performance terahertz absorbers are crucial for terahertz techniques in secure communication, radar stealth, sensing, and imaging. However, natural materials often struggle to simultaneously meet the practical demands for stable high absorption, wide field of view, controllable bandwidth, and flexibility. It has been a pressing task to find solutions of absorbers that can address these requirements for practical usage. Here, we report a novel flexible terahertz metasurface absorber empowered by bound states in the continuum (BICs). Our study systematically explores the radiation characteristics of symmetry-breaking BICs within the framework of lattice symmetry, establishing a connection between the radiative properties of BICs and absorber performance. By further combining temporal coupled-mode theory, the proposed flexible device demonstrates stable absorption over a large field of view, tunable bandwidth, and multi-band absorption capabilities. These findings enrich the theoretical understanding of BICs and provide valuable insights for the development of metasurface optoelectronic devices and terahertz photonics.

Sub-cycle THz sampling electron oscilloscope

Xie He[1], Jiaqi Zheng[1], Dace Su[1], Jianwei Ying[1], Lufei Liu[2], Hongwen Xuan[2], Jingui Ma[1], Peng Yuan[1], Nicholas H. Matlis[3], Franz X. Kärtner[3,4], Dongfang Zhang[1*], and Liejia Qian[1*]

1. Key Laboratory for Laser Plasmas (Ministry of Education), School of Physics and Astronomy, Shanghai Jiao Tong University, China

2. GBA Branch of Aerospace Information Research Institute, Chinese Academy of Sciences, China

3. Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron Germany

4. Department of Physics and The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Germany

Abstract: Accurate real-time temporal profile measurements are crucial for advancing ultrafast electron technologies. While achieving high temporal resolutions and large temporal windows has been attainable separately using different methods, simultaneous real-time measurement has remained challenging with current technologies. Here, we introduce and demonstrate a high-field THz-driven electron oscilloscope capable of mapping the temporal information of an electron beam with simultaneous high-resolution and expansive temporal coverage. The transient THz electric field enables field-induced time-dependent electron streaking in the vertical (y) axis, while the extended interaction in the horizontal (x) axis leads to spatial-dependent time delay, hence, sampling of the electron beam with sub-cycle THz wave. This enables real-time electron measurement with femtosecond resolution and a temporal window exceeding previous THz-based techniques by an order of magnitude, reaching tens of picoseconds. Moreover, we enhance this technique's capabilities through projection imaging, deflection cavity tilting, and shorted antenna utilization, resulting in signal spatial magnification, extended temporal window, and enhanced field strength. This technique should have wide applications and open up new opportunities for electron beam based ultrafast science as well as accelerator technologies.

Bioeffects of high-field terahertz waves on breast cancer cells

Xiaoyu Peng
University of Chinese Academy of Sciences

Abstract: Bioeffects on human cancer cells induced by intense terahertz (THz) waves are important for future potential application in cancer therapy. However, current researches are very limited and the mechanism for the bioeffects are not clear. We performed a series of experiments by irradiating breast cancer cells using a high-field THz source. We observed a series of evident bioeffects, especially efficient apoptosis of the breast cancer cells. We find that a new apoptotic signaling pathway different from current known pathways is triggered. These results indicate a possible strategy to develop a potential noninflammatory therapy for superficial human cancers.

Xiao-Yu Peng
Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences

Xiao-Yu Peng is currently a full professor of Chongqing Institute of Green and Intelligent Technology (CIGIT), CAS. In 2005, he graduated and received his Ph.D. from the Key Lab of Optical Physics, Institute of Physics, CAS. From 2006 to 2008, he worked as a postdoctor and then as a guest scientist at the Institute for laser and Plasma Physics, Heinrich Heine University Duesseldorf, Germany. From 2008 to 2014, he worked as a research scientist at the Institute of Materials Research and Engineering (IMRE), Agency for Science, Technology and Research (A*STAR) of Singapore. In 2014, he joined CIGIT as a full professor and worked up to now. His main research areas include generation of high-field terahertz sources and their applications in material and biomedical sciences, terahertz detection techniques, terahertz spectroscopy and imaging etc.

Terahertz channel propagation and sensing characteristics

Jianjun Ma
Beijing Institute of Technology

Abstract: The integration of terahertz communication and sensing is poised to revolutionize next-generation wireless systems by enabling ultra-high-speed data transmission alongside real-time environmental awareness. Understanding terahertz channel propagation and sensing characteristics is crucial for realizing this integration, as it directly impacts system design, performance optimization, and the development of novel applications. The unique properties of terahertz waves, including their high atmospheric absorption, sensitivity to molecular composition, and vulnerability to blockage, necessitate detailed characterization of propagation phenomena such as path loss, scattering, and multipath effects. Moreover, the sensing capabilities at terahertz frequencies, ranging from high-resolution imaging to spectroscopic analysis, require a comprehensive grasp of signal interaction with various materials and environmental conditions. These insights are essential for developing accurate channel models, designing robust communication protocols, and enhancing sensing algorithms that can adapt to the dynamic nature of terahertz propagation. In this presentation, we will share our research findings and innovations in terahertz channel propagation and sensing characteristics, providing a foundation for the successful integration of communication and sensing in this promising frequency band.

Jianjun Ma
Beijng Institute of Technology

Prof. Dr. MA Jianjun is from Beijing Institute of Technology, China. His research activities are focused on measurement and modeling of terahertz channel characteristics. His research findings have been published as first-author articles in Nature, Nature Communications, and other top journals, and he have received the First Prize of the Natural Science Award from the China Communications Society. He currently serves as a member of the first Terahertz Communications Committee of the China Communications Society and have been invited to serve as an editorial board member of multiple SCI journals and conference organizing committee members.

Distinguishing linear optical effect and nonlinear effects in coherent control of terahertz generation in ZnSe under normal and oblique incidence

Xueqin Cao, Leidong Xing, Fan Wang, Yuanyuan Huang†, and Xinlong Xu†
1Shaanxi Joint Lab of Graphene, State Key Lab Incubation Base of Photoelectric Technology and Functional Materials, International Collaborative Center on Photoelectric Technology and Nano Functional Materials, Institute of Photonics & Photon-Technology, Northwest University, People's Republic of China

Abstract: Coherent control under two-color femtosecond laser excitation plays a significant role in atomic, molecular, and semiconductor materials. Recently, terahertz (THz) emission spectroscopy has been employed to characterize the coherent ultrafast photocurrent from semiconductor materials under two-color light excitation. However, distinguishing the contributions of various optical effects to THz radiation under normal- and oblique-incident excitations with two-color light remains a challenge. Herein, we choose the zinc selenide (ZnSe) crystal as a model sample to study the THz radiation at normal and oblique incidences with two-color light excitation. Based on the dependence of the THz signal on the relative phase difference between the fundamental wave and the second harmonic wave, the contribution ratio of optical rectification (OR) to four-wave mixing (FWM) for THz radiation is calculated as 1:2.3 at normal incidence. Under oblique incidence, the contribution ratios of FWM, OR, and surface depletion field (SDF) for THz radiation are calculated as 1:1.5:6.7. This work not only elucidates the THz radiation properties of ZnSe crystal but also reveals the interplay among OR, SDF, and FWM in the coherent control of ultrafast photocurrent under femtosecond laser excitations.

Conductivity measurement of warm-dense gold with single-shot THz TDS

Dongwen Zhang
National University of Defense Technology

Abstract: Terahertz (THz) waves offer a distinctive diagnostic method for detecting high energy density matter. However, realizing the THz time-domain spectral (THz-TDS) diagnosis of matter states under extreme conditions in large high-energy density devices remains a significant obstacle. To address this requirement, we designed and implemented an optical pump-THz single-shot detection system driven by a strong femtosecond laser. In the experiment, The LiNbO3 wafer with the diameter of 3 inches generated THz radiation with pulse energy of 1 milli-Joule and electric field of 10MV/cm. The strong THz pulse was employed to measure the transient THz conductivity of 30 nm thick freestanding gold foils pumped by a 400 nm laser pulse. The system possesses the capability of THz single-shot diagnosis of nonequilibrium states of matter under extreme conditions, which promotes the strong THz field physics.

Dong-Wen Zhang
National University of Defense Technology

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 photonics-based THz technology, time-resolved THz spectroscopy of ultrafast phenomena, and strong THz field physics.

Terahertz spectroscopy of low-dimensional materials

Maria G. Burdanova
Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology, Russia

Abstract: Terahertz (THz) spectroscopy stands out as an exceptional non-contact and non-destructive technique for investigating the electrical conductivity of nanomaterials. We show the current advancements in research concerning the THz properties of quasi-one-dimensional (quasi-1D) materials, such as nanotubes (NTs), as well as the expanding family of two-dimensional (2D) materials. In these nanomaterials, significant alterations in optoelectronic properties are observed due to phenomena like localization and quantum confinement, which distinguish them from their bulk counterparts. This highlight the potential applications of these materials in various optoelectronic devices, including THz modulators, switches, shielding devices, and diffractive elements, underscoring a promising future for these technologies.

Maria Burdanova
Center for Photonics and 2D Materials, Moscow Institute of Physics and Technology

Maria G. Burdanova received her Ph.D. degree in Physics from the University of Warwick, England, and M.Sc. and B.Sc. degrees in Physics from Bauman Moscow State Technical University, Russia. Currently, she is a senior researcher at the Moscow Institute of Physics and Technology, Russia. Her research interests focus on THz science of carbon nanotubes, heteronanotubes, hybrid nanomaterials, and their optoelectronic applications.

Reliability analysis of a multistage depressed collector and output window for G-band Traveling Wave Tube

Wenxin Liu
Aerospace Information Research Institute, Chinese Academy of Sciences

Abstract: Terahertz (1 THz = 1012 Hz) technology is a significant technology in many fields like communication, medical treatment and radar. Traveling wave tube (TWT) has become the main equipment for radiating THz wave due to its excellent high power radiating ability, stability and precision. However, the reliability failure is a main problem faced by the TWT. The service environment of the TWT is not always stable, and the thermal and vibration failure may happen because of the internal and external excitations, which will affect the radiation of the wave and the useful life of the device. Multistage depressed collector (MDC) and the output radiation output window are two important components of the TWT. The MDC is used for collecting the energy of the wasted electrons, which always has the highest temperature among all the components, and the output radiation window needs to bear high heat loss, and its structure is relatively small. As a result, in this article, a series of reliability analysis of these two key components of a G-band TWT is carried out, and the rationality of the design is proved. The comparison between different heat dissipation methods of the MDC is also shown. By providing the results in this article, the possible failure situation and the whole series of reliability simulation is meaningful for the researchers who want to test the reliability of other vacuum devices.

Terahertz gyro-devices and their applications

Diwei Liu
University of Electronic Science and Technology Of China

Abstract: Terahertz technology has attracted many interests in scientific fields, such as materials processing, imaging, communications, spectroscopy, and biology research. The lack of high-power THz radiation sources is becoming a serious obstacle to these applications mentioned above. Gyrotrons based on the interaction of electrons gyrating in an external magnetic field with fast waves can produce high average power radiation in microwave, millimeter wave and THz bands, the highest operating frequency of the gyrotron has increased up to 1.0-1.3THz. in this presentation, the development of the THz gyro-devices, and their applications in dynamic nuclear polarization nuclear magnetic resonance spectroscopy (DNP-NMR), damage effects on circuits and devices, and genes expression changes in our group will be presented in details.

Diwei Liu
University of Electronic Science and Technology of China

Professor, School of Electronic Science and Engineering, University of Electronic Science and Technology of China. Research interests include terahertz radiation sources in vacuum electronics and their applications such as terahertz enhanced DNP/NMR.

THz High-integration front-end SiP System Solution Using Novel Multi-layer Interconnection Technology

Peng Wu
Aerospace Information Research Institute, Chinese Academy of Sciences

Abstract: Communication and radar systems are explored towards higher data rate, or higher detection accuracy, and there is an urgent requirement to adopt higher frequency bands, even up to terahertz frequency bands. By using higher frequency in terahertz bands, the parasitic effects of integration structures will become more and more apparent, and bring challenges to front-end circuit integration. Terahertz modules and systems are always designed and assembled by separate components due to the limitations of fabrication processes. In recent years, some system-in-package (SiP) schemes have been proposed to improve the integration of front ends. In the session, the key integration packaging technologies will be introduced and analyzed, and several typical packaging modules for terahertz integration applications proposed by our and other research groups around the word will be concluded. Multi-layer ceramic packaged interconnection technology is a useful scheme to achieve low-cost and high integration and has the potential application in integrated systems.

Peng Wu
Aerospace Information Research Institute, Chinese Academy of Science

Peng Wu is currently a research fellow and works as a deputy director in the Aerospace Information Research Institute, Chinese Academy of Sciences, Beijing, China. He is a PhD supervisor with University of Chinese Academy of Sciences. He is also a member of the Satellite Communication Committee, China Institute of Communications. His current research interests include millimeter-wave/ terahertz integrated circuits and antennas, millimeter-wave/ terahertz microsystem, communication and radar applications.

195 – 215 GHz Transmitter and Receiver in 40 nm CMOS

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

Abstract: Terahertz (THz) technology is considered a crucial component of 6G communication systems, enabling high-speed wireless transmission. This paper presents both a receiving and transmitting chip operating in the G-band, fabricated in 40 nm CMOS process. The transmitter and receiver chips employ an IQ architecture, utilizing two frequency-conversions to translate baseband signals into radio frequency signals. The local oscillator (LO) path is composed of frequency double, triple, and quadruple, generating LO signals at ×8 and ×12 frequencies. The combined IQ signal is amplified by an intermediate frequency amplifier operating in the W-band to ensure transmission quality before being input into a second mixer for conversion from W-band to G-band. The entire transceiver chip operates within the frequency range of 195 GHz to 215 GHz, with the transmitter achieving an output power of nearly 10 dBm and the receiver maintaining a noise figure of less than 17 dB.

Ruibing Dong
Aerospace Information Research Institute, CAS

Dong Ruibing obtained his doctoral degree from Kyushu University in Japan in 2011 and has conducted research at Hiroshima University and the National Institute of Information and Communications Technology in Japan. His current research field is the design of millimeter wave terahertz integrated circuits, including millimeter wave terahertz high-speed communication front-end chips, millimeter wave wireless sensor chips, high gain terahertz amplifiers, and millimeter wave radar applications. Published over 30 papers in internationally renowned journals such as JSSC, ISSCC, IEEE Transactions on Terahertz Science and Technology.

Towards Arbitrary Polarization Control of Broadband Terahertz Waves

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

Abstract: Polarization is a key parameter in light-matter interactions and is consequently closely linked to light manipulation, detection and analysis. Terahertz (THz) waves, characterized by their broad bandwidth and long wavelength, pose significant challenges to efficient polarization control with existing technologies. In this talk we will present how various reflection-based non-resonant structures can be leveraged to overcome the bandwidth limit and how different electro-optical and mechanical approaches can be applied for efficient active modulation. Specifically, we will highlight our latest device employing a mirror-coupled total internal reflection structure to mechanically modulate the phase difference between p- and s-waves by up to 289°. By incorporating a liquid crystal phase shifter to provide adaptive phase compensation, dispersion is eliminated across a broad bandwidth. An average degree of linear/circular polarization exceeding 0.996 and arbitrary polarization at any center frequency can be achieved with a fractional bandwidth exceeding 90%. These achievements pave the way for numerous polarization-sensitive applications in the THz regime.

Xuequan Chen
GBA Research Institute of AIRCAS

Xuequan Chen received his B.Eng. and PhD degrees from University of Electronic Science and Technology of China in 2014 and the Chinese University of Hong Kong in 2018, respectively. He awarded the Impact Postdoctoral Fellowship for his postdoctoral research in 2018-2021. He joined GBA Branch of Aerospace Information Research Institute, CAS as a research fellow since 2021. Prof. Xuequan Chen's research interests include terahertz functional devices, systems and algorithms for THz spectroscopy and imaging, in vivo or ex vivo biomedical applications. He has published over 30 papers in Nat. Comm., ACS Photonics, APL Photonics etc.

Multicontact Photoconductive Antennas for Polarization-Sensitive THz-TDS

Huiliang Ou
The University of Warwick

Abstract: Terahertz time-domain spectroscopy (THz-TDS) systems are generally based on the generation of linear polarized THz pulses and detection of only one of the polarization components of the THz electric fields. Multicontact photoconductive antennas (MPCA) enable THz-TDS to control and measure polarization states in an efficient way.

This talk will highlight our work on the control of polarization with MPCA emitters, as well as the measurement of polarization with MPCA detectors. On one hand, utilizing MPCA emitters to electrically control arbitrary linear and elliptical polarizations will be discussed. A demultiplexing scheme will also be discussed, which is able to simultaneously transmit and receive two polarization states. On the other hand, a MPCA detector will be demonstrated to efficiently and accurately record full THz polarization states.

Huiliang Ou
University of Warwick

Huiliang Ou was born in Guangzhou. He received his bachelor's degree in Sun Yat-Sen University in 2021. Immediately, he started doing a PhD in physics in the University of Warwick.

His researches focus on sources and detectors of Terahertz time domain Spectroscopy, THz polarization control, THz ellipsometry (polarimetry) systems.

Probing negative refraction of van der Waals hyperbolic polaritons

Tianning Zhang[1,2], Xinliang Zhang[1,2,3], Peining Li[1,2*]
1. School of Optical and Electronic Information, Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China
2. Optics Valley Laboratory, China
3. Xidian University, China

Abstract: Polaritons, collective excitations formed by the coupling of photons with oscillating charges, in anisotropic materials provide a new way to manipulate light at nanoscale. Polaritons waves propagates in anisotropic material display a number of characteristic features. The ray-like propagation is one of the most important features of hyperbolic phonon polaritons since it can lead to out-of-plane hyper-focusing. These features are due to polaritons in anisotropic materials exhibit hyperbolic dispersion that in such materials the real-part dielectric permittivity tensor along orthogonal principal axes have opposite signs. Hyperbolic media support large-k hyperbolic polaritons and the superposition of these modes form ray. Here, we used infrared nanoimaging to study the ray like propagation in Boron nitride and Calcite which are both the hyperbolic materials and the Reststrahlen band have overlapping frequencies. And we observed negative refraction at the interface between Boron nitride and Calcite. Our results deepen the understanding of the ray-like propagation of HPs that are vital to rich phenomena in nanophotonic applications.

Symposium II: Ultrafast Phenomena

November 16th, Huang Pu Hall C（黄埔 C 厅）

Presider: **Yudan Su,** Fudan University

Time	Title/Speaker
13:30-14:00	**Title:TBA** **Ye Tian** *Keynote* Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences
14:00-14:20	**High-repetition-rate high harmonic generation from a liquid plasma mirror** **Kyung Taec Kim** *Invited* Gwangju Institute of Science and Technology, Korea
14:20-14:40	**High-harmonic spectroscopy probes lattice dynamics** **Tran Trung Luu** *Invited* The University of Hong Kong
14:40-15:00	**Ultrafast metastable states of a quasi-two-dimensional lattice** **Feifan Wang** *Invited* Institute of Physics, Chinese Academy of Sciences
15:00-15:20	**Title:TBA** **Hui Li** *Invited* East China Nomal University
15:20-15:35	**Nonequilibrium dynamics of charge and lattice in pressurized SnSe** **Xinyao Wang** *Oral* ISSP
15:35-15:50	Coffee Break
Presider: **Ye Tian,** Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences	
15:50-16:20	**Dicke cooperative coupling between lattice and orbital excitations a magnetic insulator** **Qi Zhang** *Keynote* Nanjing University
16:20-16:40	**Toward Surface-specific Nonlinear Optical Spectroscopy in Terahertz Regime** **Yudan Su** *Invited* Fudan University
16:40-17:00	**Ultrafast Resonant Laser Printing of Large-area Metasurfaces** **Xiaolong Zhu** *Invited* East China Nomal University
17:00-17:20	**Title:TBA** **Zining Yang** *Invited* National University of Defense Technology

17:20-17:40	**Title:TBA** **Sunchao Huang** *Invited* Nanyang Technological University
17:40-18:00	**kW level ultrafast thin disk laser** **Xing Liu** *Invited* Shenzhen Technology University

November 17th, Huang Pu Hall C（黄埔 C 厅）

Presider: **Dong Sun,** Peking University

Time	Title/Speaker
13:30-14:00	**Light-induced ultrafast dynamics of molecules and polaritons** **Jian Wu** *Keynote* East China Nomal University
14:00-14:20	**Strong-field double ionization of alkaline-earth metal atoms** **Huipeng Kang** *Invited* Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences
14:20-14:40	**Ultrafast nonadiabatic excited state dynamics and its imaging** **Chuncheng Wang** *Invited* Jilin University
14:40-15:00	**Ultrashort IAP generation with free CEP few-cycle NIR pulses** **Xiaowei Wang** *Invited* National University of Defense Technology
15:00-15:20	**Attosecond ionization dynamics of helium and argon atoms triggered by XUV light** **Sizuo Luo** *Invited* Jilin University
15:20-15:35	**Tracking and manipulating ultrafast carrier dynamics in 3D Dirac semimetal Cd3As2** **Peng Suo, Wenjie Zhang, Xian Lin, Guohong Ma** Shanghai University, China
15:35-15:50	Coffee Break

Presider: **Jian Wu,** East China Nomal University

15:50-16:20	**Tunable Chirality Couplings and Anomalous Photo-Nernst Effect in Magnetic Weyl Cones in Co3Sn2S2** **Dong Sun** *Keynote* Peking University
16:20-16:40	**Terahertz detection and imaging base on Rydberg atoms** **Hui Yan** *Keynote* South China Normal University
16:40-17:00	**Title:TBA** **Chunyu Guo** *Invited* Shenzhen University

17:00-18:30	**Poster Session**
18:30-20:30	**Banquet**

November 18th, Huang Pu Hall C（黄埔 C 厅）

Presider: **Shixiang Xu,** Shenzhen University

Time	Title/Speaker
08:30-09:00	**A NIR phase manipulation mechanism for flexible and multiple-wavefront THz manipulations** **Shixiang Xu** *Keynote* Shenzhen University
09:00-09:20	**Title:TBA** **Wei Wu** *Invited* National University of Defense Technology
09:20-09:40	**Title:TBA** **Jinlei Liu** *Invited* National University of Defense Technology
09:40-10:00	**Title: TBA** **Weiqiang Yang** *Invited* National University of Defense Technology
10:00-10:15	**Coffee Break**

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

10:15-10:35	**Harnessing high-power terahertz for today and beyond: The latest from Menlo Systems** **Zhaoyang Tai** Menlo Systems
10:35-10:55	**Terahertz Advanced Detection Materials and Applications** **Yi-Fan Wang** Xi'An THz-chip Technology Co.,LTD
10:55-11:15	**Introduction of Conformal Scanning Terahertz NDT System** **Jinchao Li** Beijing Broad Hengtong Technology Development Co., Ltd
11:15-11:35	**Terahertz Tomography for Non-Destructive Testing of Objects with Random Surfaces** **Kun Meng** Qingdao Quenda Terahertz Technology Co., Ltd.
11:35-11:55	**Solution for Terahertz Spectral Imaging Technology for Industrial Applications** **Yinghao Yuan** B-THz Information Technology (Wuhan) Co., Ltd.
11:55-12:15	**Title: TBA** **Chao Deng**

High-repetition-rate high harmonic generation from a liquid plasma mirror

Kyung Taec Kim
Gwangju Institute of Science & Technology, Korea

Abstract: When a powerful laser field interacts with a dense material, it can create a thin plasma layer known as a plasma mirror. High harmonic generation (HHG) on this plasma mirror has shown promise in producing ultrafast attosecond pulses in the extreme ultraviolet (EUV) and X-ray wavelengths. However, a significant challenge in exploring HHG from a plasma mirror is the damage to the target, which has limited experiments to low repetition rates. This limitation has made it difficult to use plasma mirrors for high-flux or high-repetition-rate experiments. Here, we demonstrate that high harmonic emission can be generated from a liquid plasma mirror in both the coherent wake emission (CWE) and relativistic oscillating mirror (ROM) regimes. We show the continuous generation from a liquid plasma mirror in the CWE regime, achieving this at a repetition rate of 1 kHz. Furthermore, we demonstrate HHG in the ROM regime using a high-power laser. These achievements will enable the use of relativistic HHG as a valuable light source for studying laser-plasma interactions.

Kyung Taec Kim
Gwangju Institute of Science and Technology

Prof. Kyung Taec Kim has started his research carrier through his Master and Ph. D. degree courses at KAIST under the supervision of Prof. Chang Hee Nam. He has proposed an attosecond pulse compression using x-ray filters during his degree courses. After he obtained Ph. D, he participated in the project to build the PW laser facility in the APRI at Gwangju Institute of Science and Technology (GIST) in Korea. In 2010, he has joined Paul Corkum's joint attosecond science laboratory at the National Research Council and the University of Ottawa in Canada. He developed optical techniques to measure the space-time coupling of attosecond pulses and arbitrary optical waveforms of light pulses. He also demonstrated the attosecond lighthouse method. Recently, he invented a pulse characterization method called tunneling ionization with a perturbation for the time-domain observation of an electric field (TIPTOE). Prof. Kyung Taec Kim is now an associate professor at the department of physics and photon science of GIST, and He is leading the attosecond science group as an associated director of the center of the relativistic laser science (CoReLS) of the institute for basic science at GIST in Korea.

High-harmonic spectroscopy probes lattice dynamics

Tran Trung Luu
The University of Hong Kong

Abstract: High-order harmonic generation in condensed matter (solids, liquids) has been used as a probe of electronic properties, including the reconstruction of electronic bandstructure and Berry curvature. In this talk, we will discuss some emerging opportunities for scientific and industrial applications. In addition, we will discuss one example where high-harmonic spectroscopy can be used to probe lattice dynamics, obtaining both absolute electron-phonon coupling as well as anharmonic phonon-phonon coupling. Our technique is background-free and has extreme sensitivity directly in the energy domain. In combination with the optical deformation potential calculated from density functional perturbation theory and the absolute energy modulation depth, our measurement reveals the maximum displacement of neighboring oxygen atoms in α-quartz crystal to tens of picometres in real space. Our work opens a new realm for the accurate measurement of coherent phonons and their scattering dynamics, which allows for potential benchmarking ab initio calculations in solids.

Tran Trung LUU
The University of Hong Kong

Tran Trung LUU received his Master of Science in physics at Korea Advanced Institute of Science and Technology, South Korea; Doctor of Philosophy in physics in Max Planck Institute of Quantum Optics, Germany; ETH Postdoctoral Fellow in ETH Zurich, Switzerland and currently appointed as Assistant Professor in Physics in The University of Hong Kong. He has been actively engaged in state-of-the-art research on ultrashort laser pulses and attosecond science. He contributed and played an important role in bringing attosecond science from the gas phase to the condensed phase. Few notable works are the first discovery of a new source of extreme ultraviolet (EUV) light based on the interaction of intense laser pulses and solids; the first demonstration of optical attosecond pulses where the laser pulses are compressed to the limit that they are only half a cycle of the carrier wavelength; the first demonstration of generation of coherent EUV light from liquids and its spectroscopic applications; measurement of coherent phonon dynamics with absolute amplitude information. He has received numerous awards/honors for his studies as well as for his pioneering research including Physics Olympiad, Young Researcher Awards, prestigious fellowships from ERC Marie Currie, ETH Zurich, Canadian FRQNT and others.

Ultrafast metastable states of a quasi-two-dimensional lattice

Feifan Wang
Institute of Physics, Chinese Academy of Sciences

Abstract: The identification of metastable state is a key to understanding the nonequilibrium nature of phase transitions. These states can host exotic properties and thus may lead to innovative functional devices, where the response time of the associated devices is determined the ultrafast dynamics. However, such metastable states of matter are often thermodynamically inaccessible and the discovery of those states is rare. Here, we use the ultrafast laser excitation to steer a quasi-two-dimensional semiconductor into an metastable state. This state lasts for 100s picoseconds accompanied by the presence of photodoped charge carriers. The ground-state symmetry is reduced in this state manifested as the lattice deformation and the appearance of a nonequilibrium phonon mode observed by the time-resolved electron diffraction and coherent phonon spectroscopy, respectively. The charge transport property is largely modulated within the metastable state. These findings demonstrate the direct observation of electronic and atomic structures and the corresponding charge transport property of a metastable state in a photoexcited quasi-two-dimensional lattice, which might lead to novel ultrafast switchable optoelectronic devices.

Feifan Wang
Institute of Physics

Dr. Feifan Wang obtained his PhD degree from Peking University in 2017. He worked as postdoctoral researcher in Prof. Xiaoyang Zhu's group at Columbia University from 2017-2021 and in Prof. Manfred Fiebig's group at ETH Zurich from 2021-2023. He is appointed as an associated professor in Institute of Physics since Oct. 2023. His research is focused on optical spectroscopic studies of functional solid-state materials and he is particularly engaged in ultrafast spectroscopy and nonlinear optics. His work is published in PNAS, JACS, Angew journals and he has served as conference chairs such as in DPG 2022.

Nonequilibrium dynamics of charge and lattice in pressurized SnSe

Xinyao Wang[1,2#], Jiafeng Xie[3#], Shujuan Xu[1,2#], Kai zhang[3], Zhenyou Wang[3*], Tianwu Wang[3*], Fuhai Su[1*]
1. Key Laboratory of Materials Physics, Institute of Solid State Physics, HFIPS, Chinese Academy of Sciences, China
2. University of Science and Technology of China, China
3. GBA branch of Aerospace Information Research Institute, Chinese Academy of Sciences, China

Abstract: Understanding the electron-phonon (e-ph) interaction and lattice dynamics in SnSe, a representative thermoelectric (TE) compound, is vital for improving its TE performance. In this study, we investigate the non-equilibrium photocarrier dynamics in SnSe under pressure using optical pump-probe spectroscopy. The pressure evolution of electronic relaxation reveals anomalies at around 1 GPa and 5.3 GPa, corresponding to the electronic Lifshitz transition and the Pnma-Cmcm phase change, respectively. Beyond 5.3 GPa, we observe the emergence of coherent phonon (CP) from the Ag1 mode in the terahertz (THz) range, with an enhancement under increased pressure. Furthermore, a pronounced decrease in lifetime and a redshift in frequency highlight the strong anharmonicity of the Ag1 mode in the high-pressure Cmcm phase. These findings are further underscored and supported by Raman spectroscopy and density functional theory (DFT) calculations under pressure. This work provides nontrivial insights into e-ph and phonon-phonon interactions in the high-pressure phase of SnSe.

Dicke cooperative coupling between lattice and orbital excitations a magnetic insulator

Qi Zhang
Nanjing University

Abstract: A prominent many-body problem in quantum optics is the interaction of N two-level atoms with a single-mode light field, first considered by Dicke. A characteristic feature of such systems is the cooperative enhancement of the coupling strength. Such Dicke-type cooperativity can be extended to a condensed matter system in the form of matter-matter interaction, as demonstrated in the rare-earth orthoferrite ErFeO3 between its spin waves and electron paramagnetic resonance. In this presentation, we report another example of cooperative coupling in the same material system, which is between lattice and orbital excitations. We find mode hybridization between phonon and the 4I15/2 crystal-field excitations of Er3+ around 3.4 THz. By analyzing the spectra and the crystal-field transitions, the coupling strength obtained is as high as 0.1 THz and exhibits Dicke cooperativity, i.e., the coupling strength is proportional to the square root of the occupation of the two-level systems. Our findings not only expand the understanding of the cooperative Jahn-Teller effect but also shed new light on the entangled degrees of freedom in ErFeO3, especially the intriguing phonon-induced transient magnetism in this system.

Qi Zhang
Nanjing University

Qi Zhang joined Nanjing University as a professor in Nov. 2019. His research explores light-matter interactions and milli-eV low-energy excitations in quantum materials. Various optical methods (e.g. THz / Raman spectroscopy, magneto-optics) are utilized to unveil the novel quantum phenomena, and further manipulate the quantum states/phases in low dimensional quantum materials at ultrafast time scales.

Toward Surface-specific Nonlinear Optical Spectroscopy in Terahertz Regime

Yudan Su
Fudan University

Abstract: Phonons and vibrations of molecules and solids composed of heavier atoms are in terahertz range, and so are the intermolecular (or inter-molecular-group) vibrations of molecular systems in chemistry and biology. Various elementary excitations of solids also lie in this spectral region. In terahertz regime, facilitating second order nonlinear optical spectroscopy to the characterization of elementary excitations at material's interface is of great importance for materials studies. However, the experimental interrogation of fundamental excitations at surfaces/interfaces in this range remains challenging because few surface-specific probes with spectral selectivity are available. In this talk, I will present our recent endeavors to extend the frequency boundary of surface-specific nonlinear optical spectroscopy into terahertz range. We managed to utilize difference frequency mixing process to realized surface spectra measurement under 5 THz, and developed a novel high field terahertz generation scheme which bridged the 'new THz gap' of 5-15THz.

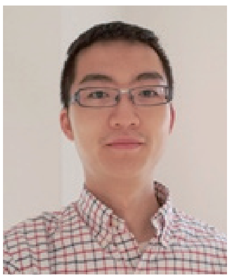
Yudan Su
Zhangjiang Lab

Yudan Su, received his Ph.D. degree from Fudan University in 2018, and completed postdoctoral research at UC Berkeley under the supervision of Prof. Y.R. Shen from 2020 to 2023. He joined Zhangjiang Lab in 2023, where he is now associated professor. His research interests include the development of new strong-field terahertz light sources, the development and application of nonlinear spectroscopy technology in terahertz frequency bands. He has published 11 papers in Light: Science and Applications, Ultrafast Science, Nano Letters, JACS, Small and other journals and conferences.

Ultrafast Resonant Laser Printing of Large-area Metasurfaces

Xiaolong Zhu
East China Nomal University

Abstract: Optical metasurfaces are a new class of ultrathin optical elements comprising arrays of nanoscale artificial atoms which collectively control the amplitude, phase, polarization, and spectrum of light. Arrays of optically resonant nanostructures have offered the control of light with nanoscale precision, which are typically realized by the state-of-the-art nanofabrication technologies. The resonant absorption in metallic or dielectric materials provides a new route for photo-to-thermal conversions and post-processing. Recently, we introduce an ultrafast resonant laser printing (RLP) technique as a flexible photothermal laser-post-writing technology for mass-customization of optical metasurfaces. In RLP, photothermal effects are taking place in the center of the resonant nanostructures, which helps to gradually control structural and shape modifications of the nanostructures. Depending on the laser pulses' energy density, different surface morphologies that support different optical resonances can be created. We applied the laser-induced reshaping in color printing and wave-front modulation. This technology can realize laser nanoprinting of metasurfaces with a printing resolution up to 127,000 DPI.



Xiaolong Zhu
East China Normal University

I am currently a research professor at the East China Normal University (faculty since 2021). My BSc (2008) and MSc (2011) academic degrees were awarded by Fudan University while my PhD (2014) degree was obtained from the Technical University of Denmark. My research focus is on complex wave phenomena and light-matter interactions in artificially structured materials. The list of past and present research topics includes photonic crystals, nanoplasmonics, metasurfaces, nanophotonics & ultrafast phenomenon.

kW level ultrafast thin disk laser

Xing Liu
Shenzhen Technology University

Abstract: Thin-disk lasers have aroused wide attention about scientific and industrial application, owing to their high peak power, efficiency, and precise pulse characteristics. In optical parametric chirped-pulse amplification (OPCPA), for example, thin-disk lasers play a crucial role as the primary pump source due to their exceptional capabilities. Their ability to generate short-duration, high-energy pulses makes them ideal drivers for nonlinear optical crystals in the OPCPA system. The outstanding peak power and energy density they offer are vital for the efficient laser pulse amplification, which are utilized for generating intense extreme ultraviolet (XUV) and attosecond(as) pulses by high-order harmonic generation. Based on the home-made disk crystals and a 48-pass pump module, we achieved a regenerative amplifier producing 150 W at a repetition rate of 500 kHz, with 7 ps pulse output and a conversion efficiency of 61%. Utilizing this regenerative amplifier as the seed source, a multi-pass thin disk amplification system employing a lens guiding scheme has achieved pulse laser outputs exceeding 1kW with high stability.

Xing Liu
Shenzhen University of Technology

Prof. Xing Liu specializes in ultrafast thin disk laser technology and nonlinear optics. His research team successfully developed China's first kilowatt-level ultrafast thin disk laser and has published over 50 papers in leading journals, including Physical Review Letters, Nanophotonics, Optics Letters, and Photonics Research. Prof. Liu has also presented this research as the lead author at multiple CLEO conferences in the U.S. and Germany. Their work has been widely cited and featured in top journals such as Nature Photonics, Nature Communications, and Nature Physics.

Light-induced ultrafast dynamics of molecules and polaritons

Jian Wu
East China Nomal University

Abstract: This talk will highlight the progress on the measurements and control of the light-induced ultrafast dynamics in molecules and polaritons. In particular, the ultrafast dynamics of cold molecules, e.g. the molecules in superfluid Helium nanodroplets and the bimolecular interactions, will be discussed. By developing a femtosecond angle-resolved spectroscopic imaging technique, we reveal the mechanisms of room-temperature polariton condensation in a microcavity and manipulates the fundamental process in condensation dynamics.

Jian Wu
East China Normal University

Jian Wu from East China Normal University (ECNU) graduated with a Bachelor's degree from the Department of Physics at ECNU in 2002 and obtained a Ph.D. in Optics from the same university in 2007. From 2005 to 2006, he studied at the University of Rochester in the United States as an exchange student. From 2010 to 2012, he conducted collaborative research at the University of Frankfurt in Germany as a Humboldt Scholar. In July 2007, he was appointed as an Associate Professor at ECNU, and in 2010 he was promoted to be full Professor. Jian Wu focus on the research of ultrafast laser physics and has published over 160 scientific articles in recent years, including 14 entries in Nature journals, 34 in PRL, and 3 in PRX.

Strong-field double ionization of alkaline-earth metal atoms

Huipeng Kang
Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences

Abstract: Ionization of alkaline-earth metal atoms by intense femtosecond laser fields exhibit interesting features, including abnormally high yields of nonsequential double ionization (NSDI) of Mg in circular polarization. Fully classical model has been put forward to explain this finding. However, its mechanism has not been completely understood. By developing a concise Monte Carlo model, we clarify the physical effects that play crucial roles in NSDI of alkaline-earth metal atoms. The simulated results are in quantitative agreement with our experimental observations of different atoms, which are obtained by our home made time-of-flight setup. We further build up another experimental setup to measure the momentum of Mg2+. The experimental results support our previous understanding on NSDI of Mg.

Huipeng Kang
Innovation Academy of Precision Measurement Science and Technology, Chinese Academy of Sciences

Huipeng Kang received his PhD in Atomic and Molecular Physics from Wuhan Institute of Physics and Mathematics of Chinese Academy of Sciences in 2011, and has been a postdoc supported by the Alexander von Humboldt Foundation at Goethe Universität Frankfurt before joining Friedrich Schiller University Jena in 2019. His research interests are ultrafast dynamics of atoms and molecules exposed to intense femtosecond laser pulses. He has published 34 papers in Physical Review Letter, Physical Review A, New Journal of Physics, and Optics Express as the first or co-author (citation>800).

Ultrafast nonadiabatic excited state dynamics and its imaging

Chuncheng Wang
Jilin University

Abstract: Molecular existed state dynamics beyond Born-Oppenheimer approximation underlying photo-physics and photochemistry pose a great challenge. We developed new experimental approaches to shoot molecular movie of the exited states basing on the strong-field tunneling and recollision ionization processes. This will allow the real-time imaging of transient structure of the electronic excited state, which is fundamentally critical to understand and control ultrafast chemical reactions. By establishing the new laser induced electron recollision-assisted Coulomb explosion imaging approach, snapshots of the vibrational wavepackets of the excited (A) and ground states (X) of D2O+ are captured simultaneously with sub-10 picometer and few-femtoseconds precision. We also developed an elliptical laser-induced electron diffraction method to achieve the tomography imaging of complex molecules with few-femtoseconds and picometer resolution. The incident angle-resolved molecular frame DCS of molecular ion has been first time obtained with this new approach. These results provide comprehensive structural information for studying the fascinating molecular dynamics of complex molecules, and pave the way towards to make a movie of excited state-resolved ultrafast molecular dynamics and light-induced chemical reaction.

Chuncheng Wang
Jilin University

Chuncheng Wang is a full professor in Jilin university, his research interest focuses on shooting the molecular movie of light-induced ultrafast chemical reaction with femtosecond temporal resolution and ultrafast dynamics in the liquid phase. Recently, he successfully managed the first comparison study of the ultrafast isomerisation in the gas- and liquid-phase using extreme-ultraviolet time-resolved photoelectron spectroscopy, and moreover, he obtained the excited-states resolved transient structure of water molecule by improving Coulomb explosion imaging (CEI) technique. So far, he published more than 30 papers in the high impact journals including Nat. Chem., Phys. Rev. Lett., Light Sci & Appl. and Nat. Commun.

Ultrashort IAP generation with free CEP few-cycle NIR pulses

Xiaowei Wang
National University of Defense Technology

Abstract: The generation of ultrashort isolated attosecond pulse (IAP) has always been one of the core research aspects in the development of burgeoning attosecond science and technology. According to the cutoff energy law of high-order harmonic generation (HHG), long wavelength driving lasers are preferred to achieve ultrabroad IAP bandwidth which is a prerequisite for shortening the IAP temporal width. However, the conversion efficiency drops dramatically as the wavelength of driving laser increases, so that trade-off has to be made between pulse duration and photon flux during IAP generation. Here, we show that the trade-off can be avoided by utilizing drivers with shorter pulse duration instead of longer central wavelength. With ultrashort femtosecond pulses centered at 750 nm, IAPs with pulse duration down to 51 as were produced, which ensured much higher conversion efficiency in principle comparing to 1800 nm driving laser pulses. Furthermore, it is shown that the narrow linear-polarization gate formed by generalized double optical gating (GDOG) technique eliminates the requirement of carrier-envelope phase stabilizations.

Xiaowei Wang
National University of Defense Technology

Xiaowei Wang is an associated professor in department of physic, National University of Defense Technology. He received his bachelor's degree in 2007 and doctor's degree in 2013 in department of physic, National University of Defense Technology. His research interests include the high-order harmonic generation and its application in ultrafast spectroscopy, the generation, characterization and application of attosecond pulses generated through the interaction between ultrashort pulses and atoms, and time resolved ultrafast electron dynamics in atoms, molecules and solids in strong-field physics regime.

Attosecond ionization dynamics of helium and argon atoms triggered by XUV light

Sizuo Luo
Jilin University

Abstract: Attosecond photoelectron spectroscopy has emerged as a powerful tool for investigating ultrafast electron dynamics in atoms and molecules. In this study, we have studied the ionization dynamics of two noble gases, helium and argon, shedding light on their distinct electron behavior. We investigate the intricate interplay of laser field-induced ionization processes of He and the ionization time delay between 3s and 3p valance shells across the Cooper minimum of Ar. The observed photoelectron spectra from He exhibit energy-domain fringes corresponding to interference from temporal slits, modifiable by additional IR laser fields. The relative attosecond delay between electrons from the 3s and 3p shells validates predictions of the RPAE and reveals discrepancies with the results from TDLDA, indicating potential electron correlation effects between inner shells that may influence the photoionization matrix element of 3s. The findings presented herein not only deepen our understanding of fundamental atomic processes but also offer valuable insights into the development of advanced laser-driven technologies and attosecond science applications.

Sizuo Luo
Jilin University

Professor Sizuo Luo received his PhD from Jilin University, and worked as a researcher in Anne L'Huillier's group at Lund University during 2021 and 2023. He published more than 50 papers on attosecond electron dynamics of atoms and molecules, and femtosecond dissociation dynamics of molecules and clusters, including notable publications in Phys. Rev. Lett., Commum. Phys., Phys. Rev. Research, and Phys. Rev. A. Additionally, He has been appointed as a youth editorial board member for Ultrafast Science and Fundamental Research magazine.

Tunable Chirality Couplings and Anomalous Photo-Nernst Effect in Magnetic Weyl Cones in $Co_3Sn_2S_2$

Dong Sun, Peking University

Abstract: In this talk, we present our scanning photocurrent microscopy studies of magnetic Weyl semimetal Co3Sn2S2. In the first part of the talk, we demonstrate that we can use mid-infrared circular polarized light to inject chiral polarized Weyl Fermion. Our results reveal interesting coupling between the circularly polarized mid-infrared light and the magnetic Weyl cones when an external electric field is applied, through third order nonlinear optical response. The coupling builds up versatile tunable chiral polarized Weyl fermions, which manifests as measurable directional photocurrent generation. In the second part of the talk, we show observation of zero-field anomalous photo-Nernst effect in Co3Sn2S2. Experimentally, clear edge photocurrent response is observed due the anomalous photo-Nernst effect, and the effect can be used to image the magnetic domains.

Dong Sun
Peking University

Professor Dong Sun is currently Boya distinguish professor of the International Center for Quantum Materials (ICQM) at Peking University. 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.

Terahertz detection and imaging base on Rydberg atoms

Hui Yan
South China Normal University

Abstract: The quantum sensor of Rydberg atoms is extremely sensitive to detect terahertz waves. And precise measurement of terahertz electric fields was realized through quantum interference effects. This technology was demonstrated to be applied in long distance terahertz wireless communication. Furthermore, the superheterodyne technology based on room temperature Rydberg atoms can achieve high-precision measurement of field strength, phase and frequency, with an equivalent noise power nearly 1fW. By Rydberg atoms, the incoherent conversion from terahertz to visible light is also practicable. Through the imaging of visible light, original terahertz images can be restored with high-speed and high-sensitivity. Since Rydberg atoms convert terahertz into visible light in the near field, they can reach high spatial resolution and near-field imaging. In summary, terahertz technology based on Rydberg atoms is expected to break through the bottleneck of traditional electronics terahertz technology. And it has significant application prospects in terahertz detection, terahertz communication, terahertz imaging, and so on.

Harnessing high-power terahertz for today and beyond: The latest from Menlo Systems

Zhaoyang Tai
Menlo Systems

Abstract: Cutting-edge commercial all-fiber coupled time-domain terahertz spectrometers (THz-TDS) are revolutionizing the exploration of the far infrared spectrum. We introduce the recent progress of our leading THz-TDS, then we investigate the impact of their recent advancements on driving fundamental research also enabling applications within industries.

Zhaoyang Tai
Menlo Systems

Dr. Zhaoyang Tai built two thermal noise-limited sub-Hz ultra stable laser systems and applied them for photonic microwave generation together with frequency combs during his doctoral period from 2014-2018. From 2018 to now, he worked for Menlo Systems as an application engineer, supporting for all the Menlo products including frequency combs, ultra stable lasers, terahertz systems and femtosecond lasers.

Terahertz Advanced Detection Materials and Applications

Yi-Fan Wang
Xi'An THz-chip Technology Co.,LTD

Abstract: In the talk,I would like to briefly report our latest and novel technologies and product in Terahertz and other radiations to emit and detect,including high quality ZnTe crystal,BNA crystal, CsPbBr3 crystal and 6LiInSe2 crystal.Besides,I will expect the non-destructive equipment in composite material and coating.

Yi-Fan Wang
Xi'An THz-chip Technology Co.,LTD

I graduated from the Department of Physics, Capital Normal University in 2008. After graduation, I have been working for 14 years at DAHENG NEW EPOCH TECHNOLOGY, INC. a listed company on Shanghai Stock Exchange. Since my graduation, I have been engaged in the field of photonics technologies, especially as the person in charge of the terahertz product line. From 2015 to 2022, I cumulatively achieved sales of nearly CNY65M for terahertz products in mainland China. At the same time, I developed the international market, selling Chinese terahertz instruments and components to the United States, Germany, Japan, Singapore, and Thailand, opening up the domestic and international markets for terahertz products. After servering 14 years in Daheng,I jointly with Prof.Yadong Xu and other partners set up Xi'An THz-chip Technology Co.,LTD to develop Terahertz advanced detection materials and applications for a new chapter.

Introduction of Conformal Scanning Terahertz NDT System

Jinchao Li
Beijing Broad Hengtong Technology Development Co., Ltd

Abstract: With all own IP, Beijing Broad Hengtong Technology Development Co., Ltd (abb. BHT) developed Conformal Scanning Terahertz NDT System, Combined with the aerospace on-site inspection scene, the integration of collaborative robots and other tooling equipment, with the three-dimensional visualization system, to achieve the engineering and intelligent application of terahertz nondestructive testing technology. The conformal scanning terahertz nondestructive testing system was developed to provide modeling and path planning of planar and curved materials, and to form a conformal scanning terahertz nondestructive testing system for aviation material inspection. BHT's scanning system has been benchmarked with international cutting-edge products in both functionality and performance, help customers to implement online scanning and also easy understanding with using spectroscopic imaging management platform.

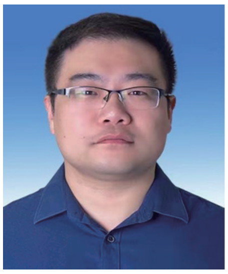
Jinchao Li
Beijing Broad Hengtong Technology Development Co., Ltd

Working Experience:
202406- Now Beijing Broad Hengtong Technology Development Co., Ltd CEO
201409-202404 Shanghai E-Planet Technologies Co., Ltd Co-Founder, VP for Sales & Market
Education Background:
200409-200812 Technical University of Munich, Department of Automotive Engineering, Diplom Engineer
199909-200307 Tsinghua University, Department of Automotive Engineering, Bachelor

Terahertz Tomography for Non-Destructive Testing of Objects with Random Surfaces

Kun Meng
Qingdao Quenda Terahertz Technology Co., Ltd.

Abstract: Terahertz three-dimensional tomography is a very promising technology for non-destructive testing and can complement the traditional non-destructive testing methods such as X-ray and ultrasound. This report first introduces the principles, background and system of terahertz 3D tomography technology. Following this, our progress is introduced. We have achieved real-time interactive communication between terahertz system and robotic arm systems, making it possible to investigate random-surface objects with the speed of 10s pixel/second and accuracy of sub-millimeter. Then, we propose a correlation coefficient correction method to improve the accuracy of thickness measurement by terahertz time-of-flight imaging method. After that, we established point-cloud-based 3D image reconstruction technology, which can accurately reconstruct the three-dimensional space of the measured object based solely on terahertz signals and corresponding robotic arm coordinate data. Based on this, we can effectively identify spatial dimensions and defect positions. At last, several non-destructive testing by using our systems are demonstrated. Finally, we give a brief outlook for our future development.



Kun Meng
Qingdao Quenda Terahertz Technology Co., Ltd.

Kun Meng, PhD, R&D Director and General Manager Assistant of Qingdao Quenda Terahertz Technology Co., Ltd. Mainly engaged in the research and development of terahertz spectral imaging technology and systems, terahertz core devices, as well as terahertz application technology and solutions. Published more than 30 academic papers, and authorized 12 invention patents.

Solution for Terahertz Spectral Imaging Technology for Industrial Applications

Yinghao Yuan
B-THz Information Technology (Wuhan) Co., Ltd.

Abstract: Terahertz time-domain spectroscopy measurement technology has unique application value in scientific research, public safety prohibited item detection, and industrial non-destructive testing in the terahertz field. In the past 20 years, it has gained extensive research heat. Its measurement sampling system has gone through the earliest mechanical optical delay scanning system, optical asynchronous sampling system based on dual frequency locked femtosecond light source, and cavity length tuning optical sampling system based on single frequency tunable femtosecond light source. This report reviews the working principles, advantages, and disadvantages of these three testing sampling systems, and introduces our research work and achievements.
Although terahertz spectroscopy measurement technology has been developed for more than 20 years, it still faces a series of challenges when facing industrial applications, such as core components being limited by foreign countries, slow measurement speed, poor spectral resolution (narrow time measurement window range), high system costs, and poor reliability, which restrict its large-scale promotion and use in the industrial field. This report proposes targeted solutions for different application scenarios to address these issues.

Yinghao Yuan
B-THz Information Technology (Wuhan) Co., Ltd.

Yuan Yinghao, Associate Researcher at Shanghai University of Technology and Founder&CEO of Bortech Information Technology (Wuhan) Co., Ltd. Engaged in long-term research and engineering application development of terahertz spectroscopy measurement technology. We have successively undertaken research and development projects such as the Ministry of Science and Technology's National International Science and Technology Cooperation Project (S2014ZI0540), the National Key R&D Program (2019YFC0810900), the Shanghai Social Development Science and Technology Research Project (22dz1200302), and the Ministry of Science and Technology of State Grid Corporation of China, with a cumulative research funding of over 30 million yuan.

Best Student Paper Session

November 17th, Kai Yuan Hall (开源厅)

Time	Title/Speaker
13:30-13:45	**Nanoscale THz-STM Imaging and Methods for Obtaining Local THz Time Domain Spectroscopy** **Hongbo Li[1,2,3,4], Kai Zhang[4], Jingyin Xu[4], Tianwu Wang[1,2,3,4*],Yirong Wu[1,2,3,4],Guangyou Fang[1,2,3,4*]** 1. Aerospace Information Research Institute, Chinese Academy of Sciences, China 2. Key Laboratory of Electromagnetic Radiation and Sensing Technology, Chinese Academy of Sciences, China 3. School of Electronic, Electrical and Communication Engineering, University of Chinese Academy of Sciences, China 4. GBA branch of Aerospace Information Research Institute, Chinese Academy of Sciences, China
13:45-14:00	**The first demonstration of an ultrawidely tunable intense superradiant THz free electron laser** Lixin Yan Tsinghua University, China
14:00-14:15	**Low and high-field terahertz response of single-walled carbon nanotubes controllably treated by air plasma** Maksim Paukov[1*], Arina Radivon[1], Aleksey Chernykh[2], Dmitry Krasnikov[3], Emil Chiglintzev[1, 4], Stanislav Kolar[1, 4], Kirill Brekhov[4, 5], Gennagy Komandin[6], Aleksandr Chernov[1, 4], Albert Nasibulin[3], Valentyn Volkov[7, 8], Aleksey Arsenin[7, 8], Maria Burdanova[1, 9*] 1.Moscow Institute of Physics and Technology (MIPT), Russia; 2.ITMO University, Russia; 3.Skolkovo Institute of Science and Technology, Russia; 4.Russian Quantum Center, Russia; 5.RTU MIREA, Russia; 6.Prokhorov General Physics Institute of the Russian Academy of Sciences, China; 7.Emerging Technologies Research Center, XPANCEO, United Arab Emirates; 8.Laboratory of Advanced Functional Materials, Yerevan State University, Armenia; 9.Osipyan Institute of Solid State Physics of the Russian Academy of Sciences, Russia
14:15-14:30	**Evaporation of cations from non-conductive nano-samples using single-cycle THz pulses: an experimental and theoretical study** Simone Taioli European Centre for Theoretical Studies in Nuclear Physics and Related Areas, Italy
14:30-14:45	**A Single-Layer Dual-Band Terahertz Information Encryption Metasurface Based on MXene** Tao Luo, Qingyang Liu, Yiwei Xue, Limei Qi School of Electronic Engineering, Beijing University of Posts and Telecommunications, China
14:45-15:00	**Cross-talk free polarization resolved terahertz photoconductive detector** Huiliang Ou, James Lloyd-Hughes, Emma MacPherson University of Warwick, United Kingdom
15:00-15:15	Coffee Break
15:15-15:30	**Characterization of porosity in solid electrolytes based on terahertz time-domain spectroscopy** Junhong Wang, Xueping Liu, Shuting Fan, Renheng Wang, Zhengfang Qian Shenzhen University, China

15:30-15:45	**Tip-enhanced THz nano-imaging and -spectroscopy of strongly coupled photonic molecules** Yuanpei Wei, Yueying Wang, Xiaoqiuyan Zhang, Fu Tang, Min Hu University of Electronic Science and Technology of China, China
15:45-16:00	**Ultrafast two-dimensional electronic spectroscopy study of carrier dynamics in 2D transition metal dichalcogenides** Jin Yang, Niu Xu, Jin-hui Zhong Southern University of Science and Technology, China
16:00-16:15	**Tracking and manipulating ultrafast carrier dynamics in 3D Dirac semimetal Cd3As2** Peng Suo, Wenjie Zhang, Xian Lin, Guohong Ma Shanghai University, China
16:15-16:30	**The isotope effect in Terahertz and High-harmonic generation from liquid** Wanchen Tao, Lixin He Huazhong University of Science and Technology, China
16:30-16:45	**Customizable multicolor free electron X-rays from van der Waals heterostructures** Sunchao Huang[1*], Ruihuan Duan[2], Nikhil Pramanik[2], Michael Go[2], Chris Boothroyd[2], Zheng Liu[2], Yubing Gong[1], Liang Jie Wong[2] 1.University of Electronic Science and Technology of China, China; 2.Nanyang Technological University, Singapore
16:45-17:45	Terahertz super-resolution technology and applications
18:30-20:30	Banquet

Customizable multicolor free electron X-rays from van der Waals heterostructures

Sunchao Huang[1,2*], Ruihuan Duan[3,4], Nikhil Pramanik[2], Michael Go[2], Chris Boothroyd[4,5], Zheng Liu[4], Yubing Gong[1] and Liang Jie Wong[2†]

1. School of Electronic Science and Engineering, University of Electronic Science and Technology of China, China
2. School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore
3. CINTRA CNRS/NTU/THALES, UMI 3288, Research Techno Plaza, Nanyang Technological University, Singapore
4. School of Materials Science and Engineering, Nanyang Technological University, Singapore
5. Facility for Analysis, Characterisation, Testing and Simulation (FACTS), Nanyang Technological University, Singapore

Abstract: The emergence of van der Waals heterostructures has provided a precise and versatile method of fabricating devices with accuracies on the atomic scale. For this reason, vdW heterostructures have shown much promise in the fields of photodetectors, photocatalysis, photovoltaic devices, ultrafast photonic devices, and field-effect transistors. These applications, however, remain confined to the optical and sub-optical regimes. Here, we predict and demonstrate the use of vdW heterostructures as a platform for versatile free electron-driven photon emission in the X-ray regime. Specifically, we generate tunable, multi-color X-ray photons whose frequency composition can be dynamically controlled. The photon energy and relative intensities of the output spectral peaks can be tailored by varying the electron energy, the electron beam position, as well as the geometry and composition of the vdW heterostructure. The wide choices of vdW material layers, and the ability to stack them in any desired combination, allow us to create precisely tailored platforms for multicolor X-ray generation. The device is driven by free electrons from a table-top electron source, although our paradigm is also valid for high-energy electrons at large facilities. Our results reveal the promise of vdW heterostructures in paving the way towards highly tunable, tabletop multicolor X-ray sources.

The First demonstration of an ultrawidely tunable intense superradiant terahertz free electron laser

Lixin Yan[1*], Yifan Liang[2], Tong Li[1], Jitao Sun[3], Zhuoyuan Liu[1], Jiayue Yang[3], Xiaofan Wang[2], Yong Yu[2], Qili Tian[1], Zhigang He[3], Li Zeng[2], Huaiqian Yi[2], Guorong Wu[3], Weiqing Zhang[3], Xueming Yang[3], Chuanxiang Tang[1]

1.Department of Engineering Physics, Tsinghua University, China

2.Institute of Advanced Science Facilities, China

3.Dalian Institute of Chemical Physics, CAS, China

High-intensity and widely tunable sources in the terahertz (THz) frequency range are highly desirable for both fundamental and applied researches. We will report the first demonstration of a superradiant THz free electron laser by pre-modulating the electron beam into microbunches which emit in phase and interact strongly with the generated THz waves in a one-meter-long undulator. The measurements show that the narrow-band radiation frequency can be tuned throughout the 1 THz to 15 THz range at the fundamental harmonic of electron microbunches and up to 20 THz at the second harmonic. The detected pulse energy reaches 150 microjoules at 10 THz without consideration of the transportation loss. With parameter optimization, this novel scheme is capable of delivering narrow band THz FEL with pulse energy up to several mJ covering the ultrawidely tuning range of 1-30THz. Such kind of THz source is stable in terms of shot-to-shot pulse intensity and frequency, and is expected to open up many novel researches.

Low and high-field terahertz response of single-walled carbon nanotubes controllably treated by air plasma

Maksim Paukov[1*], Arina Radivon[1], Aleksey Chernykh[2], Dmitry Krasnikov[3], Emil Chiglintzev[1, 4], Stanislav Kolar[1, 4], Kirill Brekhov[4, 5], Gennagy Komandin[6], Aleksandr Chernov[1, 4], Albert Nasibulin[3], Valentyn Volkov[7, 8], Aleksey Arsenin[7, 8], Maria Burdanova[1, 9*]

1.Moscow Institute of Physics and Technology (MIPT), Russia;
2.ITMO University, Russia;
3.Skolkovo Institute of Science and Technology, Russia;
4.Russian Quantum Center, Russia;
5.RTU MIREA, Russia;
6.Prokhorov General Physics Institute of the Russian Academy of Sciences, China;
7.Emerging Technologies Research Center, XPANCEO, United Arab Emirates;
8.Laboratory of Advanced Functional Materials, Yerevan State University, Armenia;
9.Osipyan Institute of Solid State Physics of the Russian Academy of Sciences, Russia

Abstract: In current research the conducting properties of the single-walled carbon nanotubes films with controllable oxygen defect treatment were investigated by low and high-field terahertz spectroscopy. The mismatch of the distance between defects found from Raman measurements and the localization length observed from terahertz time-domain spectroscopy (TDS) was proved and explained. Moreover, the shift of the plasmon to higher frequencies was found to be dependent on the number of defects. Increasing of the THz field strength has led to the decline in conductivity. This phenomenon results from the redistribution of the charge carrier population under the applied electric field, which was fitted by the Boltzmann model accounting for the neutral and charged impurity scattering. Finally, we present a finite element model of a terahertz wire grid polarizer based on the obtained dielectric characteristics for defected samples and various field strengths. Our findings offer insights into designing THz devices with varying field strengths using CNTs with different defect levels. Authors acknowledge the Russian Science Foundation project No. 24-79-00143 and ITMO-MIPT-Skoltech Clover initiative.

Evaporation of cations from non-conductive nano-samples using single-cycle THz pulses: an experimental and theoretical study

Simone Taioli

European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT)*

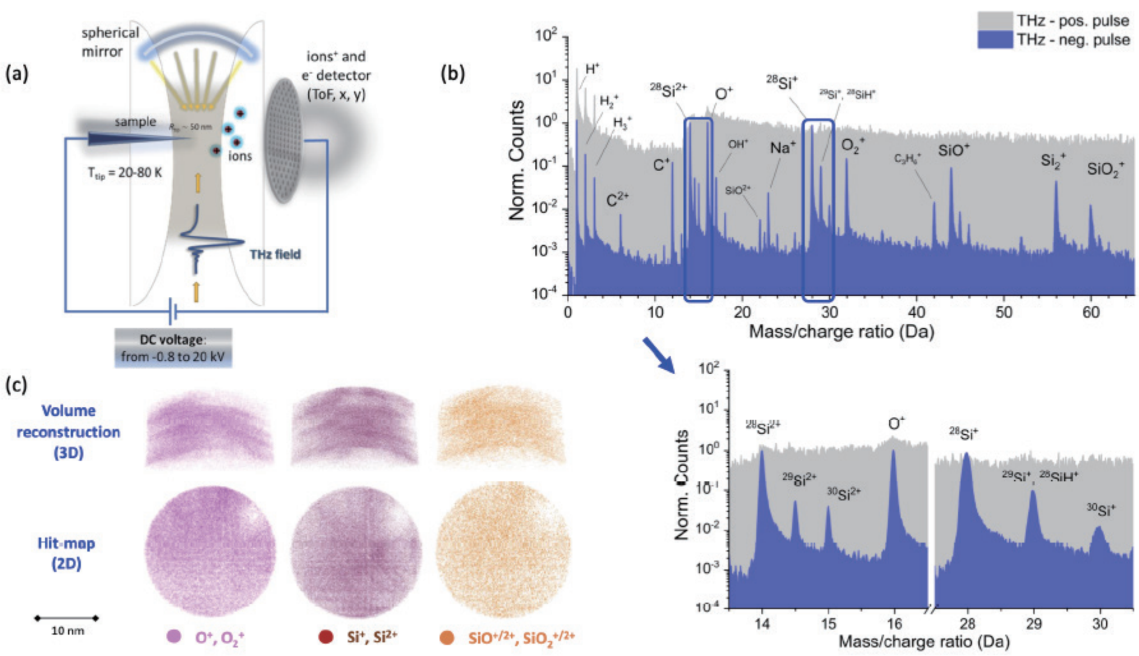
and

Trento Institute for Fundamental Physics and Applications (INFN), Trento, Italy

Abstract: The interaction of electromagnetic fields with nanostructures is of great interest for applications such as imaging, ultrafast electron microscopy, gas sensing and controlled catalysis. Over the last ten years, research has focussed on the control of materials using ultra-strong electrostatic fields and powerful optical pumping processes. In the field of terahertz science, in particular, new methods have been developed to generate intense terahertz pulses that bridge the gap between static and electromagnetic field control of matter. Terahertz pulses of picosecond duration have shown promising results in activating catalytic reactions and triggering the emission of electrons and ions from nanoscale samples. These pulses have been generated with free-electron lasers or by interaction with metallic nanostructures. High amplitude terahertz pulses are used in imaging techniques such as scanning tunnelling microscopy and atom probe tomography and influence the interaction with materials and charge emission.

This study investigates the interaction of single-cycle terahertz pulses with amorphous silica nanoneedles, a non-conducting material (see Figure below). Experimental and theoretical analyses show that both positive and negative terahertz pulses can induce the evaporation of cations from the nanoneedles, with negative pulses being more effective for silicon dioxide samples.

This work sheds light on the influence of polarity on the emission process and its effects on various applications with nanostructures and terahertz fields. The computational model based on time-dependent density functional theory (TDDFT) investigates the silicon dioxide matrix under electrostatic fields and THz laser irradiation with Si(OH)4 as a model molecule. The dynamic approach captures nonlinear effects and interaction forces and reveals critical THz laser fields and mechanisms for ion evaporation. The study highlights the importance of considering electron mobility in different materials and introduces a simplified model to analyse the experimental behaviour in silica and semi-metallic samples such as LaB_6.



A Single-Layer Dual-Band Terahertz Information Encryption Metasurface Based on MXene

Tao Luo, Qingyang Liu, Yiwei Xue, and Limei Qi
School of Electronic Engineering, Beijing University of Posts and Telecommunications,
No 10, Xitucheng Road, Haidian District, Beijing

Abstract: With the development of information and communication technology, data privacy and data security have been a serious problem. Optical encryption methods are widely used since they offer features such as fast encryption speed, high s ecurity levels, and the ability to encode both the spatial and frequency domains of images simultaneously. Metasurface is an artificially designed two-dimensional material that can precisely control electromagnetic waves passing through its surface. These metasurfaces are typically composed of many tiny structural units, the size, shape, and arrangement of which determine their ability to manipulate electromagnetic waves. Currently, optical encryption based on metasurfaces primarily operates in the visible and infrared ultraviolet spectrum, with only a small portion of the work being done in the terahertz range. What's more, all optical encryption metasurfaces are rigid, non-flexible, and inelastic, which significantly impedes their further development and application in the field of optical encryption. In this paper, we propose a MXene-based single-layer dual-band terahertz information encryption metasurface and achieve a flexible single-layer encryption metasurface. The metasurface operates at 0.3 THz and 0.84 THz. Utilizing the PB phase, at the 0.3 THz, we designed 8 C-shaped open rings to achieve phase modulation covering 0~2 . Based on Malus's law, at the 0.84 THz, we designed a square hole to modulate the intensity of the transmitted wave. By combining the square holes and C-shaped rings to form units, eventually, a single-layer dual-band information encryption metasurface was achieved, a holographic image of the letter "H" is observed at 0.3 THz, and a QR code image is observed at 0.84 THz. Proposed encryption metasurface could be applied in various high-security and anticounterfeiting applications in terahertz frequency band.

Cross-talk free polarization resolved terahertz photoconductive detector

Huiliang Ou, James Lloyd-Hughes, and Emma Pickwell-MacPherson
Department of Physics, University of Warwick, Coventry CV4 7AL, United Kingdom

Abstract: Terahertz time-domain spectroscopy (THz-TDS) systems are generally based on the generation of linear polarized THz pulses and detection of only one of the components of the THz electric fields. To record the full polarization state, either a second time-domain scan, or a second THz detector is needed, which either doubles the data acquisition time or complicates the system configuration. Polarization-resolved (PR) THz detector is efficient in recovery of full polarization state of terahertz pulses. PR detector is able to record simultaneously the two components of THz electric fields, therefore determining the full polarization state in one time-domain scan. However, the state-of-art PR detectors meet the challenge in either high polarization crosstalk between detection channels, or low signal-to-noise ratio (SNR) over the broadband THz spectrum.

In this work, we propose a novel device of a 2-channel PR-PCA (photoconductive) detector. The PR-PCA detector is made by metallization on both sides of a piece of InGaAs:Rh semiconductor. Orthogonally aligned interdigitated gold electrodes are patterned on the front side to serve as the two channels to record two components of THz electric fields. Orthogonally aligned wire-grid polarizer are patterned on the backside to greatly reduce the polarization cross-talk between the two channels. The performance of the detector is evaluated by the Jones matrix calculation, the FDTD (finite-different time-domain) simulation model and the experimental measurements. Our results show little polarization cross-talk of the proposed device, as well as high SNR and bandwidth. The PR detector can be made with traditional UV lithography techniques, and has great potential in the use of THz polarization sensitive applications, in particular THz polarization imaging, THz polarimetry and THz ellipsometry.

Characterization of porosity in solid electrolytes based on terahertz time-domain spectroscopy

Junhong Wang[1], Xueping Liu[2], Renheng Wang, Shuting Fan*, Zhengfang Qian

1.Key Laboratory of Optoelectronic Devices and Systems of Ministry of Education and Guangdong Province

2.College of Physics and Optoelectronic Engineering, Shenzhen University, Shenzhen, China

Abstract: Porosity, as a fundamental parameter of solid-state electrolytes, plays a pivotal role in evaluating their overall performance, profoundly influencing key indicators such as battery charging and discharging efficiency, as well as mechanical strength. Elevated porosity can lead to a significant decline in ionic conductivity and a reduction in mechanical integrity, resulting in a range of complications that heighten the risk of battery short circuits. Consequently, the accurate evaluation of porosity in these materials becomes critically important for ensuring reliability and safety. This study presents a non-contact and non-destructive method for characterizing the porosity of $Li_{6.4}La_3Zr_{1.4}Ta_{0.6}O_{12}$ (LLZTO) oxide solid-state electrolytes, which have been sintered at various temperatures, utilizing terahertz time-domain spectroscopy technology. This innovative material is distinguished by its high ionic conductivity, enhanced safety features, and superior energy density, effectively addressing the persistent challenges of flammability and explosion associated with lithium batteries. We acquired the terahertz time-domain spectra of solid-state electrolyte samples sintered at temperatures ranging from 1000°C to 1200°C to derive the dielectric constants. By integrating Bruggeman's effective medium theory, we predicted the porosity of these materials and conducted a comparative analysis of the accuracy of two Bruggeman approximations. Furthermore, we provided preliminary insights into the pore morphology of the sintered solid-state electrolyte, contributing to a deeper understanding of its structural characteristics and performance implications, which are essential for the development of safer and more efficient battery technologies.

Tip-enhanced THz nano-imaging and -spectroscopy of strongly coupled photonic molecules

Yuanpei Wei[1,2], Yueying Wang[1,2], Fu Tang[1,2], Xiaoqiuyan Zhang[1,2], Min Hu[1,2]

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

2. Key Laboratory of Terahertz Technology, Ministry of Education, University of Electronic Science and Technology of China, China

Abstract: Strong light-matter coupling can occur when the energy exchange rate between two photonic molecules exceeds competing dissipating processes, and thus generate two new hybridized polaritonic states. Coupled photonic molecules with near-field light-matter interactions can generate new hybridized states when reaching the strong coupling region. Terahertz(THz) metasurface with designed energy levels and high tunability has been demonstrated to be a promising platform for investigating strong coupling in nano-scale. However, limited by the poor spatial resolution of traditional far-field imaging methods in the THz range, the study of metasurface at single cell level with deep-subwavelength dimensions remains challenging. Here, we introduce the nano-resolved spatial distribution of electromagnetic field in the strongly coupled photonic molecules system. Employing the scattering-type scanning near-field optical microscopy (s-SNOM) equipped with the THz time domain spectroscopy (TDS), we successfully observed strong coupling phenomena of coupled photonic molecules at nano-scale. With the length of nanoantenna changing from 50 μm to 60 μm, we observe an anti-avoiding feature, with a coupling strength of 0.15 THz, reaching strong coupling regime. Utilizing terahertz hyperspectral nanoimaging, we observe a relative phase retardation between the two photonic molecules when changing the antenna resonance.

Ultrafast two-dimensional electronic spectroscopy study of carrier dynamics in 2D transition metal dichalcogenides

Jin Yang, Niu Xu, and Jin-hui Zhong
Department of Materials Science and Engineering, Southern University of Science and Technology, China

Abstract: At present, it is still a challenge to study the sub-picosecond carrier dynamics processes, such as carrier-carrier scattering (thermalization), hot carrier cooling, exciton formation, interlayer charge transfer, in 2D transition metal dichalcogenides (TMDs). Here, we have developed a home-built two-dimensional electronic spectroscopy (2DES), which can achieve a 10-fs time resolution and 100 kHz detection frequency, by combining a non-collinear optical parametric amplifier and a high acquisition rate fast line camera. 2DES can provide simultaneously high time and frequency resolutions, and has significant advantages for the investigation of complex and ultrafast carrier dynamics. By the ultrafast 2DES, we have carried out many studied in the $PdSe_2$ film and type I $MoS_2/PtSe_2$ heterostructure.

In $PdSe_2$ film, a short-lived photobleaching band at 1.3-1.7 eV within 1 ps has been found, indicating the strongly layer-dependent exciton effect in $PdSe_2$. Moreover, two coherent phonon modes around 4.3 THz and 0.37 THz can be clearly seen in the 2DES, which corresponds to the A_g^1 optical phonon mode and interlayer breathing mode, respectively, showing strong electron-phonon coupling for $PdSe_2$.

In type I $MoS_2/PtSe_2$ heterostructure, we revealed a two-step charge transfer process from the small bandgap $PtSe_2$ to the large bandgap MoS_2, that is the primary hot carrier transfer within 1 ps and secondary Auger-assisted carrier transfer during 6-100 ps. Also because of the interlayer charge transfer, an out-of-plane interfacial electric field is created in heterostructure, which induces a continuously blue-shifted A exciton peak in MoS_2 with the increase of delay time, due to the Stark effect and the reduction of exciton binding energy.

By using ultrafast 2DES, we have revealed many interesting dynamic mechanisms in the two-dimensional material systems, laying a foundation for the application of TMDs in optoelectronic devices.

Tracking and manipulating ultrafast carrier dynamics in 3D Dirac semimetal Cd3As2

Peng Suo[1], Wenjie Zhang[1], Yunkun Yang[2], Xian Lin[1], Faxian Xiu[2], and Guohong Ma[1]
1. Department of Physics, Shanghai University, China
2. State Key Laboratory of Surface Physics and Department of Physics, Fudan University, China

Abstract: Tracking the photocarrier dynamics in a material is fundamental for comprehending the complex many-body interactions and the evaluation mechanisms of various elementary excitations upon photoexcitation. Concurrently, flexibly manipulation of the photocarrier dynamics is the critical prerequisite for designing and developing innovative functional devices. In this study, based on ultrafast optical pump-terahertz probe spectroscopy, we have investigated the influence of Zn-element doping on the ultrafast photocarrier dynamics in 3D Dirac semimetal Cd3As2. Our analysis of pump fluence and temperature-dependent transient terahertz spectroscopy revealed that in pristine and lightly doped samples within the nontrivial semimetal phase, the photocarrier dynamics are dominated by the cooling of Dirac fermions. In contrast, the relaxation process in heavily doped alloys can be attributed to interband electron-hole recombination, which is a consequence of doping-induced transition into a trivial semiconductor phase. Our investigation highlights that Zn-doping is an effective strategy for engineering the electronic band structure and manipulating transient carrier relaxation dynamics in Cd3As2, and pave the way to design novel ultrafast optoelectronic devices based on Dirac semimetals.

The isotope effect in Terahertz and High-harmonic generation from liquid

Wanchen Tao and Lixin He
Wuhan National Laboratory for Optoelectronics and School of Optical and Electronic Informatio, Huazhong University of Science and Technology, China

Abstract: This study reports on the generation of terahertz (THz) signals and high-harmonic generation (HHG) in liquid media. By employing a tailored laser passing through columns of water and heavy water, we have successfully generated THz signals and observed distinct spectral differences between the THz signals generated by water and heavy water. Furthermore, we have harnessed the interaction of an 800nm fundamental wavelength laser with alcohol, water, and heavy water to produce HHG, achieving the generation of the 15th harmonic order with wavelength below 60 nm. This accomplishment shows the liquids' potential for applications in the extreme ultraviolet (XUV) regime. Our findings are anticipated to elucidate the unique properties of various liquid media, particularly isotope liquid media, within the framework of nonlinear optical processes, offering invaluable insights for future investigations into the electronic structure and ultrafast dynamics of liquids.

Customizable multicolor free electron X-rays from van der Waals heterostructures

Sunchao Huang[1,2*], Ruihuan Duan[3,4], Nikhil Pramanik[2], Michael Go[2], Chris Boothroyd[4,5], Zheng Liu[4], Yubing Gong[1] and Liang Jie Wong[2†]

1. School of Electronic Science and Engineering, University of Electronic Science and Technology of China, China

2. School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore

3. CINTRA CNRS/NTU/THALES, UMI 3288, Research Techno Plaza, Nanyang Technological University, Singapore

4. School of Materials Science and Engineering, Nanyang Technological University, Singapore

5. Facility for Analysis, Characterisation, Testing and Simulation (FACTS), Nanyang Technological University, Singapore

Abstract: The emergence of van der Waals heterostructures has provided a precise and versatile method of fabricating devices with accuracies on the atomic scale. For this reason, vdW heterostructures have shown much promise in the fields of photodetectors, photocatalysis, photovoltaic devices, ultrafast photonic devices, and field-effect transistors. These applications, however, remain confined to the optical and sub-optical regimes. Here, we predict and demonstrate the use of vdW heterostructures as a platform for versatile free electron-driven photon emission in the X-ray regime. Specifically, we generate tunable, multi-color X-ray photons whose frequency composition can be dynamically controlled. The photon energy and relative intensities of the output spectral peaks can be tailored by varying the electron energy, the electron beam position, as well as the geometry and composition of the vdW heterostructure. The wide choices of vdW material layers, and the ability to stack them in any desired combination, allow us to create precisely tailored platforms for multicolor X-ray generation. The device is driven by free electrons from a table-top electron source, although our paradigm is also valid for high-energy electrons at large facilities. Our results reveal the promise of vdW heterostructures in paving the way towards highly tunable, tabletop multicolor X-ray sources.

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ISUPTW2024-0819-1	**Terahertz non-destructive tests based on a raster-scan THz imaging system** Chengyao Peng, Wenbing Zhang, Zhenchun Yu Institute of Energy, Hefei Comprehensive National Science Center
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ISUPTW2024-0822-3	**Conical intersection alters fragmentation reactions of polyatomic molecular cations** Yupeng Liu Huazhong University of Science and Technology
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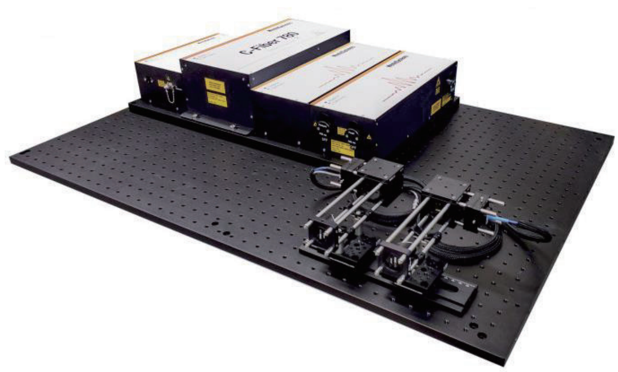

典型应用：材料检测、气体监测、药物检测、生物医学、6G通信、涂层质检

指标参数

- 光谱范围 >6 THz
- 动态范围 >100 dB
- **最新！** 太赫兹功率 >300 μW
- 扫描范围 >850 ps (可选1700 ps)
- **最新！** 扫描速度 >120 Hz at 50 ps, >85 Hz at 100 ps
- 支持远程控制及二次开发
- 集成Figure9专利锁模激光器

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- TeraLyzer 分析软件
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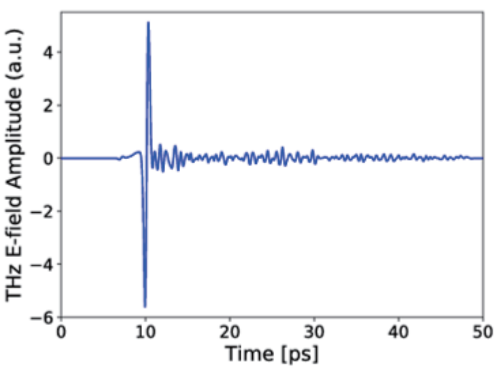
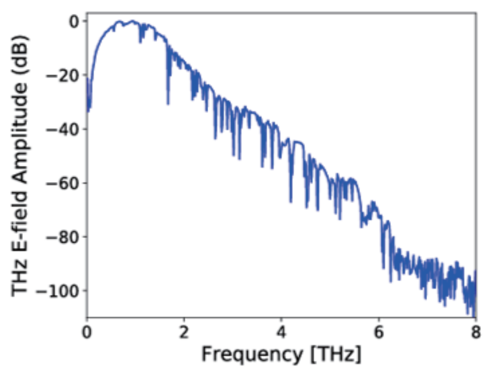
* *Pettine, J., Padmanabhan, P., Shi, T. et al. Light-driven nanoscale vectorial currents. Nature 626, 984–989 (2024).*





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