
# ULTRAFAST PHENOMENA CONFERENCE

# 15 - 19 JULY 2024, Barcelona, Spain
# https://www.up2024.org/

# PROGRAMME

# SHORT ABSTRACTS

**Opening Remarks**
**08:30 - 08:45, Monday 15 July 2024, Auditorium**
Chaired by **Jens Biegert, ICFO – The Institute of Photonic Sciences, Castelldefels, Spain**

**Mo-1A: Structural Changes**
**08:45 - 10:15, Monday 15 July 2024**
**Auditorium, Oral session**
**Chaired by Akiyoshi Hishikawa, Nagoya University, Nagoya, Japan**

08:45 - 09:15
Mo-1A.1 Invited **Two-Dimensional Electronic Spectroscopy of Transients**
Tahei Tahara
RIKEN, Wako, Japan
We carried out two-dimensional electronic spectroscopy of short-lived transient species to reveal its characteristic properties, in particular the inhomogeneous nature of structure and its temporal evolution, which is distinctly different from stable molecular systems.

09:15 - 09:30
Mo-1A.2 **Direct Observation of Nonequilibrium Planarization Dynamics upon the Onset of Excited-State Aromaticity by Ultrafast Time-Domain Raman Spectroscopy**
Yusuke Yoneda[1,2], Tomoaki Konishi[3], Shohei Saito[3], Hikaru Kuramochi[1,2]
[1]Institute for Molecular Science, Okazaki, Japan. [2]Graduate Institute for Advanced Studies, SOKENDAI, Okazaki, Japan. [3]Graduate School of Science, Kyoto University, Kyoto, Japan
Ultrafast structural dynamics associated with excited-state aromaticity was investigated by femtosecond time-resolved impulsive stimulated Raman spectroscopy on a prototypical cyclooctatetraene derivative. Time-resolved Raman data clearly capture a non-equilibrium bent-to-planar structural change in the excited state.

09:30 - 09:45
Mo-1A.3 **Ultrafast dynamics of a novel perylene diimide dimer: solvent-controlled excitonic coupling**Giovanni Bressan[1], Samuel Penty[2], Dale Green[1], Ismael Heisler[3], Timothy Barendt[2], Stephen Meech[1]
[1]University of East Anglia, Norwich, United Kingdom. [2]University of Birmingham, Birmingham, United Kingdom. [3]Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

We applied ultrafast coherent spectroscopies to probe photoinduced dynamics in a covalent perylene diimide dimer exhibiting solvent-controlled on/off excitonic coupling in toluene/1,1,2,2 tetrachloroethane solvents. The solvent-dependent population and vibrationally coherent dynamics are discussed.

09:45 - 10:00
Mo-1A.4 **Few-femtosecond UV-induced dissociative dynamics of methyl-iodide**
Sergey Ryabchuk[1], Lorenzo Colaizzi[1], Erik P. Månsson[2], Vincent Wanie[2], Andrea Trabattoni[2,3], Jesús González-Vázquez[4], Fernando Martín[4,5], Francesca Calegari[1,2]
[1]Universität Hamburg, Hamburg, Germany. [2]CFEL, DESY, Hamburg, Germany. [3]Leibniz Universität Hannover, Hannover, Germany. [4]Universidad Autonoma de Madrid, Madrid, Spain. [5]IMDEA Nanoscience, Madrid, Spain
We studied the dissociative dynamics of methyl-iodide following ultraviolet photoexcitation with unprecedented temporal resolution. Our theoretical model provided a detailed interpretation of the experimental observations by precisely identifying the involved dissociation channels.

**COFFEE BREAK**
**10:15 - 10:45, Monday, 15 July 2024, Auditorium halls**

**Mo-2A: Chirality**
**10:45 - 12:30, Monday, 15 July 2024**
**Auditorium, Oral session**
**Chaired by Olga Smirnova, Max-Born Institute, Berlin, Germany**

10:45 - 11:00
Mo-2A.1 **Laser-induced electron diffraction in chiral molecules**
Debobrata Rajak[1], Sandra Beauvarlet[1], Omer Kneller[2], Antoine Comby[1], Raluca Cireasa[3], Dominique Descamps[1], Baptiste Fabre[1], Jimena Gorfinkiel[4], Julien Higuet[1], Stéphane Petit[1], Shaked Rozen[2], Hartmut Ruf[1], Nicolas Thiré[1], Valérie Blanchet[1], Nirit Dudovich[2], Bernard Pons[1], Yann Mairesse[1]
[1]CELIA, Talence, France. [2]Weizmann Insitite of Science, Rehovot, Israel. [3]ISMO, Orsay, France. [4]Open University, Milton Keynes, United Kingdom
We use strong laser fields to investigate the collision between electrons and oriented chiral molecules. The electron momentum distributions show clear signatures of chiro-sensitive laser-induced electron diffraction.

11:00 - 11:15
Mo-2A.2 **Chiral detection by electron rescattering with linearly polarized mid-infrared laser fields**
Katharina Chirvi[1], Xinyao Liu[1], Hao Liang[2], Jie Meng[1], Aurelien Sanchez[1], Lei Geng[2], Rešad Kahvedžić[3,4], Stefanie Gräfe[3,4,5], Liang-You Peng[2,6], Jens Biegert[1,7]
[1]ICFO - Institut de Ciencies Fotoniques, Barcelona, Spain. [2]State Key Laboratory for Mesoscopic Physics and Frontiers Science Center for Nano-optoelectronics School of Physics, Peking University, Beijing, China. [3]Institute of Physical Chemistry, Friedrich Schiller University Jena, Jena, Germany. [4]Max Planck School of Photonics, Jena, Germany. [5]Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany. [6]Collaborative Innovation Center of Quantum Matter, Beijing, China. [7]ICREA, Pg. Lluís Companys 23, Barcelona, Spain
We show that a simple linearly polarized mid-IR field leads to chiral detection and electron diffraction due to the ponderomotive and Lorentz forces. We demonstrate this effect which gives access to different symmetries in molecular imaging.

11:15 - 11:30
Mo-2A.3 **Ultrafast TACOS**
Justas Terentjevas[1,2], Patricia Vindel-Zandbergen[3], Laura Rego[2,4,5], Felipe Morales[1], Olga Smirnova[1,6], David Ayuso[1,2]
[1]Max Born Institute, Berlin, Germany. [2]Imperial College London, London, United Kingdom. [3]New York University, New York, USA. [4]Instituto Madrileño de Estudios Avanzados en Nanociencia, Madrid, Spain. [5]Universidad Autónoma de Madrid, Madrid, Spain. [6]Technische Universität Berlin, Berlin, Germany
We introduce TACOS – Terahertz-Assisted Chiro-Optical Spectroscopy – for ultrafast and highly efficient chiral recognition. TACOS relies on driving ultrafast nonlinear electronic dynamics in chiral molecules using terahertz and few-cycle optical pulses, without requiring optical CEP stability.

11:30 - 11:45
Mo-2A.4 **Driving and Imaging Ultrafast Chiral Currents in Achiral Matter**
Edward Binns[1], Justas Terentjevas[1,2], Laura Rego[1,3,4], Andrés Ordóñez[1], David Ayuso[1,5]
[1]Imperial College London, London, United Kingdom. [2]Max-Born-Institut, Berlin, Germany. [3]Instituto Madrileño de Estudios Avanzados en Nanociencia, Madrid, Spain. [4]Universidad Autónoma de Madrid, Madrid, Spain. [5]Max-Born-Institut, Berln, Germany
We imprint chirality into matter that is initially achiral (e.g. atoms) by driving ultrafast chiral currents using tailored light. Such achiral-to-chiral phase transitions can be monitored by measuring the nonlinear optical response of the medium.

11:45 - 12:00
Mo-2A.5 **Ultrafast Carrier Transport in Bright Chiral Emitters tracked with Transient Holographic Imaging**
Julia Anthea Gessner[1], Philipp Kollenz[1], Shangpu Liu[1,2], Garrett May[1], Felix Deschler[1]
[1]University of Heidelberg, Heidelberg, Germany. [2]Technical University Munich, Garching b. Munich, Germany
We apply ultrafast holographic microscopy for the optical study of carrier transport in doped hybrid perovskites exhibiting chiral emission characteristics. We show wavelength-dependent kinetics effected by the presence of different phases in the chiral perovskite.

12:00 - 12:15
Mo-2A.6 **Generation of Flying Doughnut Terahertz Pulses**
Kamalesh Jana[1], Yonghao Mi[1], Dong Hyuk Ko[1], Shawn Sederberg[2], Paul B. Corkum[1]
[1]Joint Attosecond Science Laboratory, University of Ottawa and National Research Council of Canada, Ottawa, Canada. [2]Simon Fraser University, Vancouver, Canada
We demonstrate the generation of the 'Flying Doughnut' terahertz (THz) pulse having a strong longitudinal magnetic field. We measure the spatiotemporal structure of the electric field and calculate the space-time map of the magnetic field.

12:15 - 12:30
Mo-2A.7 **Probing Nanoscale Chiral Plasmonic Modes with Free Electron Vortex State Spectral Dichroism**
Neli Streshkova, Martin Kozák
Charles University, Prague, Czech Republic
We propose to use a coherent superposition of free electron vortex states for probing chirality of electromagnetic near-fields. We show that the electron spectra exhibit dichroism dependent on the local chirality of the near-fields.

**Mo-2B: Low-Dimensional Materials**
**10:45 - 12:30, Monday, 15 July 2024**
**Room A2+A3, Oral session**
**Chaired by Stefano Dal Conte, Politecnico di Milano, Milano, Italy**

10:45 - 11:00
Mo-2B.1 **Exploring the Frontier of High-Pressure Phase Transitions in $MoS_2$ Using Solid-State High Harmonic Generation Spectroscopy**
Bailey R. Nebgen[1], Jacob A. Spies[1], Lun Yue[2], Craig P. Schwartz[3], Victor C. Lee[4], Diana Y. Qiu[4], Mette B. Gaarde[2], Dean Smith[3], Michael Zuerch[1]
[1]UC Berkeley, Berkeley, USA. [2]Louisiana State University, Baton Rouge, USA. [3]University of Nevada, Las Vegas, Las Vegas, USA. [4]Yale University, New Haven, USA
We analyze the band structure of $MoS_2$ using solid-state high harmonic generation, identifying multiple conduction bands and their effects on anisotropic emissions, under ambient conditions and within a high-pressure environment inside a diamond anvil cell.

11:00 - 11:15
Mo-2B.2 **Ultrafast control over hardening and softening of coherent interlayer couplings in strongly-correlated $WSe_2/WS_2$ heterobilayers**
Jinjae Kim[1,2], Jiwon Park[1,2], Jekwan Lee[1,2], Kenji Watanabe[3], Takashi Taniguchi3[3], Hyunyong Choi[1,2]

[1]Department of physics, Seoul National University, Seoul, Korea, Republic of. [2]Institute of Applied Physics, Seoul National University, Seoul, Korea, Republic of. [3]Advanced Materials Laboratory, National Institute for Materials Science, Namiki, Tsukuba, Japan
We investigate ultrafast hardening and softening of breathing modes in correlated $WSe_2/WS_2$ electronic structures. We have found the coherent vibration period can be actively controlled with changing the boson (exciton) and the fermion (electron) density.

11:15 - 11:30
Mo-2B.3 **Observation of intervalley scattering dynamics on a 10 fs scale with time-resolved ARPES**
Kohei Nagai[1], Ryo Yoshioka[1,2], Takuya Okamoto[1], Kento Hiura[1,2], Yasushi Shinohara[1,3], Yoji Kunihashi[1], Keiko Kato[4], Hiroki Mashiko[5], Yoshiaki Sekine[1], Hiroki Hibino[6], Ikufumi Katayama[2], Jun Takeda[2], Haruki Sanada[1], Katsuya Oguri[1]
[1]NTT Basic Research Laboratories, NTT Corporation, Atsugi, Kanagawa, Japan. [2]Department of Physics, Yokohama National University, Yokohama, Kanagawa, Japan. [3]Research Center for Theoretical Quantum Information, NTT Corporation, Atsugi, Kanagawa, Japan. [4]Department of Chemistry, Nagoya University, Nagoya, Aichi, Japan. [5]Center for Ultrafast Intense Laser Science, The University of Tokyo, Tokyo, Japan. [6]School of Science and Technology, Kwansei Gakuin University, Sanda, Hyogo, Japan
Ultrafast intervalley scattering on a surface of bulk 2H-$WSe_2$ was observed with a 10 fs-scale time-resolved angle-resolved photoemission spectroscopy. The scattering time was precisely estimated for the first time to be 13±2 fs.

11:30 - 11:45
Mo-2B.4 **Giant Enhancement of Optical Nonlinearities in Hybrid $WS_2$/Plasmon Structures Probed by Ultrafast Two-Dimensional Electronic Spectroscopy**
Daniel Timmer[1], Moritz Gittinger[1], Daniel Lünemann[1], Thomas Quenzel[1], Sven Stephan[1,2], Martin Silies[1,2], Antonietta De Sio[1], Christoph Lienau[1]
[1]Institut für Physik, Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany. [2]Institute for Lasers and Optics, Hochschule Emden/Leer, Emden, Germany
[2]DES spectra of a hybrid $WS_2$/plasmon structure reveal giant nonlinearities and lineshape changes during the polariton decoherence times. The results are rationalized by analyzing the effects of many-body interactions on the coupled two-quantum states.

11:45 - 12:00
Mo-2B.5 **Fermi-polaron interactions in a doped WS2 monolayer**
Linnan Jia[1,2], Mitchell A Conway[1,2], Jack B Muir[1,2], Thi-Hai-Yen Vu[2,3], Kaijian Xing[2,3], Jonathan O Tollerud[1], Michael S. Fuhrer[2,3], Mark T. Edmonds[2,3], Jesper Levinsen[2,3], Meera M. Parish[2,3], Jeffrey A Davis[1,2]
[1]Optical Sciences Centre, Swinburne University of Technology, Melbourne, Australia. [2]ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET), Melbourne, Australia. [3]School of Physics and Astronomy, Monash University, Melbourne, Australia
Interactions between Fermi-polarons drive dynamics in Fermionic systems but are difficult to measure. Polarization-resolved 2D spectroscopy shows the dominant Fermi-polaron interactions in monolayer WS2 are repulsive at moderate electron density but attractive at high density.

12:00 - 12:15
Mo-2B.6 **Femtosecond Switching of Strong Light-Matter Interactions in 2D Semiconductor Microcavities**
Armando Genco[1], Charalambos Louca[1], Cristina Cruciano[1], Chiara Trovatello[1,2], Sam Randerson[3], Peter Claronino[3], Rahul Jayaprakash[3], Kenji Watanabe[4], Takashi Taniguchi[4], David G. Lidzey[3], Stefano Dal Conte[1], Alexander I. Tartakovskii[3], Giulio Cerullo[1,5]
[1]Politecnico di Milano, Milano, Italy. [2]Columbia University, New York, USA. [3]University of Sheffield, Sheffield, United Kingdom. [4]National Institute for Materials Science, Tsukuba, Japan. [5]CNR IFN, Milano, Italy
We studied the static and ultrafast transient optical behavior of hBN-encapsulated $MoS_2$ homobilayers embedded in planar microcavities, demonstrating strong modulations of the coupling strength, reaching a full sub-picosecond switching of the strong coupling regime.

12:15 - 12:30
Mo-2B.7 **Primary excited state relaxation events in prototypical linear carbon chains**

Piotr Kabaciński[1], Pietro Marabotti[2], Daniele Fazzi[3], Vasilis Petropoulos[1], Andrea Iudica[1], Patrick Serafini[2], Giulio Cerullo[1,4], Carlo S. Casari[2], Margherita Zavelani-Rossi[2,4]
[1]Dipartimento di Fisica, Politecnico di Milano, Milano, Italy. [2]Dipartimento di Energia, Politecnico di Milano, Milano, Italy. [3]Dipartimento di Chimica "Giacomo Ciamician", Università degli studi di Bologna, Bologna, Italy. [4]Istituto di Fotonica e Nanotecnologie IFN-CNR, Milano, Italy
We investigate a prototypical polyyne (1D chain with single-triple alternating carbon bonds). Combining transient absorption experiments with <30fs temporal resolution and density functional theory calculations, we provide comprehensive description of the excited state relaxation processes.

**LUNCH BREAK - on your own**
**12:30 - 14:00, Monday 15 July 2024**

**Mo-3A: Attosecond Science**
**14:00 - 15:45, Monday 15 July 2024**
**Auditorium, Oral session**
**Chaired by Jens Biegert, ICFO – The Institute of Photonic Sciences, Castelldefels, Spain**

14:00 - 14:30
Mo-3A.1 Invited **Attosecond ionization dynamics of 2D molecules**
Vincent Loriot[1], Alexie Boyer[1], Saikat Nandi[1], Celso Gonzalez-Collado[2], Etienne Plésiat[3], Alexandre Marciniak[4], Clara L. Garcia[1], Yaowei Hu[1], Manuel Lara-Astiaso[2], Alicia Palacios[2,5,6], Piero Decleva[7], Fernando Martín[2,3,6], Franck Lépine[1]
[1] Institut Lumière Matière, Villeurbanne, France. [2] Universidad Autónoma, Madrid, Spain. [3] IMDEA-Nanociencia, Madrid, Spain. [4] LCAR, Toulouse, France. [5] IAdChem, Madrid, Spain. [6] IFIMAC, Madrid, Spain. [7] Dipartimento di Scienze Chimiche e Farmaceutiche, Trieste, ItalyIonization time delays have been measured in several large molecules (>15 atoms) that have similar chemical compositions but different geometries and symmetries. The dynamics is driven by the quadrupole term of the planar molecule.

14:30 - 14:45
Mo-3A.2 **Attosecond Transient Interferometry**
Omer Kneller[1], Chen Mor[1], Noa Yaffe[1], Michael Krueger[2], Doron Azoury[3], Yotam Federeman[1], Debobrata Rajak[4], Barry Bruner[1], Misha Ivanov[5], Olga Smirnova[5], Serguei Patchkovskii[1], Yann Mairesse[4], Nirit Dudovich[1]
[1]Weizmann Institute of Science, Rehovot, Israel. [2]Technion - Israel Institute of Technology, Haifa, Israel. [3]Massachusetts Institute of Technology, Cambridge, USA. [4]University of Bordeaux - CNRS – CEA, Bordeaux, France. [5]Max-Born Institute, Berlin, Germany
We introduce attosecond transient interferometry to measure the sub-cycle evolution of the transient phase, decouple the multiple quantum paths induced in a light-driven atom, isolate their coherent contribution and retrieve their dynamics with attosecond precision

14:45 - 15:00
Mo-3A.3 **Attosecond XUV-NIR four-wave-mixing spectroscopy of doubly excited states in helium**
Patrick Rupprecht[1,2], Nicolette G. Puskar[1,2], Stephen R. Leone[1,2], Daniel M. Neumark[1,2]
[1] University of California Berkeley, Berkeley, USA. [2] Lawrence Berkeley National Laboratory, Berkeley, USA
The 2s2p and the $2p^2$ doubly excited state lifetimes in helium are measured in the time domain with XUV-NIR four-wave-mixing spectroscopy. Furthermore, signatures of lifetime shortening and Rabi cycling for high NIR intensities are observed.

15:00 - 15:15
Mo-3A.4 **In Search of Lost Tunneling Time**
Pablo Maier[1], Serguei Patchkovskii[1], Mikhail Ivanov[1,2,3], Olga Smirnova[1,4]
[1]Max Born Institute, Berlin, Germany. [2]Humboldt-Universität, Berlin, Germany. [3]Technion, Haifa, Israel. [4]Technische Universität, Berlin, Germany
The Larmor clock and the attoclock are two approaches to measuring a tunneling time, yielding contradictory results. We link the two approaches, reconciling so far unexplained different measurements outcomes.

15:15 - 15:30
Mo-3A.5 **Optical Simulation of Laser-Induced Tunnel Ionization Based on A Curved Waveguide**.
Arnon Ben-Levy, Amir Hen, Merav Kahn, Yoad Aharon, Noa Mazurski, Uriel Levy, Gilad Marcus
Hebrew University of Jerusalem, Jerusalem, Israel
In earlier work, we suggested using a curved waveguide to simulate the tunnel ionization process. Here we implemented such a simulator and tested our results against the Keldysh and bending loss ionization rates.

15:30 - 15:45
Mo-3A.6 **From Megabarns to Attoseconds: How to Convert the Cross-section to Time delay**
Anatoli Kheifets[1], Jiabao Ji[2], Meng Han[3], Kiyoshi Ueda[2,4,5], Hans Jakob Wörner[2]
[1] Australian National University, Canberra, Australia. [2] Federal Institute of Technology, Zürich, Switzerland. [3] Kansas State University, Manhattan, USA. [4] Tohoku University, Sendai, Japan. [5] ShanghaiTech University, Shanghai, China
By taking logarithmic Hilbert transform of the photoionization cross-section, the attosecond time delay of the photoelectron emitted the polarization direction can be obtained thus linking the frequency and time representation of the atomic photoemission process

**COFFEE BREAK**
**15:45 - 16:15 Monday, 15 July 2024**
**Auditorium halls**

**Mo-4A: Panel Discussion on Strong Coupling**
**16:15 - 18:15 Monday, 15 July 2024**
**Auditorium**
**Oral session**
**Chaired by Amber Krummel, Colorado State University, Fort Collins, USA**

16:15 - 16:37
Mo-4A.1 Invited **Impulsive and Adiabatic Ultrafast Electronic Control Schemes in Molecules**
Hendrike Braun[1], Arne Senftleben[1], Tim Bayer[2], Matthias Wollenhaupt[2], Thomas Baumert[1]
[1]Universität Kassel, Kassel, Germany. [2]Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany
Experiments to control coherent electronic excitations in gas phase and in liquid phase molecules are presented. Tailored light fields down to sub-cycle precision are employed to that end.

16:37 - 16:59
Mo-4A.2 Invited **Ultrafast molecular chirality: a topological connection**
Olga Smirnova
MBI, Berlin, Germany
Marrying chiral and topological properties in ultrafast electronic response of chiral molecules in the gas phase enables new highly efficient and topologically robust chiral observables not relying on interaction with light's magnetic field

16:59 - 17:21
Mo-4A.3 Invited **Ultrafast Dynamics of Molecular Vibrational Polaritons**
Wei Xiong
University of California, San Diego, La Jolla, USA
Using ultrafast 2D IR spectroscopy, we showed how uniquely polaritons can accelerate energy redistribution and subsequently impede reaction dynamics – a key insight of polariton chemistry.

17:21 - 17:43
Mo-4A.4 Invited **Light-matter interactions in photonic time-crystals**
Mordechai Segev[1], Ohad Segal[1], Noa Konforty[1], Mark Lyubarov[2], Yonatan Plotnik[1], Eran Lustig[3], Alexander Dikopoltsev[4]
[1]Technion, Haifa, Israel. [2]Technion, Haifa, Yemen. [3]Stanford, Palo Alto, USA. [4]ETH, Zurich, Switzerland
The fundamentals of Photonic Time-Crystals (PTCs) will be introduced, along with classical and quantum features of light emission in PTCs from free electrons, classical dipoles, quantum fluctuations, and atoms. Recent experiments will be presented.

17:43 - 18:15 **Panel Discussion**

**Tu-1A: Advanced Light Source Technologies**
**08:30 - 10:15 Tuesday 16 July 2024**
**Auditorium**
**Oral session**
**Chaired by** **Ming-Chang Chen, National Tsing Hua University, Hsinchu 300, Taiwan**

08:30 - 09:00
Tu-1A.1 Invited **Generation of intense optical Schrödinger "cat" states and applications in non-linear optics**
Paraskevas Tzallas
FORTH-IESL, Heraklion (Crete), Greece. ELI-ALPS, Szeged, Hungary
Using intense laser-matter interactions, we generate optical Schrödinger "cat" states with sufficient intensities for inducing nonlinear processes. I'll outline the operational principle and present recent findings on applying these states in nonlinear optics.

09:00 - 09:15
Tu-1A.2 **High-Throughput, Tabletop, Ultrafast EUV Ptychography across Lengthscales**
Carmelo Grova[1], Dmitry Karpov[2], Nicola Giani[1], Charles Bevis[1], Daniel Adams[3], Cristian Svetina[4], Giulia Fulvia Mancini[1]
[1]University of Pavia, LUXEM, Pavia, Italy. [2]ESRF, Grenoble, Italy. [3]Department of Physics, Colorado School of Mines, Golden, USA. [4]X-ray Wave-mixing Spectroscopies Group (X-WaveS), IMDEA Nanociencia, Madrid, Spain
We report the design of a beamline for Ultrafast Ptychography with 12.9nm and 29.1nm EUV light from HHG, capable of imaging the functional response of nanoparticles supracrystals activated by light pulses, with high spatio-temporal resolutions.

09:15 - 09:30
Tu-1A.3 **Wavefront shaping and imaging of multi-wavelength high-harmonic beams**
Antonios Pelekanidis[1], Fengling Zhang[1], Matthias Gouder[1], Augustas Karpavicius[1], Mengqi Du[1], Kjeld Eikema[1,2], Stefan Witte[1,2]
[1]ARCNL, Amsterdam, Netherlands. [2]Vrije Universiteit, Amsterdam, Netherlands
We use lensless diffractive imaging to measure wavefronts of a high-harmonic generation source at multiple wavelengths in parallel. We characterize broadband extreme-ultraviolet beams with tailored spatial structure and orbital angular momentum, and study HHG properties.

09:30 - 09:45
Tu-1A.4 **Single-Shot Double-Blind Holography of Self-Amplified Spontaneous Emission Pulses of Free Electron Lasers**
Agata Azzolin[1,2,3], Oliviero Cannelli[2], Erik Månsson[2], Josina Hahne[1,2,3], Marc Seitz[1,2], Ammar bin Wahid[1,2], Kai-Fu Wong[1,2,3], Christina Papadopoulou[4], Elisa Appi[4], Ulrike Fruehling[4], Venkata Jayasurya Yallapragada[5], Peer Biesterfeld[6], Philip Mosel[6], Sven Fröhlich[6], Markus Braune[4], Stefan Duesterer[4], Milutin Kovacev[6], Uwe Morgner[6], Robert Moshammer[7], Tino Lang[4], Christoph Heyl[4], Dan Oron[8], Nirit Dudovich[8], Christian Ott[7], Thomas Pfeifer[7], Evgeny Schneidmiller[4], Vincent Wanie[2], Andrea Trabattoni[2,6], Francesca Calegari[1,2,3]
[1]Physics Department, University of Hamburg, Hamburg, Germany. [2]Centre for Free-Electron Laser Science, DESY, Hamburg, Germany. [3]The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Hamburg, Germany. [4]Deutsches-Elektronen Synchrotron, DESY, Hamburg, Germany. [5]Indian Institute of Technology Kanpur, IIT Kanpur, Kanpur, India. [6]Institute of Quantum Optics, Leibniz Universität Hannover, Hannover, Germany. [7]Max-Planck-Institut für Kernphysik, Max-Planck-Gesellschaft, Heidelberg, Germany. [8]Weizmann Institute of Science, Rehovot, Israel
Double-blind holography is employed to characterize the spectral phase of synchronized self-amplified spontaneous emission free electron laser and high-harmonic generation pulses with a time duration of few femtoseconds on single-shot basis

09:45 - 10:00
Tu-1A.5 **Single-shot Attosecond XFEL Diagnostics**
Jack Hirschman[1,2], Razib Obaid[2], Amanda Shackelford[2,3], Auralee Edelen[2], Alberto Lutman[2], Sergio Carbajo[2,4], Ryan Coffee[2]
[1]Stanford University, Stanford, USA. [2]SLAC National Accelerator Laboratory, Menlo Park, USA. [3]University of Colorado Boulder, Boulder, USA. [4]University of California, Los Angeles, Los Angeles, USA

We present a high-throughput, low-latency data processing chain for the Multi-Resolution COokiebox (MRCO), an angle-resolved electron spectrometer, that provides shot-to-shot attosecond-level reconstruction of high repetition rate X-ray Free Electron Laser pulses.

10:00 - 10:15
Tu-1A.6 **Coherent all X-ray four wave mixing in the gas phase**
Ana Sofia Morillo Candas[1], Andre al-Haddad[1], Sven Augustin[1], Andrea Cannizzo[2], Yunpei Deng[1], Thomas Feurer[2], Jonas Knurr[1,3], Christian Ott[4], Eduard Prat Costa[1], Marc Rebholz[4], Antoine Sarracini[1], Kirsten Andrea Schnorr[1], Zhibin Sun[1], Xinhua Xie[1], Ningchen Yang[1,3], Serhane Zerdane[1], Hankai Zhang[1,3], Christoph Bostedt[1,3], Thomas Pfeifer[4], Gregor Knopp[1]
[1]Paul Scherrer Institute, Villigen PSI, Switzerland. [2]University of Bern, Bern, Switzerland. [3]École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. [4]Max-Planck-Institut für Kernphysik, Heidelberg, Germany
All-X-ray-four-wave mixing (XFWM) signals showing the coherent response from core shell electrons in an atomic gas (Ne) are experimentally demonstrated. The origin and strength of the signals are modelled and discussed in detail.

**EXHIBITION AND COFFEE BREAK**
**10:15 - 10:45 Tuesday 16 July 2024**
**Port Vell**

**Tu-2A: Topology and 2D Materials**
**10:45 - 12:30 Tuesday 16 July 2024**
**Auditorium**
**Oral session**
**Chaired by Arijit De, IISER Mohali, Mohali, India**

10:45 - 11:00
Tu-2A.1 **Lightwave controlled Haldane model in quantum material with hexagonal symmetry**
Shubhadeep Biswas[1], Sambit Mitra[2], Álvaro Jiménez-Galán[3], Mario Aulich[4], Marcel Neuhaus[4], Rui E F Silva[3], Volodymyr Pervak[5], Matthias F Kling[4]
[1]SLAC National Accelerator Laboratory, Melno Park, USA. [2]Max Planck Institute of Quantum Optics, Garching, Germany. [3]Instituto de Ciencia de Materiales de Madrid (ICMM), Consejo Superior de Investigaciones Científicas (CSIC), Madrid, Spain. [4]SLAC National Accelerator Laboratory, Menlo Park, USA. [5]Ludwig-Maximilians-Universität Munich, Garching, Germany
We demonstrate tailored lightwave-driven time-reversal symmetry breaking, and the realization of the topological model of Haldane in a laser-dressed monolayer of hBN, enabling ultrafast switching between band structure configurations [Mitra et al._Nature_2024 (in press)].

11:00 - 11:15
Tu-2A.2 **Probing Berry phase effect in topological surface states**
Ya Bai, Candong Liu, Ruxin Li, Peng Liu
Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China
We demonstrate the observation of the Berry phase effect in the topological surface states of three-dimensional topological insulators and provide a microscopic perspective of the lightwave-driven inner degrees of freedom of Bloch electrons.

11:15 - 11:30
Tu-2A.3 **Universal valley control with tailored strong fields**
Igor Tyulnev[1], Álvaro Jiménez-Galán[2,3], Julita Poborska[1], Lenard Vamos[1], Philip St. J. Russell[4,5], Francesco Tani[4], Olga Smirnova[2,6], Misha Ivanov[2,7,8], Rui Silva[9], Jens Biegert[1,10]
[1]ICFO - Institut de Ciencies Fotoniques, Barcelona, Spain. [2]Max-Born-Institut, Berlin, Germany. [3]Joint Attosecond Science Lab, Ottawa, Canada. [4]Max-Planck Institute for Science of Light, Erlangen, Germany. [5]Friedrich-Alexander-Universität, Erlangen, Germany. [6]Technische Universität Berlin, Berlin, Germany. [7]Humboldt-Universität zu Berlin, Berlin, Germany. [8]Imperial College London, London, United Kingdom. [9]Instituto de Ciencia de Materiales de Madrid, Madrid, Spain. [10]ICREA, Pg. Lluís Companys 23, Barcelona, Spain
We show that a topological mid-infrared field can induce valley polarization in bulk materials without berry curvature.

11:30 - 11:45
Tu-2A.4 **Subcycle Dynamics of Floquet-Bloch Bands**
Manuel Meierhofer[1], Suguru Ito[2], Michael Schüler[3,4], Stefan Schlauderer[1], Josef Freudenstein[1], Johannes Reimann[2], Dmytro Afanasiev[1,5], Konstantin Kokh[6], Oleg Tereshchenko[7], Jens Güdde[2], Michael Sentef[8,9], Rupert Huber[1], Ulrich Höfer[2,1]
[1]University of Regensburg, Regensburg, Germany. [2]Philipps-University of Marburg, Marburg, Germany. [3]Paul Scherrer Institute, Villingen, Switzerland. [4]University of Fribourg, Fribourg, Switzerland. [5]Radboud University, Nijmegen, Netherlands. [6]V.S. Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russian Federation. [7]Rzhanov Institute of Semiconductor Physics, Novosibirsk, Russian Federation. [8]Max Planck Institute for the Structural and Dynamics of Matter, Hamburg, Germany. [9]University of Bremen, Bremen, Germany
ARPES-based subcycle band-structure videography reveals how atomically strong mid-infrared lightfields accelerate electrons through a topological surface. Intriguingly, Floquet-Bloch sidebands emerge already after one cycle of the driving field and facilitate electronic transitions into higher-lying bands.

11:45 - 12:00
Tu-2A.5 **Floquet Engineered Valley Control in Graphene**
Daniel Lesko, Tobias Weitz, Simon Wittigschlager, Peter Hommelhoff
FAU, Erlangen, Germany
With circular/linearly polarized bi-chromatic laser fields we drive relative-phase dependent currents in graphene. Numerical analysis of emerging Floquet states and time dependent charge dynamics reveal valley specific currents critical to lightwave electronics.

12:00 - 12:15
Tu-2A.6 **Probing phase transition in strongly correlated materials by high harmonic spectroscopy**
Zhonghui Nie[1], Leo Guey[1], Eduardo Molinero[2], Peter Juergens[3], Thormas van den Hooven[1], Yu Wang[4], Álvaro Galán[3], Paul Planken[1,5], Rui Silva[2,3], Peter Kraus[1,6]
[1]Advanced Research Center for Nanolithography, Amsterdam, Netherlands. [2]Instituto de Ciencia de Materiales de Madrid, Madrid, Spain. [3]Max-Born-Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany. [4]Taishan University, Taian, China. [5]University of Amsterdam, Amsterdam, Netherlands. [6]Vrije Universiteit, Amsterdam, Netherlands
Robust experimental evidence of ultrafast insulator-to-metal transition in niobium dioxide has been found in time-resolved high harmonic spectroscopy and such sensitive methodology based on extreme nonlinearity could be generalized to any phase transitions.

12:15 - 12:30
Tu-2A.7 **Charge-density wave phase transformations at megahertz rates observed by nanobeam ultrafast electron diffraction**
Till Domröse[1,2], Thomas Danz[1,2], Sophie F. Schaible[1,2], Kai Rossnagel[3,4], Sergey V. Yalunin[1], Claus Ropers[1,2]
[1]Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany. [2]4th Physical Institute, University of Göttingen, Göttingen, Germany. [3]Institute of Experimental and Applied Physics, Kiel University, Kiel, Germany. [4]Ruprecht Haensel Laboratory, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany
Introducing nanobeam ultrafast electron diffraction at megahertz rates, we characterize laser-driven structural dynamics in charge-density wave materials, finding a cooperative femtosecond phase switching mechanism in 1T'-$TaTe_2$, and a light-induced hexatic state in 1T-$TaS_2$.

**Tu-2B: Charge Transfer**
**10:45 - 12:30 Tuesday 16 July 2024**
**Room A2+A3**
**Oral session**
**Chaired by Steve Meech, University of East Anglia, Norwich, United Kingdom**

10:45 - 11:00
Tu-2B.1 **Primary Events of Metal-to-Ligand Charge Transfer Dynamics Probed with Table-Top** Femtosecond Soft-X-Ray Spectroscopy at the Nitrogen K-edge

Zhuang-Yan Zhang[1], Marc-Oliver Winghart[1], Carlo Kleine[1], Peng Han[1], Arnab Sen[1], Michael Odelius[2], Arnaud Rouzée[1], Erik T. J. Nibbering[1]
[1]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany. [2]Stockholm University, Stockholm, Sweden
We investigate the ultrafast photophysics of aqueous $Fe^{II}(2,2'\text{-bipyridine})_3^{2+}$ upon ultraviolet excitation of metal-to-ligand charge-transfer states with femtosecond nitrogen K-edge spectroscopy using a laser-based table-top approach, showing charge-flow and spin-flip dynamics occurring within 60fs.

11:00 - 11:15
Tu-2B.2 **Parallel Intersystem Crossing and Charge Transfer State Dynamics in $[Fe(bpy)_3]^{2+}$ Unveiled by Ultrafast 2D Electronic Spectroscopy**
Angela Lee[1], Minjung Son[1,2], Mawuli Deegbey[3], Matthew Woodhouse[4], Stephanie Hart[1,5], Hayden Beissel[4], Paul Cesana[1], Elena Jakubikova[3], James McCusker[4], Gabriela Schlau-Cohen[1]
[1]Massachusetts Institute of Technology, Cambridge, USA. [2]Boston University, Boston, USA. [3]North Carolina State University, Raleigh, USA. [4]Michigan State University, East Lansing, USA. [5]University of California, Berkeley, Berkeley, USA
We observe two distinct metal-ligand charge transfer relaxation pathways in $[Fe(bpy)_3]^{2+}$ using 2D electronic spectroscopy. A lifetime analysis reveals parallel relaxation pathways resolving discrepancies from previous studies.

11:15 - 11:30
Tu-2B.3 **Realtime Observation of Dynamic Symmetry Breaking in Dinuclear Triple-Stranded Al(III) Complexes**
Takumi Ehara[1], Yusuke Yoneda[2], Yuto Konishi[3], Shintaro Yamamoto[1], Toshikazu Ono[3], Atsuya Muranaka[4], Hikaru Kuramochi[2], Kiyoshi Miyata[1], Ken Onda[1]
[1]Graduate School of Science, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan. [2]Research Center of Integrative Molecular Systems, Institute for Molecular Science, 38 Nishigo-Naka, Myodaiji, Okazaki, 444-8585, Japan. [3]Graduate School of Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395, Japan. [4]Molecular Structure Characterization Unit, RIKEN CSRS, 2–1 Hirosawa, Wako, Saitama, 351–0198, Japan
We have investigated the excited-state dynamics of Al(III) complexes using transient absorption spectroscopy and time-resolved impulsive stimulated Raman spectroscopy. We found that vibronic interaction causes a drastic change in symmetry from $D_3$ to $C_2$.

11:30 - 11:45
Tu-2B.4 **Ligand Control Ultrafast Intersystem Crossing and Nuclear Wavepacket Dynamics in Pt-based** Donor-Acceptor Complex
Partha Roy[1], Shahnawaz Rather[1,2], Nicholas Weingartz[1,3], David Shultz[4], Martin Kirk[5], Lin Chen[1,3]
[1]Northwestern University, Evanston, USA. [2]University of Kentucky, Lexington, USA. [3]Argonne National Laboratory, Lemont, USA. [4]North Carolina State University, Raleigh, USA. [5]The University of New Mexico, New Mexico, USA
Ligand-control ultrafast electronic and nuclear dynamics in (dithiolene)Pt(diimine) donor-acceptor complex are explored by broadband transient absorption spectroscopy. Substitution of single ligating-atom results in ~4-fold-deceleration in intersystem-crossing rates and dramatically impacts nuclear wavepacket dynamics.

11:45 - 12:00
Tu-2B.5 **Femtosecond Spectroscopy of New Iron Bidentate Complexes Reveal Extended Excited State Lifetimes**
Ronan Viel[1], Ulises Carrillo[2], Florian Molton[3], Carole Duboc[3], Philippe Gros[2], Cristina Cebrián[4], Stefan Haacke[1]
[1]IPCMS, Strasbourg, France. [2]L2CM, Nancy, France. [3]UGA, Grenoble, France. [4]ICS, Strasbourg, France
Ultrafast transient absorption and luminescence spectroscopy reveal the excited state dynamics of Fe(II) complexes with rationally designed N-heterocyclic carbene ligands. The preliminary data indicate record excited state lifetimes for the photo-chemically relevant $^3$MLCT states.

12:00 - 12:15
Tu-2B.6 **Vibronic coupling-induced symmetry breaking and solvation in the photoexcited charge-transfer dynamics of a quadrupolar molecule**

Katrin Winte[1], Somayeh Souri[1], Daniel Lünemann[1], Fulu Zheng[2], Mohamed Madjet[2], Teresa Kraus[3], Elena Mena-Osteritz[3], Peter Bäuerle[3], Sergei Tretiak[4], Antonietta De Sio[1], Christoph Lienau[1]
[1]Carl von Ossietzky Universität, Oldenburg, Germany. [2]Universität Bremen, Bremen, Germany. [3]Universität Ulm, Ulm, Germany. [4]Los Alamos National Laboratory, Los Alamos, USA
Two-dimensional electronic spectroscopy reveals excited-state symmetry breaking, driven by vibronic couplings during the first ~50 fs, as the primary step of the photoinduced charge transfer in a quadrupolar molecule, while solvent-induced charge localization appears frozen.

12:15 - 12:30
Tu-2B.7 **Disulfide photochemistry in Lysozyme investigated by femtosecond X-ray absorption spectroscopy**
Jessica Harich[1], Antonia Freibert[1], Ru-Pan Wang[2], Tae Gyun Woo[3], Junho Lee[3], Seonghyeon Jeong[3], Sungin Yu[3], Haneol Oh[3], Miguel Ochmann[1], Briony A. Yorke[4], Victoria Kabanova[5], Emma Beale[5], Philip J. M. Johnson[5], Claudio Cirelli[5], Camila Bacellar[5], Tae Kyu Kim[3], Nils Huse[1]
[1]University of Hamburg, Hamburg, Germany. [2]Deutsches Elektronen Synchrotron DESY, Hamburg, Germany. [3]Yonsei University, Seoul, Korea, Republic of. [4]University of Leeds, Leeds, United Kingdom. [5]Paul Scherrer Institut, Villigen PSI, Switzerland
Femtosecond X-ray absorption spectroscopy at the sulfur K-edge of Lysozyme reveals direct and indirect photochemical pathways for the reversible formation of thiyl radicals, with implications for the photostability of proteins.

**LUNCH BREAK - on your own**
**12:30 - 14:00 Tuesday 16 July 2024**

**Tu-3A: Visible Spectroscopy and New Methods**
**14:00 - 15:45 Tuesday 16 July 2024**
**Auditorium**
**Oral session**
**Chaired by Antonietta De Sio, Carl von Ossietzky Universität, Oldenburg, Germany**

14:00 - 14:15
Tu-3A.1 **Joint spectro-temporal resolution and pathway selectivity in quantum spectroscopy**
Matthias Kizmann, Hari Kumar Yadalam, Shaul Mukamel
UCI, Irvine, USA
Entangled photons with positive frequency correlation can be used to generate strong Raman signals with joint spectro-temporal time resolution. Classical light combined with coincidence detection can achieve pathway selectivity, for example in photon echo signals.

14:15 - 14:30
Tu-3A.2 **Probing plexciton dynamics with higher-order spectroscopy**
Simon Büttner[1], Luca Nils Philipp[1], Julian Lüttig[2,1], Maximilian Rödel[1], Matthias Hensen[1], Jens Pflaum[1], Roland Mitric[1], Tobias Brixner[1]
[1]Universität Würzburg, Würzburg, Germany. [2]University of Michigan, Ann Arbor, USA
Plexcitons influence charge carrier transport due to their delocalized character. We apply higher-order transient absorption spectroscopy to directly observe particle–particle interactions to determine the diffusion of charge carriers in a plexcitonic system.

14:30 - 14:45
Tu-3A.3 **Separating Orders of Two-Dimensional Spectroscopic Response Via Intensity Variation**
Jacob J Krich[1], Peter A Rose[1], Luisa Brenneis[2], Simon Büttner[2], Pavel Malý[3], Julian Lüttig[2], Tobias Brixner[2]
[1]University of Ottawa, Ottawa, Canada. [2]Universität Würzburg, Würzburg, Germany. [3]Charles University, Prague, Czech Republic
When pump amplitudes are too large, desired two-dimensional spectra are contaminated by higher-order processes. A straightforward method allows separation of the orders of response by measuring with pump pulses whose amplitudes scale together linearly.

14:45 - 15:00
Tu-3A.4 **Revealing Interactions in Strongly Correlated Electron Materials**

Rishabh Mishra[1], Nikolas Stavrias[1], Jonathan Tollerud[1], Daniele Fausti[2], Claudio Giannetti[3], Jared Cole[4], Jeffrey Davis[1]
[1]Swinburne University of Technology, Hawthorn, Australia. [2]Friedrich-Alexander-Universit¨at, Erlangen, Germany. [3]Universit`a Catolica del Sacro Cuore, Brescia, Italy. [4]RMIT University, Melbourne, Australia
Resolving interactions in strongly correlated electron matter is crucial for understanding the remarkable macroscopic phases that emerge, such as superconductivity. We show how multidimensional coherent spectroscopy can disentangle and provide new insight into these interactions.

15:00 - 15:15
Tu-3A.5 **Fluorescence-Detected Two-Dimensional Electronic Spectroscopy (F-2DES) of Single Molecules**
Sanchayeeta Jana, Simon Durst, Markus Lippitz
Chair for Experimental Physics III, Universität Bayreuth, Bayreuth, Germany
We combine Fluorescence-Detected Two-Dimensional Electronic Spectroscopy (F-2DES) with Time-Correlated Single Photon Counting (TCSPC), providing access to the temporal dynamics of a single dye molecule from femtoseconds to seconds.

15:15 - 15:30
Tu-3A.6 **Decoupled Few-femtosecond Electronic and Structural Response During the Insulator-to-Metal Transition in $VO_2$**
Christian Brahms[1], Lin Zhang[2], Xiao Shen[3], Utso Bhattacharya[2], Maria Recasens[2], Johann Osmond[2], Tobias Grass[4,5], Ravindra W. Chhajlany[6], Richard Haglund[7], Sokrates Pantelides[7], Maciej Lewenstein[2,8], John C. Travers[1], Allan S. Johnson[9]
[1]Heriot-Watt University, Edinburgh, United Kingdom. [2]ICFO - Institut de Ciencies Fotoniques, Barcelona, Spain. [3]University of Memphis, Memphis, USA. [4]DIPC - Donostia International Physics Center, San Sebastian, Spain. [5]IKERBASQUE, Basque Foundation for Science, Bilbao, Spain. [6]Adam Mickiewicz University, Poznan, Poland. [7]Vanderbilt University, Nashville, USA. [8]ICREA, Barcelona, Spain. [9]IMDEA Nanoscience, Madrid, Spain
We investigate the photoinduced insulator-to-metal transition in $VO_2$ using ultrabroadband few-femtosecond pump-probe spectroscopy. We find a sub-10-fs transition to a bad-metallic state and unprecedentedly fast ~20-fs-scale structural motion causing transient semi-metallicity before full relaxation.

15:30 - 15:45
Tu-3A.7 **Ultrafast Phase Fluctuations in Vanadium Dioxide**
Daniel Kazenwadel, Jacob Holder, Noel Neathery, Margaretha Sandor, Peter Baum
Universität Konstanz, Konstanz, Germany
Ultrafast pump-probe experiments and a cooperative lattice model indicate the presence of fractal phase fluctuations that can explain the ultrafast electronic and structural response of $VO_2$.

**Tu-PO: EXHIBITION, COFFEE BREAK AND POSTER SESSION I**
**15:45 - 17:15 Tuesday 16 July 2024**
**Port Vell**
**Poster session**

Tu-PO.1 **Ultrafast Oscillators and Amplifiers for Physics and Chemistry**
Brian Molesky, Erin McCole Dlugosz, Joseph Henrich
Coherent Corp, Glasgow, United Kingdom
Created by the Industrial Revolution in Ultrafast Science, Coherent offers ultrafast lasers for research applications, with pulse energies from µJ to mJ, repetition rates into the MHz regime, at wavelengths from UV to mid-IR.

Tu-PO.2 **Disentangling many-body effects in the coherent optical response of a 2D Semiconductor**
Chiara Trovatello[1,2], Florian Katsch[3], Qiuyang Li[2], Xiaoyang Zhu[2], Andreas Knorr[3], Giulio Cerullo[1], Stefano Dal Conte[1]
[1]Politecnico di Milano, Milano, Italy. [2]Columbia University, New York, USA. [3]Technische Universitat Berlin, Berlin, Germany
We measure the transient optical response of monolayer WS2 and we disentangle absorption reduction,

energy shift and broadening of the excitonic peak using Kramers-Kronig analysis, clarifying the complex interplay between many-body correlations and excitonic interactions.

Tu-PO.3 **High-Level Transient X-ray Absorption Spectra for the Nonadiabatic Dynamics of Chlorophyll a**

Lena Bäuml, Regina de Vivie-Riedle
Ludwig-Maximilians-Universität München, Munich, Germany
The strong coupling and ultrafast population transfer between the Q-bands of chlorophyll a could be traced with time-resolved X-ray absorption spectra simulated for the magnesium and nitrogen K-edge, at the XMS-RASPT2 level of theory.

Tu-PO.4 **Resonant Two-Dimensional Impulsive Stimulated Raman Spectroscopy of Excited States Based on Rapid-Scanning**
Yusuke Yoneda[1,2], Hikaru Kuramochi[1,2]
[1]Institute for Molecular Science, Okazaki, Japan. [2]Graduate Institute for Advanced Studies, Okazaki, Japan
A resonant 2D impulsive stimulated Raman spectroscopy system that features sub-10 fs pulses and the rapid scan of the time delay was developed. The system can clearly reveal vibrational correlations of the excited state.

Tu-PO.5 **Precision control of electronic and structural molecular dynamics via table-top x-ray spectroscopy**
Patrick Rupprecht[1,2,3], Lennart Aufleger[1], Simon Heinze[4], Alexander Magunia[1], Thomas Ding[1], Marc Rebholz[1], Stefano Amberg[1], Nikola Mollov[1], Felix Henrich[1], Maurits W. Haverkort[4], Christian Ott[1], Thomas Pfeifer[1]
[1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany. [2]Lawrence Berkeley National Laboratory, Berkeley, USA. [3]University of California Berkeley, Berkeley, USA. [4]Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
We demonstrate the control of electronic interactions in $SF_6$ purely on a quantum level with table-top x-ray spectroscopy. Furthermore, coherent vibrational dynamics of only 50 fm amplitude are induced and quantified in a time-resolved manner.

Tu-PO.6 **Excited State Dynamics in Photochemical Molecular Motors: Coupling Ultrafast Spectroscopy and Chemical Synthesis to Optimize Performance**
Palas Roy[1], Andy Sardjan[2], Wesley Browne[2], Ben Feringa[2], Stephen Meech[3]
[1]Indian Institute of Technology Bhubaneswar, Bhubaneswar, India. [2]University Groningen, Groningen, Netherlands. [3]University of East Anglia, Norwich, United Kingdom
Optimizing photon-efficiency in photochemical molecular motors (PMMs) is critical for development of nanomachines. PMM dynamics are probed by ultrafast spectroscopies. The mechanism shows charge-transfer states are critical, which is exploited to demonstrate product yield control.

Tu-PO.7 **Effect of Charge-Ordering on High-Harmonic Generation**
Aiko Nakano[1], Kento Uchida[1], Yasuhide Tomioka[2], Masaki Takaya[1], Yoichi Okimoto[3], Koichiro Tanaka[1]
[1]Kyoto University, Kyoto, Japan. [2]National Institute of Advanced Industrial Science and Technology, Ibaraki, Japan. [3]Tokyo Institute of Technology, Tokyo, Japan
We investigated high-harmonic generation from $Pr_{0.6}Ca_{0.4}MnO_3$. The harmonic intensities show a gradual increase below the charge-ordering (CO) transition temperature. We conclude that the dominant mechanism governing the intensity change is the thermal fluctuation of CO.

Tu-PO.8 **Scaling law of exciton binding energies in hBN-encapsulated monolayer transition metal dichalcogenides**
Shinya Takahashi[1], Satoshi Kusaba[1], Kenji Watanabe[2], Takashi Taniguchi[3], Kazuhiro Yanagi[4], Riichiro Saito[5,6], Koichiro Tanaka[1,7]
[1]Department of Physics, Kyoto University, Kyoto, Japan. [2]Research Center for Functional Materials, National Institute for Materials Science, Tsukuba, Japan. [3]International Center for Materials Nanoarchitectonics, National Institute for Materials Science, Tsukuba, Japan. [4]Department of Physics, Tokyo Metro University, Tokyo, Japan. [5]Department of Physics, Tohoku University, Sendai, Japan. [6]Department of Physics, National Taiwan Normal University, Taipei, Taiwan. [7]Institute for Integrated

Cell-Material Sciences, Kyoto University, Kyoto, Japan
We found a scaling law between normalized binding energies and Coulomb energies for s-series and p-series excitons in hBN-encapsulated monolayer $MX_2$ (M=Mo, W, X=S, Se) by sum frequency generation spectroscopies.

Tu-PO.9 **Electronic phase relaxation in 2H-$MoTe_2$ observed by double-excitation ultrafast electron**
Yui Iwasaki[1], Takumi Fukuda[1], Godai Noyama[1], Mizuki Akei[1], Hidemi Shigekawa[1], Paul Fons[2], Muneaki Hase[1], Yusuke Arashida[1], Masaki Hada[1]
[1]University of Tsukuba, Tsukuba, Japan. [2]Keio University, Yokohama, Japan
We developed a double-optical-pulse excitation ultrafast electron diffraction setup, which observed the extremely fast electronic phase relaxation process (within 100 fs) in the conduction band of 2H-$MoTe_2$ under saturable absorption conditions.

Tu-PO.10 **Attosecond control of electron tunnel ionization and high harmonic generation in silicon using two-color ω-3ω fields**
Adam Gindl[1], Pawan Suthar[1], František Trojánek[1], Petr Malý[1], Thibault J.-Y. Derrien[2], Martin Kozák[1]
[1]Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic. [2]HiLASE Centre, Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic
We experimentally demonstrate attosecond control of electron tunnel ionization in silicon and the modulation of amplitude and phase of emitted high harmonic radiation using coherent combination of ultrashort midinfrared pulse with its third harmonics**.**

Tu-PO.11 **Validity of the Floquet Theory to the Short Pulse Limit**
Matteo Lucchini[1,2], Fabio Medeghini[1], Yingxuan Wu[1,2], Vismarra Federico[1,2], Rocío Borrego-Varillas[2], Aurora Crego[2], Fabio Frassetto[3], Luca Poletto[3], Shunsuke A. Sato[4,5], Hannes Hübener[5], Umberto De Giovannini[5,6], Ángel Rubio[5,7], Mauro Nisoli[1,2]
[1]Department of Physics, Politecnico di Milano, Milano, Italy. [2]Institute for Photonics and Nanotechnologies, IFN-CNR, Milano, Italy. [3]Institute for Photonics and Nanotechnologies, IFN-CNR, Padova, Italy. [4]Center for Computational Sciences, University of Tsukuba, Tsukuba, Japan. [5]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany. [6]Università degli Studi di Palermo, Dipartimento di Fisica e Chimica-Emilio Segrè, Palermo, Italy. [7]Center for Computational Quantum Physics (CCQ), The Flatiron Institute, New York, USA
Few-fs pulses of controlled time duration and intensity are used to create a Floquet state of a free electron. Comparison with an analytical model proves that the Floquet theory surprisingly holds in the few-cycle limit.

Tu-PO.12 **High Energy Long-Wave Infrared Pulses From MulticolorPumped ZGP NOPCPA**
Rokas Jutas[1], Joris Roman[1], Ignas Astrauskas[1], Aref Imani[1], Paolo Carpeggiani[1], Pavel Polynkin[2], Edgar Kaksis[1], Tobias Floery[1], Jonas Kolenda[3], Tadas Bartulevičius[3], Kirilas Michailovas[3], Andrejus Michailovas[3,4], Andrius Baltuška[1,4], Audrius Pugžlys[1,4]
[1]TU Wien, Vienna, Austria. [2]University of Arizona, Tucson, USA. [3]Ekspla, Vilnius, Lithuania. [4]Center for Physical Sciences & Technology, Vilnius, Lithuania
Angularly separated multicolor pulses are generated in a pulse-burst-pumped KTAbased NOPCPA. These multicolor pulses are employed to pump ZGP NOPCPA, amplifying LWIR pulses to 80 μJ energy, with potential scalability beyond 10 mJ.

Tu-PO.13 **Table-top beamline for the generation of intense isolated XUV-pulses**
Martin Kretschmar, Rostyslav Danylo, Tamas Nagy, Arnaud Rouzée
Max Born Institute, Berlin, Germany
A setup utilizing TW-level few-cycle pulses for the generation of intense isolated XUV-pulses through overdriven high-order harmonic generation is presented. The targeted applications involve XUV-driven nonlinear processes as well as XUV-pump - XUV-probe studies.

Tu-PO.14 **Probing Photodynamics in Spinel Co3O4 with Correlative X-ray Emission and Diffraction**
Oliviero Cannelli[1,2], Simone Restelli[3], Paolo Usai[4], Carmelo Grova[3], Charles Bevis[3], Francesco Barantani[4,5], Michele Puppin[1], Malte Opperman[1,6], Camila Bacellar[1,7], Rebeca Gomez-Castillo[1,7], Ludmila Leroy[1,7], Francesco Pennacchio[1,4], Jérémy Rouxel[1,8], Grigory Smolentsev[7], Jérémie Teyssier[9],

Natacha Ohannessian[10], Daniele Pergolesi[10,11], Pietro Galinetto[12], Mario Delgado-Jaime[13], Frederico Alves Lima[14], Dmitry Khakhulin[14], Mykola Biednov[14], Yohei Uemura[14], Hazem Yousef[14], Christopher J. Milne[14], Majed Chergui[1,15], Giulia Fulvia Mancini[3]
[1]Laboratory of Ultrafast Spectroscopy (LSU) and Lausanne Centre for Ultrafast Science (LACUS), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. [2]Center for Free-Electron Laser Science, DESY, Hamburg, Germany. [3]Laboratory for Ultrafast X-ray and Electron Microscopy (LUXEM), Pavia, Italy. [4]Institute of Physics, LUMES, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. [5]Department of Physics, The University of Texas at Austin, Austin, USA. [6]Department of Chemistry, University of Basel, Basel, Switzerland. [7]Paul Scherrer Institute, Villigen, Switzerland. [8]Université de Lyon, UJM-Saint-Étienne, CNRS, IOGS, Saint-Étienne, France. [9]Department of Quantum Matter Physics, University of Geneva, Geneve, Switzerland. [10]Laboratory for Multiscale Materials Experiments, Paul Scherrer Institute, Villigen, Switzerland. [11]Electrochemistry Laboratory, Paul Scherrer Institute, Villigen, Switzerland. [12]Department of Physics, University of Pavia, Pavia, Italy. [13]Department of Chemistry, University of Guadalajara, Guadalajara, Mexico. [14]European XFEL, Schenefeld, Germany. [15]Elettra Sincrotrone Trieste S.C.p.A., Trieste, Italy
We present correlative ultrafast X-ray and optical measurements to disentangle the electronic, lattice and spin photoresponses in spinel $Co_3O_4$ upon the excitation of the system's intersite d-d charge transfer transition

Tu-PO.15 **Resolving the Ultrafast Optical Response of a Novel Protonation-Dependent Phenoxazine Derivative by Multidimensional Electronic Spectroscopy**
Rhea Kumar[1], Mattia Russo[1], Jacopo Dosso[2], Vasilis Petropoulos[1], Giulio Cerullo[1], Maurizio Prato[2], Margherita Maiuri[1]
[1]Politecnico di Milano, Milan, Italy. [2]Università degli Studi di Trieste, Trieste, Italy
We explored pH-sensitive optical properties in a phenoxazine derivative by two-dimensional electronic spectroscopy. Vibronic coherences revealed vibrational frequencies that couple the ground and excited electronic states, causing accelerated relaxation with increasing protonation of the molecule.

Tu-PO.16 **Effect of electron-donating substituents on the photoisomerization dynamics of oxindole switches**
Matthew Mgbukwu[1], Xingjie Fu[1], Camilo Andrés Granados Buitrago[1,2], Stefano Crespi[3], Stefan Haacke[1], Jérémie Léonard[1]
[1]Université de Strasbourg, CNRS, Institut de Physique et Chimie des Matériaux de Strasbourg, UMR 7504, Strasbourg, France. [2]Department of Physics, Guangdong Technion - Israel Institute of Technology, 241 Daxue Road, Shantou, 515063, Guangdong, China. [3]Department of Chemistry, Ångström Laboratory, Uppsala University, Box 523, 751 20, Uppsala, Sweden
Femtosecond UV-Vis transient absorption (TA) and fluorescence upconversion spectroscopy (FLUPS) are used to investigate the effect of an electron-donating substituent on the excited state dynamics and photoisomerization quantum yield (QY) of oxindole switches

Tu-PO.17 **Strong solvent driven dynamics of $Fe(bpy)(CN)_4$ studied with optical and X-ray light**
Diana Bregenholt Jakobsen[1], Fernando Ardana-Lamas[1], Camila Bacellar[2], Gabor Baszo[3], Emma Beale[2], Claudio Cirelli[2], Asmus O. Dohn[4], Tim B. van Driel[5], Kristoffer Haldrup[4], Bianca L. Hansen[4], Morten L. Haubro[4], Alberte H. Hoeholdt[6], Yifeng Jiang[1], Philip Johnson[2], Victoria Kabanova[2,7], abdullah Kahraman[2,8], Tamas Keszthelyi[3], Dmitry Khakhulin[1], Philipp Lenzen[4,9], Gianluca Levi[10], Frederico A. Lima[1], Verena I. Markmann[4], Christopher Milne[1], Klaus B. Moeller[6], Zoltan Nemeth[3], Martin M. Nielsen[4], Amke Nimmrich[4,11], Dmitry Ozerov[2], Matyas Papai[3], Sharmistha Paul Dutta[1], Elli Selenius[10], Jens Uhlig[12], Andor Vansza[3], Gyorgy Vanko[3], Hao Wang[1], Hazem Yousef[1], Peter Zalden[1]
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Strong solvent dependent dynamics of $[Fe(CN)_4(2,2'\text{-bipyridine})]^{2-}$ are controlled by local hydrogen

bonding effects, studied by ultrafast optical transient absorption, X-ray emission and X-ray scattering in water, methanol, ethanol, isopropanol and dimethylacetamide.

Tu-PO.18 **Terahertz two-dimensional frequency-domain analysis for light-induced anomalous Hall effect in GaAs**
Tomohiro Fujimoto[1], Yuta Murotani[1], Takayuki Kurihara[1], Tomohiro Tamaya[1], Natsuki Kanda[1,2], Changsu Kim[1], Jun Yoshinobu[1], Hidefumi Akiyama[1], Takeo Kato[1], Ryusuke Matsunaga[1]
[1]The Institute for Solid State Physics, The University of Tokyo, Kashiwa, Chiba, Japan. [2]Research Center for Advanced Photonics, RIKEN, Wako, Saitama, Japan
We investigated ultrafast dynamics of light-induced anomalous Hall current in GaAs with terahertz spectroscopy. We successfully discriminated the inverse spin Hall effect derived from Berry curvature and the injection current activated by bias terahertz fields.

Tu-PO.19 **Ultrabroadband impulsive stimulated Raman scattering of liquid water**
Gaia Giovannetti[1], Ammar Bin Wahid[1], Sergey Ryabchuk[1,2], Hui-Yuan Chen[3], Erik P. Månsson[1], Giovanni Batignani[4], Ofer Neufeld[1,5], Angel Rubio[1,2,5,6,7], Tullio Scopigno[4], Vincent Wanie[1], Hugo Marroux[8], Majed Chergui[3], Francesca Calegari[1,2,7]
[1]Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany. [2]The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany. [3]Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. [4]"Sapienza" University of Rome, Rome, Italy. [5]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany. [6]Center for Computational Quantum Physics (CCQ), The Flatiron Institute, New York, USA. [7]Universität Hamburg, Hamburg, Germany. [8]Laboratoire Interactions, Dynamiques et Lasers, Paris, France
Impulsive stimulated Raman scattering is used to monitor the ultrafast ground state vibrational dynamics of liquid water in real-time. The ultrabroadband signal is dominated by the O-H stretching mode with a period of ~10 fs.

**Tu-PO.21 High-harmonic anomalous Hall currents in 2D Weyl semimetal driven by an intense laser pulse**
Arqum Hashmi[1], M. Umar Farooq[2], Mizuki Tani[1], Kazuhiro Yabana[3], Li Huang[2,4], Tomohito Otobe[5], Kenichi L. Ishikawa[1]
[1]The University of Tokyo, Tokyo, Japan. [2]Southern University of Science and Technology, Shenzhen, China. [3]University of Tsukuba, Tsukuba, Japan. [4]Quantum Science Center of Guangdong-Hong Kong-Macao Greater Bay Area (Guangdong), Shenzhen, China. [5]Kansai Institute for Photon Science, National Institutes for Quantum Science and Technology (QST), Kyoto, Japan
We theoretically show that an intense laser pulse induces high-harmonic anomalous Hall currents with plateau and cutoff in 2D Weyl semimetal. The Berry curvatures play an important role in this strong nonlinear response.

Tu-PO.22 **Multiple Conical Intersections Drive the Photocycle in Large Stokes-shift Red Fluorescent Protein mBeRFP**
**Garima Bhutani, Archit Gupta, Sasthi Paul, Purnannanda Guptasarma, Arijit De**
**IISER Mohali, Mohali, India**

Preferential population branching through numerous conical intersections is identified to navigate ultrafast excited-state isomerization, structural reorganization and proton transfer pathways in red fluorescent protein mBeRFP, leading to distant emissions and large Stokes-shift.

Tu-PO.23 **Ultrafast dynamics of strongly coupled bound state in the continuum in a WS2 metasurface**
Cristina Cruciano[1], Luca Sortino[2], Armando Genco[1], Thomas Weber[2], Matteo Corti[1], Benedetto Ardini[1], Cristian Manzoni[3], Gianluca Valentini[1], Stefan A. Maier[4,5], Stefano Dal Conte[1], Andreas Tittl[2], Giulio Cerullo[1,3]
[1]Dipartimento di Fisica, Politecnico di Milano, Milano, Italy. [2]Ludwig Maximilians Universität München, Faculty of Physics, Chair in Hybrid Nanosystems, Munich, Germany. [3]Istituto di Fotonica e Nanotecnologie (IFN), CNR, Milano, Italy. [4]School of Physics and Astronomy, Monash University, Clayton, Australia. [5]Department of Physics, Imperial College London, London, United Kingdom
We analyze a WS2 metasurface that supports strong coupling between excitons and photonic bound state in the continuum, exploiting k-space and pump-probe **spectroscopy to characterize the dispersion and the ultrafast dynamics of the sample.**

Tu-PO.24 **Second-Order Sideband Generationin the Excitonic Insulator $Ta_2NiSe_5$**
Katsuki Morimoto, Kento Uchida, Koichiro Tanaka
Department of Physics, Kyoto University, Oiwake-cho, Kitashirakawa, Sakyo-ku, Kyoto, Japan
We studied the second-order sideband generation in the excitonic insulator $Ta_2NiSe_5$ under gap-resonance mid-infrared excitation to clarify the contribution from collective excitation modes. The observed polarization-dependence suggests that the amplitude mode contribution is not dominant.

Tu-PO.25 **Changes in the Excited State Dynamics of ArchaeRhodopsin-3 via Site-Specific Mutations**
Krystyna Herasymenko[1], Arnaud Marquette[1], Masae Konno[2], Michel Sliwa[3], Keiichi Inoue[2], Stefan Haacke[1]
[1]University of Strasbourg - CNRS, Strasbourg Institute of Material Physics and Chemistry, Strasbourg, France. [2]The Institute for Solid State Physics, University of Tokyo 5-1-5, Kashiwa, Japan. [3]LASIRE, Université de Lille, CNRS, UMR 8516, Lille, France
Multiple ultrafast spectroscopy techniques are employed to investigate the excited-state dynamics of Archaerhodopsin-3, a genetically encoded voltage indicator. As a result of site-specific mutations, a 100-fold increase in fluorescence lifetime is observed.

Tu-PO.26 **Sub-Gfps burst imaging of initial process in optical vortex laser-induced forward transfer**
Ryota Tamemoto[1], Syunta Kogie[1], Kotaro Sato[1], Keisaku Yamane[1], Yasunori Toda[1], Takashige Omatsu[2], Ryuji Morita[1]
[1]Hokkaido university, Sapporo, Japan. [2]Chiba university, Chiba, Japan
We succeeded in 0.16 Gfps burst imaging of initial process in optical vortex laser-induced forward transfer by using a newly developed frequency-swept pulse train generation system.

Tu-PO.27 **Using ultrafast electron-stimulated desorption to generate picosecond ion pulses**
Alexander Redl, Marius-Constantin Chirita-Mihaila, Markus Goldberger, Gabriel Szabo, Christoph Pachlinger, Anna Niggas, Richard Wilhelm
TU Wien, Institute of Applied Physics, Vienna, Austria
Currently, ultrafast ion pulses face limitations on ionization position spread and initial momentum. Our novel method, utilizing electron-stimulated desorption, breaks this barrier and features 230 ps pulsed protons, suggesting future advancements reaching even shorter pulses.

Tu-PO.28 **Attosecond Core-Level Spectroscopy Disentangling the Ultrafast Electronic and Nuclear Wavepacket Dynamics in Furan**
Stefano Severino[1], Karl Michael Ziems[2], Maurizio Reduzzi[1], Adam Summers[1], Hung-Wei Sun[1], Ying-Hao Chien[1], Stefanie Gräfe[2,3,4], Jens Biegert[1,5]
[1]ICFO - Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, Castelldefels (Barcelona), Spain. [2]Institute of Physical Chemistry and Max Planck School of Photonics, Friedrich-Schiller-Universität, Jena, Germany. [3]Fraunhofer Institute for Applied Optics and Precision Engineering, Albert-Einstein-Str. 7, Jena, Germany. [4]Institute of Applied Physics and Abbe Center of Photonics, Friedrich-Schiller-Universität, Jena, Germany. [5]ICREA, Pg. Lluís Companys 23, Barcelona, Spain
We reveal the entire deexcitation pathway during several conical intersections in the complex heterocyclic system furan with attosecond carbon K-edge spectroscopy. The method reveals electronic and nuclear coherences and the timing of the non-adiabatic dynamics.

Tu-PO.29 **Experimental Verification of the Non-Classicality of High-Harmonic Generation**
David Theidel[1], Viviane Cotte[1], René Sondenheimer[2,3], Viktoriia Shiriaeva[1], Marie Froidevaux[4], Vladislav Severin[1], Adam Merdji-Larue[4], Philip Mosel[5], Sven Fröhlich[5], Kim-Alessandro Weber[5], Uwe Morgner[5], Milutin Kovacev[5], Jens Biegert[6,7], Hamed Merdji[1]
[1]Laboratoire d'Optique Appliquée, ENSTA ParisTech, CNRS, École polytechnique, Palaiseau, France. [2]Fraunhofer Institute for Applied Optics and Precision Engineering IOF, Jena, Germany. [3]Friedrich-Schiller-University Jena, Institute of Condensed Matter Theory and Optics, Jena, Germany. [4]Laboratoire d'Optique Appliquée, ENSTA ParisTech, CNRS, École polytechnique, Palaiseau, Germany. [5]Institut für Quantenoptik, Leibniz Universität Hannover, Hannover, Germany. [6]ICFO - Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, Castelldefels (Barcelona), Spain. [7]ICREA - Institucio Catalana de Recerca i Estudis Avançats, Barcelona, Spain
We report experimental evidences, supported by theory, of non-classical signatures in semiconductor

high-harmonic generation (HHG). Violation of the Cauchy-Schwarz inequality and presence of two-mode squeezing, suggest HHG as a new, ultrafast quantum bosonic platform.

Tu-PO.30 **Ultrafast photo-induced progressive gap closure in a two-dimensional organic Mott insulator**

Konstantin Warawa[1], Yassine Agarmani[1], Harald Schubert[1], Martin Dressel[2], Michael Lang[1], Hartmut G. Roskos[1], Mark D. Thomson[1]
[1]Physikalisches Institut, J. W. Goethe-Universität, Frankfurt am Main, Germany. [2]1. Physikalisches Institut, Universität Stuttgart, Stuttgart, Germany

We apply optical-pump terahertz-infrared-continuum probe spectroscopy to the Mott insulator κ-(BEDT-TTF)$_2$Cu[N(CN)$_2$]Cl and examine the transient low-energy spectra in terms of a progressive Mott-gap closure, rather than a free-carrier response.

Tu-PO.31 **Low and room temperature phonon dynamics in Bi-2212 with ultrafast electron diffraction**

Rémi Claude, Michele Puppin, Bruce Weaver, Thomas La Grange
EPFL, Lausanne, Switzerland

By using ultrafast electron diffraction with a shot-to-shot acquisition, we investigate the phonon dynamics of optimally doped BSCCO-2212 after a photo-excitation at room and low temperature to resolve their contribution to the superconductive phase.

Tu-PO.33 **Ultrafast UV-Vis Spectroscopy on the Reservoir-Effect of Fe(II) Photosensitizers with Organic Chromophores**

Miguel Argüello Cordero[1], Philipp Dierks[2], Ayla Kruse[1], Moritz Lang[1], Olga Bokareva[3], Matthias Bauer[2], Oliver Kühn[1], Stefan Lochbrunner[1]
[1]Institute of Physics and Department of Life, Light and Matter, University of Rostock, Rostock, Germany. [2]Faculty of Science, Chemistry Department and Center for sustainable Systems Design (CSSD), Paderborn University, Paderborn, Germany. [3]Leibniz-Institute for Catalysis, Rostock, Germany

Iron(II) complexes with ligands combining Nheterocyclic-carbene groups with a chromophore are studied by ultrafast absorption spectroscopy. Signatures for a reservoir effect are found, but only for chromophores providing a strong driving force.

Tu-PO.34 **High-repetition-rate extreme ultraviolet beamlines at the Artemis Facility**

M. Nrisimhamurty[1], Yu Zhang[1], Charlotte E. Sanders[1], James O. F. Thompson[1], Gourab Chatterjee[1,2], Adam S. Wyatt[1], Gabriel Karras[1,3], Richard T. Chapman[1], Greg M. Greetham[1], Emma Springate[1]
[1]STFC Central Laser Facility, Harwell Science and Innovation Campus, Didcot, Oxfordshire, OX11 0QX, United Kingdom. [2]SLAC National Accelerator Laboratory, 2575 Sand Hill Road, Menlo Park, California 94025, USA. [3]Diamond Light Source, Harwell Science and Innovation Campus, Didcot, Oxfordshire, OX11 0DE, United Kingdom

Here we present our newly commissioned 100-kHz Yb-doped high-repetition extreme ultraviolet source and beamline for time- and angle-resolved photoemission studies. We also will discuss Artemis upgrade plans within the context of the new “HiLUX” project.

Tu-PO.35 **Chirality induced spin polarization in photoionization**

Philip Caesar Flores[1], Andres Ordonez[2], Olga Smirnova[1,3]
[1]Max Born Institute, Berlin, Germany. [2]Imperial College London, London, United Kingdom. [3]Technische Universitat Berlin, Berlin, Germany

We show that the geometric propensity field generating new enantio-sensitive observables in photoionization of chiral molecules by circularly polarized light provides the missing link between chirality induced spin selectivity (CISS) and photoelectron circular dichroism (PECD).

Tu-PO.36 **GHz pulse compression of low-energy electron pulses**

Dennis Epp[1,2], Benjamin Schröder[1], Marcel Möller[1], Claus Ropers[1,2]
[1]Max-Planck-Institut for Multidisciplinary Science, Göttingen, Germany. [2]University of Göttingen, Göttingen, Germany

In this contribution, we demonstrate longitudinal phase-space manipulation of low-energy electron pulses using radio-frequency fields. The cavity induced change in pulse durations results in a two- to four-fold compression of 80-,100- and 120-eV electron pulses.

Tu-PO.37 **Towards Ultra-Nonlinear Sub-Cycle Emission of Few-Electron States**
Germann Hergert, Rasmus Lampe, Andreas Wöste, Christoph Lienau
Carl von Ossietzky Universität, Oldenburg, Germany
We study multiphoton emission of electron number states from gold nanotapers with few-cycle near-infrared pulses, demonstrating nonlinearities up to order ~19. Such extreme nonlinearities temporally quench the photoemission, possibly enabling sub-cycle resolution in low-energy-electron microscopy.

Tu-PO.39 **Charge-carrier dynamics of photoexcited Nb2O5 nanoparticles using pump-probe XAS at European XFEL**
Xinchao Huang[1], Yohei Uemura1[1], Peter Zalden1[1], Shunsuke Nozawa[2], Dongxiao Fan[2], Tomoki Kanazawa[2], Jinfeng Chen[3], Fernando Ardana-Lamas[1], Martin Knoll[1], Paul Frankenberger[1], Siti Heder[1], Han Xu[1], Hao Wang[1], Doriana Vinci[1], Yifeng Jiang[1], Mykola Biednov[1], Sharmistha Paul Dutta[1], Hazem Yousef[1], Diana Jakobsen[1], Dmitry Khakhulin[1], Fred Lima[1], Chris Milne[1]
[1]European XFEL, Schenefeld, Germany. [2]KEK, Ibaraki, Japan. [3]USTC, Hefei, China
We recently succeeded in collecting transient XAS on $Nb_2O_5$ nanoparticles with ~150 fs resolution. We found that the local structural change is decoupled from the photoexcitation in short time scale below 1 picosecond, and grows until picoseconds.

Tu-PO.40 **Developing a Femtosecond Hyperspectral Source**
**Étienne Doiron[1], Pedram Abdolghader[1], Marco Scaglia[1], Maksym Ivanov[1,2], Francois Legare[2], Gabriel Tempea[1], Giulio Vampa[3], Bruno Schmidt[1]**
**[1]few-cycle, Varennes, Canada. [2]INRS, Varennes, Canada. [3]NRC, Ottawa, Canada**
**Based on a narrowband 330fs, 2mJ, 80W Yb pump source we develop a versatile ultrafast spectroscopy platform offering multiple, simultaneous output beams operating in the range from 225nm up to 11um wavelength.**

Tu-PO.41 **Towards ultrafast imaging of insulator-to-metal phase transition in a Mott insulator using harmonic holography**
Leo Guery, Zhonghui Nie, Peter Kraus
ARCNL, Amsterdam, Netherlands
We present an experiment which combines both solid high-harmonic generation with a lensless imaging technique in order to track an insulator-to-metal phase transition in a Mott insulator both spatially and temporally.

Tu-PO.42 **Vernier-Burst Plasma Generation in Air**
Vinzenz Stummer[1], Edgar Kaksis[1], Tobias Flöry[1], Audrius Pugžlys[1,2], Andrius Baltuška[1,2]
Elizaveta Gangrskaia[1]
[1]TU Wien, Photonics Institute, Vienna, Austria. [2]Center for Physical Sciences & Technology, Vilnius, Lithuania
In comparison to the application of a single ultrashort optical pulse, we demonstrate enhanced plasma generation capabilities in air by pulse bursts that are formed by the Vernier effect of a master-oscillator regenerative-amplifier laser system.

Tu-PO.43 **Ionization Interactions of light polar and heavy non-polar Molecules at the Advanced Laser Light Source (ALLS)**
Tomoyuki Endo[1,2], Karl Michael Ziems[3], Kaili Tian[4], Reza Karimi[4], Gaëtan Jargot[1], Stephen Londo[1], Hikaru Fujise[5], Mizuho FUSHITANI[6], Akiyoshi HISHIKAWA[5,6], Stefanie Gräfe'[3], André Staudte[7], Joseph Sanderson[4], François Légaré[1], Heide Ibrahim[1]
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Controlling fragment ejection directions upon excitation with asymmetric laser fields of heavy polar OCS molecules is compared to light non-polar molecules, such as $H_2$. Using Coulomb explosion imaging, we investigate the role of post-ionization interactions.

Tu-PO.44 **Advancing Attosecond X-ray Sciences through Four Wave Mixing-Driven Photoemission**

Hao Zhang[1,2], Jack Hirschman[2,3], Paris Franz[3,2], Linshan Sun[1], Randy Lemons[2], Siqi Li[2], Federico Belli[4], Agostino Marinelli[2], Sergio Carbajo[1,2,5,6]
[1]Department of Electrical & Computer Engineering, University of California Los Angeles, Los Angeles, USA. [2]SLAC National Accelerator Laboratory, Stanford University, Menlo Park, USA. [3]Department of Applied Physics, Stanford University, Menlo Park, USA. [4]School of Engineering and Physical Sciences, Heriot-Watt University, Scotland, United Kingdom. [5]Physics and Astronomy Department, University of California Los Angeles, Los Angeles, USA. [6]California NanoSystems Institute, Los Angeles, USA

We introduce a novel regime in four-wave mixing-driven photoemission to control the photoelectron phase space. This approach is designed to enable MHz repetition rate attosecond emission at X-ray Free Electron Lasers.

Tu-PO.45 **Ultrafast Pulse-Shaping Unveils the Role of Exciton-Exciton Interactions in the Generation of Four-Wave Mixing**

Omri Meron[1,2], Uri Arieli[1,2], Eyal Bahar[1,2], Swarup Deb[1], Moshe Ben-Shalom[1], Haim Suchowski[1,2]
[1]Condensed Matter Physics Department, School of Physics and Astronomy, Faculty of Exact Sciences, Tel Aviv University, Tel-Aviv, Israel. [2]Center for Light-Matter Interaction, Tel-Aviv University, Tel-Aviv, Israel

We utilize pulse-shaping for coherent control, investigating A1s exciton-driven four-wave mixing in monolayer $WSe_2$. Our experimental results corroborate theoretical predictions, highlighting the impact of exciton-exciton interactions on observed multi-photon pathway interference effects.

Tu-PO.46 **Far-field petahertz sampling of plasmonic fields**

Kai-Fu Wong[1,2], Weiwei Li[3,4], Zilong Wang[3,4], Vincent Wanie[2], Erik Månsson[2], Dominik Hoeing[1], Johannes Blöchl[3,4], Thomas Nubbemeyer[3,4], Abdallah M. Azzeer[5], Andrea Trabattoni[2,6], Holger Lange[1,7], Francesca Calegari[1,2], Matthias F. Kling[3,4,8,9]
[1]The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany. [2]Center for Free-Electron Laser Science CFEL, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany. [3]Max Planck Institute of Quantum Optics, Garching, Germany. [4]Physics Department, Ludwig-Maximilians-Universität Munich, Garching, Germany. [5]Attosecond Science Laboratory, Physics and Astronomy Department, King-Saud University, Riyadh, Saudi Arabia. [6]Institute of Quantum Optics, Leibniz Universität Hannover, Hannover, Germany. [7]Institute of Physics and Astronomy, Universität Potsdam, Potsdam, Germany. [8]Stanford PULSE Institute, SLAC National Accelerator Laboratory, Menlo Park, USA. [9]Applied Physics Department, Stanford University, Stanford, USA

We demonstrate the realtime observation of linear plasmonic fields by optical field sampling. Our findings also demonstrate the ability to manipulate the spectral properties of ultrashort laser pulses by plasmonic samples.

Tu-PO.47 **Building a Digital Twin of the Multi-Resolution Cookiebox: An Experimental Endstation for LCLS-II**

Amanda Shackelford[1,2], Jack Hirschman[1,3], Razib Obaid[1], Ryan Coffee[1]
[1]SLAC National Accelerator Laboratory, Menlo Park, USA. [2]University of Colorado Boulder, Boulder, USA. [3]UCLA, Los Angeles, USA

The digital twin of the LCLS-II Multi-Resolution COokiebox (MRCO) spectrometer array provides on-demand electron time of flight spectra and trajectories for on-the-fly experimental optimization for a suite of experiments.

Tu-PO.48 **Attosecond Control of High Harmonic Generation from a Wide Bandgap Dielectric Using Synthesized Light Fields**

Zhaopin Chen, Mark Levit, Yuval Kern, Basabendra Roy, Michael Krüger
Department of Physics and Solid State Institute, Technion - Israel Institue of Technology, Haifa, Israel

We experimentally realize attosecond control of high harmonics from MgO pumped by a synthesized two-color light field. A quasi-continuous plateau indicates the production of a single isolated attosecond XUV pulse, in agreement with numerical simulations.

Tu-PO.49 **TR-ARPES at 250 kHz with high-intensity mid-IR excitation from an OPA**

Gaëtan Jargot[1], Adrien Longa[1], François Légaré[1], Jean-Michel Parent[2], Dario Armanno[1], Benson Frimpong[2], Fabio Boschini[1]
[1]INRS, Varennes, Canada. [2]inrs, varennes, Canada

At the Advanced Laser Light Source (ALLS) laboratory we recently developed a novel mid-Infrared Optical Parametric Amplifier delivering pulses from 1.6 to 8 μm to perform Time-Resolved photoemission spectroscopy (TR-ARPES) measurements

Tu-PO.50 **Striking Differences in the Ultrafast Photoisomerization Dynamics of -$C_2H_4$- and -$CH_2$-bridged Azobenzenes**
Malte Wellmann, Pascal Pessier, Lukas Guhl, Maria Hergert, Friedrich Temps
Christian-Albrechts-University Kiel, Kiel, Germany
Femtosecond transient electronic absorption spectroscopy of Z-11,12-dihydrodibenzodiazocine (Dz) and Z-11H-dibenzodiazepine (Dzp) reveals E-isomer formation via an intermediate in the $S_0$ ground electronic state for Dz and an intermediate in the $S_1$ state for Dzp.

Tu-PO.51 **Chiral Coherent Control of Electronic Population Transfer: Towards All-Optical Highly Enantioselective Photochemistry**
Andres Ordonez[1], Patricia Vindel-Zandbergen[2], David Ayuso[1,3]
[1]Imperial College London, London, United Kingdom. [2]New York University, New York, USA. [3]Max-Born-Institut, Berlin, Germany
We propose a coherent control scheme for enantioselective electronic population transfer that yields 27% enantioselectivity across the interaction region in randomly oriented carvone using ~40-femtosecond pulses in a non-collinear setup.

Tu-PO.52 **Ion-Based High-Harmonic Generation for keV Isolated-Attosecond Pulses**
Hsu-hsin Chu
Department of Physics, National Central University, Taoyuan, Taiwan. Center for High Energy and High Field Physics, National Central University, Taoyuan, Taiwan
A new scheme of ion-based keV high-harmonic generation is analyzed. The dipole phase variation is utilized for phase matching. The time-dependent phase-matching condition automatically gates the output to an isolated attosecond pulse of 130-as duration.

Tu-PO.54 **Orbital Effects on Tunnel-electron Momentum Distribution of Ar and $H_2$ in Circularly Polarized Intense Laser Fields**
Daimu Ikeya, Akitaka Matsuda, Mizuho Fushitani, Akiyoshi Hishikawa
Nagoya University, Nagoya, Japan
Tunnel-electron momentum distributions of Ar and $H_2$ in circularly-polarized intense laser fields are investigated. By precise momentum imaging, the difference in the tunneling orbitals, 3p and $1s\sigma_g$, is successfully retrieved from the transverse momentum distributions.

**Tu-PO.55 $H_3^+$ formation through photoionization of the molecular hydrogen dimers**
Yonghao Mi[1], Enliang Wang[2], Zack Dube[3], Tian Wang[1], Andrei Naumov[3], David Villeneuve[3], Paul Corkum[1], André Staudte[3]
[1]University of Ottawa, Ottawa, Canada. [2]USTC, Anhui, China. [3]National Research Council Canada, Ottawa, Canada
Using near-infrared, femtosecond laser pulses and coincidence momentum imaging, we demonstrate that the trihydrogen cation ($H_3^+$) can be efficiently produced via single photoionization of the molecular hydrogen dimer ($H_2$-$H_2$).

Tu-PO.56 **Time-selective Resonance Generation through Ultrafast Dielectric Permittivity Modulation**
Thomas Possmayer[1], Rodrigo Berté[1], Andreas Tittl[1], Leonardo de S. Menezes[1,2], Stefan A. Maier[1,3,4]
[1]Chair in Hybrid Nanosystems, Nanoinstitut München, Fakultät fur Physik, Ludwig-Maximilians-Universität, 80799 München, Germany. [2]Departamento de Física, Universidade Federal de Pernambuco, 50670-901 Recife-PE, Brazil. [3]School of Physics and Astronomy, Monash University, Clayton, Victoria 3800, Australia. [4]The Blackett Laboratory, Department of Physics, Imperial College London, London SW7 2AZ, United Kingdom
Through interference of two ultrashort laser pulses, we periodically modulate the permittivity of a silicon film to sustain optical quasi-bound states in the continuum. These states simultaneously allow frequency- and time-selective manipulation of optical near-fields.

Tu-PO.57 **Hot carriers and exciton diffusion in suspended $MoSe_2$: from bulk down to monolayer**
Giulia Lo Gerfo Morganti[1], Guillermo D. Brinatti Vazquez[1], Roberto Rosati[2], Sebin Varghese[3], David Saleta Reig[3], Ermin Malic[2], Niek F. van Hulst[1,4], Klaas-Jan Tielrooij[3,5]
[1]ICFO - The Institute of Photonic Sciences, The Barcelona Institute of Science and Technology, Castelldefels, Barcelona, Spain. [2]Department of Physics, Philipps-Universität Marburg, Marburg, Germany. [3]Catalan Institute of Nanoscience and Nanotechnology (ICN2), BIST and CSIC, Bellaterra, Barcelona, Spain. [4]ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain. [5]Department of Applied Physics, TU Eindhoven, Eindhoven, Netherlands
Employing transient reflection microscopy and theoretical modeling, we explore the energy-transport link in suspended ultrathin TMDCs. Findings reveal remarkably fast and apparent negative diffusion of hot-carriers and excitons, mainly influenced by defects, pivotal for optoelectronics

Tu-PO.58 **Measuring the Sign of Excited-state Displacements unveils Ultrafast Photoreactions**
Giovanni Batignani[1,2], Emanuele Mai[1,2], Giuseppe Fumero[1], Shaul Mukamel[3], Tullio Scopigno[1,2,4]
[1]Physics Department, Sapienza University of Rome, Rome, Italy. [2]Center for Life, Nano- & Neuro-Science, Istituto Italiano di Tecnologia, Rome, Italy. [3]Department of Chemistry, University of California, Irvine, USA. [4]Graphene Labs, Istituto Italiano di Tecnologia, Genova, Italy
We introduce a two-color impulsive Raman scheme ad-hoc developed for measuring the sign of excited-state displacements. Unraveling this elusive quantity directly unveils the sensed direction of excited-state nuclear reconfigurations following photoexcitation in ultrafast reactions.

Tu-PO.59 **Risk of X-ray emission during femtosecond laser ablation of biological tissue**
Philip Mosel[1], Jan Düsing[2], Sonja Johannsmeier[2], Mandy Patzlaff-Günther[2], Sven Fröhlich[1], Jose Mapa[1], Stefan Kalies[1,3], Julia Bahlmann[1,3], Thomas Püster[2], Jan-Willem Vahlbruch[4], Günter Dittmar[5], Hamed Merdji[6], Marta Fajardo[7], Andrea Trabattoni[1,8], Alexander Heisterkamp[1,3], Uwe Morgner[1], Milutin Kovacev[1]
[1]Institut für Quantenoptik, Leibniz Universität Hannover, Hannover, Germany. [2]Laser Zentrum Hannover e.V., Hannover, Germany. [3]Lower Saxony Centre for Biomedical Engineering, Implant Research and Development (NIFE), Hannover, Germany. [4]Institute of Radioecology and Radiation Protection, Leibniz Universität Hannover, Hannover, Germany. [5]Ingenieur-Büro Prof. Dr.-Ing. G. Dittmar, Aalen, Germany. [6]LOA, ENSTA ParisTech, CNRS, Ecole Polytechnique, Palaiseau, France. [7]GoLP, Instituto de Plasmas e Fusao Nuclear, Instituto Superior Tecnico, Universidade de Lisboa, Lisboa, Portugal. [8]Center for Free-Electron Laser Science CFEL, Deutsches Elektron-Synchrotron DESY, Hamburg, Germany
Ultrashort lasers are an essential tool in material processing and medical treatments. As X-rays can be generated during laser ablation, there is a health risk that should be taken into account and is studied here.

Tu-PO.60 **Ultrafast intramolecular $H/H^+$ transfer induced by 1.5 fs XUV pulses in small biologically relevant molecules**
Kossi Kety[1], Mattea Carmen Castrovilli[2], Andrea Trabattoni[3,4], Paola Bolognesi[2], Patrick O'Keeffe[2], Lorenzo Avaldi[2], Mauro Nisoli[5,6], Francesca Calegari[3,7], Jesús González-Vazquez[8], Alexander Mitrushchenkov[1], Alicia Palacios[8], Loïc Joubert-Doriol[1], Piero Decleva[9], Fernando Martín[8,10], Fabien Gatti[11], Raluca Cireasa[11]
[1]Laboratoire de Modélisation et Simulation Multiéchelle, Université Gustave Eiffel, Marne-la-Vallée, France. [2]Istituto di Struttura della Materia, National Research Council, Monterotondo, Italy. [3]Center for Free-Electron Laser Science (CFEL), Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany. [4]Leibniz University Hannover, Hannover, Germany. [5]Department of Physics, Politecnico di Milano, Milano, Italy. [6]Institute for Photonics and Nanotechnologies, National Research Council, Milano, Italy. [7]Physics Department, Universität Hamburg, Hamburg, Germany. [8]Departamento de Quımica, Universidad Autónoma de Madrid, Madrid, Spain. [9]Dipartimento di Scienze Chimiche e Farmaceutiche, Università degli Studi di Trieste, Trieste, Italy. [10]Instituto Madrileño de Estudios Avanzados en Nanociencia, IMDEA-Nano, Madrid, Spain. [11]Institut des Sciences Moléculaires d'Orsay, Centre National de la Recherche Scientifique, Université Paris Saclay, Orsay, France
Ionisation by 1.5 fs XUV pulses in Glycine and 5Halouracils triggers $H/H^+$ transfers of 40-50 fs. Trajectory Surface Hopping calculations indicate that the transfer in Gly occurs following relaxation to the ground electronic state.

**Tu-4A: Nonlinear Phenomena in Solids**
**17:15 - 19:00 Tuesday 16 July 2024**
**Auditorium**

**Oral session**
**Chaired by Michael Krüger, Israel Institute of Technology, Haifa, Israel**

17:15 - 17:45
Tu-4A.1 Invited **High-Order Harmonic Generation in Confined Systems**
Martin Thümmler, Alexander Croy, Daniil Kartashov, Ulf Peschel, Stefanie Gräfe
Friedrich Schiller University Jena, Jena, Germany
We present a three-dimensional real-space tight-binding model to model high-order harmonic generation in confined semiconductor nanostructures, allowing us to model quantum dots of up to 3 nm diameter.

17:45 - 18:00
Tu-4A.2 **High-Harmonic Transient Grating Spectroscopy Traces Multi-Electron Dynamics in Photoexcited MgO**
Nataliia Kuzkova[1,2], Sylvianne D.C. Roscam Abbing[1], Simon Vendelbo Bylling Jensen[3], Pieter van Essen[1], Filippo Campi[1], Brian de Keijzer[1], Lars Bojer Madsen[3], Peter M. Kraus[1,2]
[1]Advanced Research Center for Nanolithography (ARCNL), Amsterdam, Netherlands. [2]Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit, Amsterdam, Netherlands. [3]Department of Physics and Astronomy, Aarhus University, Aarhus, Denmark
We introduce solid-state high-harmonic transient grating spectroscopy, measuring attosecond phase shifts and harmonic amplitude suppression in MgO after photoexcitation. Our findings link these effects to band-gap shrinkage and accelerated dephasing of electron-hole coherences driving HHG.

18:00 - 18:15
Tu-4A.3 **Giant optical nonlinearities from periodically poled 3R- stacked transition metal dichalcogenides**
Chiara Trovatello[1,2], Carino Ferrante[3], Birui Yang[1], Cory R. Dean[1], Andrea Marini[3], Giulio Cerullo[2], P. James Schuck[1]
[1]Columbia University, New York, USA. [2]Politecnico di Milano, Milano, Italy. [3]CNR-SPIN, L'Aquila, Italy
We demonstrate broadband quasi phase matching in a periodically poled van der Waals semiconductor (3R-$MoS_2$), opening up the new and unexplored field of phase-matched nonlinear optics with microscopic van der Waals crystals.

18:15 - 18:30
Tu-4A.4 **Ponderomotive Detuning and Attosecond Time Delays of Excitonic High Harmonics in GaN**
Zhaopin Chen[1], You Wu[2], Christopher Ayala[2], Mark Levit[1], Ido Nisim[1], Yuanpeng Wu[2], Zetian Mi[2], Steven Cundiff[2], Mackillo Kira[2], Michael Krüger[1]
[1]Technion–Israel Institute of Technology, Haifa, Israel. [2]University of Michigan, Michigan, USA
Our joint theory-experiment analysis demonstrates that high harmonics emitted from a GaN crystal undergo a set of excitonic resonances and corresponding attosecond time delays. The underlying mechanism is ponderomotive detuning, influenced by electronic many-body effects.

18:30 - 18:45
Tu-4A.5 **Nonequilibrium charge-density-wave dynamics in 1T-$TiSe_2$: the case for excitonic correlations and topological defects**
Michael Zuerch
University of California, Berkeley, Berkeley, USA. Lawrence Berkeley National Laboratory, Berkeley, USA
Using ultrafast electron diffraction and attosecond transient absorption spectroscopy, we unveil new insights about the interplay between the charge-density-wave and excitonic correlations in 1T-$TiSe_2$, and we elucidate how one-dimensional defects emerge in its transient state.

18:45 - 19:00
Tu-4A.6 **Ultrafast electron-electron scattering processes in metals revealed by high-harmonic generation spectroscopy**
Koichiro Tanaka[1], Kento Uchida[2], Kosei Takeda[1], Kohei Nagai[1], Satoshi Kusaba[1], Shinya Takahashi[1]
[1]Kyoto University, Kyoto, Japan. [2]Kyoto University, KYOTO, Japan
We show that the competition and cooperation between electron-driving and electron-electron scattering processes under a strong electric field enhances the non-perturbative behavior of high-harmonic generation and heating of electron system in metallic-phase of 2H-$NbSe_2$.

**SOCIAL EVENT**
**PRIVATE VISIT OF THE BARCELONA MARITIME MUSEUM**
**20:00 - 22:00 Tuesday 16 July 2024**
**CONFERENCE BANQUET AT THE BARCELONA MARITIME MUSEUM, GRAN SALA**
**20:30 - 23:00 Tuesday 16 July 2024**

**Kindly sponsored by our Prime Sponsor**


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**We-1A: Excitons**
**08:30 - 10:15 Wednesday 17 July 2024**
**Auditorium**
**Oral session**
**Chaired by Elisabetta Collini, University of Padova, Padova, Italy**

08:30 - 09:00
We-1A.1 Invited **Quantum Engineering of Exciton Transport and Annihilation**
Libai Huang
Purdue University, West Lafayette, USA
Exciton-exciton annihilation (EEA) has been assumed to be a diffusion-limited process. Here we challenge this assumption by demonstrating the ability to control EEA in molecular aggregates using the quantum phase relationships of excitons.

09:00 - 09:15
We-1A.2 **Tracking Many-Body Interactions in Semiconductors by Two-Dimensional Electronic Spectroscopy**
Thomas Deckert, Daniele Brida
University of Luxembourg, Luxembourg, Luxembourg
Ultrafast two-dimensional electronic spectroscopy (2DES) reveals distinct many-body effects of excitons and free charge carriers in a bulk semiconductor, while simultaneously tracking energy migration of carriers including thermalization, cooling, and exciton trapping at low temperature.

09:15 - 09:30
We-1A.3 **Visualizing local exciton formation and many-body dynamics in single-walled carbon nanotubes**
Jun Nishida[1,2], Keigo Otsuka[3,4], Yuichiro Kato[3,5], Takashi Kumagai[1,2]
[1]Institute for Molecular Science, Okazaki, Japan. [2]The Graduate Institute for Advanced Studies, SOKENDAI, Hayama, Japan. [3]Nanoscale Quantum Photonics Laboratory, RIKEN Cluster for Pioneering Research, Saitama, Japan. [4]Department of Mechanical Engineering, The University of Tokyo, Tokyo, Japan. [5]Quantum Optoelectronics Research Team, RIKEN Center for Advanced Photonics, Saitama, Japan
Using highly sensitive ultrafast infrared scattering scanning near-field optical microscopy (ultrafast IR s-SNOM), we resolve the spatial modulation of exciton formation and subsequent many-body dynamics within single-walled carbon nanotubes with ~100 nm resolution.

09:30 - 09:45
We-1A.4 **Ultrafast self-trapped exciton formation in double-halide lead-free perovskites**
Ana Maria de Paula[1], Danielle C. Teles-Ferreira[2], Shunran Li[3], Bowen Hou[4], Piotr Kabacinski[5], Hemen Hosseini[5], Giulio Cerullo[5,6], Diana Y. Qiu[4], Peijun Guo[7], Franco V.A. Camargo[6]

[1]Departamento de Física-ICEx, Universidade Federal de Minas Gerais, 31270-901, Belo Horizonte, MG, Brazil. [2]Instituto Federal de Minas Gerais, Campus Ouro Preto, 35400-000, Ouro Preto, MG, Brazil. [3]Department of Chemical and Environmental Engineering, Yale University, New Haven, Connecticut 06511, USA. [4]Department of Mechanical Engineering and Materials Science, Yale University, New Haven, Connecticut 06511, USA. [5]Dipartimento di Fisica, Politecnico di Milano, 20133, Milan, Italy. [6]Istituto di Fotonica e Nanotecnologie-CNR, Piazza L. da Vinci 32, 20133, Milan, Italy. [7]Department of Chemical and Environmental Engineering, Yale University, New Haven, USA
We use sub-20 fs UV pulses to study the self-trapped exciton formation in lead-free double-halide perovskites. We reveal an ultrafast thermalization step of ~50 fs followed by the self-trapped exciton formation on a 250-fs timescale.

09:45 - 10:00
We-1A.5 **Annihilation-limited Long-range Exciton Transport in High-mobility Conjugated Semiconducting Polymer Films**
Graham Fleming[1,2], Yuping Shi[3], Partha Roy[4], N Higashitarumizu[1], Tsung-Yen Lee[1], Quanwei Li[1], Ali Javey[1], Katherina Landfester[5], Henning Sirringhaus[6]
[1]UC Berkeley, Berkeley, USA. [2]LBNL, Berkeley, USA. [3]Max Planck Inst, Mainz, Germany. [4]Northwestern, Evanston, USA. [5]MPI, Mainz, Germany. [6]Cambridge Univ, Cambridge, United Kingdom
Ultrafast exciton transport and dynamics in a high-mobility conjugated polymer are studied with phase-cycling-based transient absorption spectroscopy. We find long-range exciton transport and low annihilation loss in thin-films, and propose this arises from quantum interference

10:00 - 10:15
We-1A.6 **Interlayer hot exciton formation and thermalization in 2D heterostructures**
Stefano Dal Conte[1], Veronica Rose Policht[2], Henry Mittenzwey[3], Oleg Dogadov[1], Manuel Katzer[3], Andrea Villa[1], Qiuyang Li[4], Benjamin Kaiser[5], Aaron Ross[1], Francesco Scotognella[1,6], Xiayang Zhu[7], Andreas Knorr[3], Malte Selig[3], Giulio Cerullo[1]
[1]Politecnico di Milano, Milano, Italy. [2]U.S. Naval Research Laboratory, Washington, USA. [3]Technische Universität Berlin, Berlin, Germany. [4]University of Michigan, Ann Arbor, USA. [5]Zuse-Institut, Berlin, Germany. [6]Politecnico di Torino, Torino, Italy. [7]Columbia University, New York, USA
By using high-sensitivity and broadband transient absorption spectroscopy, we directly resolve the formation dynamics of hot interlayer excitons and their thermalization on sub-picosecond timescale in a 2D heterostructure based on transition metal dichalcogenides layers.

**EXHIBITION AND COFFEE BREAK**
**10:15 - 10:45 Wednesday 17 July 2024**
**Port Vell**

**We-2A: Dynamics in Solids**
**10:45 - 12:30 Wednesday 17 July 2024**
**Auditorium**
**Oral session**
**Chaired by Jeff Davis, Swinburne University of Technology, Melbourne, Australia**

10:45 - 11:00
We-2A.1 **Elliptically polarized coherent phonons in a degenerate mode**
Arne Ungeheuer, Ahmed S. Hassanien, Mashood T. Mir, Lukas Nöding, Christian Gerbig, Thomas Baumert, Arne Senftleben
Universität Kassel, Kassel, Germany
We demonstrate a scheme to create circularly or elliptically polarized coherent phonons in the degenerate inter-layer shear mode in graphite. The phonon's ellipticity and sense of rotation are determined using ultrafast electron diffraction.

11:00 - 11:15
We-2A.2 **Dynamics of photoexcited $WO_3$ using femtosecond HERFD-XAS**
Yohei Uemura[1], Kohei Yamamoto[2], Yasuhiro Niwa[3], Masoud Lazemi[4], Ru-pan Wang[5], Hebatalla Elnaggar[6], Toshihiko Yokoyama[2], Frank de Groot[4], Chris Milne[1], Tetsuo Katayama[7,8], Makina Yabashi[8]
[1]European XFEL, Schenefeld, Germany. [2]Institute for Molecular Science, Okazaki, Japan. [3]Photon Factory, KEK, Tsukuba, Japan. [4]Utrecht University, Utrecht, Netherlands. [5]Hamburg University,

Hamburg, Germany. [6]Sorbonne University, Paris, France. [7]JASRI, Koto, Japan. [8]RIKEN/SPring-8, Koto, Japan
The early photoexcited states of $WO_3$ were explored using XAS and HERFD-XAS. HERFD-XAS demonstrated electronic state changes within 1 ps.

11:15 - 11:30
We-2A.3 **Selective coupling of coherent optical phonons in $YBa_2Cu_3O_{7-\delta}$ with electronic transitions**
Kunie Ishioka[1], Alexej Pashkin[2], Christian Bernhard[3], Hrvoje Petek[4], Xin Yao[5], Jure Demsar[6]
[1]National Institute for Materials Science, Tsukuba, Japan. [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany. [3]University of Fribourg, Fribourg, Switzerland. [4]University of Pittsburgh, Pittsburgh, USA. [5]Shanghai Jiao Tong University, Shanghai, China. [6]Johannes Gutenberg University Mainz, Mainz, Germany
Coherent phonons of $YBa_2Cu_3O_{7-\delta}$ with frequencies up to 15 THz were examined by transient reflectivity at 300 K. Their relative amplitudes were in apparent contrast to the relative spontaneous Raman intensities, indicating mode-dependent generation mechanism.

11:30 - 11:45
We-2A.4 **Quasiparticles generation in superconducting cuprate captured by near infrared 6 fs pulse**
Ryo Kato[1], Tatsuya Amano[1], Yuto Taniguchi[1], Yohei Kawakami[1], Hirotake Itoh[1], Yuto Nakamura[2], Hideo Kishida[2], Takahiko Sasaki[1], Terukazu Nishizaki[3], Kenya Ohgushi[1], Kenji Yonemitsu[4], Shinichiro Iwai[1]
[1]Tohoku University, Sendai, Japan. [2]Nagoya University, Nagoya, Japan. [3]Kyusyu sangyou University, Fukuoka, Japan. [4]Chuo University, Tokyo, Japan
Generation of superconducting quasiparticles in optimally doped $YBa_2Cu_3O_y$ is characterized by spectral weight transfer in the wide range (0.1~2.8 eV), showing the correlation effect. Coherent apical oxygen phonons are produced during the quasiparticle generation.

11:45 - 12:00
We-2A.**5** **Ultrafast nanoscopy of carrier dynamics and single-grain nano-morphology in metal halide perovskites**
Martin Zizlsperger[1], Svenja Nerreter[1], Qimu Yuan[2], Kilian B Lohmann[2], Fabian Sandner[1], Felix Schiegl[1], Christian Meineke[1], Yaroslav Gerasimenko[1], Laura M Herz[2], Thomas Siday[1,2], Markus A Huber[1], Michael B Johnston[2], Rupert Huber[1]
[1]University of Regensburg, Regensburg, Germany. [2]University of Oxford, Oxford, United Kingdom
Femtosecond shifts of terahertz near-field waveforms unveil the interplay of carrier dynamics and nano-morphology in metal halide perovskites. A surprising resilience of vertical diffusion against chemical and structural variations is observed on the nanoscale.

12:00 - 12:15
We-2A.6 **The Balance Between Independent and Correlated Electron Dynamics in Transition Metals**
Erik Willem de Vos, Sergej Neb, Marko Hollm, Florence Burri, Lukas Gallmann, Ursula Keller
ETH Zurich, Zurich, Switzerland
Attosecond transient absorption spectroscopy measurements on a systematically chosen set of transition metals are presented, providing a methodical understanding of the interplay between electron population dynamics and an induced change in the local-field effect.

12:15 - 12:30
We-2A.7 **The Role of Transition Matrix Elements in Attosecond Spin-Orbit Delays in Photoemission from $Bi_2Te_3$ and $Bi_2Se_3$**
Andreas Gebauer[1], Walter Enns[1], Sergej Neb[2], Tillmann Schabbehard[1], Luis Maschmann[1], Stefan Muff[3], J. Hugo Dil[4,3], Ulrich Heinzmann[1], Stephan Fritzsche[5,6,7], Nikolay M. Kabachnik[8,9], Walter Pfeiffer[1]
[1]Bielefeld University, Bielefeld, Germany. [2]ETH Zürich, Zürich, Switzerland. [3]Paul-Scherrer-Institut PSI, Villigen, Switzerland. [4]École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. [5]Helmholtz-Institut Jena, Jena, Germany. [6]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany. [7]Friedrich-Schiller-Universität Jena, Jena, Germany. [8]European XFEL GmbH, Schenefeld, Germany. [9]Donostia International Physics Center (DIPC), San Sebastián/Donostia, Spain
Photoelectron dynamics in $Bi_2Te_3$ and $Bi_2Se_3$ are investigated by RABBITT. Substantial photoemission delays between fine structure components of the Bi 5d core level can be extracted and attributed to transition matrix element phase effects.

**We-2B: Novel Schemes for Ultrashort Pulses**
**10:45 - 12:30 Wednesday 17 July 2024**
**Room A2+A3**
**Oral session**
**Chaired by Eiji Takahashi, RIKEN, Wako, Japan**

10:45 - 11:00
We-2B.1 **Nonlinear Dispersion Engineering Enables Clean and Ultrastable 4.5-fs Pulses from a Compact Er:fiber System**
SARAH R HUTTER, PHILIPP STERK, SARAH HALLER, ALFRED LEITENSTORFER
University of Konstanz, Konstanz, Germany
Tailoring nonlinear phase shifts in a germanosilicate fiber assembly combined with chirped mirrors yields 4.5-fs pulses with clean envelope. Smooth spectral coverage and intensity fluctuations below 1.5% result over more than 220 THz.

11:00 - 11:15
We-2B.2 **146 W, 7 fs, 11 µJ Thin-Disk Oscillator Compressed with Multipass Cells**
Semyon Goncharov[1], Kilian Fritsch[2], Oleg Pronin[1]
[1]Helmut-Schmidt-Universität, Hamburg, Germany. [2]n2-Photonics, Hamburg, Germany
We report nonlinear broadening and pulse compression in two consecutive multipass cells based on dielectric mirrors. The 120 fs, 12.8 µJ pulses at 14 MHz were compressed to 7.2 fs with 146 W average power.

11:15 - 11:30
We-2B.3 **on-Chip Carrier-Envelope Phase Detection and Control of Laser Beams**
Václav Hanus[1], Beatrix Fehér[1], Péter Sándor[1], Zsuzsanna Pápa[1,2], Judit Budai[2], Zilong Wang[3], Pallabi Paul[4,5], Adriana Szeghalmi[4,5], Péter Dombi[1]
[1]Wigner Research Centre for Physics, Budapest, Hungary. [2]ELI-ALPs Research Institute, Szeged, Hungary. [3]Physics Department, Ludwig-Maximilians-Universität, Munich, Germany. [4]Institute of Applied Physics, Abbe Center of Photonics, Jena, Germany. [5]Fraunhofer Institute for Applied Optics and Precision Engineering, Jena, Germany
We present an on-chip scanning CEP probe for on-air, single-beam measuring of 3D CEP maps of nJ-class few-cycle laser beam focus. We achieved a proof-of-concept sculpting of CEP distributions using an SLM-feedback loop.

11:30 - 11:45
We-2B.4 **Controlling High Harmonic Supercontinuum Generation with the Spectral Polarization of the Driver**
Eldar Ragonis[1,2], Eran Ben-Arosh[1,2], Lev Merensky[1,2], Avner fleischer[1,2]
[1]Raymond and Beverly Sackler Faculty of Exact Sciences, School of Chemistry, Tel Aviv University,, Tel Aviv, Israel. [2]Tel-Aviv University center for Light-Matter-Interaction, Tel Aviv, Israel
A High-Harmonic-Generation (HHG) scheme offering continuous control over the bandwidth of the spectral peaks is presented. The scheme uses a vectorial cross-elliptical counter-rotating two-color driver with close frequencies focused in gas.

11:45 - 12:00
We-2B.5 **Ultrafast holographic spin microscope**
Martin Hörmann[1], Julia Anthea Gessner[2], Federico Visentin[1], Felix Deschler[2], Giulio Nicola Felice Cerullo[1,3], Franco V.A. Camargo[3]
[1]Politecnico di Milano, Milano, Italy. [2]Physikalisch-Chemisches Institut Heidelberg, Heidelberg, Germany. [3]IFN-CNR, Milano, Italy
We developed a holographic microscope retrieving the Jones vector as a function of space with femtosecond resolution. Therewith we observe spin-polarized dynamics in hybrid perovskites, exciting either the entire FOV or several diffraction-limited spots.

12:00 - 12:15
We-2B.6 **Probing Nonlinear Optical Dynamics in a Microcavity with Free Electrons**
F. Jasmin Kappert[1,2], Yujia Yang[3,4], Jan-Wilke Henke[1,2], Arslan S. Raja[3,4], Germaine Arend[1,2], Guanhao Huang[3,4], Armin Feist[1,2], Zheru Qiu[3,4], Rui Ning Wang[3,4], Aleksandr Tusnin[3,4], Alexey Tikan[3,4], Tobias J. Kippenberg[3,4], Claus Ropers[1,2]

[1]Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany. [2]4th Physical Institute, University of Göttingen, Göttingen, Germany. [3]Institute of Physics, Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne, Switzerland. [4]Center for Quantum Science and Engineering, Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne, Switzerland
Photonic microcavities feature prominent nonlinear optical excitations, which we couple to free electron beams by inelastic electron-light scattering. This enables direct access to soliton formation dynamics and promises versatile electron beam shaping.

12:15 - 12:30
We-2B.7 **High Repetition Rate Ultrafast Electron Diffraction**
Fernando Rodriguez Diaz, Mark Mero, Kasra Amini
Max-Born-Institut, Berlin, Germany
We present a new 30-kHz, 95-keV ultrafast electron diffraction set-up with 300-fs temporal and <8-pm real-space resolutions combined with >9-nm transverse coherence length. Radiofrequency temporal compression of 16-aC bunches to <50-fs FWHM durations is predicted.

**LUNCH BREAK - ON YOUR OWN**
**12:30 - 14:00 Wednesday 17 July 2024**

**We-3A: Photoelectron Spectroscopy and Coulomb Explosion**
**14:00 - 15:45 Wednesday 17 July 2024**
**Auditorium**
**Oral session**
**Chaired by Heide Ibrahim, INRS-EMT, Varennes, Canada**

**14:00 - 14:30**
**We-3A.1 Invited Non-Adiabatic Dynamics of Gaseous and Aqueous Molecules Studied using Extreme Ultraviolet Time-Resolved Photoemission Spectroscopy**
Toshinori Suzuki
Kyoto University, Kyoto, Japan
Ultrafast non-adiabatic dynamics of gaseous and aqueous molecules are studied using extreme UV time-resolved photoemission spectroscopy with the time resolution of 10 – 30 fs and the probe photon energy > 21.7 eV.

14:30 - 14:45
We-3A.2 **Probing Photodissociation Dynamics in Bromine Molecules**
Nida Haram[1], Tian Wang[1], Zack Dube[1], Yonghao Mi[1], Fatemeh Mousavi Karimi[1], Andrei Naumov[1], Giulio Vampa[1], Caterina Vozzi[2], Albert Stolow[3], Michael Schuurman[4], David Villeneuve[1], Paul Corkum[1], Andre Staudte[1]
[1]Joint Attosecond Science Laboratory, National Research Council Canada & University of Ottawa, Ottawa, Canada. [2]CNR IFN - Istituto di Fotonica e Nanotecnologie, Milano, Italy. [3]Department of Physics, University of Ottawa, Ottawa, Canada. [4]National Research Council Canada, Ottawa, Canada
We investigate the ultrafast photodissociation dynamics of bromine molecules through time-resolved Photoion-Photoelectron Coincidence Momentum spectroscopy, providing insights into the evolution of molecular orbitals and atomic separation during single ionization and Coulomb explosion processes.

14:45 - 15:00
We-3A.3 **Coulomb Explosion Imaging of Ultrafast Photofragmentation and Photochemistry in Azobenzene**
Kieran Cheung[1], Arnaud Rouzée[2], Felix Allum[3], Thomas Baumann[4], Rebecca Boll[4], Kurtis Borne[5], Michael Burt[1], David Busto[6,7], Per Eng-Johnsson[7], Octave Grob[2], Till Jahnke[8], Samuel Kellerer[6], Chow-Shing Lam[1], Steffen Martin Leinberger[9], Ioannis Makos[6], Tommaso Mazza[4], Joseph McManus[1], Michael Meyer[4], Jochen Mikosch[9], Daniel Rolles[5], Giuseppe Sansone[10], Claus Peter Schulz[2], Björn Senfftleben[4], Kiyoshi Ueda[11], Sergey Usenko[4], Marc J. J. Vrakking[2], Tiffany Walmsley[1], Tobias Witting[1], Terry Mullins[4], Mark Brouard[1], Kasra Amini[2]
[1]University of Oxford, Oxford, United Kingdom. [2]Max-Born-Institut, Berlin, Germany. [3]PULSE Institute, SLAC National Accelerator Laboratory, California, USA. [4]European XFEL, Schenefeld, Germany. [5]J. R. Macdonald Laboratory, Kansas, USA. [6]Universität Freiburg, Freiburg, Germany. [7]Lund University, Lund, Sweden. [8]Max-Planck-Institut für Kernphysik, Heidelberg, Germany. [9]Universität Kassel, Kassel, Germany. [10]Universität Freiburg, Lund, Germany. [11]Tohoku University, Tokyo, Japan

Here, we present an X-ray Coulomb explosion imaging (CEI) study of the ultrafast photofragmentation and photochemistry in trans-4,4-difluoroazobenzene (DFAB) measured with the COLTRIMS Reaction Microscope at the SQS station of the European XFEL.

15:00 - 15:15
We-3A.4 **Sub-20 fs XUV Photoelectron Spectroscopy Resolving the Non-adiabatic Dynamics of UV-excited Acetylacetone**
Stefano Severino[1], Flavia Aleotti[2], Lorenzo Mai[1], Aurora Crego[3,4], Fabio Medeghini[1], Fabio Frassetto[5], Luca Poletto[5], Francesco Segatta[2], Matteo Lucchini[1,3], Artur Nenov[2], Maurizio Reduzzi[1], Mauro Nisoli[1,3], Rocío Borrego-Varillas[3]
[1]Dipartimento di Fisica, Politecnico di Milano, Milano, Italy. [2]Department of Industrial Chemistry "Toso Montanari", Università di Bologna, Bologna, Italy. [3]Institute for Photonics and Nanotechnologies, IFN-CNR, Milano, Italy. [4]Departamento de Física Aplicada, Universidad de Salamanca, Salamanca, Spain. [5]Institute for Photonics and Nanotechnologies, IFN-CNR, Padova, Italy
We employ time-resolved photoelectron spectroscopy to elucidate the UV-induced, ultrafast non-adiabatic dynamics in acetylacetone. The extreme temporal resolution enables a detailed examination of the first conical intersection and the vibrational coherences characterizing the sub-100-fs response.

15:15 - 15:30
We-3A.5 **Asymmetric Coulomb Explosion of $CH_4$ in Phase-locked ω-2ω Intense Laser Fields**
Hiroka Hasegawa[1], Akitaka Matsuda[1], Toru Morishita[2], Lars Madsen[3], Frank Jensen[3], Oleg Tolstikhin[4], Akiyoshi Hishikawa[1]
[1]Nagoya University, Nagoya, Japan. [2]The University of Electro-Communications, Chofu, Japan. [3]Aahus University, Aahus, Denmark. [4]Moscow Institute of Physics and Technology, Dolgoprudny, Russian Federation
Coulomb explosion of $CH_4$, $CH_4^{2+} \rightarrow H^+ + CH_3^+$, in ω-2ω intense laser fields is studied. Asymmetric ejection of the $H^+$ fragments exhibited clear dependence on kinetic energy, suggesting contribution from different control mechanisms.

15:30 - 15:45
We-3A.6 **ASTRA: A Transition-Density-Matrix Approach to Time-Resolved Molecular Ionization**
Luca Argenti[1], Carlos Marante[1], Siddhartha Chattopadhyay[1], Juan Martín Randazzo[2], Barry I. Schneider[3], Jeppe Olsen[4]
[1]University of Central Florida, Orlando (FL), USA. [2]CONICET, Bariloche, Argentina. [3]NIST, Gaithersburg (MD), USA. [4]Aarhus University, Aarhus, Denmark
Attosecond science is targeting increasingly larger molecules, which are a challenge for many ab-initio codes. Here we present ASTRA, a tool based on high-order transition density matrices, which tackles scalability limitations, and reproduces existing benchmarks.

**We-PO: EXHIBITION, COFFEE BREAK AND POSTER SESSION II**
**15:45 - 17:15 Wednesday 17 July 2024**
**Port Vell**
**Poster session**

We-PO.1 **Ultrafast Oscillators and Amplifiers for Physics and Chemistry**
Brian Molesky, Erin McCole Dlugosz, Joseph Henrich
Coherent Corp, Glasgow, United Kingdom
Created by the Industrial Revolution in Ultrafast Science, Coherent offers ultrafast lasers for research applications, with pulse energies from µJ to mJ, repetition rates into the MHz regime, at wavelengths from UV to mid-IR.

We-PO.2 **Real-Time Dynamics of the Electron Autodetachment from the Nonvalence-Bound States of the Anions**
Sang Kyu Kim
KAIST, Daejeon, Korea, Republic of
State-specific dynamics of the nonvalence-bound state of anions, using the pico-/femtosecond time-resolved spectroscopy on the cryogenically cooled species using the velocity-map electron imaging has been investigated to give the autodetachment/anion-fragmentation dynamics of anions.

We-PO.3 **Slow hot-exciton cooling in HgTe quantum dots: hot-phonon bottleneck and interparticle Auger coupling**
Kezhou Fan, Aleksandr A. Sergeev, Kam Sing Wong
The Hong Kong University of Science and Technology, Hong Kong, Hong Kong
We report slow hot-exciton cooling in HgTe quantum dots due to strong hot-phonon bottleneck and Auger recombination, which is further enhanced due to interparticle coupling. The discovery facilitates developing high-performance optoelectronic materials with confinement-bulk duality.

We-PO.4 **Disentangling the Redox Species Dynamics of a Perylene Bisimide Cyclophane with Ultrafast Spectroelectrochemistry**
Rebecca Fröhlich, Jessica Rühe, Michael Moos, Laura Kontschak, Patrik Ehrmann, Frank Würthner, Christoph Lambert, Tobias Brixner
Universität Würzburg, Würzburg, Germany
Charge transfer reactions can lead to overlapping spectral features of different redox species. We use ultrafast spectroelectrochemistry and subsequent singular-value decomposition to unravel the dynamics of the redox species of a perylene bisimide cyclophane.

We-PO.5 **$10U_p$ photoelectron rescattering in the multi-photon-induced emission regime**
Balázs Bánhegyi[1,2], Gellért Zsolt Kiss[1], Zsuzsanna Pápa[1,3], Péter Sándor[1], Lázár Tóth[3], László Péter[1], Péter Rácz[1], Péter Dombi[1,3]
[1]HUN-REN Wigner Research Centre for Physics, Budapest, Hungary. [2]Budapest University of Technology and Economics, Budapest, Hungary. [3]ELI-ALPS Research Institute, Szeged, Hungary
Here we show that with enhanced rescattering at plasmonic nanoparticles energetic ~$10U_p$ electrons can be observed even when the photoemission takes place deep in the multi-photon-induced photoemission regime, contrary to all previous observations.

**We-PO.6 Programmable generation of multi-terahertz counterrotating bicircular light pulses**
Kotaro Ogawa[1], Natsuki Kanda[2,3], Yuta Murotani[2], Ryusuke Matsunaga[2]
[1]The Institute for Solid State Physics, The University of Tokyo, Kashiwa, Japan. [2]The University of Tokyo, Kashiwa, Japan. [3]RIKEN Center for Advanced Photonics, Wako, Japan
Phase-stable counterrotating bicircular light pulses, including a trefoil-like field trajectory, were realized in multi-terahertz range. Orientation, shape, rotational symmetry, and helicity of trajectories are programmable on software, offering novel light sources for ultrafast science.

We-PO.7 **Direct Observation of Light-driven Molecular Motions in an Organic Light-Emitting Material**
Kaito En-ya[1], Ami Takada[2], Masaki Saigo[2], Yasuhiro Ikabata[3], Kiyoshi Miyata[2], Makoto Kuwahara[4], Shintaro Kohata[2], Yuri Saida[1], Yoichi Yamada[1], Tadahiko Ishikawa[5], Shin-ya Koshihara[5], Hitoshi Goto[3], Hajime Nakanotani[2], Ken Onda[2], Chihaya Adachi[2], Masaki Hada[1]
[1]University of Tsukuba, Tsukuba, Japan. [2]Kyushu University, Fukuoka, Japan. [3]Toyohashi University of Technology, Toyohashi, Japan. [4]Nagoya University, Nagoya, Japan. [5]Tokyo Institute of Technology, Tokyo, Japan
We observed the light-driven structural changes of a representative organic light-emitting material, 4CzIPN, by ultrafast time-resolved electron diffraction. The molecular motions revealed the mystery of the dynamics at the intersystem crossing of 4CzIPN.

We-PO.8 **Spin-Density Wave Order in $BaFe_2As_2$ under High Pressures Studied by Ultrafast Spectroscopy**
Ivan Fotev[1,2], Stephan Winnerl[1], Saicharan Aswartham[3], Bernd Büchner[3], Harald Schneider[1], Manfred Helm[1,2], Alexej Pashkin[1]
[1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany. [2]Technische Universität Dresden, Dresden, Germany. [3]Leibniz Institute for Solid State and Materials Research, Dresden, Germany
We utilize pump-probe spectroscopy to study relaxation dynamics in $BaFe_2As_2$. Tracing the amplitude of the relaxation process enables us to map the spin-density wave order over a broad range of the applied pressures and temperatures.

We-PO.9 **Ultrafast quantum control of atomic excited states via interferometric two-photon Rabi oscillations**
Yudong Chen[1], Sainan Peng[1], Xinhua Xie[2], Zhensheng Tao[1]

[1]State Key Laboratory of Surface Physics, Key Laboratory of Micro and Nano Photonic Structures (MOE), and Department of Physics, Fudan University, ShangHai, China. [2]SwissFEL, Paul Scherrer Institute, Villigen PSI, Swaziland
We demonstrate two-photon Rabi oscillations in excited states of argon operating at terahertz frequencies driven by ultrafast laser. Leveraging quantum-path interferometry, we can measure and manipulate both the amplitudes and phases of the transition dipoles.

We-PO.10 **Ultrafast Electron-Phonon Scattering Defines the Dephasing in High-Order Harmonic Generation in Solids**
Viacheslav Korolev[1], Thomas Lettau[1], Vipin Krishna[1], Alexander Croy[1], Michael Zuerch[2,3], Christian Spielmann[1,4], Ulf Peschel[1], Stefanie Graefe[1], Giancarlo Soavi[1], Daniil Kartashov[1]
[1]Friedrich-Schiller University Jena, Jena, Germany. [2]University of California at Berkeley, Berkeley, USA. [3]Lawrence Berkeley National Laboratory, Berkeley, USA. [4]Helmholtz-Institut Jena, Jena, Germany
Using detailed experimental measurements and rigorous numerical simulations, we pinpoint electron-phonon scattering as the predominant ultrafast dephasing mechanism in high-order harmonic generation in solids and introduce a novel concept of the momentum dependent dephasing time.

We-PO.11 **Femtosecond Laser Modulation of the Electron Wavefunction Enables Electron Single Pixel Imaging**
Cameron Duncan[1], Beatrice Ferrari[1], Irene Ostroman[1], Maria Giulia Bravi[1], Paolo Rosi[2], Enzo Rotunno[2], Vincenzo Grillo[2], Giovanni Maria Vanacore[1]
[1]Università degli Studi di Milano-Bicocca, Milano, Italy. [2]Istituto Nanoscienze, Consiglio Nazionale delle Ricerche, Modena, Italy
We report preliminary results that demonstrate Electron Single Pixel Imaging in an Ultrafast Transmission Electron Microscope, with the potential to dramatically reduce the radiation dosage required for high-resolution imaging, a game-changer for life science applications**.**

We-PO.12 **Locally Chiral Evanescent Waves for Efficient Enantio-Discrimination**
Peilin Yang[1], Patricia Vindel-Zandbergen[2], Joshua Vogwell[1], Laura Rego[1,3,4], Andres Ordonez[1], David Ayuso[1,5]
[1]Imperial College London, London, United Kingdom. [2]New York University, New York, USA. [3]Instituto Madrileño de Estudios Avanzados en Nanociencia, Madrid, Spain. [4]Departamento de Química, Universidad Autónoma de Madrid, Madrid, Spain. [5]Max-Born-Institut, Berlin, Germany
Confinement of light in optical nanofibers creates tremendous opportunities for shaping its polarization in 3D, creating syntheticchiral light. We show how the nonlinear response of chiral molecules to such tailored light becomes strongly enantiosensitive.

We-PO.13 **Tight Focusing in Air of a mJ-class FemtosecondLaser: A Radiation Safety Issue**
Simon Vallières[1], Jeffrey Powell[1], Tanner Connell[2], Michael Evans[2], Sylvain Fourmaux[1], Stéphane Payeur[1], Marianna Lytova[1], Philippe Lassonde[1], Francois Fillion-Gourdeau[3], Steve MacLean[3], Francois Legare[1]
[1]INRS-EMT, Varennes, Canada. [2]McGill, Montreal, Canada. [3]Infinite Potential Laboratories, Waterloo, Canada
We report on the generation of a high dose-rate, MeV-ranged electron beam through the tight focusing in ambient air of a mJ-class femtosecond IR laser. The source finds an application in FLASH radiation therapy.

We-PO.14 **Light-Field-Driven Currents in Metals**
Beatrix Fehér[1], Václav Hanus[1], Zsuzsanna Pápa[1,2], Judit Budai[2], Pallabi Paul[3,4], Adriana Szeghalmi[3,4], Zilong Wang[5,6], Weiwei Li[6], Péter Dombi[1,2]
[1]HUN-REN Wigner Research Centre for Physics, Budapest, Hungary. [2]ELI-ALPS Research Institute, Szeged, Hungary. [3]Institute of Applied Physics, Abbe Center of Photonics, Friedrich Schiller University, Jena, Germany. [4]Fraunhofer Institute for Applied Optics and Precision Engineering, Centre of Excellence in Photonics, Jena, Germany. [5]Physics Department, Ludwig Maximilians Universität, München, Germany. [6]Max Planck Institute of Quantum Optics, Garching, Germany
Our study reveals that light-field-driven current generation is a universal phenomenon. Beyond dielectrics and semiconductors, appears also in metals. We attribute the mechanism to intraband electron motion, and provide an empirical relationship employing nonlinear susceptibility.

We-PO.15 **Strong Field Ionization and Dissociation Dynamics of Singly Charged Argon Dimer in Two-Color Laser Field**

Arnab Sen, Serguei Patchkovskii, Kiyoshi Ueda, Marc J. J. Vrakking, Arnaud Rouzee
Max Born Institute, Berlin, Germany

The strong field ionization and dissociation dynamics of $Ar_2$-dimers induced by an intense 800 nm laser pulse are investigated by time-resolved photoion spectroscopy using a time-delayed, tunable mid-infrared laser pulse.

We-PO.16 **Generation of Ultrafast Magnetic Fields with Spectrally Tunable Vector Beams for Magneto-Optical Spectroscopy of $Eu^{3+}$ ions**

Elizaveta Gangrskaia[1], Alessandra Bellissimo[1], Valentina Shumakova[1], Sarah Pulikottil Alex[1], Ignác Bugár[1], Lorenz Grünewald[2,3], Sebastian Mai[2], Thomas Schachinger[4], Dariusz Pysz[5], Ryszard Buczyński[5], Andrius Baltuška[1,6], Audrius Pugžlys[1,6]
[1]Photonics Institute, TU Wien, Vienna, Austria. [2]Institute of Theoretical Chemistry, Faculty of Chemistry, University of Vienna, Vienna, Austria. [3]Vienna Doctoral School in Chemistry (DoSChem), University of Vienna, Vienna, Austria. [4]University Service Centre for Transmission Electron Microscopy (USTEM), TU Wien, Vienna, Austria. [5]Lukasiewicz Research Network - Institute of Microelectronics and Photonics, Warsaw, Poland. [6]Center for Physical Sciences & Technology, Vilnius, Lithuania

By combining stimulated Raman scattering and spectral focusing, we demonstrate narrowband tunable ultrafast azimuthally polarized pulses for spectrally and spatially selective excitation of either electric or magnetic dipole transitions in $Eu^{3+}$ ions.

We-PO.17 **Probing Core Electron Dynamics with a Laser-Induced Molecular Clock**

Xinhua Xie[1], Ningchen Yang[1], Andre Al Haddad[1], Antoine Sarracini[1], Gregor Knopp[1], Ana Sofia Morillo Candas[1], Hongtao Hu[2], Yunpei Deng[1], Abhishek Nag[1], Suddhasattwa Mandal[1], Hankai Zhang[1], Jonas Knurr[1], Zhaoheng Guo[1], Edwin James Divall[1], Daniel Charles Haynes[1], Eduard Prat[1], Sven Augustin[1], Christoph Bostedt[1,3], Adrian L. Cavalieri[1,4], Kirsten Schnorr[1], Steven L. Johnson[1,5]
[1]Paul Scherrer Institute, Villigen, Switzerland. [2]Technische Universität Wien, Vienna, Austria. [3]EPFL, Lausanne, Switzerland. [4]University of Bern, Bern, Switzerland. [5]ETH Zurich, Zurich, Switzerland

We utilize a laser-induced molecular clock to study x-ray-induced ultrafast core electron dynamics in nitrogen. This approach maps core electron dynamics to kinetic energy release during molecular dissociation triggered by an ultrashort near-infrared laser pulse.

We-PO.18 **Generation and characterization of polarization shaped pulses in multi-terahertz frequency**

Natsuki Kanda[1,2], Kotaro Ogawa[2], Mayuri Nakagawa[2], Yuta Murotani[3], Ryusuke Matsunaga[2]
[1]RIKEN, Wako, Japan. [2]ISSP, The Univ. of Tokyo, Kashiwa, Japan. [3]ISSP, The Univ. of Tokyo, Wako, Japan

We demonstrated pulse shaping of circularly polarized multi-terahertz waves by intra-pulse difference frequency generation from polarization shaped near-infrared pulses. The method for characterizing multi-terahertz electric field vectors in arbitrary directions is also developed.

We-PO.19 **Operando Dynamics of Trapped Carriers in Perovskite Solar Cells Observed via Infrared Optical Activation Spectroscopy**

Ziming Chen[1], Beier Hu[1], Jiaxin Pan[1], Tiankai Zhang[2], Ganghong Min[3], Feng Gao[2], Artem Bakulin[1]
[1]Imperial College London, London, United Kingdom. [2]Linköping University, Linköping, Sweden. [3]Queen Mary University of London, London, United Kingdom

Infrared optical activation spectroscopy (pump-push-photocurrent) was employed to observe the properties and dynamics of trapped carriers within solar cells. The study delves into the impact of interfacial engineering and perovskite strain on trapped carrier behaviours.

We-PO.20 **Coherence Mapping to Identify the Intermediatesof Multi-Channel Dissociative Ionization**

Jacob Stamm[1], Sung Kwon[1], Shawn Sandhu[1], Jesse Sandhu[1], Benjamin Levine[2], Marcos Dantus[1]
[1]Michigan State University, East Lansing, USA. [2]Stony Brook University, Stony Brook, USA

Identifying intermediates and reaction mechanisms in radical cation fragmentation is a challenge in mass spectrometry. Here, the Fourier transform of the vibrational coherence in the time-dependent yields reveals the origin of fragments and formation mechanism

We-PO.21 **Ladder Climbing Excitation of Carbon Dioxide Stretch by Intense Down-Chirped Mid-Infrared Pulses**
Ikki Morichika, Hiroki Tsusaka, Satoshi Ashihara
Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo, Japan
Ultrashort laser excitation of molecular vibrations provides a novel route toward steering chemical reactions at the electronic ground state. Here we demonstrate 9-step ladder-climbing in the anti-symmetric stretch of $CO_2$ with intense down-chirped mid-infrared pulses.

We-PO.22 **Lightwave Harmonic Frequency Mixing for Broadband Sampling of Optical Waveforms**
Matthew Yeung, Lu-Ting Chou, Marco Turchetti, Karl Berggren, Phillip Keathley
MIT, Cambridge, USA
We experimentally demonstrate lightwave electronic harmonic frequency mixing in plasmonic nanoantennas for time-domain sampling of waveforms having spectral content of higher frequency than **the driving waveform (the local oscillator) without the need for carrier-envelope-phase locking.**

We-PO.23 **Generation of Rotational Wave Packets at High-Lying Vibrational States with Mid-Infrared Pulses**
Hiroki Tsusaka, Ikki Morichika, Satoshi Ashihara
Institute of Industrial Science, The University of Tokyo, Tokyo, Japan
We report on successful generation of rotational wave packet at high-lying vibrational states in the anti-symmetric stretch of gas-phase carbon dioxide molecules by multi-step rovibrational excitation with intense mid-infrared pulses.

We-PO.24 **Scaling Principles in Chemistry: Elucidating the Reaction Kernel**
Soumyajit Mitra[1,2], Simon Bittmann[2], Stuart Hayes[1,2], Daniel Jacob[1], Ming Zhang[3], Zheng Li[3], Dilara Farkhutdinova[4], Leticia Gonzalez[4], Yifeng Jiang[5], Tadahiko Ishikawa[6], Scott Murphy[7], Kazuyuki Takahashi[8], Dwayne Miller[1]
[1]University of Toronto, Toronto, Canada. [2]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany. [3]Peking University, Beijing, China. [4]University of Vienna, Vienna, Austria. [5]European XFEL, Schenefeld, Germany. [6]Tokyo Institute of Technology, Tokyo, Japan. [7]University of Regina, Regina, Canada. [8]Kobe University, Kobe, Japan
Through ultrafast spectroscopy, we unearth the concept of dimensionality reduction and the effect of anharmonicity in ring-closing and spin-crossover reactions. We show that only a few key motions drive the system across the transition state.

We-PO.25 **Enabling Real-Time Ultrafast Ptychographic Imaging through Unsupervised Deep Learning**
Carmelo Grova[1], Nicola Giani[1], Charles Bevis[1], Daniel Adams[2], Giulia Fulvia Mancini[1], Giovanni Pellergini[3]
[1]University of Pavia, LUXEM, Pavia, Italy. [2]Department of Physics, Colorado School of Mines, Golden, USA. [3]University of Pavia, Department of Physics, Pavia, Italy
We combine an unsupervised deep learning approach with a complete physical model that describes Ptychography-like image formation process. By using weight initialization, we demonstrate robustness, high fidelity, full-field image reconstruction and fast convergence.

We-PO.26 **Pump-probe spectroscopy of layered halide perovskites with different organic spacers**
Justas Deveikis[1], Marcin Giza[2], Jack Woolley[1], Pablo Docampo[2], James Lloyd-Hughes[1], Rebecca Milot[1]
[1]University of Warwick, Coventry, United Kingdom. [2]University of Glasgow, Glasgow, United Kingdom
We use ultrafast pump-probe spectroscopy to investigate technologically applicable layered halide perovskite thin films with various organic spacer ligands. Optical and terahertz measurements revealed differences in charge carrier recombination dynamics and photoconductivity.

We-PO.27 **Femtosecond Photoexcitation Dynamics of Dimers Solvated in Helium Nanodroplets: Vibrational Wavepackets and Predissociation**
Michael Stadlhofer, Patricia Brugger, Matthias Gritzner, Bernhard Thaler, Markus Koch
University of Technology, Graz, Austria
We investigate iodine molecules solvated inside superfluid He nanodroplets with pump-probe velocity map imaging to reveal the quantum solvent influence on the nuclear and electronic structure, manifested in enhanced predissociation and decelerated dissociation kinetics.

We-PO.28 **Interplay of Electron and Energy Transfer in Organic Photovoltaics Bulk-Heterojunctions with Non-Fullerene Acceptors**

Federico Visentin[1], Mattia Gallazzi[1], Zhuoran Qiao[2], Giulio Cerullo[1,3], Nicola Gasparini[2], Franco V. A. Camargo[3]
[1]Dipartimento di Fisica, Politecnico di Milano, Milan, Italy. [2]Department of Chemistry, Imperial College London, London, United Kingdom. [3]IFN-CNR, Milan, Italy

Donor exciton separation in organic bulk-heterojunctions is still debated as non-fullerene acceptors allow for both electron and energy transfer. We use transient absorption spectroscopy to disentangle these two charge generation pathways in four photovoltaic blends.

We-PO.29 **Room-Temperature Polaron Dynamics in Lead-free Cs4CuSb2Cl12 Layered Double Perovskite Nanocrystals**

Amit Kumar[1], Pabitra Nayek[2], Sakshi Chawla[1], Dibyajyoti Ghosh[2], Arijit De[1]
[1]IISER Mohali, Mohali, India. [2]IIT Delhi, Delhi, India

We investigate charge-carrier relaxation dynamics coupled to low-frequency phonons in $Cs_4CuSb_2Cl_{12}$ double-perovskite nanocrystals and effect of capping ligands on these dynamics, combining transient absorption spectroscopy and broadband time-resolved impulsive stimulated Raman spectroscopy with computational studies.

We-PO.30 **Nonadiabatic High-order Harmonic Generation in Chip**

Agata Azzolin[1], Gaia Giovannetti[1], Guangyu Fan[2], Md. S. Ahsan[1], Sabine Rockenstein[1], Oliviero Cannelli[1], Lorenzo Colaizzi[3], Erik. P. Månsson[1], Davide Faccialà[4], Fabio Frassetto[5], Anna G. Ciriolo[4], Dario W. Lodi[3], Cristian Manzoni[4], Rebeca Martínez-Vázquez[4], Michele Devetta[4], Roberto Osellame[3], Luca Poletto[5], Salvatore Stagira[3], Caterina Vozzi[4], Vincent Wanie[1], Andrea Trabattoni[1,6], Francesca Calegari[1]
[1]CFEL-DESY, Hamburg, Germany. [2]Shangai Key Lab of Modern Optical System, University of Shangai for Science and Technology, Shangai, China. [3]Politecnico di Milano, Milano, Italy. [4]IFN-CNR Milano, Milano, Italy. [5]IFN-CNR Padova, Padova, Italy. [6]Institute of Quantum Optics, Leibniz Universität Hannover, Hannover, Germany

This work discusses a highly performing High-order Harmonic Generation scheme to reach the water-window spectral region. The measurements lay in the framework of the nonadiabatic regime and are supported by 3D full-space propagation.

We-PO.31 **Experimental Realisation of Synthetic Chiral Light**

Rose Picciuto[1], Samuel J. Eardley[1], Joseph J. Broughton[1], Katarzyna M. Kowalczyk[1], Joshua Vogwell[1], Laura Rego[1,2,3], John W. G. Tisch[1], Misha Ivanov[1,4,5], Olga Smirnova[4,6], Andrés F. Ordóñez[1], Jon P. Marangos[1], David Ayuso[1,4], Mary Matthews[1]
[1]Department of Physics, Imperial College London, London, United Kingdom. [2]Instituto Madrileño de Estudios Avanzados en Nanociencia, Madrid, Spain. [3]Departamento de Química, Universidad Autónoma de Madrid, Madrid, Spain. [4]Max-Born-Institut, Berlin, Germany. [5]Institute für Physik, Berlin, Germany. [6]Technische Universität, Berlin, Germany

Experimental realisation of a locally chiral field, whereby the tip of the electric-field vector traces a 3D chiral trajectory in time. The non-linear optical response of a BBO crystal was used to characterise the field.

We-PO.32 **Tracking the conformational puckering dynamics of labeled carbohydrates with 2D-IR spectroscopy**

Till Stensitzki[1], Philip Gasse[1], Yasemin Mai-Linde[1], Torsten Linker[1], Thomas L.C. Jansen[2], Henrike M. Müller-Werkmeister[1]
[1]University of Potsdam, Potsdam, Germany. [2]University of Groningen, Groningen, Netherlands

Ring-puckering dynamics are notoriously difficult to determine experimentally. Here we present a novel approach to observe ring-puckering dynamics directly using 2D-IR spectroscopy and MD simulations on carbohydrates with vibrational reporter groups.

We-PO.33 **Ultrafast inter- and intraband excitations interrogated by femtosecond surface plasmon wavepackets**

Béla Lovász[1], Péter Sándor[1], Judit Budai[2], Zsuzsanna Pápa[1,2], Péter Dombi[1,2]
[1]HUN-REN Wigner Research Centre for Physics, Budapest, Hungary. [2]ELI-ALPS Research Institute, ELI-HU Nonprofit Kft., Szeged, Hungary

Interband and intraband generation of hot carriers and the multi-stage time-evolution of their subsequent

relaxation is revealed by a surface-selective, ultrafast probing method based on surface-plasmons. Results are also interpreted with model calculations.

We-PO.34 **Study of Temperature Rise in fs Laser Tooth Drilling**
Hrvoje Skenderovic[1,2], Mario Rakic[1], Eva Klaric[3], Silvije Vdovic[1]
[1]Institute of Physics, Zagreb, Croatia. [2]Centre of Exellence for Advanced Materials and Sensing Devices, Zagreb, Croatia. [3]School of Dental Medicine, University of Zagreb, Zagreb, Croatia
Femtosecond laser pulses were employed to make rectangular cavities in hard dental tissue by simultaneously monitoring the temperature rise in tooth. The temperature rise was numerically modelled and compared to experiment.

We-PO.35 **Spin dynamics across metallic layers at the few-femtosecond timescale**
Romain Geneaux[1,2], Hung-Tzu Chang[2,3], Alexander Guggenmos[2], Renaud Delaunay[4], François Légaré[5], Katherine Légaré[5], Jan Lüning[6], Tymur Parpiiev[2], Ilana Porter[2], Bethany de Roulet[2], Michael Zuerch[2,7], Sangeeta Sharma[8,9], Martin Schultze[10], Stephen Leone[2,7]
[1]CEA Saclay, LIDYL, Gif-sur-Yvette, France. [2]University of California, Berkeley, Berkeley, USA. [3]Max Planck Institute for Multidisciplinary Sciences, Goettingen, Germany. [4]Sorbonne Université, Paris, France. [5]INRS, Varenne, Canada. [6]Helmholtz-Zentrum, Berlin, Germany. [7]Lawrence Berkeley National Laboratory, Berkeley, USA. [8]Max-Born-Institute, Berlin, Germany. [9]Institute for Theoretical Solid-State Physics, Berlin, Germany. [10]Institute of Experimental Physics, Graz, Austria
The light-driven response of a magnetic multilayer structure is studied at the few-femtosecond timescale. Attosecond magnetic circular dichroism evidences a sub-5 fs spike of magnetization, which is interpreted as a strikingly short spin injection.

We-PO.36 **Dephasing enabled efficient Sum Frequency Generation in nanoscale ultra-strongly coupled Polaritonic System**
Ruben Pompe[1], Matthias Hensen[2], Matthew Otten[3], Stephen Gray[4], Walter Pfeiffer[1]
[1]Bielefeld University, Bielefeld, Germany. [2]Universität Würzburg, Würzburg, Germany. [3]University of Wisconsin, Madison, Madison, USA. [4]Argonne National Laboratory, Lemont, USA
Efficient up-conversion based on ultra-strong coupling of two quantum systems is proposed. Ultrafast dephasing induced symmetry breaking enables the required cyclic three level system and yields ten times higher up-conversion efficiencies than conventional schemes.

We-PO.37 **Time-domain Visualization of Enhanced Electron-Phonon Coupling in Chlorinated Nanographene**
Rafael Muñoz-Mármol[1,2], Saurav Raj[3], Mattia Russo[1], Giacomo Bassi[1], Andrea Lucotti[1], Hao Zhao[3], Margherita Maiuri[1], Matteo Tommasini[1], Giulio Cerullo[1], Guglielmo Lanzani[1], Akimitsu Narita[3], Giuseppe M. Paternò[1]
[1]Politecnico di Milano, Milan, Italy. [2]Universidad de Alicante, Alicante, Spain. [3]Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan
Coherent oscillations are investigated in a nanographene and its chlorinated derivative through 15-fs-resolution transient absorption, Raman spectroscopy and 2D electronic spectroscopy, showing enhanced electron-phonon coupling in its excited state as endorsed by full-quantum calculations.

We-PO.38 **Photoemission time delays from RABBIT experiments in vibrationally active ammonia**
Ignacio M. Casasús[1], Lisa-Marie Koll[2], Celso M. González-Collado[3], Kushal Shaw[1], David Sorribes[1], Tobias Witting[2], Oleg Kornilov[2], Mark J. J. Vrakking[2], Alicia Palacios[3], Fernando Martín[3,4,5], Luis Bañares[1,4]
[1]Universidad Complutense de Madrid, Madrid, Spain. [2]Max-Born Institut, Berlin, Germany. [3]Universidad Autónoma de Madrid, Madrid, Spain. [4]Instituto Madrileño de Estudios Avanzados, Madrid, Spain. [5]Condense Matter Physics Center, Madrid, Spain
RABBIT experiments were performed in $NH_3$ ($ND_3$) in a VMI set-up, attempting to unveil the vibrational effect of the long progression of the bending $v_2$ umbrella mode of the X $^2A_2$ state of their cation**.**

We-PO.39 **Real-time observation of coherent vibrational dynamics and electron-phonon coupling in TiN films**
Andrea Iudica[1], Silvia Rotta Loria[1], Cristina Mancarella[1], Luca Mascaretti[2], Andrea Li Bassi[1], Margherita Zavelani-Rossi[1]
[1]Politecnico di Milano, Milan, Italy. [2]Palàcky University Olomouc, Olomouc, Czech Republic

We reveal ultrafast (<100fs) electron-lattice cooling and coherent (≈10THz) vibrational modes in TiN through time-resolved spectroscopy. Insights into electron-phonon interaction and its entity are discussed in detail providing a complete scenario of the physical processes.

We-PO.40 **Rediscovering strong-field effects in ammonia**
María Eugenia Corrales Castellanos[1], Ignacio Martínez Casasús[2], Luis Bañares Morcillo[2,3]
[1]UAM, Madrid, Spain. [2]UCM, Madrid, Spain. [3]IMDEA, Madrid, Spain
Multiphoton ionization of ammonia has been investigated with the photoelectron imaging technique, using high intensity femtosecond laser pulses at 800 nm. A plethora of strong-field phenomena have been investigated, including the appearance of Freeman resonances.

We-PO.41 **Simulating Propagation of High Harmonic Generation in Semiconductor and Insulator Bulk Crystals**
Ava Hejazi[1], Isabelle Tigges-Green[1], Nicholas Karpowicz[2], Gregory Scholes[1], Julia Mikhailova[1]
[1]Princeton University, Princeton, USA. [2]Max Planck Institute For Quantum Optics, Hannover, Germany
Propagation of high harmonic generation in GaAs and α-$Al_2O_3$ is simulated by solving the semiconductor Bloch equations coupled to the unidirectional wave propagation equation to evaluate the interplay of macroscopic effects.

We-PO.42 **Ultrafast spatiotemporal microscopy revealing charge and heat diffusion in graphene nanoribbons**
Jake Dudley Mehew[1], Sebin Varghese[2], Hai I. Wang[3,4], Akimitsu Narita[3], Klaas-Jan Tielrooij[1,2]
[1]Catalan Institute of Nanoscience and Nanotechnology, Bellaterra, Spain. [2]Eindhoven University of Technology, Eindhoven, Netherlands. [3]Max Planck Institute for Polymer Research, Mainz, Germany. [4]Utrecht University, Utrecht, Netherlands
Obtaining the charge mobility and heat diffusivity of nanomaterials is generally very challenging. This is especially the case for graphene nanoribbons produced by bottom-up growth. We show that ultrafast spatiotemporal microscopy provides a promising solution.

We-PO.43 **Direct Sampling of Electric Field Transients Generated by Both States of a Degenerate Optical Parametric Oscillator**
Hannes Kempf[1], Andrey Muraviev[2], Felix Breuning[1], Peter Schunemann[3], Ron Tenne[1], Konstantin Vodopyanov[2], Alfred Leitenstorfer[1]
[1]University of Konstanz, Konstanz, Germany. [2]CREOL, College of Optics and Photonics, Orlando, USA. [3]BAE Systems Inc, Nashua, USA
A degenerate optical parametric oscillator provides phase-locked mid-infrared pulses in two different states. A pump with vanishing carrier-envelope offset frequency enables probing the few-cycle output of this resonant system directly in the time domain.

We-PO.45 **Monitoring Myogenic and Adipogenic Markers of Differentiation in Cultivated Meat via Label-free Multimodal Nonlinear Optical Microscopy**
Francesco Manetti[1], Arianna Bresci[1], Salvatore Sorrentino[1], Chiara Ceconello[1], Renzo Vanna[1,2], Giulio Cerullo[1,2], Dario Polli[1,2]
[1]Department of Physics, Politecnico di Milano, Milan, Italy. [2]CNR Institute for photonics and nanotechnologies (IFN), Milan, Italy
Cultivated meat, an innovative solution to global food challenges, demands non-invasive high quality measurement tools. We introduce label-free multimodal nonlinear optical microscopy for probing myogenic and adipogenic markers in 2D cultures and 3D meat-like structures.

We-PO.46 **Topological Properties of Photoelectron Currents in Photoionization of Chiral Molecules**
Astrid Bratland Lund[1], Andrés F. Ordonez[2], Philip C. M. Flores[1], David Ayuso[2], Piero Decleva[3], Olga Smirnova[1,4]
[1]Max Born Institute, Berlin, Germany. [2]Imperial College London, London, United Kingdom. [3]Università degli Studi di Trieste, Trieste, Italy. [4]Technische Universität Berlin, Berlin, Germany
We uncover connections between molecular geometry and topological properties of the geometric field characterizing electronic response in photoionization. A topological transition in the field streamlines occurs as molecular geometry changes from achiral to chiral.

We-PO.48 **Hot Carrier Cooling and Trapping in Atomically Thin WS2 Probed by Three-Pulse Femtosecond Spectroscopy**
Tong Wang[1], Thomas Hopper[2,1], Artem Bakulin[1]
[1]Imperial College London, London, United Kingdom. [2]Stanford University, Stanford, USA
Using pump-push-probe spectrosscopy, we observed hot-phonon-bottleneck (HPB) effect in hot carrier cooling in single-layer WS2. HPB is reduced at elevated cold carrier densities. During hot carrier cooling, hot carrier can be trapped with enough energy.

We-PO.49 **Status report on the few-cycle, high average power lasers of ELI-ALPS**
Adam Borzsonyi
ELI-ALPS, Szeged, Hungary
We report on the few-cycle lasers of ELI-ALPS user facility, operating in the 100W average power regime, while peak powers and repetition rates range from 0.1TW at 100kHz up to PW at 10Hz.

We-PO.50 **Polarization Control of High-Harmonic generated in Two-Colour Bicircular Laser Fields**
Nickolai Zhavoronkov
Max-Born-Institute, Berlin, Germany
ω+3ω and ω+4ω approaches for generation of circularly polarized harmonics by two-colour bi-circular method is realized resulting in decreasing of unpolarized content, and ellipticity-control up to value of 0.9. A new idea for characterization of attosecond chiral pulses on basis of dynamic of forbidden harmonics is proposed.

We-PO.51 **New insights into the laser-assisted photoelectric effect from solid-state surfaces**
Lukas Wenthaus[1], Nikolay Kabachnik[2,3], Mario Borgwardt[4], Steffen Palutke[1], Dmytro Kutnyakhov[1], Federico Pressacco[1], Markus Scholz[1], Dmitrii Potorochin[5], Nils Wind[6], Stefan Düsterer[1], Günter Brenner[1], Oliver Gessner[4], Serguei Molodtsov[2,5], Wolfgang Eberhardt[1], Friedrich Roth[5]
[1]DESY, Hamburg, Germany. [2]European XFEL GmbH, Schenefeld, Germany. [3]Donostia International Physics Center (DIPC), San Sebastian/Donostia, Spain. [4]Lawrence Berkeley National Laboratory, Berkeley, USA. [5]TU Bergakademie Freiberg, Freiberg, Germany. [6]Universität Hamburg, Hamburg, Germany
We present a systematic investigation of the laser-assisted photoelectric effect in two similar metallic solids – W (110) and Pt (111) single crystals – using femtosecond time-resolved X-ray photoelectron spectroscopy conducted at the X-ray Free-Electron Laser FLASH.

We-PO.52 **$N_2^+$ lasing with and without population inversion**
Yao Fu[1], Jincheng Cao[1], Erik Lötstedt[2], Helong Li[1], Kaoru Yamanouchi[2], Huailiang Xu[1]
[1]Jilin University, Changchun, China. [2]The University of Tokyo, Tokyo, Japan
We demonstrate that strong-field-induced $N_2^+$ lasing can occur with population inversion either by superradiance or by seed amplification emissions as well as without population inversion by a phase control of the free induction decay.

We-PO.53 **Ultrafast carrier coupling dynamics of WS2-CsPbBr3 nanocomposites using femtosecond transient absorption spectroscopy**
Sudhanshu Kumar Nayak[1], Chinmay Barman[1], Md Soif Ahmed[1], Subbiah Alwarappan[2], Soma Venugopal Rao[3], Sai Santosh Kumar Raavi[1]
[1]Ultrafast Photophysics and Photonics Laboratory, Department of Physics, Indian Institute of Technology Hyderabad, Hyderabad, India. [2]CSIR - Central Electrochemical Research Institute, Karaikudi, Tamil Nadu, Tamilnadu, India. [3]Advanced Centre of Research in High Energy Materials (ACRHEM), University of Hyderabad, Hyderabad, Hyderabad, India
The ultrafast carrier coupling dynamics of $WS_2$-$CsPbBr_3$ nanocomposites are studied using transient absorption spectroscopy. This study suggests the ultrafast carrier transfer from $CsPbBr_3$ to $WS_2$, which will be emerging material for photodetector and optoelectronic applications.

We-PO.54 **Two-dimensional Electronic Spectroscopy of Size and Anion Dependent Metal Halide** Perovskite Reveals Unobserved Peak Splittings of Electronically Coherent Nature
Arnab Ghosh, Patanjali Kambhampati
McGill University, Montreal, Canada
The electronic states of perovskite nanocrystals fluctuate in ultrafast timescale. We observed these

correlations and dynamics in perovskite nanocrystals of different sizes spanning from weakly to strongly confined using two-dimensional electronic (2DE) spectroscopy.

We-PO.55 **Subcycle dynamics and tomography of quantum light**
Andrey Moskalenko
KAIST, Daejeon, Korea, Republic of
How to obtain a sufficiently complete local picture of quantum light at the most basic of its characteristic timescales, namely the oscillation cycle of its mode? Our contribution provides an answer to this fundamental question.

We-PO.56 **Ultrafast Time-Resolved ARPES based on sub-10-fs Pump and Probe Pulse Configuration**
Takuya Okamoto[1], Ryo Yoshioka[1,2], Kento Hiura[1,2], Kohei Nagai[1], Yasushi Shinohara[1,3], Hiroki Mashiko[4], Yoji Kunihashi[1], Keiko Kato[5], Yoshiaki Sekine[1], Hiroki Hibino[6], Ikufumi Katayama[2], Jun Takeda[2], Haruki Sanada[1], Katsuya Oguri[1]
[1]NTT Basic Research Laboratories, Kanagawa, Japan. [2]Yokohama National University, Kanagawa, Japan. [3]NTT Research Center for Theoretical Quantum Information, Kanagawa, Japan. [4]The University of Tokyo, Tokyo, Japan. [5]Nagoya University, Aichi, Japan. [6]Kwansei Gakuin University, Hyogo, Japan
We developed a time-resolved ARPES based on pump and high-harmonic probe pulses with sub-10-fs duration through the implementation of multiple-plate continuum compression. The probe pulses were characterized by frequency-resolved optical gating via momentum-resolved Volkov band.

We-PO.58 **FEL-based time-of-flight momentum microscopy: 3 time-resolved photoemission modalities in 1 experiment**
Dmytro Kutnyakhov[1], Nils Wind[2,3], Michael Heber[2], Lukas Wenthaus[2], Kai Rossnagel[3,4]
[1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany. [2]Deutsches Elektronen Synchrotron DESY, Hamburg, Germany. [3]Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Kiel, Germany. [4]Ruprecht-Haensel-Labor, Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany
We have constructed and optimized a versatile setup (HEXTOF), commissioned at FLASH/PG2, which combines FEL capabilities with the multidimensional recording scheme of a momentum microscope for time-resolved photoemission techniques: trMM, trXPS and trXPD.

We-PO.59 **Iron (II)-Complexes – Femtosecond Infrared Spectroscopy and Quantum Chemistry to Elucidate Spin Multiplicity**
Clark Zahn[1], J. Luis Pérez Lustres[1], Xiao Hui Li[1], Mariachiara Pastore[2], Emmanouil Giannoudis[2], Philippe C. Gros[2], Stefan Haacke[3], Karsten Heyne[1]
[1]Freie Universität Berlin, Berlin, Germany. [2]Université de Lorraine, Nancy, France. [3]Université de Strasbourg, Strasbourg, France
Quantum chemical calculations and femtosecond transient absorption in Vis and mid-IR are applied to iron (II) complexes. Global analysis yields species-associated spectra which, by comparison with calculations, reveal quintet spin multiplicity of long-living species.

We-PO.60 **High-harmonic generation in p-doped Si by band non-parabolicity, energy-dependent relaxation and dopant photo-ionization**
Fanqi Meng[1], Frederik Walla[1], Sergey Kovalev[2], Jan-Christoph Deinert[2], Igor Ilyakov[2], Min Chen[2], Alexey Ponomaryov[2], Sergey Pavlov[3], Heinz-Wilhelm Hübers[3,4], Nikolay Abrosimov[5], Christoph Jungemann[6], Hartmut Roskos[1], Mark Thomson[1]
[1]Goethe-Universität Frankfurt, Frankfurt, Germany. [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany. [3]German Aerospace Center (DLR), Berlin, Germany. [4]Humboldt-Universität zu Berlin, Berlin, Germany. [5]Leibniz-Institut für Kristallzüchtung (IKZ), Berlin, Germany. [6]RWTH Aachen, Aachen, Germany
We report harmonic generation (HG) in Si:B up to 11$^{th}$ order pumped with intense terahertz pulses. By employing FDTD simulation integrated with the Monte-Carlo model, we identify the physical mechanisms of the HG processes.

**Th-1A: Light Harvesting and Energy Transfer**
**08:30 - 10:15 Thursday, 18th July, 2024**
**Auditorium**
**Oral session**

**Chaired by Jérémie Leonard, IPCMS, Strasbourg, France**

08:30 - 09:00
Th-1A.1 Invited **Ultrafast 2D Spectroscopy Unveils Self-Assembly Pathways of an Artificial Light-Harvesting Complex**
Maxim S. Pshenichnikov[1], Marìck Manrho[1], Sundar Raj Krishnaswamy[1], Björn Kriete[1], Ilias Patmanidis[2,3], Alex H. de Vries[2], Siewert J. Marrink[2], Thomas L. C. Jansen[1], Jasper Knoester[1,4]
[1]University of Groningen, Zernike Institute for Advanced Materials, Groningen, Netherlands. [2]University of Groningen, Groningen Biomolecular Sciences and Biotechnology Institute, Groningen, Netherlands. [3]Aarhus University, Department of Chemistry, Aarhus, Denmark. [4]Leiden University, Faculty of Science, Leiden, Netherlands
We applied a combination of ultrafast two-dimensional spectroscopy and microfluidics to reveal the self-assembly stages of an artificial light-harvesting complex: first, relatively small molecular structures are formed which later rearrange into the final well-ordered structure.

09:00 - 09:15
Th-1A.2 **Ultrafast charge transport in a synthetic analogue of Photosystem II probed by Two-dimensional electronic spectroscopy**
Mattia Russo[1], Rhea Kumar[1], Vasilis Petropoulos[1], Leonardo Cognigni[2], Francesco Rigodanza[2], Jacopo Dosso[3], Giulio Cerullo[1], Maurizio Prato[3], Marcella Bonchio[2], Margherita Maiuri[1]
[1]Politecnico di Milano, Milan, Italy. [2]University of Padua, Padua, Italy. [3]University of Trieste, Trieste, Italy
Two-dimensional electronic spectroscopy combined with spectroelectrochemistry revealed ultrafast formation and long-lived migration of charges in a robust synthetic analogue of photosystem II comprised of naphthalene diimide antenna with a ruthenium-based catalyst.

09:15 - 09:30
Th-1A.3 **Few-femtosecond Electron Transfer Dynamics in Photoionized Donor-π-Acceptor Molecules**
Federico Vismarra[1,2], Francisco Fernández Villoria[3,4], Daniele Mocci[1], Jesús González-Vázquez[4], Yingxuan Wu[1,2], Lorenzo Colaizzi[1], Fabian Holzmeier[5], Jorge Delgado[3,4], José Santos[3,6], Luis Bañares[3,7], Laura Carlini[8], Mattea Castrovilli[8], Paola Bolognesi[8], Robert Richter[9], Lorenzo Avaldi[8], Alicia Palacios[4], Matteo Lucchini[1,2], Maurizio Reduzzi[1], Rocío Borrego-Varillas[2], Nazario Martín[3,7], Fernando Martín[3,4], Mauro Nisoli[1,2]
[1]Department of Physics, Politecnico di Milano, Milan, Italy. [2]IFN-CNR, Milan, Italy. [3]Instituto Madrileño de Estudios Avanzados en Nanociencia, Madrid, Spain. [4]Departamento de Química, Universidad Autónoma de Madrid, Madrid, Spain. [5]imec, Leuven, Belgium. [6]Departamento de Química Orgánica I, Universidad Complutense de Madrid, Madrid, Spain. [7]Departamento de Química Física, Universidad Complutense de Madrid, Madrid, Spain. [8]Istituto di Struttura della Materia-CNR (ISM-CNR), Rome, Italy. [9]Sincrotrone Trieste, Trieste, Italy
Charge transfer in nitroanilines, prototypical donor-acceptor molecules, has been investigated using attosecond spectroscopy and advanced many-body quantum chemistry calculations. XUV ionization initiates an ultrafast planarization of the $NH_2$ group, which favors 10-fs electron transfer.

09:30 - 09:45
Th-1A.4 **Driving optomagneto dynamics between correlated triplet pair states in single-crystal singlet fission materials**
Gina Mayonado[1], Winston Goldthwaite[1], Fangyi Zhu[1], Liangdong Zhu[1], John Anthony[2], Oksana Ostroverkhova[1], Matt Graham[1]
[1]Oregon State University, Physics, Corvallis, USA. [2]University of Kentucky, Chemistry, Lexington, USA
Tunable magnetic field (±7T) TA microscopy drives conversion between correlated triplet pair states in singlet fission semiconductors, showing: A. Ultrafast spin-conversion from S=0 to S=1 and 2 triplet pairs. B. Near-complete suppression of charge multiplication

09:45 - 10:00
Th-1A.5 **Ultrafast Action Spectroscopy Reveals the Unique Exciton Photochemistry of State-of-the-art Acceptor Y6**
Marios Maimaris[1], Haoqing Ning[1], Clement Ferchaud[2], Pabitra Shakya Tuladhar[1], John Marangos[2], Artem A. Bakulin[1]
[1]Department of Chemistry and Centre for Processable Electronics, Imperial College London, London, United Kingdom. [2]Department of Physics, Imperial College London, London, United Kingdom

10-fs ultrafast photocurrent and photoluminescence action spectroscopies applied on Non-Fullerene photovoltaic devices reveals unique exciton photochemistry of state-of-the-art acceptor Y6. Our results suggest unbound states formation within 200-fs after Y6 excitation via intermolecular interactions.

10:00 - 10:15
Th-1A.6 **Electric Interactions in Liquids and Proteins Probed by Ultrafast Terahertz Stark Spectroscopy**
Thomas Elsaesser[1], Jia Zhang[1], Poonam Singh[1], Dieter Engel[1], Matthias Broser[2], Peter Hegemann[2], Benjamin Fingerhut[3]
[1]Max Born Institut, Berlin, Germany. [2]Institut für Biologie, Humboldt Universität zu Berlin, Berlin, Germany. [3]Department Chemie, Ludwig-Maximilians-Universität München, München, Germany
Electric interactions in polar molecular environments are mapped by terahertz Stark spectroscopy. In bacteriorhodopsin, the dipole difference measured between ground and excited state of the retinal chromophore demonstrates a mixing of $S_1$ and $S_2$ states.

**EXHIBITION AND COFFEE BREAK**
**10:15 - 10:45 Thursday, 18th July, 2024**
**Port Vell**

**Th-2A: Coupling to Environment and Vibrations**
**10:45 - 12:30 Thursday, 18th July, 2024**
**Auditorium**
**Oral session**
**Chaired by Stefan Lochbrunner, Institute of Physics and Department of Life, Light and Matter, University of Rostock, Rostock, Germany**

10:45 - 11:00
Th-2A.1 **Ultrafast Multidimensional Spectroscopy for Molecules Strongly Coupled to Microcavities**
Zhedong Zhang
City University of Hong Kong, Hong Kong, Hong Kong
We present an overview of our recent works on multidimensional spectroscopy of molecular polaritons. The results developed a microscopic theory, showing a real-time monitoring of polariton dynamics and its couplings to dark states and polarons.

11:00 - 11:15
Th-2A.2 **Cavity-Enhanced Energy Transport in Organic Semiconductors: From Enhanced Diffusion to Ultrafast Ballistic Flow**
Mukundakumar Balasubrahmaniyam, Adina Golombek, Gal Sandik, Tal Schwartz
Tel Aviv University, Tel Aviv, Israel
Using ultrafast microscopy, we reveal that strong light-molecule coupling boosts exciton diffusion by $10^6$ and even leads to ballistic transport at 2/3 the speed of light over macroscopic distances, completely overcoming the effect of disorder.

11:15 - 11:30
Th-2A.3 **Absorption from an Extreme Ultrafast Stokes' Shift**
Sarang Yeola, David Jonas
University of Colorado, Boulder, USA
We develop generalized Einstein absorption-emission relations between ultrabroad spectra. Ultrafast dynamics, such as in the solvated electron, may generate Stokes' shifts so extreme that the expected emission becomes predominantly absorption.

11:30 - 11:45
Th-2A.4 **Capturing ultrafast molecular motions and lattice dynamic response in a spin crossover thin film using femtosecond electron diffraction and X-ray diffraction**
Yifeng Jiang[1], Doriana Vinci[1], Karl Rider[2], Fengfeng Qi[3], Peter Zalden[1], Fernando Ardana[1], Tobias Eklund[1], Robin Schubert[1], Carsten Deiter[1], Radoslaw Kaminski[4], Katarzyna Jarzembska[4], Renske van der Veen[5], Henrike Mueller-Werkmeister[6], Dao Xiang[3], Chris Milne[1], Maciej Lorenc[7]
[1]EuXFEL, Schenefeld, Germany. [2]CNRS and Université de Toulouse, Toulouse, France. [3]Shanghai Jiaotong University, Shanghai, China. [4]University of Warsaw, Warsaw, Poland. [5]Technical University of

Berlin, Berlin, Germany. [6]University of Potsdam, Potsdam, Germany. [7]Université de Rennes 1, Rennes, France
A novel spin crossover nanocrystalline film was studied by complementary ultrafast electron diffraction and X-ray diffraction for sequential photo-switching dynamics. This research highlights opportunities from modern light sources to understand ultrafast dynamics of photo-switchable materials.

11:45 - 12:00
Th-2A.5 **Ultrafast Vibration Control of Soft Optoelectronic Materials**
Beier Hu, Dmitry Maslennikov, Navendu Mondal, Nathaniel Gallop, Artem Bakulin
Imperial College London, London, United Kingdom
We apply state-of-the-art vibrationally promoted electronic resonance (VIPER) spectroscopy to selectively investigate the charge dynamics change when being strongly coupled with molecule vibration in soft electronic materials on femtosecond-picosecond timescale.

12:00 - 12:15
Th-2A.6 **Probing temporal and spatial resolved molecular chirality by X-ray pulses**
Victor M. Freixas[1], Jeremy R. Rouxel[2], Niranjan Govind[3,4], Shaul Mukamel[1]
[1]University of California, Irvine, Irvine, USA. [2]Argonne National Laboratory, Lemont, USA. [3]Pacific Northwest National Laboratory, Richland, USA. [4]University of Washington, Seattle, USA
The X-ray regime provides spatial and element specific sensitivities required to probe local chiral features near X-ray chromophores. Here we explore the conditions in which these signals can be used to track photo-triggered molecular motions.

12:15 - 12:30
Th-2A.7 **Proton Transfer interplays with Intermolecular Coulombic Decay in Liquid W**ater
Pengju Zhang[1], Joel Trester[2], Jakub Dubsky[3], Přemysl Kolorenč[4], Petr Slavíček[5], Hans Jakob Wörner[2]
[1]Laboratorium fur Physikalische Chemie, ETH Zurich, Zurich, Switzerland. [2]ETH Zurich, Zurich, Switzerland. [3]Department of Physical Chemistry, University of Chemistry and Technology, Prague, Czech Republic. [4]Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic. [5]University of Chemistry and Technology, Prague, Czech Republic
The efficiency of Intermolecular Coulombic decay in liquid $H_2O$ compared to $D_2O$ was measured below unity, suggesting an interplay between ICD and proton transfer, which is supported by an ab-initio simulation including solvent effects.

**Th-2B: Ultrafast Technologies and Applications**
**10:45 - 12:30 Thursday, 18th July, 2024**
**Room A2+A3**
**Oral session**
**Chaired by Avner Fleischer, Tel-Aviv University center for Light-Matter-Interaction, Tel Aviv, Israel**

10:45 - 11:00
Th-2B.1 **Multi-TW single-cycle pulse by dual-chirped optical parametric amplification**
Eiji Takahashi
RIKEN, Wako, Japan
A new form of optical parametric amplification with two kinds of nonlinear crystals can generate a multi-TW carrier-to-envelope phase-stable single-cycle laser pulse in the mid-infrared region.

11:00 - 11:15
Th-2B.2 **In-Situ Field Characterization of Multicolor Optical Waveforms Down to Sub-Cycle Durations using an All-Optical Approach**
Maximilian Kubullek[1,2], Miguel A. Silva-Toledo[1,2], Roland E. Mainz[1,2], Fabian Scheiba[1,2], Felix Ritzkowsky[1,2,3], Phillip Junker[1,2], Giulio Maria Rossi[1,2], Franz X. Kärtner[1,2]
[1]Center of Free-Electron Laser Science CFEL, Deutsches Elektronen Synchrotron DESY, Hamburg, Germany. [2]Physics Department and The Hamburg Centre for Ultrafast Imaging (CUI), University of Hamburg, Hamburg, Germany. [3]Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, USA
An all-optical technique for in-situ field characterization of multicolor optical waveforms is presented and demonstrated by characterizing extremely broadband pulses with down to sub-cycle pulse durations from a waveform synthesizer.

11:15 - 11:30
Th-2B.3 **Flexible frequency conversions in pump-probe beamlines driven by a long-term-stable 800-W, 8-mJ, 240-fs, 1030-nm fiber-laser system**
Christian Grebing, Maxim Tschernajew, Evgeny Shestaev, Florian Just, Vinzenz Hilber, Christian Kern, Anke Heilmann, Marco Kienel, Tobias Heuermann, Christian Gaida, Oliver Herrfurth, Sven Breitkopf, Tino Eidam, Jens Limpert
Active Fiber Systems GmbH, Jena, Germany
Femtosecond lasers enable versatile spectral coverage. For providing sufficient power, lasers powers are increasing or multiple systems are used in parallel. Here, emphasizing timing stabilization ensures precision in experiments with high temporal resolution.

11:30 - 11:45
Th-2B.4 **Characterization of sub-4 fs tunable VUV pulses**
José R. C. Andrade, Martin Kretschmar, Rostyslav Danylo, Tobias Witting, Alexandre Mermillod-Blondin, Marc J. J. Vrakking, Arnaud Rouzée, Tamas Nagy
Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany
We generate and characterize ultrashort pulses in the vacuum ultraviolet. The laser source delivers tunable VUV pulses below 200 nm with multi-microjoule energy and sub-4 fs duration.

11:45 - 12:00
Th-2B.5 **Direct Temporal Characterization of Sub-3-fs Deep UV Pulses Generated by Resonant Dispersive Wave Emission**
Marta Pini[1], Maurizio Reduzzi[1], Lorenzo Mai[1], Federico Cappenberg[1], Lorenzo Colaizzi[1], Federico Vismarra[1,2], Aurora Crego[3], Matteo Lucchini[1,2], Christian Brahms[4], John C. Travers[4], Rocío Borrego-Varillas[2], Mauro Nisoli[1,2]
[1]Department of Physics, Politecnico di Milano, 20133 Milano, Italy. [2]Institute for Photonics and Nanotechnologies, IFN-CNR, 20133 Milano, Italy. [3]Grupo de Investigación en Aplicaciones del Láser y Fotónica, Departamento de Física Aplicada, Universidad de Salamanca, 37008 Salamanca, Spain. [4]School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh EH14 4AS, United Kingdom
We temporally characterize, via Self-Diffraction FROG, sub-3-fs pulses generated by Resonant Dispersive Wave emission in gas-filled Hollow Capillary Fibers, tuneable between 250 and 350 nm, to be integrated into a UV-pump XUV-probe attosecond beamline.

12:00 - 12:15
Th-2B.6 **Sub-20-fs UV Pump – XUV Probe Beamline for Ultrafast Molecular Spectroscopy**
Aurora Crego[1,2], Stefano Severino[3], Lorenzo Mai[3], Fabio Medeghini[3], Federico Vismarra[3,2], Fabio Frassetto[4], Luca Poletto[4], Matteo Lucchini[3,2], Maurizio Reduzzi[3], Mauro Nisoli[3,2], Rocio Borrego-Varillas[2]
[1]Universidad de Salamanca, Salamanca, Spain. [2]CNR-IFN, Milano, Italy. [3]Politecnico di Milano, Milano, Italy. [4]CNR-IFN, Padova, Italy
We present a UV-XUV ultrafast photoelectron spectroscopy beamline with a temporal resolution of 20 fs, unambiguously characterized by an in-situ photoelectron cross-correlation measurement. We resolve with unprecedented detail the first conical intersection of cyclohexadiene.

12:15 - 12:30
Th-2B.7 **Flexible generation of structured terahertz fields via programmable exchange-biased spintronic emitters**
Zhensheng Tao[1,2], Shunjia Wang[1,2], Wentao Qin[1], Tongyang Guan[1,2], Jingyu Liu[3], Qingnan Cai[1,2], Sheng Zhang[1,2], Lei Zhou[1,2], Yan Zhang[3], Yizheng Wu[1]
[1]State Key Laboratory of Surface Physics and Department of Physics and Key Laboratory of Micro and Nano Photonic Structures (MOE), Fudan University, Shanghai, China. [2]Shanghai Key Laboratory of Metasurfaces for Light Manipulation, Shanghai, China. [3]Beijing Key Laboratory of Metamaterials and Devices, Key Laboratory of Terahertz Optoelectronics, Ministry of Education, Beijing Advanced Innovation Center for Imaging Theory and Technology, Department of Physics, Capital Normal University, Beijing, China
We present a novel spintronic emitter generating diverse structured terahertz waves through precise magnetization programming, achieved via laser-assisted field cooling of exchange-biased heterostructures.

**LUNCH BREAK - ON YOUR OWN**
**12:30 - 14:00 Thursday, 18th July, 2024**

**Th-3A: Electronic Structure of Materials**
**14:00 - 15:45 Thursday, 18th July, 2024**
**Auditorium**
**Oral session**
**Chaired by Natalia Kuzkova, ARCNL, Amsterdam, Netherlands**

14:00 - 14:30
Th-3A.1 Invited **High-Harmonic Microscopy Reveals Ultrafast Spin Dynamics at Magnetic Domain Boundaries**
Sergey Zayko[1], Hung-Tzu Chang[1], Ofer Kfir[2], Timo Schmidt[3], Murat Sivis[1], Manfred Albrecht[3], Claus Ropers[1]
[1]Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany. [2]School of Electrical Engineering, Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel. [3]Experimental Physics IV, Institute for Physics, University of Augsburg, Augsburg, Germany
We report the development of element-specific ultrafast microscopy employing an advanced high-harmonic source. For the first time, we provide direct real-space observation of femtosecond evolution of magnetically heterogeneous systems, unambiguously resolving domain wall dynamics.

14:30 - 14:45
Th-3A.2 **Decay of Spin-Polarization in Semiconductors Measured by Attosecond Transient Absorption**
Lorenz Drescher, Kylie Gannan, Stephen Leone
University of California, Berkeley, USA
The spin-polarization of valence band holes is often overlooked due to their extremely short lifetime. Here we use dichroic attosecond transient absorption spectroscopy to experimentally access the few-femtosecond decay of hole spins in Germanium.

14:45 - 15:00
Th-3A.3 **Attosecond Spectroscopy of Virtual Carrier Dynamics in Monocrystalline Diamond**
Gian Luca Dolso[1], Shunsuke Sato[2], Nicola Di Palo[1], Giacomo Inzani[1], Rocío Borrego-Varillas[3], Mauro Nisoli[1,3], Matteo Lucchini[1,3]
[1]Politecnico di Milano, Milano, Italy. [2]University of Tsukuba, Tsukuba, Japan. [3]IFN-CNR, Milano, Italy
We measure attosecond electron dynamics in single-crystalline diamond, initiated by few-femtosecond optical pulses. Supported by TDDFT simulations, our results discern the light-induced intra- and inter-band phenomena in virtual carrier dynamics for the first time.

15:00 - 15:15
Th-3A.4 **Unraveling ultrafast many-body effects in strongly-driven photo-excited semi-metallic graphite**
Themistoklis Sidiropoulos[1,2], Nicola Di Palo[2], Daniel Rivas[2], Adam Summers[2], Stefano Severino[2], Maurizio Reduzzi[2], Jens Biegert[2]
[1]Max-Born-Institute, Berlin, Germany. [2]ICFO, Barcelona, Spain
We use attosecond core-level X-ray absorption spectroscopy to disentangle the spectral and dynamical signatures of the many-body interactions that lead to an enhanced optical conductivity in strongly photo-excited semi-metallic graphite.

15:15 - 15:30
Th-3A.5 **Creating Electronic Molecular Movies Using Time-Resolved X-Ray Photoelectron Spectroscopy**
Dennis Mayer[1], Fabiano Lever[1], David Picconi[2], Skirmantas Alisauskas[1], Agata Azzolin[3,4], Francesca Calegari[3,4,5], Giovanni Cirmi[1,4], Stefan Düsterer[1], Ulrike Frühling[1], Alice Green[6,7], Ingmar Hartl[1], Marion Kuhlmann[1], Tommaso Mazza[6], Steffen Palutke[6], Sebastian Schulz[8], Andrea Trabattoni[4,9], Atia Tul Noor[1], Markus Gühr[1,3]
[1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany. [2]University of Groningen, Groningen, Netherlands. [3]University of Hamburg, Hamburg, Germany. [4]Center for Free-Electron Laser Science CFEL, DESY, Hamburg, Germany. [5]The Hamburg Centre for Ultrafast Imaging, University of Hamurg, Hamburg, Germany. [6]European XFEL, Schenefeld, Germany. [7]Stanford PULSE Institute, Menlo Park,

USA. [8]Deutsches Elektronen-Synchrotron DESY, Hamburg, Ghana. [9]University of Hannover, Hannover, Germany
We study the ultrafast relaxation dynamics of 2-thiouracil using time-resolved x-ray photoelectron spectroscopy. The S 2p and C 1s spectra show opposite shifts after UV excitation which we attribute to a valence charge rearrangement.

15:30 - 15:45
Th-3A.6 **Attosecond Coherent Electron Motion in Photoionized Molecular Isomers**
Erik Isele[1,2,3] on behalf of the LCLS Attosecond Campaign Collaboration
[1]Stanford PULSE Institute, Menlo Park, USA. [2]Department of Applied Physics, Stanford University, Stanford, USA. [3]Linac Coherent Light Source, SLAC National Accelerator Laboratory, Menlo Park, USA
We generated attosecond soft x-ray pulse pairs at the Linac Coherent Light Source to probe coherent electron motion in aminophenol isomers and investigated the effect of changing substituent position on the coherent electron motion.

**Th-PO: EXHIBITION, COFFEE BREAK AND POSTER SESSION III**
**15:45 - 17:15 Thursday, 18th July, 2024**
**Port Vell**
**Poster session**

Th-PO.1 **Ultrafast Oscillators and Amplifiers for Physics and Chemistry**
Brian Molesky, Erin McCole Dlugosz, Joseph Henrich
Coherent Corp, Glasgow, United Kingdom
Created by the Industrial Revolution in Ultrafast Science, Coherent offers ultrafast lasers for research applications, with pulse energies from µJ to mJ, repetition rates into the MHz regime, at wavelengths from UV to mid-IR.

Th-PO.2 **Integrated XUV Ultrafast Spectroscopy and Scatterometry of Nanostructures**
Francesco Corazza[1], Leo Guery[1], Emmanouil Kechaoglou[1], Zhonghui Nie[1], Peter Kraus[1,2]
[1]ARCNL, Amsterdam, Netherlands. [2]Vrij Universiteit, Amsterdam, Netherlands
We present an innovative HHG-based method to characterise layered nanostructures. XUV scatterometry and ultrafast pump-probe spectroscopy are combined to extract simultaneously the morphological features and charge-related information from the sample on the 0th diffraction order.

Th-PO.4 **Reaction Pathways and Transient Species after Photodissociation of ironpentacarbonyl in gas phase and in ethanol solution**
Michael R. Coates[1], Ambar Banerjee[2,1], Hampus Wikmark[2], Raphael Jay[2], Markus Kowalewski[1], Philippe Wernet[2], Michael Odelius[1]
[1]Stockholm University, Stockholm, Sweden. [2]Uppsala University, Uppsala, Sweden
Molecular dynamics simulations in excited states and in solution reveal evolution of ironpentacarbonyl during and after photodissociation. Synchronous bond oscillations in charge-transfer states led to pulsed CO release and irontetracarbonyl forms different solvent coordination motifs.

Th-PO.5 **Generating Isolated Attosecond Pulses in a Semi-Infinite Gas cell via Controlled Time-Window Phase Matching**
Daniele Mocci[1], Federico Vismarra[1,2], Marina Fernández Galán[3,4], Lorenzo Colaizzi[1], Victor W. Segundo[3,4], Roberto Boyero-García[3], Javier Serrano[3,4], Enrique Conejero Jarque[3,4], Marta Pini[1,2], Lorenzo Mai[1], Yingxuan Wu[1,2], Hans Jacob Wörner[5], Elisa Appi[6], Cord L. Arnold[6], Maurizio Reduzzi[1], Matteo Lucchini[1,2], Julio San Román[3,4], Mauro Nisoli[1,2], Carlos Hernández-García[3,4], Rocío Borrego-Varillas[2]
[1]Department of Physics, Politecnico di Milano, 20133 Milano, Italy. [2]IFN-CNR, 20133 Milano, Italy. [3]Departamento de Física Aplicada, Universidad de Salamanca, 37008 Salamanca, Spain. [4]Unidad de Excelencia en Luz y Materia Estructuradas (LUMES), Universidad de Salamanca, 37008 Salamanca, Spain. [5]Laboratorium für Physikalische Chemie, ETH Zürich, 8093 Zürich, Switzerland. [6]Department of Physics, Lund University, Lund, Sweden
Isolated attosecond pulses are synthesized within a semi-infinite gas cell, employing controlled time-window phase matching. The process is elucidated through the simulation of the generation process at the single-atom level, by three-dimensional time-dependent Schrödinger equation.

Th-PO.6 **Experiments on ultrafast electron dynamics at the MAC user end-station driven by coherent XUV pulses**
Andreas Roos[1], Eva Klimešová[1], Ziaul Hoque[1], Ltaief Ben Ltaief[2], Marcel Mudrich[2], Lucie Jurkovičová[1,3], Ondřej Hort[1], Martin Albrecht[1,3], Matyáš Staněk[1,3], Jaroslav Nejdl[1,3], Jakob Andreasson[1], Maria Krikunova[1,4]
[1]ELI Beamlines facility, Dolní Břežany, Czech Republic. [2]Department of Physics and Astronomy, Aarhus University, Aarhus, Denmark. [3]Czech Technical University in Prague, FNSPE, Prague, Czech Republic. [4]Technical University of Applied Sciences Wildau, Wildau, Germany
We present new results on femtosecond dynamics in low-density matter from the MAC end-station at ELI Beamlines facility. In our experiments, we study collective multi-ionization of helium nanodroplets and ultrafast electron dynamics in krypton.

Th-PO.7 **Polarization dependent harmonic generation from molecular crystals**
Falk-Erik Wiechmann[1,2], Samuel Schöpa[1], Alexander Villinger[3], Dieter Bauer[1], Franziska Fennel[1,2]
[1]Institute of Physics, University of Rostock, Rostock, Germany. [2]Department of Life, Light and Matter, University of Rostock, Rostock, Germany. [3]Institute of Chemistry, University of Rostock, Rostock, Germany
We demonstrate polarization dependent harmonic generation from an organic molecular crystal driven by a linearly polarized MIR laser pulse. The harmonic yield strongly depends on the orientation between the driving field and the crystal orientation.

Th-PO.8 **Ultrafast Structured Light through Nonlinear Frequency Generation in an Optical Enhancement Cavity**
Walker Jones, Melanie Reber
University of Georgia, Athens, GA, USA
We report a new method to generate ultrafast structured light. An ultrafast laser is coupled to the higher order modes of a cavity with a nonlinear crystal and, through autocorrelation-style setup, outputs shaped ultrafast light.

Th-PO.9 **Determining excited state absorption properties of flavin by polarization-resolved transient spectroscopy**
Yi Xu[1], Martin Peschel[2], Miriam Jänchen[1], Richard Foja[1], Golo Storch[1], Erling Thyrhaug[1], Regina de Vivie-Riedle[2], Jürgen Hauer[1]
[1]Technical University of Munich, TUM School of Natural Sciences, Department of Chemistry, Garching, Germany. [2]Ludwig-Maximilians-Universität München, Department of Chemistry, München, Germany
We employ polarization associated spectra (PAS) to study the excited state absorption transitions their transition dipole moment directions of oxidized flavin.

Th-PO.10 **Er Fiber Front End, 100 kHz, Tunable Source for 2D Mid-IR Spectroscopy**
Bradley Luther, Amber Krummel, Luke Guerrieri, Sarah Hall
Colorado State University, FORT COLLINS, USA
A tunable, 100 kHz Mid-IR source based on a Raman shifted Er fiber front end is presented. The system uses a PPLN based, Yb pumped, OPCPA and DFG in ZGP to generate 4-6.5 μm light**.**

Th-PO.11 **Ultrashort Optical Diffractometry for Spatiotemporal Characterization of Laser Induced Plasma**
Ivan Ostrovsky[1], Gilad Hurvitz[2], Sharly Fleischer[1]
[1]Tel-Aviv University, Tel-Aviv, Israel. [2]Soreq NRC, Yavne, Israel
We utilize optical diffractometry for studying laser-induced plasmas. Modeling the plasma cross-section as Supergaussian distribution we extract spatially-localized plasma properties (density, size, shape) and monitor the spatio-temporal evolution with unique resolution (20μm, 100fs) and sensitivity.

Th-PO.12 **Resolving the Effects of Chemical Substitution on the Non-Adiabatic Dynamics of Benzaldehyde by UV-XUV Time-Resolved Photoelectron Spectroscopy**
Lorenzo Mai[1], Stefano Severino[1], Federico Vismarra[1], Aurora Crego[2], Fabio Frassetto[3], Luca Poletto[3], Matteo Lucchini[1], Rocío Borrego-Varillas[4], Mauro Nisoli[1], Maurizio Reduzzi[1]
[1]Dipartimento di Fisica, Politecnico di Milano, 20133 Milano, Italy. [2]Departamento de Fisica Aplicada, Universidad de Salamanca, 37070 Salamanca, Spain. [3]Institute for Photonics and Nanotechnologies, IFN-CNR, 35131 Padova, Italy. [4]Institute for Photonics and Nanotechnologies, IFN-CNR, 20133 Milano,

Italy
We investigate the non-inertial effects of chemical substitution on the UV-induced non-adiabatic relaxation dynamics of benzaldehyde and its derivatives through sub-20-fs UV XUV time-resolved photoelectron spectroscopy.

Th-PO.13 **Femtosecond-resolved anisotropy decay unveils ultrafast energy transport in light-harvesting nanoparticles**
Amira Mounya GHARBI[1], Deep Sekhar Biswas[2], Andrey Klymchenko[2], Jérémie Léonard[1]
[1]Université de Strasbourg, CNRS, IPCMS, UMR 7504, F-67200, Strasbourg, France. [2]Université de Strasbourg, Faculté de Pharmacie, LBP, UMR 7021, F-67400, Illkirch, France
We investigate exciton energy transport in disordered dye-loaded organic nanoparticles using fluorescence up-conversion spectroscopy. Anisotropy decay kinetics reveal signatures of structural heterogeneity within the nanoparticles and unveil an ultrafast, sub-200 fs exciton hopping time.

Th-PO.14 **Attosecond Photoinjection Dynamics in Germanium**
Nicola Di Palo[1], Giacomo Inzani[1], Lyudmyla Adamska[2], Amir Eskandari-asl[3], Gian Luca Dolso[1], Bruno Moio[1], Luciano Jacopo D'Onofrio[3], Alessio Lamperti[4], Alessandro Molle[4], Rocío Borrego-Varillas[5], Mauro Nisoli[1,5], Stefano Pittalis[2], Carlo Andrea Rozzi[2], Adolfo Avella[3,6,7], Matteo Lucchini[1,5]
[1]Department of Physics, Politecnico di Milano, Milan, Italy. [2]CNR - Istituto Nanoscienze, Modena, Italy. [3]Dipartimento di Fisica “E. R. Caianiello”, Fisciano, Italy. [4]CNR - IMM, Agrate Brianza, Italy. [5]Institute for Photonics and Nanotechnologies, Milano, Italy. [6]CNR - SPIN, Fisciano, Italy. [7]Unità CNISM di Salerno, Fisciano, Italy
Attosecond transient reflectivity is employed to investigate nonlinear photoinjection dynamics in germanium. Supported by theoretical calculations, we clarify the role of several distinct but concurring physical phenomena and their timing within the pump pulse envelope.

Th-PO.15 **Transient X-ray absorption signatures resolve the non-adiabatic pathway of Thiopyridone**
Sambit Das[1], Douglas Garratt[2], Michael Odelius[1], Kelly Gaffney[2]
[1]Stockholm University, Stockholm, Sweden. [2]Stanford Pulse Institute, SLAC National Accelerator Laboratory, California, USA
Theoretical spectral evaluations, along with dynamical molecular simulations, validate experimental transient X-ray absorption spectroscopic measurements to trace the ultrafast internal conversion and intersystem crossing dynamics in Thiopyridone species.

Th-PO.16 **$H_3^+$ Formation from Methyl Halogens andPseudohalogens: Experiments, Theory, and Predictions**
Jacob Stamm[1], Shawn Sandhu[1], Arnab Chakraborty[1], Swati Priyadarsini[1], Jun Shen[1], Sung Kwon[1], Jesse Sandhu[1], Clayton Wicka[1], Arshad Mehmood[2], Benjamin Levine[2], Piotr Piecuch[1], Marcos Dantus[1]
[1]Michigan State University, East Lansing, USA. [2]Stony Brook University, Stony Brook, USA
A collaborative experimental and theoretical investigation focused on discerning trends in the yield and timescale of $H_3^+$ formation from methyl-halogen and -pseudohalogen dications. Our results pinpoint key predictive factors for a successful roaming mechanism.

Th-PO.17 **Simulation of energy flow in femtosecond-laser excited h-BN/graphene heterostructures**
Tobias Zier[1], Arne Ungeheuer[2], Ahmed Hassanien[2], Thomas Baumert[2], Arne Senftleben[2], David A. Strubbe[1]
[1]University of California Merced, Merced, USA. [2]University of Kassel, Kassel, Germany
The energy flow in fs-laser excited vdW heterostructures are determined by intra and inter-material correlations. We were able to identify dominant correlations in h-BN/graphene by combining theoretical TDDFT simulations with measured time-resolved electron-diffraction results.

Th-PO.18 **Third-Order Harmonic Generation in Bulk Topological and Non-Topological Crystals**
Isabelle Tigges-Green[1], Matthew Mason[1], Nicholas Fasano[2], Andreas Giakas[2], Vedin Dewan[2], Michelle Wang[3], Ava Hejazi[1], Somnath Biswas[4], Timothy Bennett[2], Matthew Edwards[5], Nicholas Karpowicz[6], Gregory Scholes[1], Julia Mikhailova[2]
[1]Princeton University Department of Chemistry, Princeton, USA. [2]Princeton University Department of

Mechanical and Aerospace Engineering, Princeton, USA. [3]Princeton University Department of Electrical and Computer Engineering, Princeton, USA. [4]University of Washington Department of Chemistry, Seattle, USA. [5]Stanford University Department of Mechanical Engineering, Stanford, USA. [6]Max Planck Institute of Quantum Optics, Garching, Germany
We compare the third-order harmonic generation energy produced in bulk topological and non-topological crystals driven by a near-IR laser in the reflection geometry. The third-order harmonic generation energy produced by the crystals is compared.

Th-PO.19 **Probing core-excited state lifetimes in xenon using attosecond noncollinear four-wave-mixing spectroscopy**
Nicolette G. Puskar[1,2], Patrick Rupprecht[1,2], Yen-Cheng Lin[1,2], Avery E. Greene[3], Stephen R. Leone[1,2,4], Daniel M. Neumark[1,2]
[1]Department of Chemistry, University of California, Berkeley, USA. [2]Chemical Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, USA. [3]Department of Chemistry, Lawrence University, Appleton, USA. [4]Department of Physics, University of California, Berkeley, USA
We present few-femtosecond core-excited state decay lifetimes in xenon's $4d^{-1}6p$ Rydberg series measured using attosecond noncollinear four-wave-mixing spectroscopy**.**

Th-PO.20 **High-Sensitivity, Background-Free Mid-Infrared Absorption Spectroscopy Using Sub-Cycle Pulses**
Neil Irvin Cabello[1], Shinta Ozawa[1], Yue Zhao[2], Takao Fuji[1]
[1]Laser Science Laboratory, Toyota Technological Institute, Nagoya, Japan. [2]Graduate School of Engineering, College of Design and Manufacturing Technology, Muroran Institute of Technology, Muroran, Japan
We have demonstrated highly sensitive, background-free mid-infrared absorption spectroscopy by the upconversion of the free-induction decay signals initiated by sub-cycle mid-infrared pulses. The spectrum of ~50 mM glucose in water was recorded using the system.

Th-PO.21 **Polarization and phase resolved 3D subwavelength field imaging in dielectric metamaterial**
Bingbing Zhu, Qingnan Cai, Yaxin Liu, Sheng Zhang, Weifeng Liu, Qiong He, Lei Zhou, Zhensheng Tao
State Key Laboratory of Surface Physics and Department of Physics and Key Laboratory of Micro and Nano Photonic Structures (MOE), Fudan University, Shanghai, China
We present a novel method for all-optical super-resolution imaging of mid-infrared fields inside dielectric media. Based on high-order sideband harmonics in dielectrics, three-dimensional spatial, polarization, and phase resolutions are simultaneously achieved.

Th-PO.22 **Ultrafast Topological Phase Transition in the Dirac Semimetal $Cd_3As_2$**
Ahmed Ghalgaoui[1,2], Patrick Pilch[1], Fan Yang[3], Changqing Zhu[1], Shengying Yue[4], Yunkun Yang[5], Faxian Xiu[5], Xian-Lei Sheng[3], Shengyuan A. Yang[6], Zhe Wang[1]
[1]TU Dortmund University, Dortmund, Germany. [2]Max-Born-Institute, Berlin, Germany. [3]Beihang University, Beijing, China. [4]Xi'an Jiaotong University, Xi'an, China. [5]Fudan University, Shanghai, China. [6]University of Macau, Macau, China
We present proof for topological phase switching dressed by strong THz field, through the excitation of Raman phonon in the 3D Dirac semimetal $Cd_3As_2$. The topological phase can be tuned by adjusting the phonon amplitude.

Th-PO.23 **pH dependent reaction dynamics of photolabile protecting groups used in time-resolved structural dynamics**
Yannik Pfeifer[1], Till Stensitzki[1], Evgenii Titov[1], Jakub Dostál[2], Miroslav Kloz[2], Peter Saalfrank[1], Henrike Müller-Werkmeister[1]
[1]University of Potsdam, Potsdam, Germany. [2]The Extreme Light Infrastructure ERIC, Dolní Břežany, Czech Republic
Photolabile protection groups, like para-hydroxyphenacyl, are important tools for time-resolved serial crystallography. Their ultrafast reaction dynamics change dramatically by pH as shown here in a detailed study combining ultrafast transient absorption, IR and theoretical calculations.

Th-PO.24 **Hot Carrier Transfer to Gold Tips in Photocatalytic Quantum Dot Nanohybrids**
Diego Florio[1], Shira Gigi[2], Giulio Cerullo[1,3], Uri Banin[2], Franco V. A. Camargo[3]

[1]Dipartimento di Fisica, Politecnico di Milano, Milano, Italy. [2]Institute of Chemistry & the Center for Nanoscience and Nantechnology, The Hebrew University of Jerusalem, Jerusalem, Israel. [3]Istituto di Fotonica e Nanotecnologie-CNR, Milano, Italy
Hot-carrier transfer from ZnSe to Au is studied in heavy-metal-free ZnSe/ZnS-Au colloidal nanohybrids with varying ZnS shell thickness via ultrafast spectroscopy. An intermediate-thickness ZnS shell stabilizes ZnSe's surface while promoting efficient transfer to Au.

Th-PO.25 **Multi-phonon resonant and nonresonant scattering of electrons in doped semiconductors with diamond-type-lattices**
S. G. Pavlov[1], N. Deßmann[2], A. Pohl[1], N. V. Abrosimov[3], B. Redlich[2], M. Gensch[1,4], H.-W. Hübers[1,5]
[1]German Aerospace Center, Berlin, Germany. [2]Radboud University, Nijmegen, Netherlands. [3]Leibniz-Institut für Kristallzüchtung, Berlin, Germany. [4]Technische Universität Berlin, Berlin, Germany. [5]Humboldt-Universität zu Berlin, Berlin, Germany
Time-resolved spectroscopies acquired rates of electron-phonon scattering of helium-like states of Mg double donor centers in silicon. The fastest rates of intracenter dephasing and depopulation correlate spectrally to the two-phonon branches of silicon.

Th-PO.26 **The photodynamics of aza-substitution uracil: Insights from time-resolved photoelectron spectroscopy**
Susanne Ullrich, Moti Chudali
University of Georgia, Athens, GA, USA
UV-photoexcited uracil undergoes ultrafast internal conversion through ethylenic conical intersections between singlet excited states and the ground state. Here, time-resolved photoelectron spectroscopy is used to investigate how site-specific aza-substitution alters this deactivation mechanism in 6-azauracil**.**

Th-PO.27 **Build-up and dephasing of exciton-Floquet composites: entanglement and information**
Hyosub Park[1], Noejung Park[2], JaeDong Lee[1]
[1]Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, Republic of. [2]Ulsan National Institute of Science and Technology, Ulsan, Korea, Republic of
We theoretically investigate exciton, and Floquet states in 2D systems through the tr-ARPES and discover two branches of novel quantum states, exciton-Floquet composites, which are accompanied by the build-up and dephasing of entanglement and information.

Th-PO.29 **Single Spatio-Temporal Mode Bright Twin Beams Driven by Sub-10-fs Pump Pulses**
Patrick Cusson, Stéphane Virally, Denis Seletskiy
Polytechnique Montréal, Montréal, Canada
Bright squeezed states show great promise for field-resolved detection of mid-infrared wavepackets. Toward this, we demonstrate the generation and characterization of intense ultrabroadband twin beams operating in the single-mode limit.

Th-PO.31 **Nonlinearly-driven memory loss of incubative effects in fused silica excited by few-cycle pulses**
José R. C. Andrade[1], Vladimir Fedorov[2], Vincenzo De Michele[2], Peter Sneftrup[1], Peter Jürgens[1], Laura Rammelt[1], Marc J. J. Vrakking[1], Razvan Stoian[2], Jean-Philippe Colombier[2], Tamas Nagy[1], Alexandre Mermillod-Blondin[1]
[1]Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany. [2]Univ-Lyon, Laboratoire Hubert Curien (LabHC), Saint-Etienne, France
When using sub-4-fs pulses, in contrast to 40 fs pulses, we observed the absence of the typically measured reduction of the laser intensity threshold for plasma formation due to defect incubation in fused silica.

Th-PO.32 **Efficient Picosecond Temporal Shaping for High-Average Power Applications**
Randy Lemons[1], Jack Hirschman[1], Charles Durfee[2], Sergio Carbajo[3,1]
[1]SLAC National Accelerator Laboratory, Menlo Park, USA. [2]Colorado School of Mines, Golden, USA. [3]University of California Los Angeles, Los Angeles, USA
We present a novel framework for generating temporally shaped, near transform-limited, picosecond pulses via non-colinear sum frequency generation bypassing limitations of typical picosecond shaping methods and demonstrate it producing temporally flattop, high-average power, deep-UV pulses.

Th-PO.33 **Development of Ultrafast Electron Beam Induced Current Measurements**
Joël Rehmann, Nikolaus Edler von Schickh, Francisco Carrion, Andreas Vaterlaus, Yves Acremann
ETH, Zürich, Switzerland
The emergence of the Ultrafast SEM allows for the development of time resolved EBIC with ps time resolution. A pulsed reverse bias is applied to a Si photodiode as a proof of principle experiment.

Th-PO.34 **Three-Pulse Pump-Probe Technique for the Low-Energy Gain Dynamics in Epitaxial Graphene**
Kalliopi Mavridou[1,2], Angelika Seidl[1,2], Alexej Pashkin[1], Thales V. A. G. de Oliveira[1,3], Claire Berger[4], Walter A. de Heer[4], Manfred Helm[1,2], Stephan Winnerl[1]
[1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany. [2]Faculty of Physics, Technische Universität Dresden, Dresden, Germany. [3]Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany. [4]School of Physics, Georgia Institute of Technology, Atlanta, USA
Gain dynamics of graphene in the mid-infrared regime has attracted significant interest. Here, by utilizing a three-pulse pump-probe technique, we find evidence for transient gain and discuss relevant carrier relaxation channels.

Th-PO.35 **Accelerating laser-induced demagnetization in ferromagnetic films by adjacent antiferromagnetic layers through optically-induced intersite spin transfer**
Ming-Shian Tsai[1,2], Li-Han Chang[1], Guang-Yu Guo[3,4], Bo-Yao Wang[2], Ming-Chang Chen[1,5]
[1]Institute of Photonics Technologies, National Tsing Hua University, Hsinchu 300, Taiwan. [2]Department of Physics, National Changhua University of Education, Changhua 500, Taiwan. [3]Department of Physics and Center for Theoretical Physics, National Taiwan University, Taipei 106, Taiwan. [4]Physics Division, National Center for Theoretical Sciences, Taipei 106, Taiwan. [5]Department of Physics, National Tsing Hua University, Hsinchu 300, Taiwan
Upon femtosecond light exposure, antiferromagnetic Mn remarkably accelerates neighboring ferromagnetic layer demagnetization, approaching the pump pulse duration. This study identifies the underlying mechanism as optically-induced intersite spin transfer and precisely quantifies its contribution to demagnetization.

Th-PO.36 **Ultrafast Predissociation in Vinyl Iodide**
Marta Murillo-Sánchez[1], Sonia Marggi Poullain[2], Alexandre Zanchet[3], Jesús González-Vázquez[4], Paulo Limão-Vieira[5], Nelson De Oliveira[6], Luis Bañares[2]
[1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany. [2]Universidad Complutense de Madrid, Madrid, Spain. [3]Instituto de Física Fundamental (IFF-CSIC), Consejo Superior de Investigaciones Científicas, Madrid, Spain. [4]Universidad Autónoma de Madrid, Madrid, Spain. [5]Universidade Nova de Lisboa, Lisboa, Portugal. [6]Synchrotron SOLEIL, Gif sur Yvette, France
A joint experimental and theoretical investigation of the time-resolved photodissociation dynamics of vinyl iodide upon photoexcitation around 200 nm is presented. An ultrafast predissociation mechanism between $n\perp\pi^*/\pi\pi^*$ and $n//\pi^*$ states is reported.

Th-PO.37 **Ultrafast Dynamics of a -$CH_2$-Bridged Azobenzene by Femtosecond Mass Spectrometry and Photoionization–Photofragmentation Spectroscopy**
Pascal Pessier, Lukas Guhl, Friedrich Temps
Christian-Albrechts-University Kiel, Kiel, Germany
Femtosecond time-resolved mass spectrometry and photoionization–photofragmentation spectroscopy of Z-11H-Dibenzodiazepine in a molecular beam revealed an ultrashort $S_1$ state lifetime and a pronounced butterfly oscillation in the $D_0$ ground state of the cation.

Th-PO.38 **Spectroscopic Investigation of Bi-Ho Co-Doped Lead-Free Double Perovskite Nanocrystals**
Md Soif Ahmed[1,2], Chinmay Barman[1], Demetra Tsokkou[2], Natalie Banerji[2], Sai Santosh Kumar Raavi[1]
[1]Indian Institute of Technology Hyderabad, Sangareddy, India. [2]University of Bern, Bern, Switzerland
By combining photoluminescence, time-resolved photoluminescence, temperature-dependent photoluminescence, and optical-pump-terahertz-probe experiments, we reveal the photophysical properties and excited state carrier dynamics of Bi-Ho co-doped double perovskite nanocrystals in this study.

Th-PO.39 **Ultrafast Self- and Cross-Switching of Long Wavelength Near-Infrared Pulses in Dual-Core Soft Glass Fibers**

Sarah Pulikottil Alex[1], Vinzenz Stummer[1], Mattia Longobucco[2], Dariusz Pysz[2], Ryszard Buczynski[2], Edgar Kaksis[1], Audrius Pugžlys[1], Andrius Baltuška[1], Ignác Bugár[1]
[1]Institut für Photonik, TU Wien, Vienna, Austria. [2]Łukasiewicz IMiF, Warsaw, Poland

We demonstrate high-contrast nonlinear all-optical switching of femtosecond pulses using soft glass dual-core fibers. Self-switching of 2.1 μm and cross-switching of 1.7 μm pulses, respectively, reveal an improved application potential.

Th-PO.40 **Optical spectroscopy of thermal current fluctuations detected via quantum interference of absorption pathways in centrosymmetric semiconductors**

Amin Lakhal[1], Jacob B. Khurgin[2], Denis V. Seletskiy[1]
[1]Polytechnique Montreal, Montreal, Canada. [2]Johns Hopkins University, Baltimore MD, USA

We propose a time-resolved optical measurement scheme for providing access to intraband current fluctuations in bulk centrosymmetric semiconductors, and using proposed scheme estimate a few-percent coupling to thermal fluctuations in materials like GaAs

Th-PO.42 **Ultrafast Control over Chiral Sum-frequency Generation**

Joshua Vogwell[1], Laura Rego[2], Olga Smirnova[3], David Ayuso[1,3]
[1]Imperial College London, London, United Kingdom. [2]Universidad Autonoma de Madrid, Madrid, Spain. [3]Max-Born Institut, Berlin, Germany

We introduce an ultrafast and all-optical technique for efficient chiral recognition relying on interference between sum-frequency generation and third-harmonic generation, two low-order non-linear processes which are ubiquitous in non-linear optics.

Th-PO.43 **Two-Color Effects in the Formation of Periodic Surface Structures in Polymers**

Rebeca de Nalda[1], Maria Eugenia Corrales[2], Ignacio Casasús[3], Luis Bañares[3], Tiberio Ezquerra[1], Esther Rebollar[1]
[1]CSIC, Madrid, Spain. [2]Universidad Autónoma de Madrid, Madrid, Spain. [3]Universidad Complutense de Madrid, Madrid, Spain

Laser-induced surface structures were generated on the surface of a polymeric material with sequences of ultrashort bichromatic laser fields. The effect of the interpulse delay on the surface structures is described

Th-PO.45 **Ligand-to-cluster energy transfer in colloidal Ag29 clusters upon direct ligand excitation**

Huan Zhao[1,2], Torben Steenbock[3], Arved Heilmann[3], Matthais Ruppert[1], Yuan Zeng[1], Indranath Chakraborty[1,4], Wolfgang Parak[1,2], Gabriel Bester[2,3], Nils Huse[1,2]
[1]Department of Physics, University of Hamburg, Hamburg, Germany. [2]The Hamburg Centre for Ultrafast Imaging, Hamburg, Germany. [3]Department of Chemistry, University of Hamburg, Hamburg, Germany. [4]School of Nano Science and Technology, Indian Institute of Technology Kharagpur, Kharagpur, India

We observe ligand-to-cluster energy transfer from excitations to the lowest exciton state in colloidal $Ag_{29}$ clusters within 3 ps and – upon direct ligand excitation –coupling the lowest exciton transition- to $Ag_{29}$ Raman modes.

Th-PO.46 **Rewritable and Lattice-Coupled Surface Structures in Single-Crystalline Vanadium Dioxide**

Daniel Kazenwadel, Noel Neathery, Peter Baum
Universität Konstanz, Konstanz, Germany

We create laser-induced periodic surface structures (LIPSS) on single crystals of $VO_2$ and discover an anisotropic response that is linked to the crystal structure.

Th-PO.47 **Ultrafast spin-current generation driven by linearly polarized light field on surface of three-dimensional topological insulators**

Yasushi Shinohara[1,2], Haruki Sanada[1], Katsuya Oguri[1]
[1]NTT Basic Research Laboratories, Atsugi, Japan. [2]NTT Research Center for Theoretical Quantum Information, Atsugi, Japan

We explored ultrafast electron motion control using intense infrared light. We conducted theoretical

investigation on spin-polarized current generation through a strong electric field of light. The results indicate spin-current generation, independent of charge-current direction.

Th-PO.48 **Traversal time regimes across potential barriers**
Philip Caesar Flores[1], Dean Alvin Pablico[2], Eric Galapon[2]
[1]Max Born Institute, Max-Born-Str. 2A 12489 Berlin, Germany. [2]National Institute of Physics, Quezon City, Philippines
We use the theory of time-of-arrival operators to reconcile the conflicting reports on instantaneous and non-zero tunneling times by establishing the relation between an incident wavepacket's momentum distribution and the shape of the barrier.

Th-PO.49 **Third-harmonic generation driven by out-of-equilibrium electron dynamics in XUV near-zero index materials**
Matteo Silvestri[1], Ambaresh Sahoo[1], Luca Assogna[1], Paola Benassi[1,2], Carino Ferrante[2], Alessandro Ciattoni[2], Andrea Marini[1,2]
[1]University of L'Aquila, L'Aquila, Italy. [2]CNR-SPIN, L'Aquila, Italy
We theoretically model third-harmonic generation due to collision-driven nonlinear electron dynamics in extreme ultraviolet near-zero index materials, exploring their potential for the development of table-top extreme ultraviolet radiation sources and integrated spectroscopy schemes.

Th-PO.50 **Asymmetric Dissociation of Vibrationally Excited $NO_2$ in Phase-locked ω-2ω Intense Laser Fields**
Yuki Ono[1], Hiroka Hasegawa[2], Akitaka Matsuda[1], Akiyoshi Hishikawa[1]
[1]Nagoya University, Nagoya, Japan. [2]The University of Electro-communications, Tokyo, Japan
Asymmetric dissociation of vibrationally excited $NO_2$ in ω-2ω intense laser fields is investigated by coincidence ion momentum imaging. The observed phase-dependent asymmetry suggests that the dominant reaction control mechanism changes by the initial vibrational state.

Th-PO.51 **Tracking Chemical Bond Reorganization in Intramolecular Proton Transfer via Ultrafast X-ray Photoelectron Spectroscopy**
Yonghao Gu[1], Haiwang Yong[2], Bing Gu[3], Shaul Mukamel[1]
[1]University of California, Irvine, Irvine, USA. [2]University of California San Diego, La Jolla, USA. [3]Westlake University, Hangzhou, China
Local observation of the chemical bond breaking and forming dynamics is challenging. We show theoretically that time-resolved X-ray photoelectron spectroscopy can track the local bond dynamics through the time evolution of excited-state chemical shifts.

Th-PO.52 **Femtosecond time-resolved spectroscopy of incommensurate LaVS3 crystal – photo-induced metal to insulator transition.**
Mateusz Weis, Davide Boschetto
LOA, ENSTA ParisTech, CNRS, Ecole Polytechnique, Palaiseau, France
This work presents findings from femtosecond time-resolved spectroscopy on LaVS3, revealing interactions between carriers and phonon modes. It elucidates effects on thermal conductivity and emergence of metastable states due to carrier trapping within vanadium clusters.

Th-PO.53 **GRIN Fiber Induced by Laser Vortex Beam in Silicon**
Nadav Shabairou, Zeev Zalevsky, Moshe Sinvani
Bar-Ilan University, Ramat-Gan, Israel
We present a technique for focusing NIR laser in semiconductors based on the plasma dispersion effect. We demonstrate focusing of a beam at λ=1550nm to PSF of 500nm by ps laser vortex beam at λ=775nm.

Th-PO.54 **A Grism-Based Approach for Single-Shot Dispersion-Scan**
Daniel Diaz Rivas, Ivan Sytcevich, Miguel Canhota, Chen Guo, Anne-Lise Viotti, Anne L'Huillier, Cord Arnold
Department of Physics, Lund University, Lund, Sweden
We demonstrate a new d-scan implementation, capable of measuring in single-shot ultrashort pulses with a bandwidth corresponding to a transform-limited duration of up to 30 fs.

Th-PO.55 **Two-Color-Driven Harmonic Generation using a Cascaded Plasma Mirror Set-up**
Vedin Dewan[1], Nicholas Fasano[1], Matthew Edwards[2], Andreas Giakas[1], Timothy Bennett[1], Julia Mikhailova[1]
[1]Princeton University, Princeton, USA. [2]Stanford University, Stanford, USA
A cascaded plasma mirror set-up is used to experimentally demonstrate enhanced and suppressed third harmonic generation using a phase-controlled two-color beam. Enhancement of 1.6x is seen at on-target intensity of $2x10^{19}$ $Wcm^{-2}$.

Th-PO.56 **Full Time-Scale Charge-Carrier Dynamics in Perovskite CaTiO3 powder revealed with a Fs-to-Ms Diffuse Reflectance Spectrometer**
Anton Trifonov[1,2], Muzaffar Boda[3], Chen Chen[3], Stanislav Stanimirov[4], Stefan Georgiev[2,1], Zhiguo Yi[3], Ivan Buchvarov[1,2]
[1]Physics Department, Sofia University, Sofia, Bulgaria. [2]IBPhotonics Ltd., Sofia, Bulgaria. [3]Shanghai Institute of Ceramics, Chinese Academy of Sciences, Shanghai, China. [4]Department of Chemistry and Pharmacy, Sofia, Bulgaria
The full-time scale of charge-carrier dynamics in perovskite CaTiO3 nanopowder has been revealed with a new fs-to-ms diffuse-reflectance technique. The observed time rates of the relaxation processes are: 350fs,ca.1ns,100-250 ns and 8–15 μs.

Th-PO.57 **Compression, Amplification and Frequency Up-Conversion of Optical Pulses by Laser-Kicked Molecules**
Alexander Loehr[1,2], Margarita Khokhlova[3,1], Misha Ivanov[1,4,2]
[1]Max Born Institute, Berlin, Germany. [2]Humboldt University, Berlin, Germany. [3]Kings College, London, United Kingdom. [4]Imperial College, London, United Kingdom
Laser-kicked molecules offer a prime opportunity for spatio-temporal control of the refractive index. We propose pulse propagation through impulsively aligned molecules inside a hollow core fiber as a tunable source of UV femtosecond light pulses.

Th-PO.58 **Investigate the electron phonon coupling of the 2D Sn perovskites using the impulsive Raman spectroscopy**
Ziyuan Ge, Artem Bakulin
Imperial College London, London, United Kingdom
By comparing the impulsive Raman and low frequency Raman result, the dominant phonon modes in the 2D Sn perovskites couple to electronic exited state could be determined.

Th-PO.59 **A Femtosecond-to-Millisecond Transient Absorption Technique for Characterizing TADF Molecules for Advanced OLED Devices**
Stanislav Stanimirov[1], Anton Trifonov[2,3], Lyuben Petrov[2,3], Ivan Buchvarov[3,4], Yulian Zagranyarski,[1], Anela Ivanova[1]
[1]Faculty of Chemistry and Pharmacy, Sofia University, Sofia, Bulgaria. [2]IBPhotonics, Sofia, Bulgaria. [3]John Atanasoff Center for Bio and Nano Photonics, Sofia, Bulgaria. [4]Department of Physics, Sofia University, Sofia, Bulgaria
We report a new approach for studying relaxation processes with femtosecond resolution in the fs-ms range. The ultrafast and long-lived states of thermally activated delayed fluorescence molecules for advanced OLED devices have been studied.

**Th-4A: Postdeadline Paper Session**
**17:15 - 19:00 Thursday, 18th July, 2024**
**Auditorium**
**Oral session**
**Chaired by** **Tobias Brixner, University of Würzburg, Würzburg, Germany**

**Fr-1A: Applications**
**08:30 - 10:15 Friday, 19th July, 2024**
**Auditorium**
**Oral session**
**Chaired by** **Martin Hörmann, Politecnico di Milano, Milano, Italy**

**08:30 - 09:00**
**Fr-1A.1 Invited Attosecond Electron Microscopy**
Peter Baum
Universität Konstanz, Konstanz, Germany
We report the advance of transmission electron microscopy to attosecond time resolution and show selected experimental results.

**09:00 - 09:15**
**Fr-1A.2 Tracking Ultrafast Nanoscale Energy Transport Using Extremely Low Excitation Fluences**
Guillermo D. Brinatti Vazquez[1], Giulia Lo Gerfo Morganti[1], Cvetelin Vasilev[2], C. Neil Hunter[2], Niek F. van Hulst[1,3]
[1]ICFO-Institut de Ciencies Fotoniques, The Barcelona Institute of Science and Technology, Castelldefels (Barcelona), Spain. [2]School of Biosciences, University of Sheffield, Sheffield, United Kingdom. [3]ICREA, Barcelona, Spain
We introduce a novel spatio-temporal microscopy technique that exploits structured illumination to dramatically reduce excitation fluence. We prove this by showing the first exciton diffusion measurements below sunlight intensity in two different light-harvesting systems.

09:15 - 09:30
Fr-1A.3 **Ultrafast Broadband Nanoscopy on Asymmetric Nanogaps**
Haoqing Ning[1], Marios Maimaris[1], Dmitrii Maslennikov[1], Emilie Gérouville[2], Jiewen Wei[1], Zhu Meng[1], Navendu Mondal[1], Evangelos Moutoulas[2], Tong Wang[1], Aleksandar Ivanov[3], Joshua B. Edel[3], Saif A. Haque[1], M. Yu. Ivanov[4], Jon P. Marangos[5], Dimitra G. Georgiadou[2], Artem A. Bakulin[1]
[1]Department of Chemistry and Centre for Processible Electronics, Imperial College London, London, United Kingdom. [2]Electronics and Computer Science & Optoelectronics Research Centre, University of Southampton, Southampton, United Kingdom. [3]Department of Chemistry, Molecular Science Research Hub, Imperial College London, London, United Kingdom. [4]Max Born Institute, Berlin, Germany. [5]Quantum Optics and Laser Science Group, Blackett Laboratory, Imperial College London, London, United Kingdom
We demonstrate ultrafast electron pulses in an asymmetric nanogap induced by laser pulses spectrally expanded from UV to mid-IR. Employing optical pump-electron probe, we demonstrate ultrafast nanoscopy of in-gap metal-halide perovskite quantum dot.

09:30 - 09:45
Fr-1A.4 **Terahertz coherent excitation of Raman-active phonons in van-der-Waals semiconductor $WSe_2$**
Satoshi Kusaba[1,2], Haw-Wei Lin[3], Ryo Tamaki[1], Ikufumi Katayama[1,4], Jun Takeda[1,4], Geoffrey A. Blake[2,3]
[1]Department of Physics, Graduate School of Engineering Science, Yokohama National University, Yokohama, Japan. [2]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, USA. [3]Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, USA. [4]Semiconductor and Quantum Integrated Electronics Research Center, Institute for Multidisciplinary Sciences, Yokohama National University, Yokohama, Japan
In this study, we demonstrate coherent sum-frequency excitation of Raman-active phonons in van-der-Waals semiconductor $WSe_2$ by irradiating intense and broadband terahertz pulses.

09:45 - 10:00
Fr-1A.5 **Ultrafast Coherent Control of Valley Polarization in a 2D Semiconductor**
Francesco Gucci[1], Mattia Russo[1], Franco V. A. Camargo[2], Rui E. F. Silva[3,4], Misha Ivanov[4,5,6], Álvaro Jiménez-Galán[4,7], Stefano dal Conte[1], Giulio Cerullo[1,2]
[1]Dipartimento di fisica, Politecnico di Milano, Milano, Italy. [2]IFN-CNR, Milano, Italy. [3]ICMM, Centro Superior de Investigaciones Científicas, Madrid, Spain. [4]Max Born Institute, Berlin, Germany. [5]Department of Physics, Humboldt University, Berlin, Germany. [6]Blackett Laboratory, Imperial College London, London, United Kingdom. [7]Joint Attosecond Science Laboratory, National Research Council of Canada and University of Ottawa, Ottawa, Canada
By employing a sequence of phase-locked collinear pulses, with precise sub-femtosecond-scale delay control, we experimentally demonstrate a new all-optical coherent ultrafast protocol for manipulating exciton valley polarization in a two-dimensional semiconductor at room temperature.

10:00 - 10:15
Fr-1A.6 **Single-shot THz-bursts-in-GHz-burst (BiBurst) imaging of picosecond dynamics in each GHz burst laser ablation**
Keitaro Shimada[1], Denisa Todorache[1,2], Rikako Tanaka[1], Takao Saiki[1], Yuki Inada[1,3], Keiichi Nakagawa[1]
[1]The University of Tokyo, Tokyo, Japan. [2]Friedrich-Alexander-Universtität Erlangen-Nürnberg, Erlangen, Germany. [3]Saitama University, Saitama, Japan
We developed an all-optical technique for THz-burst imaging at GHz repetition, and captured the 0.9 ps-burst images of plasma dynamics induced by each laser pulse in 1 GHz burst copper ablation.

**COFFEE BREAK**
**10:15 - 10:45 Friday, 19th July, 2024**
**Auditorium halls**

**Fr-2A: Microscopy**
**10:45 - 12:30 Friday, 19th July, 2024**
**Auditorium**
**Oral session**
**Chaired by Jun Nishida, Institute for Molecular Science, Okazaki, Japan**

10:45 - 11:15
Fr-2A.1 Invited **Few-electron correlations and number statistics of free electron pulses in ultrafast photoemission from metal needle tips**
Jonas Heimerl[1], Stefan Meier[1], Alexander Mikhaylov[2], Maria Chekhova[1,2], Peter Hommelhoff[1]
[1]Friedrich-Alexander Universität Erlangen-Nürnberg, Erlangen, Germany. [2]Max Planck Institute for the Science of Light, Erlangen, Germany
We show that electrons triggered from nanometric needle tips exhibit Coulomb repulsion in energy. Furthermore, we demonstrate that the electron number statistics inherits the statistics of the driving light, both for classical and non-classical light.

11:15 - 11:30
Fr-2A.2 **All-Optical Subcycle Microscopy with Atomic-Scale Resolution**
Johannes Hayes, Thomas Siday, Felix Schiegl, Fabian Sandner, Peter Menden, Valentin Bergbauer, Martin Zizlsperger, Svenja Nerreter, Sonja Lingl, Jascha Repp, Jan Wilhelm, Markus A. Huber, Yaroslav A. Gerasimenko, Rupert Huber
University of Regensburg, Regensburg, Germany
Utilizing a qualitatively new nonlinear contrast mechanism in near-field light-matter interaction, we promote all-optical microscopy to atomic-scale resolution. This way we trace the atomically confined quantum flow of electrons faster than a cycle of light.

11:30 - 11:45
Fr-2A.3 **Two-Color Control of Attosecond Tunneling Currents in a Scanning Tunneling Microscope**
Boyang Ma, Adi Goldner, Michael Krüger
Technion-Israel institute of technology, Haifa, Israel
Our experimental and theoretical study shows that tunneling currents in a scanning tunneling microscope driven by a two-color laser field have sub-cycle duration and can be controlled by the optical phase, enabling extreme spatio-temporal microscopy.

11:45 - 12:00
Fr-2A.4 **Single-Particle Coupling in Event-Based and Ultrafast Electron Microscopy**
Armin Feist[1,2], Germaine Arend[1,2], Rudolf Haindl[1,2], Guanhao Huang[3,4], Yujia Yang[3,4], Jan-Wilke Henke[1,2], Arslan Sajid Raja[3,4], Till Domröse[1,2], Marcel Möller[1,2], John H. Gaida[1,2], F. Jasmin Kappert[1,2], Rui Ning Wang[3,4], Hugo Lourenço-Martins[1,2], Zheru Qiu[3,4], Junqiu Liu[3,4], Sergey V. Yalunin[1,2], Ofer Kfir[1,2], Tobias J. Kippenberg[3,4], Claus Ropers[1,2]
[1]Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany. [2]University of Göttingen, Göttingen, Germany. [3]Swiss Federal Institute of Technology Lausanne, Lausanne, Switzerland. [4]Center for Quantum Science and Engineering, EPFL, Lausanne, Switzerland
We implement event-based detection in ultrafast transmission electron microscopy, resolving stochastic scattering and beam fluctuations. Strong few-particle correlations between electrons and photons are induced, enabling versatile heralding schemes and sub-Poissonian electron beam statistics.

12:00 - 12:15
Fr-2A.5 **Ultrafast atomic-scale scanning tunneling spectroscopy of a phonon-driven vacancy in a monolayer crystal**
Yaroslav Gerasimenko, Carmen Roelcke, Lukas Kastner, Maximilian Graml, Andreas Biereder, Jan Wilhelm, Jascha Repp, Rupert Huber
Department of Physics and Regensburg Center for Ultrafast Nanoscopy (RUN), University of Regensburg, Regensburg, Germany
Deciphering the interplay of atomic and electronic motion requires probing at intrinsic space-time-energy scales. We resolve phonon modulations of defect-bound states by sampling electronic spectra with atomic and sub-ps precision, faster than a vibration period.

12:15 - 12:30
Fr-2A.6 **Attosecond Electron Microscopy using Free-Electron Homodyne Detection**
John Gaida[1,2], Hugo Lourenço-Martins[1,2,3], Murat Sivis[1,2], Thomas Rittmann[1,2], Armin Feist[1,2], F. Javier García de Abajo[4,5], Claus Ropers[1,2]
[1]Department of Ultrafast Dynamics, Max Planck Institute for Multidisciplinary Sciences, Göttingen, Germany. [2]4th Physical Institute, University of Göttingen, Göttingen, Germany. [3]CEMES-CNRS, Université de Toulouse, CNRS, Toulouse, France. [4]ICFO-Institut de Ciencies Fotoniques, Castelldefels (Barcelona), Spain. [5]ICREA-Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain
We introduce homodyne detection of free electrons to measure the electronic quantum state and image the optical near-field of a plasmonic nanoprism with 23 as (rms) temporal and few-nm spatial resolutions.