The 19th International Conference on Ultrafast Phenomena (UP2014)

Organized by

Japan Intense Light Field Science Society (JILS)
http://www.jils.jp/

Center for Ultrafast Intense Laser Science (CUILS),
the University of Tokyo
http://www.cuils.org/

Technical Program supported by

The Optical Society (OSA)
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Coherent, Inc.
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http://www.toptica.com/

Contents

Welcome to Okinawa and to the International Conference on Ultrafast Phenomena!

This year's event – the XIX biannual international conference – continues the tradition of bringing together a multidisciplinary group of researchers sharing a common interest in science and technology at the highest temporal resolution. Scientists and engineers from all over the world will join us to take part in this event.

The conference will include 315 oral and poster contributions. We have scheduled 11 invited, 124 oral and 180 poster presentations over what should be five very full days. The presentations are in our opinion exceptional in their scientific quality and range of topics.

A sponsor exhibit featuring leading companies will be held in conjunction with the meeting.

We hope that you will enjoy the unique beauty of Okinawa, the program, and the opportunity to spend time with colleagues from around the globe.

Sincerely,

General Chairs

Kaoru Yamanouchi, *University of Tokyo, Japan*
Steven Cundiff, *JILA, NIST and University of Colorado, USA*
Regina de Vivie-Riedle, *Ludwig-Maximilians-University, Germany*

Program Committee Chairs

Makoto Kuwata-Gonokami, *University of Tokyo, Japan*
Louis DiMauro, *Ohio State University, USA*

Conference topics

Pulse generation and measurement

New sources, new wavelength regimes, frequency conversion techniques, amplifiers, attosecond pulse generation, pulse shaping, pulse diagnostics, measurement techniques and frequency standards.

Physics

Ultrafast nonlinear optical processes, kinetics of non-equilibrium processes, quantum confinement, coherent transients, nonlinear pulse propagation, novel ultrafast spectroscopic techniques, high intensity physics, attosecond dynamics.

Materials science

Highly correlated systems, coherent phonons in solids, carrier dynamics in nanoparticles, carbon-based materials, structural dynamics with X-rays and electrons.

Chemistry

Vibrational and conformational dynamics, energy transfer, femtochemistry, proton and electron transfer, solvation dynamics, wave packet dynamics and coherent control of reactions, structural dynamics with X-rays and electrons.

Biology

Photosynthesis, vision, heme proteins, photoactive proteins, photoisomerization in chromoproteins, wavepacket dynamics, femtobiology, structural dynamics with X-rays and electrons, medical applications.

Electronics & optoelectronics

Photoconductivity, generation, propagation and detection of ultrafast electrical signals, plasmonics, terahertz radiation, electro-optical sampling and detectors.

Applications

Real world applications of ultrafast technology, including ultrafast near-field, nonlinear and confocal microscopes, real-time/real-space electron microscopy, medical applications, high speed communication, micromachining and more.

Speaker instructions

Duration of oral presentations are:

- 15 minutes (including 3 minutes for discussion) for contributed talks
- 30 minutes (including 5 minutes for discussion) for invited talks

Speakers are requested to bring their own computers. Our projectors will be equipped with standard D-SUB 15-pin cables. If your computer is Macintosh, you must bring your own adapter.

Make sure to test your computer and its connection to the projector during the coffee break preceding the talk or the afternoon of the day before for those scheduled in the morning. This is mandatory as the schedule is tight and time has to be respected in order for listeners to move from one lecture hall to the other during parallel sessions.

Speakers are asked to check-in with the session presider in the conference room ten minutes before the session begins. The lecture halls are equipped with microphones and projectors.

Postdeadline contributions

As a tradition, the 19th International Conference on Ultrafast Phenomena will showcase postdeadline presentations. The purpose of these contributions is to give conference participants the opportunity to hear new and significant results in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness will be accepted for presentation as an oral contribution. The post deadline papers are scheduled for oral presentation on Thursday July 10 between 16:15 - 18:00

in Room A. Authors will be notified whether their papers have been accepted on Monday July 7 directly at the registration desk. Postdeadline papers may be included in the proceedings if the authors can submit the manuscript in a timely manner.

Poster instructions

180 posters will be presented during three sessions that will take place on Monday July 7, Tuesday July 8, and Thursday July 9 (all sessions scheduled from 15:45 to 17:15). There will be no oral presentations during this time.

Poster sessions are scheduled to provide an opportunity for selected papers to be presented in greater visual details and to facilitate discussions among attendees. To display his/her poster, each author is provided with a 90 cm wide × 210 cm high space (maximum dimensions). A poster may only be put up on the day of the assigned poster session. Each presenter must take care to remove his/her poster by no later than 19:00 on the same day. Poster presenters are asked to be at their posters during their poster session. Note: Fixing material will be provided. The boards will be marked with poster presentation codes.

Proceedings

As at previous conferences, a book of Proceedings of the Ultrafast Phenomena XIX will be published. Authors of all accepted contributions (invited, oral, and poster) are invited to submit a paper for the book of Proceedings. We anticipate this volume to contain around 300 articles of 3 pages each. The Proceedings will be published by Springer Verlag. Each conference participant will receive a hard copy of the book, as well as a one-year online access to its electronic version.

All papers must follow the format and style set by Springer. Author instructions are given on the conference website at:

http://up2014.org/proceedings.html

The most salient information is the following:

- The paper is limited to no more than 3 pages, including all text, figures, and references.
- Papers are to be submitted in LaTeX (with PDF) or MS Word format by email to up2014@chem.s.u-tokyo.ac.jp. Papers must be submitted no later than 17:00 on July 19, 2014, JST (8:00 on July 19, GMT). A signed Consent to Publish form and high-resolution image files for all figures must accompany each submission.
- No late papers, incorrectly formatted papers, or papers longer than 3 pages will be accepted.

Conference digest

An online technical digest including the two-page summaries will be available to the participants.

Registration information

On-site registration fees are as follows:

	Member *	Non-member
Regular participant	50,000 JPY	60,000 JPY
Student	30,000 JPY	40,000 JPY
Accompanying person		15,000 JPY

* Members of the Japan Intense Light Field Science Society (JILS), the Optical Society (OSA), the European Physical Society (EPS), the Chemical Society of Japan (CSJ), the Physical Society of Japan (JPS), the Japan Society of Applied Physics (JSAP), the Laser Society of Japan (LSJ), and the Spectroscopical Society of Japan (SPSJ) are eligible to attend UP2014 at a member participant rate.

All registered regular and student participants are eligible to:

- Admission to the technical sessions of the conference.
- Online digest including the two page summaries.
- Hard copy of the proceedings.
- One-year access to the electronic edition of the proceedings.
- Sponsor exhibition running from Monday morning to Friday noon time.
- Coffee breaks (Monday July 7 through Friday July 11) as mentioned in the program.
- Lunches (Monday July 7 through Friday July 11).
- Welcome reception on Sunday July 6 at 18:00 (the registration desk will be open on this day from 15:00 to 18:00).
- Beach side barbecue party sponsored by Spectra-Physics on Tuesday evening, July 8, at 19:00.
- Conference banquet dinner on Thursday evening, July 10, at 19:00.

An attendee registered as an accompanying person is eligible to the five lunches, coffee service, and the three social events (welcome reception, beach side barbeque party sponsored by Spectra-Physics, and conference banquet). They cannot receive the online digest of the conference, or the hard copy or online version of the proceedings volume.

Registration hours are as follows:

Sunday July 6, 2014 ····· 15:00 - 18:00
Monday July 7, 2014 ····· 8:00 - 12:30 and 13:45 - 17:00
Tuesday July 8, 2014 ····· 8:00 - 12:30 and 13:45 - 17:00
Wednesday July 9, 2014 ····· 8:00 - 12:30 and 13:45 - 17:00
Thursday July 10, 2014 ····· 8:00 - 12:30 and 13:45 - 17:00
Friday July 11, 2014 ····· 8:30 - 11:00

Social program

Sunday July 6, 18:00-19:30

Welcome reception
at the Pool Side Garden, Laguna Garden Hotel
URL: http://www.laguna-garden.jp/
Phone: 098 (897) 2121
(To be held in Hagoromo West in case of rain)

Tuesday July 8, 19:00-21:00

Beach side barbecue party sponsored by Spectra-Physics
at Ginowan Tropical Beach
(To be postponed to Wednesday July 9, 19:00-21:00, in case of rain)

Thursday July 10, 19:00-22:00

Conference banquet dinner
in Banquet Hall Hagoromo, Laguna Garden Hotel
URL: http://www.laguna-garden.jp/
Phone: 098 (897) 2121

Lunches

All UP2014 attendees are eligible to five lunches (from Monday July 7 to Friday July 11). Lunch will be served in the Exhibition Hall, Okinawa Convention Center.

Attention

All indoor areas of the Okinawa Convention Center are strictly non-smoking. No food or drink is allowed inside Room A (the Theater).

On-site facilities

Free wireless Internet access is available at the Okinawa Convention Center, to be used at your own risk and discretion.

A message board will be installed near the registration area.

Sponsor exhibition

Sponsor exhibition booths are situated around the poster session area. See the list of sponsors on pages XXIV-XXV. The exhibits will be shown throughout the conference.

The exhibition space is located close to the lecture halls and next to the poster area, in order to allow the participants easy access to the booths. Coffee breaks are arranged to give the participants the opportunity to visit the booths.

Exhibitor information

Exhibitors are able to set up their booths in the morning on Monday July 7 from 9:00.

All exhibition equipment and material must be removed by Friday 14:00 at the latest.

Conference committees

General Chairs

Kaoru Yamanouchi, *University of Tokyo, Japan*
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Masayuki Yoshizawa, *Tohoku University*

Timetable

	Sunday, July 6	Monday, July 7		Tuesday, July 8	
8:00					
		Opening Comments, **Room A, 8:30 - 8:45**			
9:00		[07.Mon.A] Attosecond and High Harmonic Generation **Room A, 8:45 - 10:15** Presider: Kaoru Yamanouchi **Katsumi Midorikawa, Ming-Chang Chen, Vincent Juvé, Andrius Baltuska, Chii Dong Lin*		[08.Tue.A] Attosecond Electron Dynamics **Room A, 8:30 - 10:15** Presider: Louis DiMauro **Thomas Pfeifer, Maurizio Reduzzi, Mauro Nisoli, Shunsuke Adachi, Dimitrios Charalambidis, Jens Herrmann*	
10:00		Coffee Break **10:15 - 10:45**		Coffee Break **10:15 - 10:45**	
		[07.Mon.B] Electronic and Reaction Dynamics **Room A, 10:45 - 12:30** Presider: Kevin Kubarych *Martin Zanni, Heide Ibrahim, Andreas Steinbacher, Regina de Vivie-Riedle, Thomas Wolf, Franziska Fennel, Yuki Obara*	[07.Mon.C] Ultrafast Phenomena in Semiconductors **Room B, 10:45 - 12:30** Presider: Daniele Brida *Steven Cundiff, Kunie Ishioka, Takeshi Suzuki, Kohji Mizoguchi, Yasushi Shinohara, Itay Gdor, Simon Gelinas*	[08.Tue.B] Nanotips and Nanooptics **Room A, 10:45 - 12:30** Presider: Walter Pfeiffer *Alexander Paarmann, Kazunori Toma, William Putnam, Fumiya Kusa, Max Gulde, *Frank Hegmann*	[08.Tue.C] Biology **Room B, 10:45 - 12:30** Presider: Erik T.J. Nibbering *Jennifer Ogilvie, Thomas Oliver, Takeshi Miki, Jeffrey Davis, Margherita Maiuri, Yutaka Nagasawa, Masayuki Yoshizawa*
11:00					
12:00					
		Lunch Break **12:30 - 14:00**		Lunch Break **12:30 - 14:00**	
13:00					
14:00		[07.Mon.D] Correlated Materials **Room A, 14:00 - 15:45** Presider: Ken Onda *Roman Mankowsky, Georgi Dakovski, Rohit Prasankumar, Michael Först, Tim Huber, Paul Beaud, Simon Wall*		[08.Tue.D] Pulse Generation **Room A, 14:00 - 15:45** Presider: Katsumi Midorikawa *Takao Fuji, Atsushi Yabushita, François Légaré, Eberhard Riedle, Keisaku Yamane, Jeffrey Moses, Tadas Balciunas*	
15:00					
16:00	Registration Open **15:00 - 18:00**	Poster Session I (60 papers) & Coffee Break **15:45 - 17:15**		Poster Session II (60 papers) & Coffee Break **15:45 - 17:15**	
17:00		[07.Mon.E] Condensed Phase Dynamics **Room A, 17:15-19:00** Presider: Shaul Mukamel **Tahei Tahara, Thomas Elsaesser, Kevin Kubarych, Toshinori Suzuki, Roland Wilcken, Kaoru Ohta*		[08.Tue.E] Singlet Imaging and Charge Transfer **Room A, 17:15 - 19:00** Presider: Gregory Scholes *Carlito Ponseca, Holger Lange, Artem Bakulin, Maxim Pshenichnikov, Kiyoshi Miyata, Tiago Buckup, Oleg Kozlov*	
18:00	Welcome Reception **18:00 - 19:30**				
19:00				Beach side barbecue party sponsored by Spectra-Physics **19:00 - 21:00**	
20:00					
21:00					

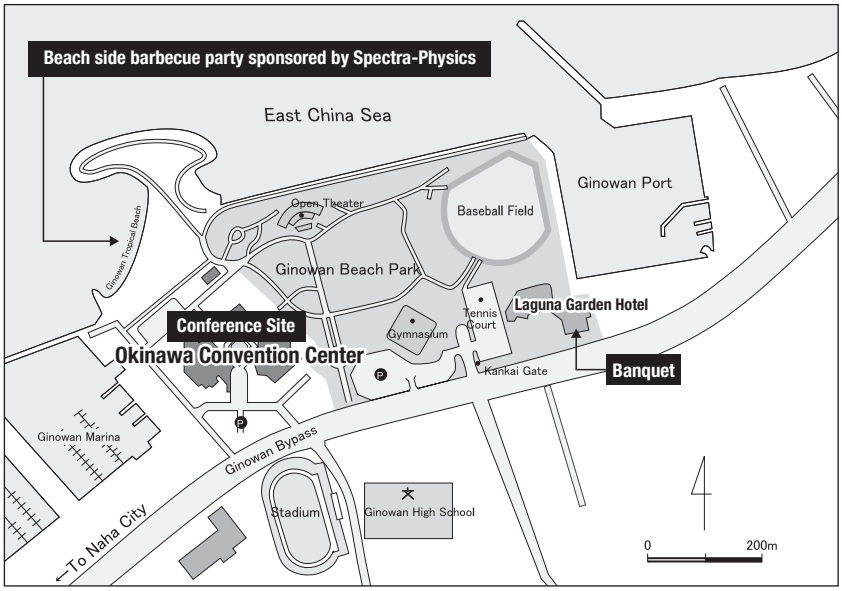
Invited speakers are marked by an asterisk (*)

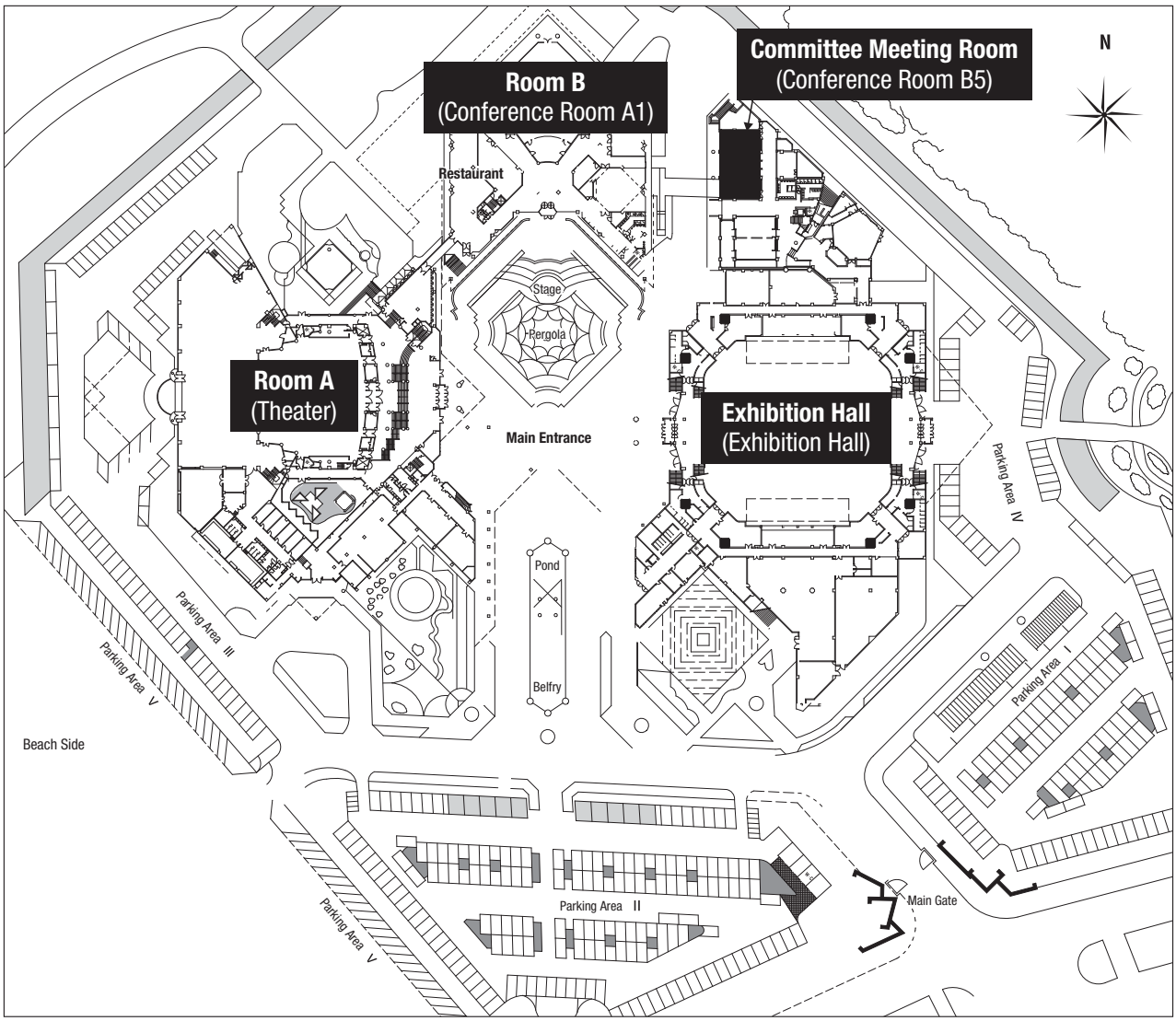
Timetable

Wednesday, July 9	Thursday, July 10	Friday, July 11	
			8:00
[09.Wed.A] 2D Spectroscopy **Room A, 8:30 - 10:15** Presider: Steven Cundiff **Giulio Cerullo, Shaul Mukamel, Trevor Courtney, Valentyn Prokhorenko, Luuk van Wilderen, Damian Schimpf*	[10.Thu.A] Strong THz Field Phenomena in Solids **Room A, 8:30 - 10:15** Presider: Koichiro Tanaka **Ryo Shimano, Yihua Wang, *Matthias Hohenleutner, Vincent Juvé, Alexander Grupp*	[11.Fri.A] Vibrational Dynamics **Room A, 8:30 - 10:15** Presider: Tahei Tahara *Erik T.J. Nibbering, Kevin Kubarych, Gregory Scholes, Akshay Rao, Jumpei Tayama, Tullio Scopigno, Ken Onda*	9:00
Coffee Break **10:15 - 10:45**	Coffee Break **10:15 - 10:45**	Coffee Break **10:15 - 10:45**	10:00
[09.Wed.B] Terahertz Dynamics **Room A, 10:45 - 12:30** Presider: Frank Hegmann *Bernhard Mayer, Fernando Ardana, József Fülöp, Dmitry Turchinovich, Yu Mukai, Tatsuya Miyamoto, Sim Sangwan* [09.Wed.C] Electron Diffraction and Rescattering Dynamics **Room B, 10:45 - 12:30** Presider: Reika Kanya *Peter Baum, Yuya Morimoto, Michael Pullen, Henning Geiseler, Xinhua Xie, Markus Kitzler, Sebastian Heuser*	[10.Thu.B] Novel Ultrafast Spectroscopy in Solids **Room A, 10:45 - 12:30** Presider: Kazutaka Nakamura *Patrick Grychtol, Marcus Ossiander, Walter Pfeiffer, Antoine Moulet, Petra Gross, Stanislav Kruchinin, Kazuhiko Misawa* [10.Thu.C] Microscopy and Dielectrics **Room B, 10:45 - 12:30** Presider: Jesse Clark *Takayuki Suzuki, Ilyas Saytashev, *Sergiu Amarie, Yusuke Yamanaka, Gunter Steinmeyer, Sabine Keiber*	[11.Fri.B] XFEL and High-order Harmonic Spectroscopy **Room A, 10:45 - 12:30** Presider: Tomoya Okino *Barry Bruner, Cheng-Tien Chiang, Matteo Negro, Guillaume Laurent, Oren Pedatzur, *Philip Bucksbaum*	11:00
			12:00
		Closing Remarks 12:30 - 12:45	
Lunch Break **12:30 - 14:00**	Lunch Break **12:30 - 14:00**	Lunch Hour **12:45 - 13:45**	13:00
[09.Wed.D] Structural Dynamics **Room A, 14:00 - 15:45** Presider: Eberhard Riedle *Christopher Milne, Hana Cho, Matthew Ross, Elena Samoylova, Koji Motomura, Benjamin Fingerhut, Yifeng Jiang*	[10.Thu.D] Excited State Dynamics **Room A, 14:00 - 15:45** Presider: Regina de Vivie-Riedle **Leticia González, Friedrich Temps, Sebastian Thallmair, Dominik Bucher, Hikaru Kuramochi, Henrike Müller-Werkmeister*		14:00
			15:00
Poster Session III (60 papers) & Coffee Break **15:45 - 17:15**	Coffee Break **15:45 - 16:15**		16:00
	Postdeadline Papers **Room A** **16:15 - 18:00** Presider: Makoto Kuwata-Gonokami		17:00
[09.Wed.E] Time-resolved Imaging **Room A, 17:15 - 19:00** Presider: Marcos Dantus **Jesse Clark, Daniel Hickstein, Keiki Fukumoto, Yoshio Nishiyama, John Papanikolas, Renske van der Veen*			18:00
	Conference Banquet **19:00 - 22:00**		19:00
			20:00
			21:00

Invited speakers are marked by an asterisk (*)

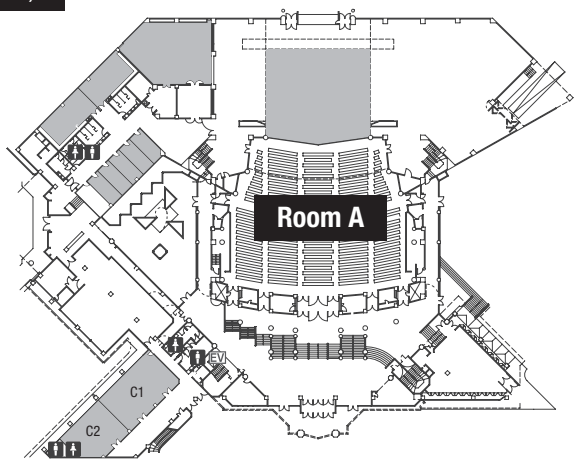
Conference site maps and floor plans





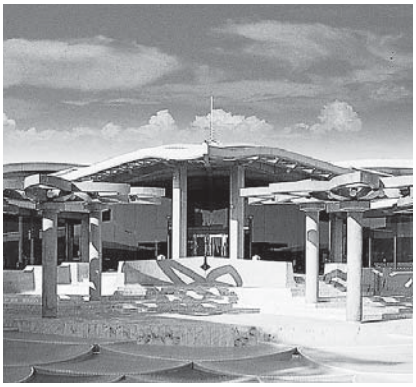
Room A
(Theater)

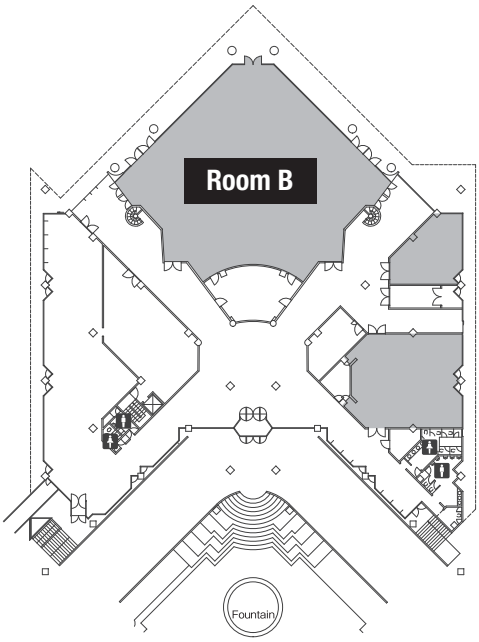
■ Oral presentations



Room B
(Convention Room A1, Conference Building A)

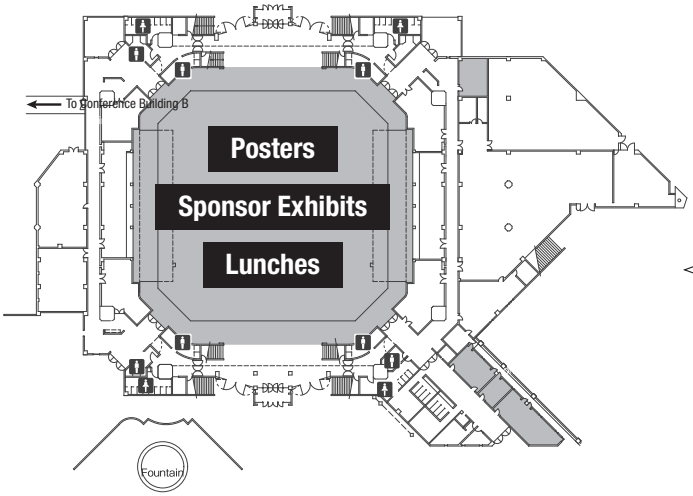
■ Oral presentations





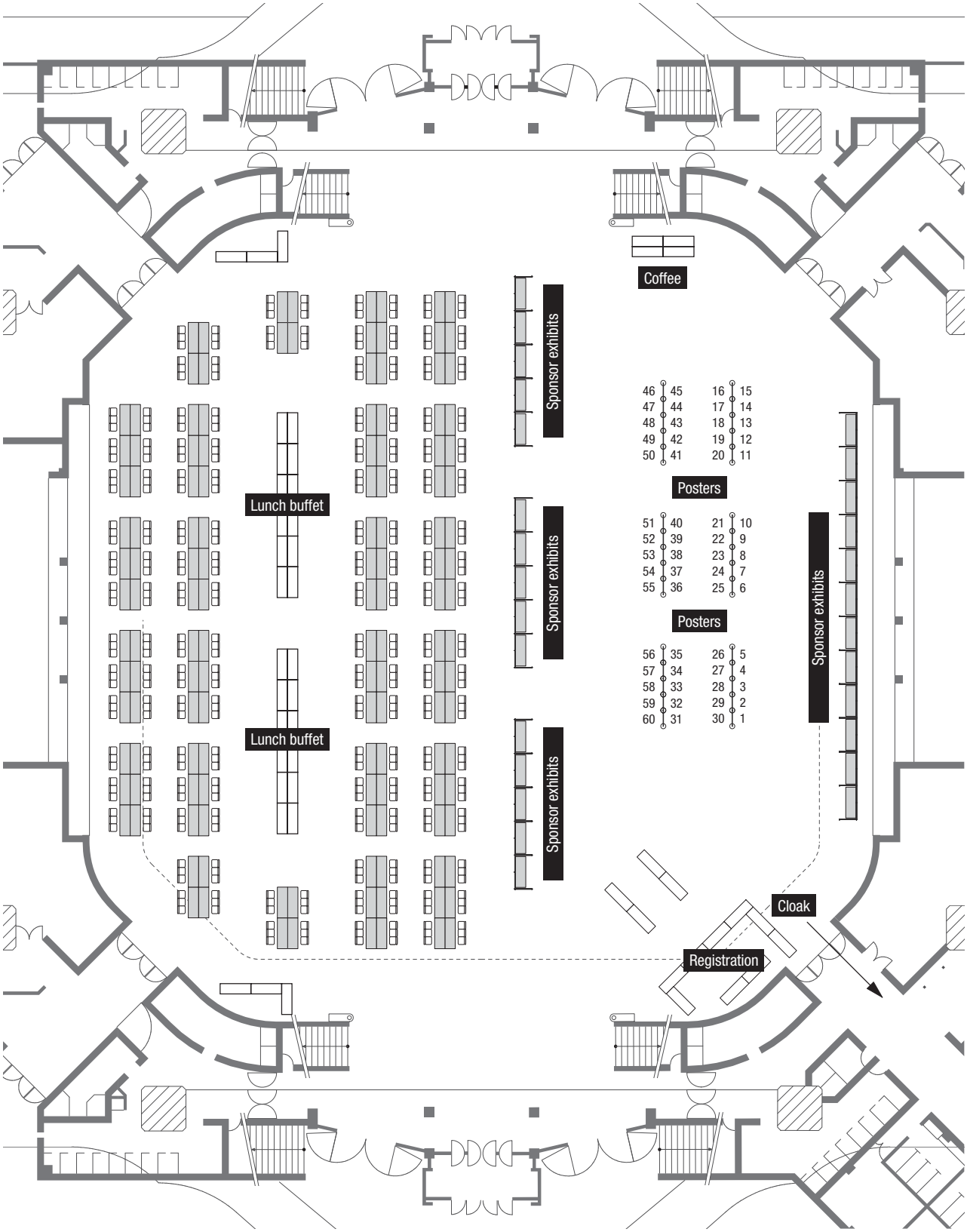
Exhibition Hall
(Exhibition Hall)

■ Posters, Sponsor exhibits and lunches



Exhibition Hall

Posters, Sponsor exhibits and lunches



Monday, July 7

Room A **08:45-10:15**

07.Mon.A Attosecond and High Harmonic Generation

Presider: Kaoru Yamanouchi *(University of Tokyo, Japan)*

07.Mon.A.1 08:45 ---------- Invited

Probing Ultrafast Molecular Dynamics with Intense Attosecond Pulses

Katsumi Midorikawa[1]; *[1]RIKEN Center for Advanced Photonics, Japan.*

ABSTRACT Recent results on a new attosecond spectroscopic method called as nonlinear Fourier transform spectroscopy using attosecond pulse train and generation of multi-gigawatt isolated attosecond pulses by the infrared two-color laser field synthesis are reported.

07.Mon.A.2 09:15 ---------- Contributed

Generation of Bright Isolated Attosecond Soft X-Ray Pulses Driven by Multi-Cycle Mid-Infrared Lasers

Ming-Chang Chen[1,2], Christopher A. Mancuso[1], Carlos Hernandez-Garcia[1,3], Franklin Dollar[1], Benjamin Galloway[1], Dimitar Popmintchev[1], Benjamin Langdon[4], Amelie Auger[4], Pei-Chi Huang[2], Barry Walker[5], Luis Plaja[3], Agnieszka Jaron-Becker[1], Andreas Becker[1], Margaret Murnane[1], Henry Kapteyn[1], Tenio Popmintchev[1]; *[1]Physics, JILA/University of Colorado at Boulder, USA; [2]Institute of Photonics Technologies, National Tsing Hua University, Taiwan; [3]Grupo de Investigación en Óptica Extrema, Universidad de Salamanca, Spain; [4]Kapteyn-Murnane Labs Inc., USA; [5]University of Delaware, USA.*

ABSTRACT By driving the high harmonic generation process with multi-cycle mid-infrared laser pulses, we demonstrate bright isolated, attosecond soft X-ray pulses for the first time.

07.Mon.A.3 09:30 ---------- Contributed

Sub-100 fs mid-infrared pulses as driver for a table-top hard x-ray source

Jannick Weisshaupt[1], Vincent Juvé[1], Shi-an Ku[1], Marcel Holtz[1], Michael Woerner[1], Thomas Elsaesser[1], Skirmantas Alisauskas[2], Audrius Pugzlys[2], Andrius Baltuška[2]; *[1]Max-Born-Institut Berlin, Germany; [2]Photonics Institute, Austria.*

ABSTRACT Midinfrared powerful 90 fs pulses at a wavelength of λ=3.9μm drive a femtosecond hard x-ray source (Cu~Kα: $\hbar\omega$ =8.05 keV). Up to 10^8 X-ray photons/pulse are generated which is twice as many as with 800 nm drivers of a 100 times higher peak intensity.

07.Mon.A.4 09:45 ---------- Contributed

Optimization of Quantum Trajectories Driven by Strong-Field Waveforms

Stefan Haessler[1], Tadas Balciunas[1], Guangyu Fan[1], Tobias Witting[2], Richard Squibb[2], Luke Chipperfield[3], Amelle Zair[2], Giedrius Andriuskaitis[2], Audrius Pugzlys[2], John W. G. Tisch[2], Jonathan P. Marangos[2], Andrius Baltuska[1]; *[1]Photonics Institute, TU Vienna, Austria; [2]Blackett Laboratory, Imperial College, United Kingdom; [3]Max Born Institute, Germany.*

ABSTRACT We combine phase-locked femtosecond pulses with 1.5μm, 1.0μm and 0.5μm wavelength to shape optical cycles and experimentally realize the concept of the “perfect wave for high harmonic generation”. This has far-reaching implications for attosecond spectroscopy.

07.Mon.A.5 10:00 ---------- Contributed

Optimized waveforms for enhancing high-harmonic yield by synthesizing multi-color laser fields

Chii Dong Lin[1], Cheng Jin[1], Gouli Wang[2], Fei Wei[1], Anh Thu Le[1]; *[1]Physics, Kansas State University, USA; [2]Physics, Northwest Normal University, China.*

ABSTRACT High harmonics favoring phase-matching conditions can be enhanced by one to two orders of magnitude if the laser’s waveform is optimized by synthesizing two or three-color fields without an increase in the total energy.

Room A 10:45-12:30

07.Mon.B Electronic and Reaction Dynamics

Presider: Kevin Kubarych
(University of Michigan, United States)

07.Mon.B.1 10:45 ---------- Contributed

[Canceled]

07.Mon.B.2 11:00 ---------- Contributed

Tabletop Imaging of structural Evolutions in chemical Reactions

Heide Ibrahim[1], Benji Wales[2], Samuel Beaulieu[1], Bruno E. Shmidt[1], Nicolas Thiré[1], Éric Bisson[1], Christoph Hebeisen[3,4], Vincent Wanie[1], Mathieu Giguére[1], Jean-Claude Kieffer[1], Joseph Sanderson[2], Michael Schuurman[3], François Légaré[1]; *[1]INRS EMT, Canada; [2]Physics and Astronomy, University of Waterloo, Canada; [3]NRC, Canada; [4]Physics, Universitiy of Ottawa, Canada.*

ABSTRACT The first high-resolution molecular movie of proton migration in the acetylene cation is obtained using a tabletop multiphoton pump-probe approach - an alternative to demanding free-electron-lasers and other VUV light sources when ionizing from the HOMO-1.

07.Mon.B.3 11:15 ---------- Contributed

The Ultrafast Wolff Rearrangement in the Gas Phase

Andreas Steinbacher[1], Sebastian Roeding[1], Tobias Brixner[1], Patrick Nuernberger[1,2]; *[1]Institut für Physikalische und Theoretische Chemie, Universität Würzburg, Germany; [2]Physikalische Chemie II, Ruhr-Universität Bochum, Germany.*

ABSTRACT The sub-picosecond Wolff rearrangement of gas-phase 5-diazo Meldrum's acid is disclosed with femtosecond ion spectroscopy. Distinct differences are found for 267 nm and 200 nm excitation, the latter leading to even two ultrafast rearrangement reactions.

07.Mon.B.4 11:30 ---------- Contributed

Sub-Femtosecond Steering of Carbonhydrogen Bonds

Robert Siemering[1], Matthias Kübel[1], Boris Bergues[2], Ali Alnaser[3,4], Matthias Kling[1,2], Regina de Vivie-Riedle[1]; *[1]Ludwig-Maximillians-Universität München, Germany; [2]Max-Planck-Institut für Quantenoptik, Germany; [3]American University of Sharjah, United Arab Emirates; [4]King-Saud University, Saudi Arabia.*

ABSTRACT During sub-femtosecond double ionization of acetylene vibrational wavepackets are formed which contain the directional information on the targetted hydrocarbon bond. The mechanism for preferential deprotonation of individual bonds is demonstrated by quantum dynamical simulations.

07.Mon.B.5 11:45 ---------- Contributed

Time-resolved photoelectron spectroscopy

Room B 10:45-12:30

07.Mon.C Ultrafast Phenomena in Semiconductors

Presider: Daniele Brida
(University of Konstanz, Germany)

07.Mon.C.1 10:45 ---------- Contributed

Quantum Droplets of Electrons and Holes in GaAs QuantumWells

Steven T. Cundiff[1,2], Andrew Almand-Hunter[1,2], Hebin Li[1], Martin Mootz[3], Mackillo Kira[3], Stephan W. Koch[3]; *[1]JILA, NIST and University of Colorado, USA; [2]Physics Department, University of Colorado, USA; [3]Department of Physics, Philipps-University Marburg, Germany.*

ABSTRACT We present evidence for electron-hole quantum droplets in GaAs quantum wells using transient-absorption spectroscopy. Quantum droplets have a correlation function characteristic of a liquid, but have quantized binding energy, unlike macroscopic droplets.

07.Mon.C.2 11:00 ---------- Contributed

Carrier-phonon Dynamics at Buried Interfaces of GaP/Si(001)

Kunie Ishioka[1], Kristina Brixius[2], Andreas Beyer[2], Wolfgang Stolz[2], Kerstin Volz[2], Ulrich Höfer[2], Hrvoje Petek[3]; *[1]National Institute for Materials Science, Japan; [2]Philipps-University, Germany; [3]University of Pittsburgh, USA.*

ABSTRACT Phonon-plasma coupling dynamics of lattice-matched GaP/Si(001) interface is investigated by photo-doping with femtosecond NUV pulses. Anti-phase domains arising from the interfaces are found to induce steep band bending within the nanometer-thick GaP film.

07.Mon.C.3 11:15 ---------- Contributed

Rabi Oscillations in an InAs Quantum Dot Ensemble Observed in pre-pulse 2D Coherent Spectroscopy

Takeshi Suzuki[1], Rohan Singh[1,2], Ilya Akimov[3,4], Manfred Bayer[3], Dirk Reuter[5], Andreas Wieck[5], Steven T. Cundiff[1,2]; *[1]JILA, University of Colorado and National Institute of Standards and Technology, USA; [2]Physics, University of Colorado, USA; [3]Experimentelle Physik 2, Technische Universität Dortmund, Germany; [4]A. F. Ioffe Physical-Technical Institute, Russian Academy of Sciences, Russian Federation; [5]Angewandte Festkörperphysik, Ruhr-Universtaet Bochum, Germany.*

ABSTRACT Pre-pulse 2D coherent spectroscopy is used to observe Rabi oscillations in an InAs quantum dot ensemble. The 2D spectra can monitor the coherent evolution in an ensemble system despite inhomogeneous broadening.

07.Mon.C.4 11:30 ---------- Contributed

Dynamical Coupling of Rabi Oscillation to Coherent Phonon in Semiconductor Microcavities

Kohji Mizoguchi[1], Shngo Yoshino[1], Goro Oohata[1]; *[1]Physical*

and ab initio multiple spawning studies of hexamethylcyclopentadiene

Thomas Wolf[1,2], Thomas S. Kuhlman[3], Oliver Schalk[4,5], Todd J. Martínez[2,6], Klaus B. Møller[3], Albert Stolow[5], Andreas-Neil Unterreiner[1]; *[1]Institut für Physikalische Chemie, Karlsruhe Institute of Technology (KIT), Germany; [2]Stanford PULSE Institute, Stanford University, USA; [3]Department of Chemistry, Technical University of Denmark, Denmark; [4]Stockholm University, Sweden; [5]National Research Council, Canada; [6]Department of Chemistry, Stanford University, USA.*

ABSTRACT Time-resolved photoelectron spectroscopy and ab initio multiple spawning were applied to the ultrafast non-adiabatic dynamics of hexamethylcyclopentadiene. The high level of agreement between experiment and theory associates wavepacket motion with a distinct degree of freedom.

07.Mon.B.6 **12:00** ---------- Contributed

S_2 to S_1 Relaxation Dynamics in Perylene Bisimide Dye Aggregates and Monomers

Steffen Wolter[1], Franziska Fennel[1], Marco Schröter[1], Jan Schulze[1], Frank Würthner[2], Oliver Kühn[1], Stefan Lochbrunner[1]; *[1]Institut für Physik, Universität Rostock, Germany; [2]Institut für Organische Chemie and Center for Nanosystems Chemistry, Universität Würzburg, Germany.*

ABSTRACT The ultrafast relaxation from the S_2 to the S_1 state in perylene bisimides is investigated by femtosecond absorption spectroscopy. The relaxation takes place on a timescale of 150 fs and accelerates slightly upon aggregation.

07.Mon.B.7 **12:15** ---------- Contributed

Femtosecond time-resolved X-ray absorption spectroscopy by a multichannel spectral detection using a hard X-ray free electron laser

Yuki Obara[1], Tetsuo Katayama[2], Yoshihiro Ogi[3], Takayuki Suzuki[1,4], Naoya Kurahashi[5], Shutaro Karashima[5], Yuhei Chiba[1], Yusuke Isokawa[1], Tadashi Togashi[6], Yuichi Inubushi[6], Makina Yabashi[6], Toshinori Suzuki[3,5], Kazuhiko Misawa[1,4]; *[1]Department of Applied Physics, Tokyo University of Agriculture and Technology, Japan; [2]Japan Synchrotron Radiation Research Institute, Japan; [3]RIKEN Center for Advanced Photonics, Japan; [4]Interdisciplinary Research Unit in Photon-nano Science, Tokyo University of Agriculture and Technology, Japan; [5]Kyoto University, Japan; [6]RIKEN SPring-8 Center, Japan.*

ABSTRACT We have performed the first time-resolved X-ray absorption spectroscopy using the SACLA with a dual-beam dispersive detection method. The photoexcited iron complex exhibits a red-shifted iron K-edge with a rise time constant of 260 fs.

Science, Osaka Prefecture University, Japan.

ABSTRACT We report on the dynamical coupling between Rabi oscillation and coherent phonon in CuCl semiconductor microcavities, which induces the time-dependent frequency-shift of the coherent phonon mode driven by Rabi oscillation.

07.Mon.C.5 **11:45** ---------- Contributed

Ab-initio theoretical approach to coherent phonon generation in solids

Yasushi Shinohara[1,2], Shunsuke A. Sato[1], Kazuhiro Yabana[1,3], Tomohito Otobe[4], Jun-Ichi Iwata[5], George F. Bertsch[6]; *[1]Graduate School of Pure and Applied Sciences, University of Tsukuba, Japan; [2]Max-Planck Institut für Mikrostrukturphysik, Germany; [3]Center for Computational Sciences, University of Tsukuba, Japan; [4]Kansai Photon Sciences Institute, Japan Atomic Energy Agency, Japan; [5]Department of Applied Physics, University of Tokyo, Japan; [6]Department of Physics, University of Washington, USA.*

ABSTRACT We investigate mechanisms of coherent phonon generation in time-dependent density-functional theory. It provides intuitive understanding of the generation mechanism as well as its change depending on electric field frequency.

07.Mon.C.6 **12:00** ---------- Contributed

Novel Spectral Decay Dynamics of Hot Excitons in PbSe Nano-Crystals

Itay Gdor[1], Chunfan Yang[1], Diana Yanover[2], Hanan Sachs[1], Efrat Lifshitz[2], Sanford Ruhman[1]; *[1]Institute of Chemistry, The Hebrew University, Israel; [2]Department of Chemistry and Solid State Institute, Technion, Israel.*

ABSTRACT Ultrafast exciton cooling in highly mono-disperse PbSe nanocrystals (NC) is followed with tunable pump - Hyperspectral near-IR probe spectroscopy. Unexpected kinetic and spectral correlations are revealed arguing against the standard models for excited NC absorption.

07.Mon.C.7 **12:15** ---------- Contributed

Ultrafast Long-Range Charge Separation in Organic Semiconductor Photovoltaic Diodes

Simon Gelinas[1], Akshay Rao[1], Abhishek Kumar[1], Samuel L. Smith[1], Alex Chin[1], Jenny Clark[1], Tom S. van der Poll[2], Guillermo C. Bazan[2], Richard Friend[1]; *[1]Cavendish laboratory, University of Cambridge, United Kingdom; [2]Center for Polymers and Organic Solids, University of California, Santa Barbara, USA.*

ABSTRACT By tracking the modulation of the optical absorption due to the electric field generated between the charges, we are able to observe the ultrafast electron-hole separation process in organic photovoltaic materials.

Room A **14:00-15:45**

07.Mon.D Correlated Materials

Presider: Ken Onda *(Tokyo Institute of Technology, Japan)*

07.Mon.D.1 14:00 Contributed

Transient atomic structure of vibrationally excited YBCO with enhanced superconducting coherence above Tc

Roman Mankowsky[1], Alaska Subedi[2], Michael Foerst[1], Simon Mariager[3], Matthieu Chollet[4], Henrik Lemke[4], Joe Robinson[4], James Glownia[4], Michael Minitti[4], Alex Frano[5], Michael Fechner[6], Nicola Spaldin[6], Toshinao Loew[5], Mathieu Le Tacon[5], Bernhard Keimer[5], Antoine George[2], Andrea Cavalleri[1,7]; *[1]Condensed Matter Dynamics, Max Planck Institute for the Structure and Dynamics of Matter, Germany; [2]Strongly Correlated Quantum Materials Group, Ecole Polytechnique, France; [3]FEMTO Group, Paul Scherrer Institut, Switzerland; [4]Linac Coherent Light Source, SLAC, USA; [5]Solid State Spectroscopy, Max Planck Institute for Solid State Research, Germany; [6]Materials Theory, Eidgenooessische Technische Hochschule Zuerich, Switzerland; [7]Clarendon Laboratory, Oxford University, United Kingdom.*

ABSTRACT Nonlinear lattice excitation in $YBa_2Cu_3O_{6.5}$ has been shown recently to transiently induce signatures of superconducting coherence up to room temperature. Here, we present ultrafast x-ray diffraction measurements used to determine the corresponding atomic structure.

07.Mon.D.2 14:15 Contributed

Selective THz excitation of collective modes in underdoped YBCO

Georgi L. Dakovski[1], Wei-Sheng Lee[2], Joshua J. Turner[1], Matthias C. Hoffmann[1]; *[1]LCLS, SLAC National Accelerator Laboratory, USA; [2]SIMES, SLAC National Accelerator Laboratory, USA.*

ABSTRACT We use intense broadband THz pulses to excite underdoped YBCO exhibiting competing superconducting and charge density wave ground states. We observe pronounced coherent oscillations at 1.85 and 2.65THz, attributed to renormalized low-energy phonon modes.

07.Mon.D.3 14:30 Contributed

Ultrafast optical manipulation of interfacial magnetoelectric coupling

Yu-Miin Sheu[1], Stuart Trugman[1], Li Yan[1], Quanxi Jia[1], Antoinette J. Taylor[1], Rohit P. Prasankumar[1]; *[1]Center for Integrated Nanotechnologies, Los Alamos National Laboratory, USA.*

ABSTRACT We demonstrate a new paradigm for all-optical detection and control of interfacial magnetoelectric coupling on ultrafast timescales, achieved by using time-resolved second harmonic generation (SHG) in a ferroelectric/ferromagnet oxide heterostructure.

07.Mon.D.4 14:45 Contributed

Heterogeneous Magnetic Order Melting Triggered by Ultrafast Lattice Control at the $LaAlO_3/NdNiO_3$ Interface

Michael Först[1], Andrea D. Caviglia[2], Raoul Scherwitzl[3], Pavlo Zubko[3], Hubertus Bromberger[1], Roman Mankowsky[1], Stuart B. Wilkins[4], Yi-De Chuang[5], Wei-Sheng Lee[6], William F. Schlotter[7], Joshua J. Turner[7], Georgi L. Dakovski[7], Michael Minitti[7], Joe Robinson[7], Jean-Marc Triscone[3], Sarnjeet S. Dhesi[8], Andrea Cavalleri[1,9]; *[1]Max Planck Institute for the Structure and Dynamics of Matter, Germany; [2]Kavli Institute of Nanoscience, Delft University of Technology, Netherlands; [3]Département de Physique de la Matière Condensée, University of Geneva, Switzerland; [4]Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, USA; [5]Advanced Light Source, Lawrence Berkeley Laboratory, USA; [6]SIMES, Stanford Linear Accelerator Center, USA; [7]Linac Coherent Light Source, Stanford Linear Accelerator Center, USA; [8]Diamond Light Source, United Kingdom; [9]Department of Physics, University of Oxford, United Kingdom.*

ABSTRACT We use femtosecond Resonant Soft X-ray Diffraction to observe heterogeneous melting of antiferromagnetic order in an epitaxially grown $NdNiO_3$ film. Cross-interface coupling launches a propagating phase front following direct lattice excitation of the $LaAlO_3$ substrate.

07.Mon.D.5 15:00 Contributed

Coherent dynamics of structural symmetry during the ultrafast melting of a charge density wave

Tim Huber[1], Simon Mariager[2], Andres Ferrer[1,2], Hanjo Schäfer[3], Jeremy A. Johnson[2], Sebastian Gruebel[2], Andrea Luebcke[2,5], Andrin Caviezel[2], Lucas Huber[1], Teresa Kubacka[1], Christian Dornes[1], Claire Laulhe[6], Sylvain Ravy[6], Gerhard Ingold[2], Paul Beaud[2], Jure Demsar[3,4], Steven L. Johnson[1]; *[1]ETH Zurich, Switzerland; [2]Swiss Light Source, Paul Scherrer Institut, Switzerland; [3]Physics Department, Universitaet Konstanz, Germany; [4]Ilmenau University of Technology, Institute of Physics, Germany; [5]Laboratoire de Spectroscopie Ultrarapide, EPF Lausanne, Switzerland; [6]Synchrotron SOLEIL, France.*

ABSTRACT We use time-resolved hard x-ray diffraction to directly follow the dynamics of structural symmetry change during the ultrafast melting of a charge density wave. We observe a transient recovery of the periodic lattice distortion on a sub-picosecond timescale.

07.Mon.D.6 **15:15** Contributed

A detailed view of an ultrafast phase transition using femtosecond resonant x-ray diffraction

Paul Beaud[1,2], Andrin Caviezel[1], Simon Mariager[1], Laurenz Rettig[1], Gerhard Ingold[2], Christian Dornes[3], Shi-Wen Huang[1], Jeremy A. Johnson[1], Milan Radovic[1,2], Tim Huber[3], Teresa Kubacka[3], Andres Ferrer[1,3], Henrik Lemke[4], Matthieu Chollet[4], Diling Zhu[4], James Glownia[4], Marcin Sikorski[4], Aymeric Robert[4], Hiroki Wadati[5,6], Masao Nakamura[6], Masashi Kawasaki[5,6], Yoshinori Tokura[5,6], Steven L. Johnson[3], Urs Staub[1]; *[1]Swiss Light Source, Paul Scherrer Institut, Switzerland; [2]SwissFEL, Paul Scherrer Institut, Switzerland; [3]Institute for Quantum Electronics, ETH Zürich, Switzerland; [4]LCLS, SLAC National Accelerator Laboratory, USA; [5]Department of Applied Physics and Quantum-Phase Electronics Center, University of Tokyo, Japan; [6]Center for Emergent Matter Science (CEMS), RIKEN, Japan.*

ABSTRACT We apply time-resolved resonant x-ray diffraction near the Mn K-edge to directly measure the structural and electronic long-range order changes during ultrafast melting of the charge and orbitally ordered phase in a perovskite manganite.

07.Mon.D.7 **15:30** Contributed

Competition Between Thermal and Non-Thermal Processes During Femtosecond Switching of Phase Change Materials

Simon Wall[1], Lutz Waldecker[2], Timothy A. Miller[1], Ralph Ernstorfer[2], Valerio Pruneri[1], Miquel Rude[1], Robert Simpson[3]; *[1]ICFO-Institut de Ciencies Fotoniques, Spain; [2]Physical Chemistry, Fritz Haber Institute of the Max Planck Society, Germany; [3]Singapore University of Technology and Design, Singapore.*

ABSTRACT We use ultrafast optics and electron diffraction to measure irreversible amorphization of crystalline $Ge_2Sb_2Te_5$ phase change films. We find that light directly modifies the local bonding environment leading to a hardening of bonds.

Exhibition Hall **15:45-17:15**

07.Mon.P1 Poster Session I

07.Mon.P1.1

Discriminating Racemic from Achiral Solutions with Femtosecond Accumulative Spectroscopy

Andreas Steinbacher[1], Patrick Nuernberger[1], Tobias Brixner[1]; *[1]Institut für Physikalische und Theoretische Chemie, Universität Würzburg, Germany.*

ABSTRACT We follow asymmetric photodissociation reactions of chiral substances with a sensitive polarimeter specifically designed for applications with femtosecond pulses. The accumulative detection scheme allows the discrimination of racemic and achiral solutions with high sensitivity.

07.Mon.P1.2

Filament-driven Lasing Action for Combustion Diagnosis

Huailiang Xu[1,3], Wei Chu[1,2], Helong Li[1], Jielei Ni[2], Bin Zeng[2], Jinping Yao[2], Haisu Zhang[2], Guihua Li[2], Chengrui Jing[2], Hongqiang Xie[2], Kaoru Yamanouchi[3], Ya Cheng[2]; *[1]Jilin University, China; [2]SIOM, China; [3]The University of Tokyo, Japan.*

ABSTRACT We report on the lasing action for the combustion intermediate of CN in an ethanol/air flame by femtosecond laser excitation. It is confirmed that the lasing action results from amplified spontaneous emission with the population inversion achieved in the femtosecond-laser-induced plasma filament.

07.Mon.P1.3

Time-Dependent Multiconfiguration Methods for Multielectron Dynamics in Intense Laser Fields

Takeshi Sato[1], Kenichi L. Ishikawa[1]; *[1]University of Tokyo, Japan.*

ABSTRACT Time-dependent complete-active-space and general multiconfiguration self- consistent-field methods are formulated. The concept of orbital subspacing in these methods enables compact yet accurate description of multielectron dynamics in intense laser fields.

07.Mon.P1.4

Phase-Matched Generation of High Order Harmonic for Study of Molecular dynamics

Lap V. Dao[1], Khuong B. Dinh[1], Hoang L. Vu[1], Peter Hannaford[1]; *[1]CAOUS, FSET, Swinburne University of Technology, Australia.*

ABSTRACT We present a pump-probe experiment based on the use of a second field to modulate the intensity and the spatial profile of the phase-matched high-order harmonics radiation for study of the dynamics of molecular gases.

07.Mon.P1.5

Ultrafast Photoelectron Spectroscopy of Electron-Ion Wave Packets in Rydberg N_2

Mizuho Fushitani[1], Yuto Toida[1], François Légaré[2], Akiyoshi Hishikawa[1]; *[1]Nagoya University, Japan; [2]INRS, Energie, Matériaux et Télécommunication, Canada.*

ABSTRACT Time-resolved photoelectron spectroscopy of N_2 Rydberg using single-order high harmonics at 80 nm reveals ultrafast wavepacket dynamics (~3 fs) of both Rydberg electron and the corresponding N_2^+ core as the beating oscillation (~ 300 fs).

07.Mon.P1.6

Simultaneous Observation of Vibrational Wavepackets of Nitrogen Molecule in Neutral and Singly-charged Manifolds

Tomoya Okino[1], Yusuke Furukawa[1], A. Amani Eilanlou[1], Yasuo Nabekawa[1], Eiji J. Takahashi[1], Kaoru Yamanouchi[2], Katsumi Midorikawa[1]; *[1]RIKEN, Japan; [2]University of Tokyo, Japan.*

ABSTRACT Vibrational wavepackets are launched at neutral and single-charged electronic excited states of nitrogen molecule by sub-10 fs high harmonics. The evolution of vibrational wavepackets are tracked by sub-10 fs high harmonics.

07.Mon.P1.7

Tunneling channels in strong field enhanced ionization of diatomic molecules

Pengfei Lan[1], Cheng Huang[1], Yueming Zhou[1], Qingbing Zhang[1], Peixiang Lu[1]; *[1]Huazhong Univ. of Sci. & Tech., China.*

ABSTRACT We theoretically demonstrated two new ionization channels through which the electron can be released either from the down-field or up-field site of diatomic molecules. Our finding provides a comprehensive physical picture of molecular enhanced ionization.

07.Mon.P1.8

Correlation between photoelectron emission and fragment recoil of methanol in intense laser fields

Shinichi Fukahori[1,2], Motoyoshi Nakano[1], Kaoru Yamanouchi[2], Ryuji Itakura[1]; *[1]Kansai Photon Science Institute, Japan Atomic Energy Agency, Japan; [2]Department of Chemistry, School of Science, The University of Tokyo, Japan.*

ABSTRACT Dissociative ionization of methanol in an intense laser field is investigated using photoelectron-photoion coincidence momentum imaging. Energy and angular correlations between a photoelectron and a fragment ion reveal the ionization and subsequent electronic excitation processes.

07.Mon.P1.9

Laser induced rescattering photoelectron spectroscopy of CO_2 molecule

Misaki Okunishi[1], Vandana Sharma[2], Yuta Itoh[1], Robert R. Lucchese[3], Toru Morishita[4], Oleg I. Tolstikhin[5], Lars B. Madsen[6], Kiyoshi Ueda[1]; *[1]IMRAM, Tohoku University, Japan; [2]Department of Physics, IIT Hyderabad, India; [3]Department of Chemistry, Texas A & M University, USA; [4]Department of Engineering Science, University of Electro-Communications, Japan; [5]Kurchatov Institute, Russian Federation; [6]Department of Physics and Astronomy, Aarhus University, Denmark.*

ABSTRACT We have measured rescattering photoelectron spectra of CO_2 induced by ultrashort intense laser pulses at 1250 and 1300 nm and extracted field-free differential cross sections of electron scattering from CO_2^+ from the spectra.

07.Mon.P1.10

Real-time Probing of Ultrafast Hydrogen Migration in Methanol by Near-IR Few-cycle Laser Pulses

Toshiaki Ando[1], Akihiro Shimamoto[1], Shun Miura[1], Katsunori Nakai[1], Huailiang Xu[2], Atsushi Iwasaki[1], Kaoru Yamanouchi[1]; *[1]Department of Chemistry, School of Science, University of Tokyo, Japan; [2]College of Electronic Science and Engineering, Jilin University, China.*

ABSTRACT Hydrogen migration in CH_3OH was probed by pump-probe measurements using few-cycle laser pulses. Oscillation in the kinetic-energy release of the fragment ions was interpreted theoretically as the motion of a migrating hydrogen atom in CH_3OH^+.

07.Mon.P1.11

Generation of stationary on-axis optical filaments by means of Dammann lenses

Jorge Pérez Vizcaíno[1], Rocio Borrego-Varillas[1,2], Omel Mendoza-Yero[1], Glaldys Minguez-Vega[1], Javier R. Vazquez de Aldana[2], Jesus Lancis[1]; *[1]University Jaume I, Spain; [2]Universidad de Salamanca, Spain.*

ABSTRACT Dynamical spatial shaping of a 30 fs laser beam by encoding Dammann lenses in a spatial light modulator allows us the formation up to six on-axis stable and stationary filaments in a fused silica sample.

07.Mon.P1.12

A Regulation of Energy Flow in Purple Bacterial Photosynthetic Antennas

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ABSTRACT Ultrafast energy transfer dynamics in photosynthetic antennas were investigated by femtosecond pump-probe measurements. Photo-excited carotenoids with short-polyene chains efficiently transfer energy to bacteriochlorophylls, while the energy rapidly dissipates to carotenoids in antennas containing longer carotenoids.

07.Mon.P1.13

Vibrational Energy Flow in Hemeproteins

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ABSTRACT We demonstrate that time-resolved anti-Stokes ultraviolet resonance Raman spectroscopy is a powerful tool for studying the vibrational energy flow in proteins with a spatial resolution of an amino acid residue.

07.Mon.P1.14

Structural Motives of Acetic Acid from Ultrafast CARS Spectroscopy of the CO Vibration

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ABSTRACT The carbonyl vibration of acetic acid is analyzed by spontaneous and ultrafast coherent anti-Stokes Raman spectroscopy. The complex band is decomposed into four contributions from different structural motives and the cyclic dimer signature is extracted.

07.Mon.P1.15

Reconstruction of a Rotational Wave Packet Created in the $X^2\Pi_{1/2}$ State of the NO Radical by a Nonresonant Intense Ultrashort Laser Pulse

Hirokazu Hasegawa[1], Yasuhiro Ohshima[2]; *[1]Department of Basic Science, The University of Tokyo, Japan; [2]Institute for Molecular Science, Japan.*

ABSTRACT We experimentally reconstructed a rotational wave packet created in NO($X^2\Pi_{1/2}$) by a nonresonant intense ultrashort laser field. The determined phase shifts show a clear signature of bifurcated pathways in the nonadiabatic rotational excitation.

07.Mon.P1.16

Natural Orbitals and Potential Curves within the Framework of Extended Multi-configuration Time-dependent Hartree-Fock Method

Yoshihiro Ide[1], Tsuyoshi Kato[1], Kaoru Yamanouchi[1]; *[1]The University of Tokyo, Japan.*

ABSTRACT The extended multi-configuration time-dependent Hartree-Fock method is proposed to calculate time-dependent wave functions. By constructing the ground-state wave function of one-dimensional H_2 by imaginary time-propagation, the natural orbitals and the potential energy curves were derived.

07.Mon.P1.17

Ultrafast and Photodissociation Dynamics of 1,2-Butadiene Studied by Photoelectron Spectroscopy

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ABSTRACT Ultrafast and photodissociation dynamics of a cumulated dine molecule, 1,2-butadiene, were investigated by time-resolved photoelectron spectroscopy using a high harmonic. In contrast with 1,3-butadiene, coherent oscillation by stimulated Raman process was observed prior to photodissociation.

07.Mon.P1.18

Ultrafast electronic structures and dynamics of CdSe nanocrystals revealed by gas phase time-resolved photoelectron spectroscopy

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ABSTRACT Using time-resolved photoelectron spectroscopy in a gas phase environment, we observed the evanescent electron wavefunction of quantum dot excited states, and the effect of solvent on QD charge transfer.

07.Mon.P1.19

Coherent Wavepacket Motion in Ultrafast Intermolecular Electron Transfer in Electron-Donating Solvent

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ABSTRACT Coherent wavepacket motion in an ultrafast electron transfer (ET) system consisting of electron accepting solute, 5,12-bis(phenylethynyl)-naphthacene and donating solvent, N,N-dimethylaniline was investigated by means of femtosecond transient absorption spectroscopy and excitation wavelength dependence was investigated.

07.Mon.P1.20

Detection of the G(-H)$^{\bullet}$ Radical in the Electronic Deactivation of the G-C Watson-Crick Base Pair

Katharina Röttger[1], Friedrich Temps[1]; *[1]Institute of Physical Chemistry, Germany.*

ABSTRACT Transient absorption spectroscopy of the G-C base pair revealed the formation of the G(-H)$^{\bullet}$ radical with lifetime 3 ps in the electronic deactivation. This radical is the key intermediate in an electron-coupled proton transfer.

07.Mon.P1.21

Two-Step Explosion Dynamics of Highly Charged Fullerene Cations C_{60}^{q+} (q = 20-60)

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ABSTRACT C_{60}^{q+} (q = 20-60) firstly ejects fast atomic cations C^{z+} ($z \geq 1$) via Coulomb explosions on a 10 fs timescale. Thermal evaporations of slow atomic and molecular fragments subsequently occur in 100-1000 fs.

07.Mon.P1.22

Ultrafast Electron Solvation in Room Temperature Ionic Liquid/Metal Interfaces

Alex Shearer[1], Benjamin Caplins[1], David Suich[1], Charles Harris[1]; *[1]University of California Berkeley, USA.*

ABSTRACT The room temperature ionic liquid $[Bmpyr]^+[NTf_2]^-$ is studied on Ag(111). Monolayer and bilayer films both show a single state solvating, the timescale of solvation and magnitude of energy relaxation is significantly greater for the bilayer.

07.Mon.P1.23

Vibrational Dynamics of the CN Stretching in the Electronically Excited State by UV and Visible-Pump and Infrared-Probe Spectroscopy

Sho Hiraoka[1], Kaoru Ohta[2], Keisuke Tominaga[1,2]; *[1]Chemistry, Graduate School of Science, Kobe University, Japan; [2]Molecular Photoscience Research Center, Kobe University, Japan.*

ABSTRACT We have carried out visible-pump infrared-probe measurements on a CN-containing coumarin in a protic solvent. The time-dependent changes of the infrared spectra are measured on a picoseconds time scale, likely because of vibrational cooling.

07.Mon.P1.24

Microsecond Charge Recombination Lifetimes in Complexes of CdS Quantum Dots and Organic Hole Acceptors Enabled by Hole-Hopping within the Ligand Shell

David J. Weinberg[1], Zane Khademi[1], Michal Malicki[1], Seth Marder[2], Emily Weiss[1]; *[1]Chemistry, Northwestern University, USA; [2]Chemistry, Georgia Institute of Technology, USA.*

ABSTRACT Transient absorption (TA) and NMR measurements were used to demonstrate that carrier mobility within the ligand shell contributes to photoinduced charge transfer dynamics between a bis(diarylamino)biphenyl (TPD)-based thiol and cadmium sulfide quantum dots.

07.Mon.P1.25

Ab Initio Quantum Dynamical Study on Ultrafast Nonradiative Transition Pathways of Pyrazine

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Chemistry, Graduate School of Science, Osaka Prefecture University, Japan; [4]Department of Applied Chemistry, National Chiao-Tung University, Taiwan.

ABSTRACT We theoretically verified the participation of optically dark $n\pi^*$ states other than S_1 in ultrafast internal conversion of pyrazine. Contrary to a recent semiclassical study, our quantum dynamical calculations demonstrated that their contributions are negligible.

07.Mon.P1.26

Initial Phase in Quantum Beat Created via Ultrafast Internal Conversion of Pyrazine

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ABSTRACT We present a simple interpretation for the phase-shifted quantum beat that is created on the lower electronic state from the higher state upon a nonradiative transition, using the classical mechanics and harmonic potentials.

07.Mon.P1.27

Ultrafast vibrational dynamics of water at a zwitterionic lipid/water interface revealed by two-dimensional heterodyne-detected vibrational sum frequency generation (2D HD-VSFG)

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ABSTRACT 2D HD-VSFG is applied to the study of ultrafast vibrational dynamics at a zwitterionic lipid/water interface for the first time. The 2D spectrum reveals spectral diffusion of three distinct water species existing at the interface.

07.Mon.P1.28

Electronic Ground and Excited State Spectral Diffusion of a Photocatalyst

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ABSTRACT Equilibrium and transient 2D IR spectroscopies were used to measure spectral diffusion of the electronic ground and excited states of the photocatalyst $Re(bpy)(CO)_3Cl$. The ground state spectral diffusion decays 3 times faster than the 3MLCT.

07.Mon.P1.29

Nonlinear Carrier Responses in Gold Thin Films Induced by Intense Terahertz Waves

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ABSTRACT Terahertz transmittances of the gold thin-films with thicknesses ranging from 1 to 12 nm were investigated. As terahertz field becomes intense, the transmittance of the terahertz field decreases, suggesting the increase of the carrier density.

07.Mon.P1.30

Ultrafast terahertz spectroscopy of rapid carrier relaxation in graphene oxide

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ABSTRACT We study the distinct terahertz (THz) carrier relaxation dynamics in graphene oxide (GO). In contrast to the graphene, we observe that the photoexcited carrier relaxation in GO exhibits a peculiar non-Drude behavior.

07.Mon.P1.31

Slow Electron Cooling Dynamics of Highly Luminescent CdS_xSe_{1-x} Alloy Quantum Dot

Hirendra Ghosh[1], Partha Maity[1]; *[1]Bhabha Atomic Research Centre, India.*

ABSTRACT Ultrafast Electron cooling dynamics of highly luminescent oleic acid caped CdS_xSe_{1-x} alloy quantum dot (QD) is investigated by femtosecond transient absorption studies and found to much smaller as compared to pure CdSe and CdS Qds.

07.Mon.P1.32

Thickness dependent hot-phonon effects observed by femtosecond mid-infrared luminescence in graphene

Tohru Suemoto[1], Tomohiro Kawasaki[1], Hiroshi Watanabe[1]; *[1]Institute of Solid State Physics, Japan.*

ABSTRACT Femtosecond luminescence of graphene and graphite is studied from near- to mid-infrared regions. Remarkable reduction of lifetime at 0.3 eV in mono- and bi-layer graphenes is found, indicating carrier cooling due to interaction with substrate.

07.Mon.P1.33

Snapshots of the retarded interaction of charge carriers with ultrafast fluctuations in cuprates

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ABSTRACT We measure the transient reflectivity of an high-Tc superconductor with an unprecedented temporal resolution (~15fs) demonstrating that on the 20-fs timescale electron dynamics is described in terms of charge carriers interacting with short-range antiferromagnetic fluctuations.

07.Mon.P1.34

Femtosecond time-resolved photoemission spectroscopy by using high-repetition rate Yb-fiber laser system

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ABSTRACT Time-resolved photoemission spectroscopy using the 5th harmonic of a mode-locked, 95-MHz Yb-fiber laser enabled the detection of ultrafast electron dynamics in bismuth induced by a pump density as small as 30 nJ/mm^2.

07.Mon.P1.35

Mid-IR Pump, EUV Probe Femtosecond Time-and-Angle-Resolved Photoemission Spectroscopy

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ABSTRACT Using EUV high harmonic probe in time- and angle-resolved photoemission spectroscopy extends the energy and momentum observation window for studies of electron dynamics in condensed matter, while tunable mid-infrared pumping allows control of excitation mechanisms.

07.Mon.P1.36

Ultrafast carriers dynamics in silicon: a joint experimental and theoretical study

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ABSTRACT We investigate the carriers dynamics in bulk silicon using pump-probe spectroscopy. The experimental results are compared with theoretical calculations which combines for the first time the non-equilibrium Green's functions theory with ab-initio methods.

07.Mon.P1.37

Polarization State Changes of Femtosecond, Polarization-shaped Pulsed Beams on Free Space Propagation

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ABSTRACT We show that free space propagation of polarization-shaped pulsed beams induces substantial changes in their polarization state. The physical origin of this effect, its theoretical description, and classical polarization measurements reflecting this phenomenon, are presented.

07.Mon.P1.38

Ultrafast Spin Dynamics in an Antiferromagnet NiO Observed in Pump-Probe and Terahertz Experiments

Takeshi Moriyasu[1], Toshiro Kohmoto[1]; *[1]Kobe University, Japan.*

ABSTRACT We observed the ultrafast spin dynamics in an antiferromagnet NiO. The dynamics of the antiferromagnetic magnons and the magnetostriction was studied using the pump-probe technique and THz-TDS.

07.Mon.P1.39

Ultrafast control of electron-phonon entangled systems in bulk solids

Yosuke Kayanuma[1]; [1]*Tokyo Institute of Technology, Japan.*

ABSTRACT A simple theory is presented for the ultrafast coherent control of electron-phonon entangled systems in condensed matter which agrees well with the transient reflectivity measurement by the sub-femtosecond phase-locked dual pulse technique in bulk GaAs.

07.Mon.P1.40

Spontaneous formation of correlated charge coherence induced by 1.5-cycle pulse in 1-D organic metal $(TMTTF)_2AsF_6$

Takahiro Ishikawa[1], Yuto Sagae[1], Yohei Kawakami[1], Hirotake Itoh[1,2], Kaoru Yamamoto[3], Kyuya Yakushi[4], Sumio Ishihara[1], Takahiko Sasaki[5,2], Kenji Yonemitsu[6], Shinichiro Iwai[1,2]; [1]*Physics, Tohoku University, Japan;* [2]*CREST, JST, Japan;* [3]*Applied Physics, Okayama Science University, Japan;* [4]*Toyota Physical and Chemical Research, Japan;* [5]*Institute for Materials Research, Tohoku University, Japan;* [6]*Physics, Chuo University, Japan.*

ABSTRACT Ultrafast response of $(TMTTF)_2AsF_6$ induced by 1.5 cycle (7 fs) infrared pulse was investigated. Coherent oscillation of correlated charge (18 fs) grows in the time scale of 50 fs, reflecting the spontaneous-formation of the electronic coherence before the electronic thermalization

07.Mon.P1.41

Phase Transitions in Co-Doped NiMnGa Magnetic Shape Memory Alloys Probed by Coherent Phonons

Thomas Dekorsy[1], Martin Schubert[1], Jan Mayer[1], Mike Hettich[1], Hanjo Schäfer[1], Alexej Laptev[1], Moritz Merklein[1], Chuan He[1], Martin Grossmann[1], Oliver Ristow[1], Yuanson Luo[2], Vitalyi Gusev[3], Jure Demsar[1], Mikhail Fonin[1], Konrad Samwer[2]; [1]*Universitat Konstanz, Germany;* [2]*University Goettingen, Germany;* [3]*Université du Maine, France.*

ABSTRACT We investigate undoped and Co-doped NiMnGa magnetic shape memory alloys by ultrafast spectroscopy. The temperature dependence of collective modes is explained on the base of a charge-density-wave excitation shining new light on the phase transition.

07.Mon.P1.42

Electrochemical Control of Coherent Phonon Generations in Single-walled Metallic Carbon Nanotubes

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ABSTRACT Coherent phonons in single-walled metallic carbon nanotubes were measured under the application of a gate voltage through ionic liquid. We found that the frequencies, amplitudes and phases of the phonons strongly depend on the voltage.

07.Mon.P1.43

Ultrabroadband infrared pump-probe spectroscopy using chirped-pulse upconversion

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ABSTRACT We have demonstrated infrared pump-probe spectroscopy using chirped-pulse upconversion with a nonlinear mixing in a gas. Ultrafast dynamics of free carrier in Ge was clearly observed in the range 200-5000 cm^{-1}.

07.Mon.P1.44

Ultrafast Phonon Dynamics in Few-quintuple layer Topological Insulator Sb_2Te_3

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ABSTRACT We found few-quintuple layer Sb_2Te_3 presents the in-plane coherent oscillation (E_g^2 mode) using time-resolved transmission measurements, which is different from the results, out-of-plane oscillations (A_{1g}^1 and A_{1g}^2 modes) obtained in bulk.

07.Mon.P1.45

A compact MHz high-harmonic light source for efficient laboratory photoemission spectroscopy

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ABSTRACT We demonstrate high-order harmonic generation driven by a compact fiber laser as a light source for efficient photoemission spectroscopy, which allows mapping of the dominant part of the valence band of Ag(100) within 10 seconds.

07.Mon.P1.46

Investigation on Dynamics of Nano-Plasma of Rare-Gas Clusters by EUVFEL Pump - NIR Laser Probe Measurements

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ABSTRACT Via extreme ultraviolet free electron laser pump and near infrared laser probe experiments for rare-gas clusters, we found clear enhancement of highly charged ions when EUVFEL and NIR pulses overlap, indicating efficient heating of nano-plasma

07.Mon.P1.47

Enhancement of superconducting coherence in $YBa_2Cu_3O_x$ by resonant lattice excitation

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ABSTRACT By using femtosecond pulses in the mid-infrared, we resonantly excite an infrared-active phonon mode in the high-temperature superconductor $YBa_2Cu_3O_x$. The electronic properties of the driven state, probed with ultra-broadband time-domain terahertz spectroscopy, are highly unconventional.

07.Mon.P1.48

Controlling coherent energy flow between collective THz excitations in condensed matter

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ABSTRACT Coherent control over the magnetization state of the rare-earth orthoferrite $ErFeO_3$ is achieved by nonlinear lattice excitation via mid-infrared laser pulses. This low-dissipative approach enables new pathways in light-driven manipulation of magnetic materials.

07.Mon.P1.49

Strong-Field-Enhanced Forward Scattering of High-Order Harmonics

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ABSTRACT We show that scattering of ultrashort XUV pulses from strong-field driven electron wavepackets is enhanced as compared with normal weak scattering from bound or free electrons. We predict large XUV amplification in high-order harmonic generation.

07.Mon.P1.50

Improvement for HHG-seeded EUV Free Electron Laser with Timing Measurement System by EO Sampling

Kanade Ogawa[1], Takahiro Sato[5], Shigeki Owada[1], Shinichi Matsubara[2], Yuichi Okayasu[2], Tadashi Togashi[2], Takahiro Watanabe[1,2], Eiji J. Takahashi[3], Katsumi Midorikawa[3], Makoto Aoyama[4], Koichi Yamakawa[4], Atsushi Iwasaki[5], Kaoru Yamanouchi[5], Takashi Oshima[1,2], Yuji Otake[1,2], Toru Hara[1,2], Takashi Tanaka[1,2], Hitoshi Tanaka[1,2], Hiromitsu Tomizawa[1,2], Makina Yabashi[1,2], Tetsuya Ishikawa[1]; *[1]RIKEN, Japan; [2]Japan Synchrotron Radiation Research Institute, Japan; [3]RIKEN Advanced Science Institute, Japan; [4]Japan Atomic Energy Agency, Japan; [5]The University of Tokyo, Japan.*

ABSTRACT Using the arrival timing measurement system based on EO (Electro-Optic) sampling technique, we improved the number of successful seeded FEL. HHG-seeded FEL was operated over half a day with a 20-30 % effective hit rate.

07.Mon.P1.51

Arrival-timing diagnostics for pump-probe experiments in SACLA using X-ray-induced optical transparency in GaAs

Tadashi Togashi[1,2], Takahiro Sato[2,3], Kanade Ogawa[2], Tetsuo Katayama[1,2], Shigeki Owada[2], Yuichi Inubushi[1,2], Kensuke Tono[1,2], Makina Yabashi[2,1]; *[1]XFEL Utilization Division, Japan Synchrotron Radiation Research Institute, Japan; [2]SPring-8 Center,*

RIKEN, Japan; [3]The University of Tokyo, Japan.

ABSTRACT We have developed an arrival-timing monitor between XFEL and optical laser pulses in SACLA by using X-ray-induced optical transparency in GaAs. We have evaluated the timing jitter to be 130 fs with 10 fs resolution.

07.Mon.P1.52

Collinear two dimensional infrared spectroscopy with a phase-locked pulse pair delayed by a birefringent delay line

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ABSTRACT We perform two dimensional spectroscopy in the mid-IR by using a set of birefringent wedges to generate and delay a phase-locked pair of pump pulses.

07.Mon.P1.53

Generation of Isolated Soft X-Ray Pulses Around the Carbon K-Edge Using CEP-Stabilized Few-Cycle IR Pulses

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ABSTRACT We demonstrate the generation of a 75-eV-wide continuum in the water window via HHG using CEP-stabilized, few-cycle IR pulses. A pressure dependence of harmonic spectra indicates sub-cycle deformation of IR pulses in the HHG process.

07.Mon.P1.54

High flux coherent supercontinuum soft X-ray source driven by a single-stage Ti:sapphire-pumped OPA

Chengyuan Ding[1], Wei Xiong[1], Tingting Fan[1], Daniel Hickstein[1], Tenio Popmintchev[1], Xiaoshi Zhang[2], Mike Walls[2], Margaret Murnane[1], Henry Kapteyn[1]; *[1]JILA and Physics, University of Colorado at Boulder, USA; [2]Kapteyn-Murnane Laboratories, USA.*

ABSTRACT We demonstrate the highest flux tabletop coherent soft X-ray source to date, using high harmonics driven by a single-stage Ti:sapphire-pumped OPA at 1.3μm. The spectrum extends to 200eV, with a flux of >10^6 photons/pulse/1% bandwidth.

07.Mon.P1.55

High-Energy Sub-Optical-Cycle Parametric Waveform Synthesizer

Giovanni Cirmi[1,3], Giulio Rossi[1,3], Shaobo Fang[1,3], Shih-Hsuan Chia[1,3], Oliver D. Mücke[1,3], Cristian Manzoni[5], Paolo Farinello[5], Giulio Cerullo[5], Franz X. Kärtner[2,4]; *[1]Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Germany; [2]Physics Department, University of Hamburg, Germany; [3]The Hamburg Center for Ultrafast Imaging, Germany; [4]Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, USA; [5]IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Italy.*

ABSTRACT We present FROG characterization of all three spectral channels of a multi-amplification-stage sub-optical-cycle parametric waveform synthesizer covering more than two octaves in bandwidth. The compressed 0.4-mJ energy can be scaled to the multi-mJ level.

07.Mon.P1.56

Direct Generation of 7 fs Whitelight Pulses from Bulk Sapphire

Emanuel Wittmann[1], Maximilian Bradler[1], Eberhard Riedle[1]; *[1]Ludwig Maximilians Universität München, Germany.*

ABSTRACT Generation of sub-10 fs continuum pulses without external compression is demonstrated. We investigate the propagation of the newly generated wavelengths and find that a short crystal in combination with an achromatic telescope leads to nearly chirp free continua.

07.Mon.P1.57

[Canceled]

07.Mon.P1.58

Passively CEP-Stable front end for frequency synthesis

Huseyin Cankaya[1,2], Anne-Laure Calendron[1,2], Franz X. Kärtner[1,3]; *[1]Ultrafast Optics and X-Rays Division, CFEL DESY, Germany; [2]The Hamburg Centre for Ultrafast Imaging, Universität Hamburg, Germany; [3]Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, USA.*

ABSTRACT We demonstrate a passive CEP-stable two-octave wide front-end for a high-energy optical waveform synthesizer driven by slightly sub-picosecond pump pulses from a multi-mJ regenerative amplifier.

07.Mon.P1.59

Towards a Compact Fiber Laser for Multimodal Imaging

Ilyas Saytashev[1], Bai Nie[2], Marcos Dantus[1,2]; [1]*Department of Chemistry, Michigan State University, USA;* [2]*Department of Physics and Astronomy, Michigan State University, USA.*

ABSTRACT We report on multimodal depth-resolved imaging of unstained living Drosophila Melanogaster larva using sub-50 fs pulses centered at 1060 nm wavelength. Both second harmonic and third harmonic generation imaging modalities are demonstrated.

07.Mon.P1.60

X-rays from quasi-phase-matched high-harmonic generation

Emeric Balogh[1], Katalin Varjú[1]; [1]*Department of Optics and Quantum Electronics, University of Szeged, Hungary.*

ABSTRACT Extension of high-order harmonic cutoff in quasi-phase-matched environment is proposed, using low-intensity, counterpropagating pulses in the NIR and MIR regime. We calculate the optimal field parameters, bandwidth and possible cutoff extension of the generated radiation.

Room A **17:15-19:00**

07.Mon.E Condensed Phase Dynamics

Presider: Shaul Mukamel *(University of California at Irvine, United States)*

07.Mon.E.1 **17:15** Invited

Ultrafast Vibrational Spectroscopy at Liquid Interfaces by Heterodyne-Detected Sum-Frequency Generation

Tahei Tahara[1,2]; [1]*Molecular Spectroscopy Laboratory, RIKEN, Japan;* [2]*RIKEN Center for Advanced Photonics, RIKEN, Japan.*

ABSTRACT Ultrafast dynamics at liquid interfaces are still obscure. Femtosecond time-resolved heterodyne-detected vibrational sum-frequency generation spectroscopy now enables us to investigate vibrational/photochemical dynamics at liquid interfaces with the same clarity as in solution-phase ultrafast spectroscopy.

07.Mon.E.2 **17:45** Contributed

Hydrated Phospholipid Surfaces Probed by Ultrafast 2D Spectroscopy of Phosphate Vibrations

Thomas Elsaesser[1], Rene Costard[1], Ismael A. Heisler[1]; [1]*Max Born Institute, Germany.*

ABSTRACT Phosphate stretching vibrations probe interfacial dynamics in hydrated phospholipids. Two-dimensional spectra in the 1000-1300 cm^{-1} range reveal structural fluctuations on a 300 fs time scale while water-phosphate hydrogen bonds persist for longer than 10 ps.

07.Mon.E.3 **18:00** Contributed

Detecting the Influence of Ions on Protein Hydration Dynamics with Site-Specific 2D-IR

John T. King[1], Evan J. Arthur[1], Charles L. Brooks[1], Kevin J. Kubarych[1]; [1]*Chemistry, University of Michigan, USA.*

ABSTRACT A strong vibrational probe bound to the surface of the model protein lysozyme reveals ion-specific modulation of the local hydration dynamics. Explicit water and ion simulations reveal strong cation association with a nearby charged side-chain.

07.Mon.E.4 **18:15** Contributed

Femtosecond Time and Angle Resolved Photoemission Spectroscopy of Liquids

Yo-Ichi Yamamoto[1,2], Yoshi-Ichi Suzuki[1,2], Toshinori Suzuki[1,2]; [1]*Chemistry, Kyoto University, Japan;* [2]*RIKEN, Japan.*

ABSTRACT We report the first time and angle resolved photoemission spectroscopy of liquids using a time-of-flight photoelectron spectrometer and a sub MHz deep ultraviolet femtosecond laser.

07.Mon.E.5 **18:30** Contributed

Bimolecular Reactions on a Timescale below 1 ps

Roland Wilcken[1], Herbert Mayr[2], Eberhard Riedle[1]; [1]*Chair for BioMolecular Optics, Ludwig-Maximilians-University Munich,*

Germany; [2]Department for Chemistry, Ludwig-Maximilians-University Munich, Germany.

ABSTRACT Access to the intrinsic reaction rate is gained by canceling out diffusion. The use of precursors on demand and reactive solvents allows the study of reactions down to 220 fs. Even the molecular rotation is considerably slower and a preformed, favorable configuration is concluded.

07.Mon.E.6 **18:45** ---------- Contributed

Vibrational Dynamics of Nitrosyl Stretch of Ru Complex in Aqueous Solution Studied by Two-Dimensional Infrared Spectroscopy

Kaoru Ohta[1], Kyoko Aikawa[2], Keisuke Tominaga[1,2]; *[1]Molecular Photoscience Research Center, Kobe University, Japan; [2]Graduate School of Science, Kobe University, Japan.*

ABSTRACT Vibrational frequency fluctuation of NO stretch of $[RuCl_5(NO)]^{2-}$ in water was studied by two-dimensional infrared spectroscopy. Observed temperature dependence provides evidence that collective dynamics of hydrogen bonding network controls the time scale of frequency fluctuation.

Tuesday, July *8*

Room A **08:30-10:15**

08.Tue.A Attosecond Electron Dynamics

Presider: Louis DiMauro *(Ohio State University, United States)*

08.Tue.A.1 **08:30** ---------- Invited

Ultrafast Laser Control of Absorption and Emission via the Fano Phase

Thomas Pfeifer[1]; *[1]Quantum Dynamics, Max-Planck-Institut fur Kernphysik, Germany.*

ABSTRACT Transmission of attosecond-pulsed light through Helium gas driven by few-cycle laser fields of tunable intensity allows to temporally resolve and control the process of absorption. The results enabled the understanding of Fano resonances in the time domain and corresponding scientific applications.

08.Tue.A.2 **09:00** ---------- Contributed

Attosecond dynamics of autoionizing states in electronic molecular wave packets

Maurizio Reduzzi[1], Wei-Chun Chu[2], Chengyong Feng[1], Antoine Dubrouil[1], Johan Hummert[1], Francesca Calegari[3], Fabio Frassetto[4], Luca Poletto[4], Oleg Kornilov[5], Mauro Nisoli[1,3], Chii Dong Lin[2], Giuseppe Sansone[1,3]; *[1]Physics, Politecnico di Milano, Italy; [2]Physics, Kansas State University, USA; [3]Institute of Photonics and Nanotechnologies, IFN-CNR, Italy; [4]Institute of Photonics and Nanotechnologies, IFN-CNR, Italy; [5]Max-Born-Institut, Germany.*

ABSTRACT By combining an isolated attosecond pulse and a few-cycle infrared field, we resolve in time the autoionization dynamics of two series of Fano resonances in nitrogen.

08.Tue.A.3 **09:15** ---------- Contributed

Sub-4-fs Charge Migration in Phenylalanine

Francesca Calegari[1], David Ayuso[2], Louise Belshaw[3], Andrea Trabattoni[4], Sunilkumar Anumula[4], Simone De Camillis[3], Fabio Frassetto[5], Luca Poletto[5], Alicia Palacios[2], Piero Decleva[6], Jason Greenwood[3], Fernando G. Martin[2,7], Mauro Nisoli[4,1]; *[1]IFN-CNR, Italy; [2]Universidad Autonoma de Madrid, Spain; [3]Queen's University Belfast, United Kingdom; [4]Politecnico di Milano, Italy; [5]IFN-CNR, Italy; [6]Università di Trieste, Italy; [7]Instituto Madrileno de Estudios Avanzados en Nanociencia, Spain.*

ABSTRACT Charge migration initiated by attosecond pulses was experimentally observed in an amino-acid. An oscillatory pattern in the yield of a doubly-charged fragments was measured with periods of 3.7 fs and 2.6 fs.

08.Tue.A.4 **09:30** ---------- Contributed

Pump-probe photoelectron imaging with 90-nm excitation pulses

Shunsuke Adachi[1,2], Motoki Sato[1], Yoshi-Ichi Suzuki[1], Toshinori Suzuki[1,2]; *[1]Department of chemistry, Graduate school of Science, Kyoto University, Japan; [2]RIKEN Center for Advanced Photonics, RIKEN, Japan.*

ABSTRACT Pump-probe photoelectron imaging was performed with 90-nm excitation pulses. Quantum beat by coherent excitation of multiple Rydberg states in Kr, and photodissociation of CO_2 within a few ps from initially excited Rydberg state(s) were observed.

08.Tue.A.5 **09:45** ---------- Contributed

XUV pump-XUV probe studies of 1fs scale dynamics in atoms and molecules

Dimitrios Charalambidis[1,2], Paraskevas Tzallas[1], Emmanouil Skantzakis[1], Alicia Palacios[3], David Gray[1], Fernando G. Martin[3,4], Poalo Antonio Carpeggiani[1,2]; *[1]FORTH-IESL, Greece; [2]Physics Department, Univ. of Crete, Greece; [3]Departamento de Química, Módulo 13, Universidad Autónoma de Madrid, Spain; [4]Instituto Madrileño de Estudios Avanzados en Nanociencia, Spain.*

ABSTRACT Exploiting intense coherent XUV continua, supporting attosecond pulse formation, we have performed the first ever XUV-pump-XUV-probe studies of 1fs scale dynamics in atoms and molecules. Progress towards single shot non-linear XUV autocorrelation is also reported.

08.Tue.A.6 **10:00** ---------- Contributed

Multiphoton Transitions for Robust Delay-Zero Calibration in Attosecond Transient Absorption

Jens Herrmann[1], Matteo Lucchini[1], Shaohao Chen[2], Mengxi Wu[2], André Ludwig[1], Lamia Kasmi[1], Kenneth J. Schafer[2], Lukas Gallmann[1,3], Mette B. Gaarde[2], Ursula Keller[1]; *[1]ETH Zurich, Switzerland; [2]Louisiana State University, USA; [3]University of Bern, Switzerland.*

ABSTRACT We present a novel in-situ method for the delay-zero calibration in attosecond transient absorption experiments. Our method is based on oscillations on the sub-femtosecond timescale originating from multiphoton transitions.

Room A 10:45-12:30

08.Tue.B Nanotips and Nanooptics

Presider: Walter Pfeiffer
(Zephyr Photonics, Germany)

08.Tue.B.1 10:45 ---------- Contributed

Visualization of Photocurrents in Nanoobjects by Ultrafast Low-Energy Electron Point-Projection Imaging

Melanie Müller[1], Alexander Paarmann[1], Ralph Ernstorfer[1]; *[1]Physical Chemistry, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Germany.* *Ultrafast dynamics of photocurrents in semiconductor nanowires are investigated with femtosecond time and nanometer spatial resolution.*

ABSTRACT We demonstrate the capability of time-resolved low-energy electron point-projection imaging as a novel tool for mapping transient fields at nanostructures.

08.Tue.B.2 11:00 ---------- Contributed

Control of Femtosecond Surface Plasmon Coupled onto a Gold Tapered Tip and its Nonlinear Emission

Kazunori Toma[1], Yuta Masaki[1], Kenichi Hirosawa[1], Fumihiko Kannari[1]; *[1]Keio University, Japan.*

ABSTRACT Spatiotemporal nanofocusing of surface plasmon polariton excited by femtosecond laser pulses on a sharp conical Au tip with a tip edge radius of few tens of nanometers is deterministically controlled.

08.Tue.B.3 11:15 ---------- Contributed

Ultrafast optical-field controlled photoemission from plasmonic nanoparticle arrays

William Putnam[1], Richard Hobbs[1], Yujia Yang[1], Karl Berggren[1], Franz Kaertner[1,2]; *[1]Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, USA; [2]Center for Free-Electron Laser Science, DESY and Department of Physics, University of Hamburg, Germany.*

ABSTRACT Exciting plasmonic nanoparticles with two-cycle optical pulses, we observe photoemission across few-micron gaps under ambient conditions. The photoemission is modulated by the carrier-envelope phase with a signal-to-noise ratio exceeding 20 dB at 1 Hz resolution-bandwidth.

08.Tue.B.4 11:30 ---------- Contributed

Photoelectron Emission from Resonant Nanoantennas Driven by Femtosecond Mid-infrared Pulses

Fumiya Kusa[1], Katharina Echternkamp[2], Georg Herink[2], Claus Ropers[2], Satoshi Ashihara[1]; *[1]Applied Physics, Tokyo Univ of Agriculture and Technology, Japan; [2]IV. Physikalisches Institut, University of Goettingen, Germany.*

Room B 10:45-12:30

08.Tue.C Biology

Presider: Erik T.J. Nibbering
(Max Born Institute, Germany)

08.Tue.C.1 10:45 ---------- Contributed

Coherence in Oxygenic Photosynthesis

Franklin D. Fuller[1], Jie Pan[1], Andrius Gelzinis[2,3], Vytautas Butkus[2,3], Seckin Senlik[1], Daniel E. Wilcox[1], Leonas Valkunas[2,3], Darius Abramavicius[2], Jennifer P. Ogilvie[1]; *[1]Physics and Biophysics, University of Michigan, USA; [2]Department of Theoretical Physics, Vilnius University, Lithuania; [3]Center for Physical Sciences and Technology, Vilnius University, Lithuania.*

ABSTRACT We report coherent dynamics in the photosystem II reaction center observed by two dimensional electronic spectroscopy. We discuss the physical nature of the coherences and their importance for charge separation.

08.Tue.C.2 11:00 ---------- Contributed

Following the Excited State Dynamics of β-apo-8'-carotenal with Two-Dimensional Electronic-Vibrational Spectroscopy

Thomas Oliver[1], Nicholas Lewis[1], Graham R. Fleming[1]; *[1]Chemistry, UC Berkeley, USA.*

ABSTRACT Two-dimensional electronic-vibrational spectroscopy is used to study the excited state evolution of the carotenoid β-apo-8'-carotenal in solution. This new multidimensional spectroscopy is unique in its ability to directly follow the electronic and nuclear degrees of freedom simultaneously.

08.Tue.C.3 11:15 ---------- Contributed

Ultrafast Interaction of Dark and Bright Electronic States in Open-Chain Carotenoids Investigated by Pump-DFWM

Takeshi Miki[1], Tiago Buckup[1], Marie Marek[1], Richard Cogdell[2], Marcus Motzkus[1]; *[1]Physikalisch-Chemisches Institut, Heidelberg University, Germany; [2]Institute of Biomedicine & Life Science, University of Glasgow, United Kingdom.*

ABSTRACT Coupling between dark and bright electronic states in carotenoids was observed in the ultrafast evolution of vibrational coherence and in the non-oscillatory signal of pump-DFWM. Coupling efficiency depends on the number of conjugated double bonds.

08.Tue.C.4 11:30 ---------- Contributed

Disentangling Electronic and Vibrational Coherence in the Phycocyanin-645 Light-Harvesting Complex

Gethin H. Richards[1], Krystyna E. Wilk[2], Paul M. Curmi[2], Jeffrey A. Davis[1]; *[1]Swinburne University of Technology, Australia; [2]University of New South Wales, Australia.*

ABSTRACT We selectively excite coherence pathways in the light-

ABSTRACT Strong-field photoelectron emission from gold nanorod antennas induced by mid-infrared pulses is studied using time-of-flight spectroscopy. The emission and acceleration of photoelectrons are maximized at the half-wave antenna resonance, evidencing substantial near-field enhancements.

08.Tue.B.5 **11:45** ---------- Contributed

THz-Controlled Photoelectron Emission from Nanotips

Lara Wimmer[1], Georg Herink[1], Katharina Echternkamp[1], Sergey Yalunin[1], Daniel R. Solli[1], Max Gulde[1], Claus Ropers[1]; *[1]4. Physical Institute, University of Goettingen, Germany.*

ABSTRACT We introduce terahertz gating and streaking of photoelectron emission at a single nanostructure. The THz-near-field enhancement allows for far-reaching electron trajectory control, including phase-resolved streaking by the momentary THz field and propagation-induced spectral reshaping.

08.Tue.B.6 **12:00** ---------- Invited

Terahertz STM for imaging ultrafast nanoscale dynamics

Tyler Cocker[1], Vedran Jelic[1], James Hoffman[1], Manisha Gupta[2], Reginald Miller[1], Sean Molesky[2], Jacob Burgess[1], Glenda De Los Reyes[1], Lyubov Titova[1], Ying Tsui[2], Mark Freeman[1], Frank A. Hegmann[1]; *[1]Physics, University of Alberta, Canada; [2]Electrical and Computer Engineering, University of Alberta, Canada.*

ABSTRACT A new ultrafast technique that couples terahertz pulses to the tip of a scanning tunneling microscope (THz-STM) and allows direct imaging of sub-picosecond dynamics on surfaces with nanometer spatial resolution is described.

harvesting complex PC645 and with wavelength and polarization control identify contributions from both electronic and vibrational coherences. Insight into the interactions between excited electronic and vibrational states follows.

08.Tue.C.5 **11:45** ---------- Contributed

Ultrafast Energy Flow and Equilibration Dynamics in Photosynthetic Light-Harvesting Complexes

Margherita Maiuri[1], Larry Luer[2], Sarah Henry[3], Anne-Marie Carey[3], Richard Cogdell[3], Giulio Cerullo[1], Dario Polli[1]; *[1]IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Italy; [2]Department of Nanoscience, Madrid Institute for Advanced Studies, Spain; [3]University of Glasgow, United Kingdom.*

ABSTRACT We disentangle various energy transfer pathways in the bacterio-chlorophyll excitation cascade from LH2 to LH1 in Chromatium vinosum grown under high-light or low-light illumination using tunable narrowband selective excitation and broadband infrared probing.

08.Tue.C.6 **12:00** ---------- Contributed

Ultrafast Energy Transfer in LH2 Photosynthetic Antenna Conjugated with Artificial Fluorescent Dyes

Yutaka Nagasawa[1,3], Yusuke Yoneda[1], Tetsuro Katayama[3], Hiroshi Miyasaka[1,4], Naoto Mizutani[2], Tomoyasu Noji[2], Takehisa Dewa[2]; *[1]Graduate School of Engineering Science, Osaka University, Japan; [2]Department of Life and Materials Engineering, Nagoya Institute of Technology, Japan; [3]PRESTO, Japan Science and Technology Agency, Japan; [4]Center for Quantum Science and Technology under Extreme Conditions, Osaka University, Japan.*

ABSTRACT Femtosecond transient absorption spectroscopy was carried out for energy transfer in photosynthetic purple bacteria LH2 antenna complex conjugated with artificial fluorescent dyes. Time constants of 3 ps and 18 ps were obtained by global analysis.

08.Tue.C.7 **12:15** ---------- Contributed

Primary Process in Light-Harvesting Complex Studied by Pump-Repump-Probe Spectroscopy

Kazuki Sobue[1], Kenta Abe[1], Shunsuke Sakai[2], Mamoru Nango[3], Hideki Hashimoto[3,4], Masayuki Yoshizawa[1]; *[1]Department of Physics, Tohoku University, Japan; [2]Department of Life and Materials Engineering, Nagoya Institute of Technology, Japan; [3]Department of Physics, Osaka City University, Japan; [4]OCARINA, Osaka City University, Japan.*

ABSTRACT Dark excited states of carotenoid in LH1 complex have been investigated by measuring recovery dynamics following the repump. The S^* state is different from the S_1 state but is similar to the T state.

Room A **14:00-15:45**

08.Tue.D Pulse Generation

Presider: Katsumi Midorikawa *(RIKEN, Japan)*

08.Tue.D.1 14:00 Contributed

Carrier-envelope phase of single-cycle pulses generated through two-color laser filamentation

Takao Fuji[1], Yutaka Nomura[1], Yu-Ting Wang[2], Atsushi Yabushita[2], Chih Wei Luo[2]; *[1]National Institutes of Natural Sciences, Japan; [2]Department of Electrophysics, National Chiao Tung University, Taiwan.*

ABSTRACT Carrier-envelope phase (CEP) control of the pulses from two-color filamentation has been investigated. The CEP variation with the relative phase between the two-color pulses is explained with a four-wave mixing model.

08.Tue.D.2 14:15 Contributed

Spectral Shaping and Continuous Tuning of Multi-color Carrier-envelope Phase Locked Pulse

Atsushi Yabushita[1], Chih-Hsien Kao[1], Takayoshi Kobayashi[2,3]; *[1]Electrophysics, National Chiao Tung University, Taiwan; [2]Department of Applied Physics and Chemistry and Institute for Laser Science, University of Electro-Communications, Japan; [3]CREST, JST, Japan.*

ABSTRACT We have demonstrated to generate multi-color CEP-locked beams using the non-collinear optical parametric amplifier. Spatial filter in the spatially dispersed seed light was for arbitrary spectral shaping and parabolic chirp was for tunable double color.

08.Tue.D.3 14:30 Contributed

High Gain Frequency domain Optical Parametric Amplifier (FOPA) for High Contrast Pulses

Philippe Lassonde[1], Maxime Boivin[1], Ladan Arissian[2], François Légaré[1], Bruno E. Schmidt[1,3]; *[1]Institut National de la Recherche Sci., Canada; [2]Electrical and Computer Engineering, University of New Mexico, USA; [3]few-cycle Inc., Canada.*

ABSTRACT 800nm, nJ level pulses are amplified >2.000 times in a single 2mm BBO crystal, pumped by picosecond 400nm pulses. Experiments evidence that the picosecond pulse contrast within the pump window remains unchanged upon amplification.

08.Tue.D.4 14:45 Contributed

Pushing the NOPA to New Frontiers: Output to below 400 nm, MHz Operation and ps Pump Duration

Eberhard Riedle[1], Maximilian Bradler[1], Peter Baum[2], Lamia Kasmi[2]; *[1]LS für BioMolekulare Optik, Ludwig-Maximillians-Universität Munchen, Germany; [2]LS Krausz, Ludwig-Maximilians-Universität München, Germany.*

ABSTRACT Two sub-ps MHz range Yb-based lasers are used to pump NOPAs at 343 nm. A SHG driven supercontinuum allows tuning down to 395 nm. For a 1-ps pump, supercontinuum seeding is applicable, the pulses are compressed to the 20-fs regime with a potential for sub-10 fs.

08.Tue.D.5 15:00 Contributed

Over 1-mJ intense ultrashort optical-vortex pulse generation with programmable topological-charge control by chirped-pulse amplification

Keisaku Yamane[1,2], Asami Honda[1], Yasunori Toda[1,2], Ryuji Morita[1,2]; *[1]Hokkaido University, Japan; [2]JST CREST, Japan.*

ABSTRACT We demonstrated the generation of over 1-mJ intense optical-vortex pulses of which topological charges were programmably controlled by computer-generated holograms. The pulse duration was characterized to be 27 fs by two-dimensional spectral shearing interferometry.

08.Tue.D.6 15:15 Contributed

Tunable Few-Cycle Mid-IR Pulses towards Single-Cycle Duration by Adiabatic Frequency Conversion

Peter R. Krogen[1], Haim Suchowski[2], Gregory J. Stein[1], Franz X. Kärtner[1,3], Jeffrey Moses[1]; *[1]Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, USA; [2]NSF Nanoscale Science and Engineering Center, University of California, USA; [3]Center for Free-Electron Laser Science, DESY and University of Hamburg, Germany.*

ABSTRACT Using adiabatic difference frequency generation, we generate Fourier-limited, few-cycle, tunable 2-4-μm mid-IR pulses at μJ-level, with controllable amplitude and phase by shaping before conversion from the near-IR, paving the way for arbitrary single-cycle mid-IR waveforms.

08.Tue.D.7 **15:30** Contributed

Strong field applications of Gigawatt self-compressed pulses from a Kagome fiber

Tadas Balciunas[1], Guangyu Fan[1], Stefan Haessler[1], Coralie Fourcade-Dutin[2], Tobias Witting[3], Alexander Voronin[4], Alexei Zheltikov[4,5], Gerome Frédéric[2], Gerhard G. Paulus[6], Andrius Baltuska[1], Fetah Benabid[2]; *[1]Technische Universität Wien, Austria; [2]Xlim Research Institute, University of Limoges, France; [3]Blackett Laboratory, Imperial College London, United Kingdom; [4]M.V. Lomonosov Moscow State University, Russian Federation; [5]Department of Physics and Astronomy, Texas A&M University, USA; [6]Institute of Optics and Quantum Electronics, Germany.*

ABSTRACT Nonlinear self-compression of 1.7-um pulses in a gas-filled Kagome fiber down to a single cycle duration and pulse energies up to 100 uJ provides a uniquely simple driver source for high-harmonic generation and above-threshold ionization experiments.

Exhibition Hall **15:45-17:15**

08.Tue.P2 Poster Session II

08.Tue.P2.1

Analysis of strong-field enhanced ionization of molecules using Bohmian trajectories

Ryohto Sawada[1,2], Takeshi Sato[2], Kenichi L. Ishikawa[1,2]; *[1]Applied physics, Graduate School of Enginieering, The University of Tokyo, Japan; [2]Photon Science Center, Graduate School of Engineering, The University of Tokyo, Japan.*

ABSTRACT We investigate strong-field enhanced ionization of 1D hydrogen molecule using Bohmian trajectories. Contrary to the common belief, we find that the electron ejections both from the down- and up-field atoms are comparably important.

08.Tue.P2.2

Observation of Multiphoton Absorptions in Laser-Assisted Electron Scattering in a Femtosecond Intense Laser Field

Kakuta Ishida[1], Yuya Morimoto[1], Reika Kanya[1], Kaoru Yamanouchi[1]; *[1]The University of Tokyo, Japan.*

ABSTRACT High-order multiphoton laser-assisted electron scattering processes induced by collision of electrons and Xe atoms in a femtosecond intense laser field were observed for investigating high-order laser-atom interactions.

08.Tue.P2.3

Electronic pre-determination of ethylene fragmentation dynamics

Xinhua Xie[1], Stefan Roither[1], Erik Lötstedt[2], Markus Schöffler[1], Daniil Kartashov[1], Gerhard G. Paulus[3,4], Atsushi Iwasaki[2], Andrius Baltuska[1], Kaoru Yamanouchi[2], Markus Kitzler[1]; *[1]Photonics Institute, Vienna University of Technology, Austria; [2]Department of Chemistry, School of Science, The University of Tokyo, Japan; [3]Institute of Optics and Quantum Electronics, Friedrich-Schiller-University Jena, Germany; 4Helmholtz Institute Jena, Germany.*

ABSTRACT We demonstrate, using ethylene, that controlling lower-valence ionization and field-driven excitation dynamics with ultrashort, intense laser pulses allows steering fragmentation reactions of polyatomic molecules along a certain pathway towards a specific set of fragment ions.

08.Tue.P2.4

Two-Photon Rabi Oscillations of Excited He Atoms in Ultrafast Strong Laser Field Ionization

Mizuho Fushitani[1,2], Chien-Nam Liu[3], Akitaka Matsuda[1], Tomoyuki Endo[1], Yuto Toida[1], Yasumasa Hikosaka[2,4], Mitsuru Nagasono[2], Tadashi Togashi[5], Makina Yabashi[2,5], Tetsuya Ishikawa[2], Toru Morishita[6], Akiyoshi Hishikawa[1,2]; *[1]Nagoya University, Japan; [2]RIKEN, Japan; [3]Fu-Jen Catholic University, Taiwan; [4]Niigata University, Japan; [5]JASRI, Japan; [6]The University of Electro-Communications, Japan.*

ABSTRACT Intensity dependence of polarized He (2^1P) atoms in intense NIR laser fields are investigated by single-shot photoelectron spectroscopy, revealing two-photon Rabi oscillations between the initial 1s2p and 1snf (n = 5,6) Rydberg states.

08.Tue.P2.5

Determination of Absolute Cross-Sections of Nonresonant EUV-UV Two-Color Two-Photon Ionization of He

Mizuho Fushitani[1,2], Yasumasa Hikosaka[2,3], Akitaka Matsuda[1], Tomoyuki Endo[1], Eiji Shigemasa[2,4], Mitsuru Nagasono[2], Takahiro Sato[2], Tadashi Togashi[5], Makina Yabashi[2,5], Tetsuya Ishikawa[2], Akiyoshi Hishikawa[1,2]; *[1]Nagoya University, Japan; [2]RIKEN, Japan; [3]Niigata University, Japan; [4]Institute for Molecular Science, Japan; [5]JASRI, Japan.*

ABSTRACT Single-shot photoelectron spectroscopy was performed for nonresonant EUV-UV two-color two-photon ionization of He. From data analysis on the shot-by-shot basis, the absolute cross-section was determined to be $\sigma(2)(597nm, 268nm) = 4.1(6)\times10^{-52}$ cm^4 s.

08.Tue.P2.6

Direct comparison of multi-photon and EUV single photon probing of molecular relaxation processes

Thomas Wolf[1], Markus Koch[1,2], Emily F. Sistrunk[1], Jakob Grilj[1,3], Markus Gühr[1]; *[1]Stanford PULSE Institute, SLAC National Accelerator Laboratory, USA; [2]Institute of Experimental Physics, Graz University of Technology, Austria; [3]Laboratoire de Spectroscopie Ultrarapide, Ecole Polytechnique Fedrale de Lausanne EPFL, Switzerland.*

ABSTRACT We present a new setup for time-resolved photoelectron and photoion spectroscopy allowing for single-photon EUV or multi-photon NIR ionization. Comparison of different probe schemes reveals disagreements shedding light on the underlying advantages of different probes.

08.Tue.P2.7

Mirrorless Backward SRS in Free-Space Gas Driven by Filament-Initiated UV Laser

Daniil Kartashov[5,1], Pavel Malevich[1], Faffael Maurer[1], Skirmantas Alisauskas[1], Marko Marangoni[2], Giulio Cerullo[2], Alexei Zheltikov[3,4], Audrius Pugzlys[1], Andrius Baltuska[1]; *[1]Photonics Institute Vienna University of Technology, Austria; [2]IFN-CNR, Dipartimento di Fisica, Politecnico di Milano, Italy; [3]Physics Department, International Laser Center, M.V. Lomonosov Moscow State University, Russian Federation; [4]Department of Physics and Astronomy, Texas A&M University, USA; [5]Friedrich-Schiller University Jena, Germany.*

ABSTRACT Stimulated Raman scattering combined with ASE lasing from nitrogen molecules in a femtosecond filament is shown to provide a highly directional chemical-bond-sensitive coherent readout in the direction opposite to that of the driver laser beams.

08.Tue.P2.8

Laser-coupled R-matrix calculations for high-harmonic spectroscopy

Danilo Simoes Brambila[1]; *[1]Max Born Institute, Germany.*

ABSTRACT We develop R-matrix calculations for systems embedded in a quasi static field. We report the field effects on the Rydberg series of Helium, and on the tunnel ionization rates of CO_2.

08.Tue.P2.9

Laser Induced Rescattering Photoelectron Spectroscopy on Hydrocarbon Molecules

Yuta Ito[1], Misaki Okunishi[1], Chuncheng Wang[2], Robert R. Lucchese[3], Toru Morishita[4], Oleg I. Tolstikhin[5], Lars B. Madsen[6], Kiyoshi Ueda[1]; *[1]Tohoku University, Japan; [2]Jilin University, China; [3]Texas A&M University, USA; [4]University of Electro-Communications, Japan; [5]National Research Centre "Kurchatov Institute", Russian Federation; [6]Aarhus University, Denmark.*

ABSTRACT We have extracted field-free differential cross sections of electron scattering from $C_2H_4^+$ and $C_2H_6^+$ ions from rescattering photoelectron spectra of C_2H_4 and C_2H_6 induced by ultrashort intense infrared laser pulses at 1300 and 1650 nm.

08.Tue.P2.10

Non-adiabatic Effects in Electron Momenta

Cornelia Hofmann[1], Alexandra S. Landsman[1], Claudio Cirelli[1], Ursula Keller[1]; *[1]Physics Department, ETH Zurich, Switzerland.*

ABSTRACT In strong-field tunnel ionization of Helium, both adiabatic and fully non-adiabatic theoretical descriptions predict smaller final longitudinal electron momentum distributions than measured experimentally. Semiclassical simulations including an initial longitudinal momentum spread reproduce experimental values.

08.Tue.P2.11

Nonlinear Fourier-transform spectroscopy using ultrabroadband femtosecond pulses for the measurement of photobleaching of fluorescent proteins

Akira Suda[1]; *[1]Tokyo University of Science, Japan.*

ABSTRACT We examine the mechanism of photobleaching of fluorescent proteins using nonlinear Fourier-transform spectroscopy with ultrabroadband femtosecond pulses. Photobleaching of two-photon excited fluorescent molecules occurs through one-photon excited-state absorption.

08.Tue.P2.12

Vibrational Dynamics in Photoactive Yellow Protein Revealed by Mid-IR Pump / Visible Probe Spectroscopy

Ryosuke Nakamura[1], Norio Hamada[1]; [1]*Osaka University, Japan.*

ABSTRACT Vibrational dynamics of the chromophore in photoactive yellow protein is studied by mid-IR-pump-visible-probe spectroscopy. So-called 'ground state intermediate', which is believed to be a cis isomer, is directly generated by vibrational excitation.

08.Tue.P2.13

Light Harvesting Dynamics in Gloeobacter Rhodopsin (GR)

E Siva Subramaniam Iyer[1], Itay Gdor[1], Tamar Eliash[2], Mordechai Sheves[2], Sanford Ruhman[1]; [1]*Institute of Chemistry, Hebrew University of Jerusalem, Israel;* [2]*Department of Organic Chemistry, Weizmann Institute, Israel.*

ABSTRACT GR is directly shown by ultrafast pump-probe measurements to bind the carotenoid Salinixanthin, which acts as an efficient light harvesting antenna. Along with Xanthorhodopsin, This proves light harvesting to be a prevalent strategy in retinal proteins.

08.Tue.P2.14

Ultrafast Relaxation and Photodissociation Dynamics of 1,3-Butadiene Studied by Probing Molecular Orbitals

Ayumu Makida[1], Takehisa Fujiwara[1], Taro Sekikawa[1], Yu Harabuchi[2], Tetsuya Taketsugu[2]; [1]*Applied Physics, Hokkaido University, Japan;* [2]*Chemistry, Hokkaido University, Japan.*

ABSTRACT Femtosecond relaxation and picosecond photodissociation dynamics of 1,3-butadiene were investigated by time-resolved photoelectron spectroscopy with high harmonics pulses, probing the deeper molecular orbitals which are sensitive to the molecular structure.

08.Tue.P2.15

Ultrafast Time-Domain Raman Study to Visualize Large-Amplitude Distortions in Copper Complexes

Satoshi Takeuchi[1,2], Munetaka Iwamura[3], Tahei Tahara[1,2]; [1]*RIKEN, Japan;* [2]*RIKEN Center for Advanced Photonics, Japan;* [3]*University of Toyama, Japan.*

ABSTRACT Time-resolved impulsive-Raman with narrowband photoexcitation was utilized to study structural dynamics of bis-diimine copper complex in solution. A copper-ligand symmetric stretch band showed up with frequency oscillation, demonstrating its anharmonic coupling with large-amplitude distortional motions.

08.Tue.P2.16

Control of Chemical Bond Break with both Electronic and Nuclear Dynamics

Xinhua Xie[1], Erik Lötstedt[2], Stefan Roither[1], Markus Schöffler[1], Daniil Kartashov[1], Kaoru Yamanouchi[3], Katsumi Midorikawa[2], Andrius Baltuška[1], Markus Kitzler[1]; [1]*Photonics Institute, Vienna University of Technology, Austria;* [2]*Laser Technology Laboratory, RIKEN, Japan;* [3]*Department of Chemistry, The University of Tokyo, Japan.*

ABSTRACT We experimentally demonstrated control of chemical bond break of ethylene in intense laser fields with employing both electronic dynamics and nuclear vibrational dynamics.

08.Tue.P2.17

Observing the Elusive Double-Peak Structure in R-dependent Tunneling Ionization Rate of Hydrogen Molecular Ion

Igor Litvinyuk[1], Han Xu[1], Tian-Yu Xu[3], Feng He[3], Dave Kielpinski[1,2], Robert Sang[1,2]; [1]*Centre for Quantum Dynamics, Griffith University, Australia;* [2]*ARC Centre for Coherent X-ray Science, Griffith University, Australia;* [3]*Department of Physics and Astronomy, SJTU, China.*

ABSTRACT We performed pump-probe experiment on H_2 using intense few-cycle laser pulses and Reaction Microscope detection apparatus. We observe the theoretically predicted double-peak structure in R-dependent tunneling ionization rate for the first time experimentally.

08.Tue.P2.18

Time-resolved Coulomb Explosion Imaging of Ultrafast Fragmentation of CS_2 in Highly Charged States

Akitaka Matsuda[1], Eiji J. Takahashi[2], Akiyoshi Hishikawa[1]; [1]*Department of Chemistry, Graduate School of Science, Nagoya University, Japan;* [2]*Attosecond Science Research Team, RIKEN Center for Advanced Photonics, Japan.*

ABSTRACT Time-resolved Coulomb explosion imaging of CS_2 in few-cycle intense laser fields revealed that the ultrafast fragmentation dynamics of CS_2 in highly charged states proceed in a different timescale depending on the charge state.

08.Tue.P2.19

Ionization of Aligned O_2 by Intense Laser Pulse

Kotaro Sonoda[1], Hirokazu Hasegawa[1], Takahiro Sato[2], Atsushi Iwasaki[2], Kaoru Yamanouchi[2]; *[1]Integrated Sciences, University of Tokyo, Japan; [2]Chemistry, University of Tokyo, Japan.*

ABSTRACT Intense field ionization of aligned O_2 is investigated by a pump-probe method. The different behavior of O_2^+ and O_2^{2+} yields against a pump-probe delay is ascribed to the angular dependence of the ionization probability.

08.Tue.P2.20

Multidimensional Photochemistry Models: Application to Aminobenzonitrile and Benzopyran

Aurelie Perveaux[1,3], Pedro Javier Castro Pelaez[2], Mar Reguero[2], Hans-Dieter Meyer[4], Fabien Gatti[3], David Lauvergnat[1], Benjamin Lasorne[3]; *[1]Chimie, LCP, France; [2]Quimica fisica i inorganica, Pl. Imperial Tarraco, Spain; [3]Chimie, CTMM, France; [4]Theoretische Chemie, Physikalisch-Chemische Institut, Germany.*

ABSTRACT To understand the photoreactivity of aminobenzonitrile and benzopyran, their electronic structures and the potential energy landscapes were analyzed at the CASSCF level and models were developed to perform quantum dynamics calculations

08.Tue.P2.21

Femtosecond Pump - Probe Spectroscopy Reveals the Photo-excited State and Charge Transfer of a Photocatalytic Metal-Organic Framework

Monique van der Veen[1,2], Kamila Mazur[2], Maxim Nasalevich[1], Martijn Hurkmans[1], Jorge Gascon[1], Freek Kapteijn[1], Arjan Houtepen[1], Ferdinand Grozema[1], Mischa Bonn[2], Johannes Hunger[2]; *[1]Delft University of Technology, Netherlands; [2]Max-Planck Institute for Polymer Research, Germany.*

ABSTRACT With femtosecond pump-probe spectroscopy we found for photocatalytically active NH_2-MIL-125 that after photo-excitation the hole resides on -NH_2. Charge transfer from the MOF to an occluded molecule capable to shuttle single charges to a reaction centre is extremely fast (< 200 fs) while charge recombination only occurs on the ns-µs time scale.

08.Tue.P2.22

Coherent Control of the Photodissociation of Triiodide in Solution Reveals New Pathways

Rui Xian[1], Valentyn Prokhorenko[1], Ryan L. Field[2], Dwayne Miller[1,2]; *[1]Max Planck Institute (MPSD), Germany; [2]Chemistry and Physics, University of Toronto, Canada.*

ABSTRACT We demonstrate control of the photodissociation of triiodide, solvated in ethanol, via phase-shaped UV pulses. The second-order chirp dependence of the diiodide yield hints at additional pathways involving higher-lying potential energy surfaces.

08.Tue.P2.23

Solvent Environment Revealed by Positively Chirped Pulses

Arkaprabha Konar[1], Vadim V. Lozovoy[1], Marcos Dantus[1,2]; *[1]Michigan State University, USA; [2]Physics and Astronomy, Michigan State University, USA.*

ABSTRACT We compare the fluorescence yield for laser dyes as a function of linear chirp. Negatively chirped pulses are insensitive to solvent viscosity while positively chirped pulses are found to be uniquely sensitive probes of solvent viscosity.

08.Tue.P2.24

Interpreting Coherence Beats in Numerically Exact Simulations of 2D Spectra

Daniele Monahan[1], Lukas Whaley-Mayda[1], Akihito Ishizaki[2], Graham R. Fleming[1]; *[1]Chemistry, University of California, Berkeley, USA; [2]Institue for Molecular Science, Natural Institute of Natural Sciences, Japan.*

ABSTRACT Coherence beats are simulated in a numerically exact hierarchy method treatment of an electronic heterodimer coupled to a vibration and bath. We vary coupling parameters to analyze the lifetimes and contributions from different Liouville pathways.

08.Tue.P2.25

Long-Lived Neutral H_2 in Hydrogen Migration within Hydrocarbon Dication

Katsunori Nakai[1], Kaoru Yamanouchi[1]; *[1]Department of Chemistry, School of Science, The University of Tokyo, Japan.*

ABSTRACT First principles molecular dynamics calculations of energized $CH_3NH_2^{2+}$ and $CH_3CH_3^{2+}$ show that a long-lived neutral H_2 moiety is formed within a doubly charged parent ion,leading eventually to the formation of H_3^+.

08.Tue.P2.26

Time-Resolved Impulsive Raman Study of Excited State Structures of Green Fluorescent Protein

Tomotsumi Fujisawa[1], Hikaru Kuramochi[1], Satoshi Takeuchi[1,2], Tahei Tahara[1,2]; *[1]Molecular Spectroscopy Lab., RIKEN, Japan; [2]Ultrafast Spectroscopy Research Team, RIKEN Center for Advanced Photonics, Japan.*

ABSTRACT Structural dynamics of green fluorescent protein was studied by femtosecond time-resolved impulsive Raman spectroscopy. The excited-state vibrational spectra of the protein with three different chromophore forms were obtained, revealing their structural differences and excited-state deprotonation.

08.Tue.P2.27

Hydrogen Bond Dynamics in Alcohols Studied by 2D IR Spectroscopy

Keisuke Shinokita[1], Ana Cunha[1], Thomas Jansen[1], Maxim S. Pshenichnikov[1]; *[1]Zernike Institute for Advanced Materials, University of Groningen, Netherlands.*

ABSTRACT Ultrafast hydrogen-bond dynamics in alcohols are studied with 2D IR spectroscopy and combined molecular dynamics - quantum mechanical simulations on the OH stretching mode. Timescales of ~200 fs and 1 ps are attributed to hydrogen-bond fluctuations and hydrogen-bond exchange dynamics, respectively.

08.Tue.P2.28

Excited-state dynamics of catalytically active transition metal complexes studied by transient photofragmentation in gas phase and transient absorption in solution

Dimitri Imanbaew[1], Yevgeniy Nosenko[1], Katharina Chevalier[2], Fabian Rupp[2], Christian Kerner[1], Frank Breher[3], Werner Thiel[1], Christoph Riehn[1], Rolf Diller[2]; *[1]Chemistry and OPTIMAS, TU Kaiserslautern, Germany; [2]Physics, TU Kaiserslautern, Germany; [3]Inorganic Chemistry, Karlsruhe Institute of Technology (KIT), Germany.*

ABSTRACT Femtosecond photofragmentation (gas phase) and transient absorption (solution) revealed ultrafast electronic coupling (0.1-3ps) and energy transfer (7-12 ps) in a Ru(II)-complex and ultrafast formation (~0.4ps) of a long-lived triplet state in a Pd_3-complex.

08.Tue.P2.29

Femtosecond transient absorption measurement of energy and charge transfers in donor-acceptor liquid crystalline dyad and triad

Jae Heun Woo[5], Kwang Jin Lee[1], Leszek Mazur[2,3], Eun Sun Kim[1], Yiming Xiao[3], Fabrice Mathevet[3], André-Jean Attias[3], Jeong Weon Wu[1], Jean-Charles Ribierre[1,4]; *[1]Department of Physics & CNRS-Ewha International Research Center, Ewha Womans University, Republic of Korea; [2]Laboratory of Polymer Chemistry, University Pierre et Marie Curie, France; [3]Institute of Physical and Theoretical Chemistry, Wroclaw University of Technology, Poland; [4]Center for Organic Photonics and Electronics Research, Kyushu University, Japan; [5]Center for Length, Division of Physical Metrology, Korea Research Institute of Standards and Science (KRISS), Republic of Korea.*

ABSTRACT We investigated the energy transfer and charge transfer processes in dyad and triad based on triphenylene (donor) and perylene (acceptor) units by femtosecond transient absorption spectroscopy. Our results demonstrate that energy transfer from triphenylene to perylene occurs in solution and charge transfer is observed in thin films.

08.Tue.P2.31

Snapshots of Dirac Fermions near the Dirac Point in Topological Insulators

Tien-Tien Yeh[1], Chih Wei Luo[1], Harn-Jiunn Wang[1], Shin-An Ku[1], Hsueh-Ju Chen[1], Jiunn-Yuan Lin[2], Kaung-Hsiung Wu[1], Jenh-Yih Juang[1], Ben-Li Young[1], Takayoshi Kobayashi[3], Cheng-Maw Cheng[4], Ching Hung Chen[4], Ku-Ding Tsuei[4], Fang-Cheng Chou[5]; *[1]Electrophysics, National Chiao Tung University, Taiwan; [2]Physics, National Chiao Tung University, Taiwan; [3]Engineering Science, University of Electro-Communications, Japan; [4]National Synchrotron Radiation Research Center, Taiwan; [5]Center for Condensed Matter Sciences, National Taiwan University, Taiwan.*

ABSTRACT We utilized a ultrafast optical pump mid-infrared probe to explore the dynamics of Dirac fermions near the Dirac point in topological insulator. The femtosecond snapshots of the relaxation process were revealed by the ultrafast optics.

08.Tue.P2.32

[Canceled]

08.Tue.P2.33

Beating of Terahertz Pulse Induced Spin Precession in $ErFeO_3$

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ABSTRACT Terahertz pulse induced spin precession in $ErFeO_3$ was observed via the Faraday rotation of the visible probe pulse. Unreported splitting of the magnetic resonance was discovered and mechanism explaining this splitting is proposed.

08.Tue.P2.34

Ultrafast charge photogeneration and dynamics in semiconducting carbon nanotubes

Giancarlo Soavi[1], Francesco Scotognella[1], Daniele Viola[1], Timo Hefner[2], Tobias Hertel[2], Guglielmo Lanzani[3], Giulio Cerullo[1]; *[1]IFN-CNR Dipartimento di Fisica, Politecnico di Milano, Italy; [2]Department of Chemistry and Pharmacy, University of Wuerzburg, Germany; [3]Center for Nano Science and Technology@PoliMi, Istituto Italiano di Tecnologia, Italy.*

ABSTRACT We show that charge-carriers are instantaneously photogenerated in semiconducting carbon nanotubes by identifying their spectral signature in transient absorption. We exploit carbon nanotubes as ideal systems for the study of charge-carriers dynamics in one dimension.

08.Tue.P2.35

Observation of the Photoinduced Phase Transition in $Me_4P[Pt(dmit)_2]_2$ by Femtosecond Electron Diffraction

Stuart Hayes[1], Tadahiko Ishikawa[2], Sercan Keskin[1], Masaki Hada[2,3], Alexander Marx[1], Gaston Corthey[1], Kostyantyn Pichugin[1], Mitsushiro Nomura[4], Reizo Kato[4], Ken Onda[2,3], Yoichi Okimoto[2], Shin-ya Koshihara[2,5], R. J. Dwayne Miller[1]; *[1]Max-Planck Institute (MPSD), Germany; [2]Tokyo Institute of technology, Japan; [3]JST-PRESTO, Japan; [4]RIKEN, Japan; [5]JST-CREST, Japan.*

ABSTRACT Femtosecond electron diffraction has been used to probe the photoinduced phase transition in the strongly-correlated system, $Me_4P[Pt(dmit)_2]_2$, revealing molecular motions involved in this process and breaking new ground in terms of chemical complexity.

08.Tue.P2.36

Ultrafast Magnetostriction of Antiferromagnetic Holmium studied by Femtosecond X-Ray Diffraction

Daniel Schick[1], Alexander von Reppert[1], Matthias Rössle[1], Matias Bargheer[1,2]; *[1]Institut für Physik, Universität Potsdam, Germany; [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany.*

ABSTRACT We present time-resolved X-ray diffraction data on antiferromagnetic Holmium thin films after direct femtosecond laser excitation. The strong magnetostriction in Holmium allows to correlate the observed ultrafast lattice dynamics to the antiferromagnetic helical spin structure.

08.Tue.P2.37

Ultrafast Dynamics of Single Crystal $[Fe^{II}(bpy)_3](PF_6)_2$

Ryan Field[1,2], Lai Chung Liu[1,2], Cheng Lu[1], Wojciech Gawelda[3], Yifeng Jiang[1,2], Dwayne Miller[1,2]; *[1]University of Toronto, Canada; [2]Max Planck Institute for Structural Dynamics, Germany; [3]European XFEL, Germany.*

ABSTRACT Transient absorption spectroscopy is used to characterize the ultrafast spin-transfer process in single crystal iron(II)-tris(bipyridine)-bis(hexafluorophosphate). Preliminary data analysis shows evidence of the formation of a high spin state and oscillatory signals on multiple time scales.

08.Tue.P2.38

Single-shot Real-time Observation of Ultrafast Amorphization in $Ge_2Sb_2Te_5$ Thin Film

Wataru Oba[1], Ikufumi Katayama[1], Yasuo Minami[1], Toshiharu Saiki[2], Jun Takeda[1]; *[1]Yokohama National University, Japan; [2]Graduate School of Science and Technology, Keio University, Japan.*

ABSTRACT Ultrafast dynamics of photo-induced amorphization in $Ge_2Sb_2Te_5$ thin film has been studied using broadband single-shot real-time pump-probe imaging spectroscopy. We successfully observed the transient absorption changes accompanied with the ultrafast amorphization with a single-shot detection.

08.Tue.P2.39

Femtosecond demagnetization of ferromagnetic metal: cooperative precession of delocalized spins

Jaedong Lee[1], Won Seok Yun[1,2]; *[1]Dept. Emereging Materials Science, DGIST, Republic of Korea; [2]Center for X-ray Optics, LBNL, USA.*

ABSTRACT A microscopic model of coherent Elliot-Yafet phonon inducing the delocalized spin precession is proposed to drive a cooperative femtosecond quenching of the magnetization in ferrromagnetic metal, beyond the phenomenological temperature model.

08.Tue.P2.40

Accessing Energy-Dependent Photoemission Delays in Solids

Matteo Lucchini[1], Luca Castiglioni[2], Reto Locher[1], Michael Greif[2], Lukas Gallmann[1,3], Jürg Osterwalder[2], Matthias Hengsberger[2], Ursula Keller[1]; *[1]ETH Zurich, Switzerland; [2]University of Zurich, Switzerland; [3]University of Bern, Switzerland.*

ABSTRACT Our new detection scheme combines the RABBITT technique in solids with simultaneous measurements in a reference argon target. The experiment resolved attosecond delays in the photoemission from noble metal surfaces beyond simple ballistic transport.

08.Tue.P2.41

10 fs dynamics of photoinduced magnetic transition in double-layered charge ordering in $LuFe_2O_4$ under interlayer excitation

Yuto Sagae[1], Kentaro Yamada[1], Takahiro Ishikawa[1], Keisuke Itoh[1], Hirotake Itoh[1,2], Takahiko Sasaki[3], Tomoko Nagata[4], Jun Kano[4], Takashi Kambe[4], Sumio Ishihara[1], Naoshi Ikeda[4], Shinichiro Iwai[1,2]; *[1]Physics, Tohoku University, Japan; [2]CREST, JST, Japan; [3]Institute for Materials Research, Tohoku University, Japan; [4]Physics, Okayama University, Japan.*

ABSTRACT Photoinduced ferrimagnetic to antiferromagnetic transition was investigated in double layered Fe oxide $LuFe_2O_4$ by 12fs infrared pulse. Inter-layer charge imbalance successively induce the changes of charge/magnetic structures interacting with several phonons through the exchange interaction.

08.Tue.P2.42

Terahertz Induced Electromigration

Andrew C. Strikwerda[1], Maksim Zalkovskij[1], Krzysztof Iwaszczuk[1], Peter Uhd Jepsen[1]; *[1]Danmarks Tekniske Universitet, Denmark.*

ABSTRACT We report the first observation of THz-field-induced electromigration in sub-wavelength metallic gap structures after exposure to intense single-cycle, sub-picosecond electric field transients of amplitude up to 400 kV/cm.

08.Tue.P2.43

Ultrafast Lattice Dynamics of Phase-change Materials Monitored by a Pump-pump-probe Technique

Muneaki Hase[1], Paul Fons[2], Kirill Mitrofanov[2], Alexander Kolobov[2], Junji Tominaga[2]; *[1]Institute of Applied Physics, University of Tsukuba, Japan; [2]Nanoelectronics Research Institute, National Institute of Advanced Industrial Science and Technology, Japan.*

ABSTRACT We explore ultrafast structural transformation in the Ge_2Te_2/Sb_2Te_3 superlattice, using pump-pump-probe spectroscopy. The coherent phonon spectra exhibit complex structural dynamics upon photo-excitation, being described as the mixing of two different Ge bonding configurations.

08.Tue.P2.44

Sagnac Interferometer for Two-Dimensional Femtosecond Spectroscopy in the Pump-Probe Geometry

Samuel Park[1], Trevor Courtney[1], Dmitry Baranov[1], Byungmoon Cho[1], David Jonas[1]; *[1]Department of Chemistry and Biochemistry, University of Colorado at Boulder, USA.*

ABSTRACT An intrinsically phase-stable Sagnac interferometer is introduced for enhanced sensitivity detection in partially collinear two-dimensional spectroscopy in the short-wave IR. The sensitivity and phase accuracy of the apparatus are demonstrated on the dye IR-26.

08.Tue.P2.45

Ultrafast Non-Thermal Response of Plasmonic Resonance in Gold Nanoantennas

Giancarlo Soavi[1], Giuseppe Della Valle[1], Paolo Biagioni[1], Andrea Cattoni[2], Stefano Longhi[1], Giulio Cerullo[1], Daniele Brida[3]; *[1]Politecnico di Milano, Italy; [2]Laboratoire de Photonique et de Nanostructures, France; [3]University of Konstanz, Germany.*

ABSTRACT Ultrafast thermalization of electrons in metal nanostructures is studied by means of pump-probe spectroscopy. We track in real-time the plasmon resonsance evolution, providing a tool for understanding and controlling gold nanoantennas non-linear optical response.

08.Tue.P2.46

Ultrafast Terahertz Response of Lithium Niobate in the Nonperturbative Regime

Carmine Somma[1], Klaus Reimann[1], Michael Woerner[1], Thomas Elsaesser[1], Christos Flytzanis[2]; *[1]Max-Born-Institut,*

Germany; [2]École Normale Supérieure, France.

ABSTRACT The response of a $LiNbO_3$ crystal to THz pulses in the nonperturbative regime is studied by two-dimensional spectroscopy. Phase-resolved detection allows for separating the THz bulk photovoltaic effect from other nonlinear contributions.

08.Tue.P2.47

Resonant Optical Kerr Response with Ultrashort Decay Time by Nonlocal Wave Coupling of Light and Excitons

Masayoshi Ichimiya[1], Takayuki Umakoshi[1], Hiroyuki Murata[1], Takashi Kinoshita[2], Hajime Ishihara[2], Masaaki Ashida[1]; *[1]Graduate School of Engineering Science, Osaka University, Japan; [2]Graduate School of Engineering, Osaka Prefecture University, Japan.*

ABSTRACT Resonant optical Kerr effects have been investigated in high-quality CuCl thin films. The peculiar spectral feature and ultrafast response below 200 fs due to a long-range coherent coupling between light and multinode-type excitons are observed.

08.Tue.P2.48

Controlling Dirac Carrier Dynamics in Graphene via Phonon Pumping

Isabella Gierz[1], Matteo Mitrano[1], Hubertus Bromberger[1], Andrea Cavalleri[1], Cephise Cacho[2], Richard Chapman[2], Emma Springate[2], Stefan Link[3], Ulrich Starke[3]; *[1]Max Planck Institute for the Structure and Dynamics of Matter, Germany; [2]Central Laser Facility, STFC Rutherford Appleton Laboratory, United Kingdom; [3]Max Planck Institute for Solid State Research, Germany.*

ABSTRACT Using time- and angle-resolved photoemission spectroscopy, we find that resonant excitation of the in-plane E_{1u} lattice vibration in epitaxial bilayer graphene leads to a decrease of the relaxation time associated with electron - optical phonon coupling.

08.Tue.P2.49

Infrared double optical gating for generating submicrojoule isolated attosecond pulses

Eiji J. Takahashi[1], Pengfei Lan[1], Katsumi Midorikawa[1]; *[1]RIKEN Center for Advanced Photonics, Japan.*

ABSTRACT We experimentally demonstrate an infrared two-color polarization gating scheme for generating an intense isolated attosecond pulse using the multicycle laser. The obtained submicrojoule continuum harmonic spectrum supports the generation of a pulse duration of sub-500 as.

08.Tue.P2.50

Ultrafast 2 μm Laser Oscillators Based on Thulium-Doped ZBLAN Fibers

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ABSTRACT Mode-locked fiber laser oscillators are demonstrated by using thulium-doped ZBLAN fibers. Thanks to very low dispersion of ZBLAN glass fibers, pulses as short as 45 fs are generated at 1900 nm.

08.Tue.P2.51

Wavefront Analysis of High-Efficiency, Large-Scale, Thin Transmission Gratings

Chun Zhou[1,4], Takashi Seki[2], Tsuyoshi Kitamura[2], Yoshiyuki Kuramoto[2], Takashi Sukegawa[2], Nobuhisa Ishii[3], Teruto Kanai[3], Jiro Itatani[3], Yohei Kobayashi[3], Shuntaro Watanabe[1,4]; *[1]Tokyo University of Science, Japan; [2]Corporate R&D Headquarters, CANON Inc., Japan; [3]Institute for Solid State Physics, University of Tokyo, Japan; [4]CREST, Japan Science and Technology Agency (JST), Japan.*

ABSTRACT Large-scale transmission gratings with groove densities of 1250 and 1740 lines/mm have been developed with diffraction efficiencies above 95%. The minimized bending of the grating results in a negligible wavefront distortion of a pulse compressor.

08.Tue.P2.52

In-Situ Measurement of Intensity-Dependent Carrier-Envelope Phase Changes in Hollow Fiber Compression

Fabian Lücking[1], Andrea Trabattoni[2], Sunilkumar Anumula[2], Giuseppe Sansone[2], Francesca Calegari[2], Mauro Nisoli[2], Thomas Oksenhendler[3], Gabriel Tempea[1]; *[1]Femtolasers Produktions GmbH, Austria; [2]Politecnico di Milano, Department of Physics, Institute of Photonics and Nanotechnologies,CNR-IFN, Italy; [3]Fastlite, France.*

ABSTRACT We report on a single-shot, in-situ interferometric method for measuring intensity-dependent phase changes in laser pulse propagation. With this method, the impact of hollow fiber compressors on phase stability was characterized.

08.Tue.P2.53

Measurement and Characterization of sub-5 fs Broadband UV Pulses in the 230-350 nm Range

Valentyn Prokhorenko[1], Samansa Maneshi[1], R. J. Dwayne Miller[1]; [1]*Max Planck Institute for Structure and Dynamics of Matter, Germany.*

ABSTRACT We report a new design of all-reflective 3rd-order frequency resolved optical gating setup (FROG) for measurement and characterization of ultrashort UV-pulses in the 230-350 nm range and tested it using 7.3 fs pulses generated in the 250-300 nm range. This setup allows also heterodyne detection which significantly increases its sensitivity.

08.Tue.P2.54

Femtosecond Pulses in 375 nm - 405 nm Region by Chirped Sum Frequency

Prem B. Bisht[1], Akbar S. Ali[1]; [1]*Indian Institute of Technology, Madras, India.*

ABSTRACT Tunable femtosecond pulses have been obtained from nJ pulse energies of the oscillator by sum frequency between the fundamental and the chirped pulse. The pulse has been characterized by the same set up.

08.Tue.P2.55

Two Novel Schemes for Photon-Number Squeezed Pulse Generation in Ultrafast Nonlinear Fiber Optics

Aruto Hosaka[1], Shota Sawai[1], Kenichi Hirosawa[1], Fumihiko Kannari[1]; [1]*Keio University, Japan.*

ABSTRACT We experimentally prove two novel techniques which solve issues in photon-number squeezed pulse generation: one is with Er-doped fiber laser source, and the other is with a normal dispersion fiber at 800 nm.

08.Tue.P2.56

Ultra-Broadband Mid-IR OPCPA Schemes Enabled By Quasi-Phase-Matching

Christopher R. Phillips[1,2], Benedikt W. Mayer[1], Lukas Gallmann[1,3], Martin M. Fejer[2], Ursula Keller[1]; [1]*ETH Zurich, Switzerland;* [2]*Stanford University, USA;* [3]*University of Bern, Switzerland.*

ABSTRACT We present mid-IR OPCPA system configurations producing sub-four-cycle pulses, based on PPMgO:$LiNbO_3$. We demonstrate an all-collinear system via APPLN, and a hybrid system with a noncollinear PPLN power amplifier. Combining these techniques could offer octave-spanning-OPCPA.

08.Tue.P2.57

Solitonic Regime of Mid-infrared Filamentation at Highly Overcritical Power in Transparent Solids

Daniil Kartashov[5], Pavel Malevich[1], Skirmantas Alisauskas[1], Audrius Pugzlys[1], Alexander Voronin[2], Alexei Zheltikov[2,3], Daniele Faccio[4], Andrius Baltuska[1]; [1]*Photonics Institute Vienna University of Technology, Austria;* [2]*Physics Department, International Laser Center, M.V. Lomonosov Moscow State University, Russian Federation;* [3]*Department of Physics and Astronomy, Texas A&M University, USA;* [4]*Institute of Photonics and Quantum Sciences, Heriot-Watt University Edinburgh, United Kingdom;* [5]*Friedrich-Schiller University Jena, Germany.*

ABSTRACT Filamentation of femtosecond pulses in transparent solids with anomalous group-velocity dispersion is investigated for a broad range of the peak powers. Solitonic self-compression of multi-millijoule mid-IR pulses is achieved using a 1.5-mm-thick CaF_2 plate.

08.Tue.P2.58

Generation and characterization of microJoule-level 10 fs UV pulses

Rocio Borrego Varillas[1], Alessia Candeo[1], Sandro De Silvestri[1], Giulio Cerullo[1], Cristian Manzoni[1]; [1]*IFN, CNR - Politecnico di Milano, Italy.*

ABSTRACT We demonstrate microJ-level 10-fs pulses in the 315-380 nm spectral range generated by broadband sum-frequency generation. The pulses are characterized using 2D spectral shearing interferometry based on difference-frequency with a visible NOPA.

08.Tue.P2.59

Generating Efficient Femtosecond Mid-infrared Pulse by Single Near-infrared Pump Wavelength in Bulk Nonlinear Crystal Without Phase-matching

Binbin Zhou[1], Hairun Guo[1], Morten Bache[1]; [1]*Danmarks Tekniske Universitet, Denmark.*

ABSTRACT We experimentally demonstrate efficient mid-infrared pulse generation by dispersive wave radiation in bulk lithium niobate crystal. Femtosecond mid-infrared pulses centering from 2.8-2.92 μm are generated using the single pump wavelengths from 1.25-1.45 μm.

08.Tue.P2.60

Spatiotemporal Dynamics of Femtosecond Pulses Shaped by Diffractive Optical Elements (DOEs)

Rocio Borrego Varillas[1,2], Benjamin Alonso[1], Jorge Perez Vizcaino[2], Isabel Gallardo Gonzalez[3], Glaldys Minguez-Vega[2], Omel Mendoza-Yero[2], Jesus Lancis[2], Andrew Forbes[4], Iñigo Sola[1]; *[1]Universidad de Salamanca, Saint Barthelemy; [2]Universitat Jaume I, Spain; [3]Centro de Làseres Pulsados, Spain; [4]CSIR National Laser Center, South Africa.*

ABSTRACT We present a complete experimental characterization and simulation of the spatiotemporal and spatio-spectral effects taking place when a femtosecond pulse is shaped by a diffractive optical element.

Room A **17:15-19:00**

08.Tue.E Singlet Imaging and Charge Transfer

Presider: Gregory Scholes *(University of Toronto, Canada)*

08.Tue.E.1 **17:15** Contributed

Ultrafast charge generation, high and balanced charge carrier mobilities in organo halide perovskite solar cell

Carlito S. Ponseca[1], Mohamed Abdellah[1], Kaibo Zheng[1], Arkady Yartsev[1], Tobjorn Pascher[1], Tobias Harlang[1], Pavel Chabera[1], Tonu Pullerits[1], Andrey Stepanov[2], Jean-Pierre Wolf[2], Villy Sundstrom[1]; *[1]Chemical Physics, Lunds Universitet, Sweden; [2]GAP-Biophotonics, University of Geneva, Switzerland.*

ABSTRACT Using terahertz and transient absorption spectroscopy, carrier dynamics in organo halide perovskite solar cell is probed. Charge generation is <100 fs, followed by 2 ps charge formation with balanced electron hole mobility of 20 $cm^2V^{-1}s^{-1}$.

08.Tue.E.2 **17:30** Contributed

Charge Transfer Dynamics between Colloidal Nanocrystals and Graphene

Holger Lange[1], Christian Strelow[1], Robert A. Barton[2], Octavi E. Semonin[2], Erik Busby[3], Matthew Sfeir[3], Tony F. Heinz[2]; *[1]Universitaet Hamburg, Germany; [2]Columbia University, USA; [3]Brookhaven National Laboratory, USA.*

ABSTRACT We apply time-resolved photoluminescence and ultrafast transient absorption spectroscopy to investigate the electron transfer between PbS nanocrystals and graphene. We find sub-ns decay times and we find strong evidence for a major contribution of charge transfer.

08.Tue.E.3 **17:45** Contributed

Ultrafast Optical Control of Charge Dynamics in Organic and Hybrid Electronic Nanodevices

Artem Bakulin[1], Robert Lovrincic[5], Simon Gelinas[2], Akshay Rao[2], Yu Xi[3], Oleg Selig[1], Zhuoying Chen[4], Richard Friend[2], Huib Bakker[1], David Cahen[3]; *[1]FOM Institute AMOLF, Netherlands; [2]University of Cambridge, United Kingdom; [3]Weizmann Institute of Science, Israel; [4]ESPCI/CNRS/UPMC UMR, France; [5]InnovationLab, Germany.*

ABSTRACT Using ultrafast visible/IR pulse-sequence spectroscopy combined with electric current detection, we engage vibronic and charge-delocalization phenomena to control the performance of optoelectronic devices base on organic semiconductors, colloidal quantum dots and conductive oxides.

08.Tue.E.4 **18:00** Contributed

Ultrafast Spectroscopy Reveals Bulk Heterojunction Morphology

Maxim S. Pshenichnikov[1], Almis Serbenta[1], Paul van Loosdrecht[1]; *[1]Rijksuniversiteit Groningen, Netherlands.*

ABSTRACT We propose a new technique to probe the nanosized morphology in polymer-fullerene bulk heterojunctions by ultrafast spectroscopy. The method reveals the size of fullerene clusters in an all-optical way and is applicable “on-the-fly” to functional photovoltaic devices.

08.Tue.E.5 **18:15** Contributed

Coherent phonon dynamics in singlet fission of rubrene single crystal

Kiyoshi Miyata[1], Shunsuke Tanaka[1], Toshiki Sugimoto[1], Kazuya Watanabe[1], Takafumi Uemura[2], Jun Takeya[2], Yoshiyasu Matsumoto[1]; *[1]Chemistry, Kyoto University, Japan; [2]Fronteir Science, The Universty of Tokyo, Japan.*

ABSTRACT We observed wavepacket motions in singlet fission of rubrene single crystal at 35 K. A coherent phonon shows a transient frequency shift, indicating that a transition from S_1 to an intermediate state of the fission occurs within 2 ps.

08.Tue.E.6 **18:30** ---------- Contributed

Acceleration of Ultrafast Singlet Fission in Aza-derivative of TIPS-Pentacene

Tiago Buckup[1], Julia Herz[1], Marcus Motzkus[1]; *[1]Phyisikalisch-Chemisches Institut, Heidelberg University, Germany.*

ABSTRACT We unveil a new general channel for formation of triplet states via singlet fission in TIPS-pentacene derivatives by probing sub 100 fs dynamics in the near infrared spectral region with transient absorption.

08.Tue.E.7 **18:45** ---------- Contributed

Ultrafast Electron and Hole Dynamics in Novel Conjugated Star-Shaped Molecules

Oleg V. Kozlov[1,2], Yuriy N. Luponosov[3], Sergei A. Ponomarenko[3], Dmitry Paraschuk[2], Nina Kausch-Busies[4], Maxim S. Pshenichnikov[1]; *[1]Zernike Institute for Advanced Materials, University of Groningen, Netherlands; [2]International Laser Center and Faculty of Physics, Moscow State University, Russian Federation; [3]Institute of Synthetic Polymeric Materials of the Russian Academy of Science, Russian Federation; [4]Heraeus Precious Metals GmbH & Co. KG, Conductive Polymers Division, Germany.*

ABSTRACT Charge dynamics in organic photovoltaic blends based on novel star-shaped molecules are studied by ultrafast visible-IR spectroscopy. Pathways of intra- and intermolecular electron and hole transfer and their recombination are identified and discussed.

Wednesday, July 9

Room A **08:30-10:15**

09.Wed.A 2D Spectroscopy

Presider: Steven Cundiff *(University of Colorado at Boulder JILA, United States)*

09.Wed.A.1 **08:30** ---------- Invited

Ultrabroadband two-dimensional spectroscopy by a birefringent delay line

Julien Rehault[1], Aurelio Oriana[1], Margherita Maiuri[1], Daniele Brida[2], Dario Polli[1], Cristian Manzoni[1], Giulio Cerullo[1]; *[1]Physics, Politecnico di Milano, Italy; [2]Physics, University of Konstanz, Germany.*

ABSTRACT We introduce a passive birefringent delay line for the generation of collinear, interferometrically locked ultrashort pulse pairs. Their delay is controlled with attosecond precision and stability <λ/360, enabling two-dimensional electronic spectroscopy from UV to infrared.

09.Wed.A.2 **09:00** ---------- Contributed

Multidimensional spectroscopy with entangled light; A novel pulse scanning protocol

Konstantin E. Dorfman[1], Frank Schlawin[1,2], Shaul Mukamel[1]; *[1]Chemistry, University of California, USA; [2]Institute of Physics, Albert-Ludwigs University of Freiburg, Germany.*

ABSTRACT Quantum light can induce correlations in photo excited molecules and probe them with unusual spectral and temporal resolution. A new non-time-ordered pulse delay scanning protocol in multidimensional signals reveals resonances not accessible by standard techniques.

09.Wed.A.3 **09:15** ---------- Contributed

Two-Dimensional Fourier Transform Infrared-Visible and Infrared-Raman Spectroscopies

Trevor L. Courtney[1], Zachary W. Fox[1], Karla Slenkamp[1], Michael Lynch[1], Munira Khalil[1]; *[1]Chemistry, University of Washington, USA.*

ABSTRACT Femtosecond nonlinear spectroscopies using new IR and visible pulse sequences are demonstrated, including 2D IR-visible spectroscopy to study vibrational-electronic couplings and 2D IR-Raman spectroscopy to study anharmonic inter- and intramolecular vibrational couplings.

09.Wed.A.4 **09:30** ---------- Contributed

Broadband Electronic Two-Dimensional Spectroscopy in the Deep UV

Valentyn Prokhorenko[1], Alessandra Picchiotti[1], Samansa Maneshi[1], Dwayne Miller[1]; *[1]Max Planck Institute, Germany.*

ABSTRACT We developed an all-reflective fully-noncollinear setup for two-dimensional electronic spectroscopy in the broadband UV (2DUV) with great phase stability (Λ/150) and applied it to the UV-chromophores dissolved in ethanol using 8-fs UV-pulses, generated in the 245-300 nm range. We are able to resolve 2D-spectra in the ~6000 cm^{-1} spectral window.

09.Wed.A.5 **09:45** ---------- Contributed

VIPER 2D-IR: A Novel Pulse Sequence to Track Exchange Beyond the Vibrational Lifetime

Luuk J. van Wilderen[1], Andreas T. Messmer[1], Jens Bredenbeck[1]; *[1]Johann Wolfgang Goethe-University, Germany.*

ABSTRACT We present a new IR/UV-VIS pulse sequence that uses an IR pulse to pick a molecule within a mixture, in order to monitor its photochemistry. The benefits of this sequence over commonly used ones discussed.

09.Wed.A.6 **10:00** ---------- Contributed

Characterizing phase fluctuations of fiber oscillators by using external optical cavities

Damian N. Schimpf[1], Roman Schmeissner[2], Jan Schulte[1], Wei Liu[1], Franz X. Kärtner[1], Nicolas Treps[2]; *[1]Center for Free Electron Laser Science, Deutsches Elektronen-Synchrotron, Germany; [2]Laboratoire Kastler Brossel, Université Pierre et Marie Curie, CNRS, ENS, France.*

ABSTRACT We experimentally characterize amplitude and phase fluctuations of a femtosecond fiber oscillator close to the standard quantum limit. A passive cavity is employed to convert frequency noise to RIN with close to quantum-limited sensitivity.

Room A 10:45-12:30

09.Wed.B Terahertz Dynamics

Presider: Frank Hegmann
(University of Alberta, Canada)

09.Wed.B.1 10:45 ---------- Contributed

Tailoring of High-Field Multi-THz Waveforms with Sub-Cycle Precision

Bernhard Mayer[1], Christian Schmidt[1], Johannes Bühler[1], Jonathan Fischer[1], Denis V. Seletskiy[1], Daniele Brida[1], Alexej Pashkin[1], Alfred Leitenstorfer[1]; *[1]Deparment of Physics, University of Konstanz, Germany.*

ABSTRACT Shaping of extremely intense mid-infrared transients by means of time-domain slicing and frequency-domain synthesis is demonstrated. We achieve phase-stable transients with multiple MV/cm peak fields and having single-cycle duration and strong polar asymmetry.

09.Wed.B.2 11:00 ---------- Contributed

Filling the entire Terahertz frequency gap by single-cycle MV/cm pulses

Carlo Vicario[1], Balazs Monoszlai[1], Fernando Ardana[1], Christoph P. Hauri[1,2]; *[1]Paul Scherrer Institut, Switzerland; [2]Ecole Polytechnique Federale de Lausanne, Switzerland.*

ABSTRACT We demonstrate highly efficient Terahertz production and absolute phase control in the hardly accessible THz frequency gap (1-15 THz) by optical rectification in organic crystals leading to single-cycle field oscillations beyond 150 MV/m and 0.5 Tesla.

09.Wed.B.3 11:15 ---------- Contributed

0.4 mJ THz Pulses by Optical Rectification

József A. Fülöp[1,3], Zoltan Ollmann[2], Csaba Lombosi[2], Christoph Skrobol[4,5], Sandro Klingebiel[4], László Pálfalvi[2], Ferenc Krausz[4,5], Stefan Karsch[4,5], János Hebling[1,2]; *[1]MTA-PTE High-Field Terahertz Research Group, Hungary; [2]Institute of Physics, University of Pecs, Hungary; [3]ELI-Hu Nkft., Hungary; [4]Max-Planck-Institut für Quantenoptik, Germany; [5]Department für Physik, Ludwig-Maximilians-Universität, Germany.*

ABSTRACT THz pulses with more than 0.4 mJ energy were generated with 0.77% efficiency by optical rectification of 785-fs laser pulses in $LiNbO_3$ using tilted-pulse-front pumping. The spectral peak is at about 0.2 THz, suitable for charged-particle manipulation.

09.Wed.B.4 11:30 ---------- Contributed

Inherent Resistivity of Graphene to Strong THz Fields

Dmitry Turchinovich[1,2], Zoltan Mics[1], Søren A. Jensen[1], Khaled Parvez[1], Ivan Ivanov[1], Klaas-Jan Tielrooij[3], Frank Koppens[3], Xinliang Feng[1], Klaus Müllen[1], Mischa Bonn[1]; *[1]Max Planck Inst. for Polymer Research, Germany; [2]DTU Fotonik, Technical University of Denmark, Denmark; [3]ICFO - The Institute of Photonic Sciences, Spain.*

ABSTRACT The nonlinear THz conductivity of graphene is

Room B 10:45-12:30

09.Wed.C Electron Diffraction and Rescattering Dynamics

Presider: Reika Kanya
(University of Tokyo, Japan)

09.Wed.C.1 10:45 ---------- Contributed

Ten-femtosecond (rms) single-electron diffraction

Stefan Lahme[1,2], Alexander Gliserin[1,2], Matthew Walbran[1,2], Ferenc Krausz[1,2], Peter Baum[1,2]; *[1]Ludwig-Maximilians-Universität, Germany; [2]Max-Planck-Institute of Quantum Optics, Germany.*

ABSTRACT We report single-electron pulses of 12-fs/28-fs duration (rms/FWHM), characterized by laser streaking. A time-resolved diffraction study on fibrous graphite polycrystals reveals the practical feasibility of single-electron diffraction at potentially few-femtosecond resolution.

09.Wed.C.2 11:00 ---------- Contributed

Laser-assisted Electron Diffraction for Probing Femtosecond Nuclear Dynamics of Gas-phase Molecules

Yuya Morimoto[1], Reika Kanya[1], Kaoru Yamanouchi[1]; *[1]Department of Chemistry, The University of Tokyo, Japan.*

ABSTRACT By detecting 1 keV electrons scattered by CCl_4 in a femtosecond laser field, we observed laser-assisted electron diffraction images with which we can probe ultrafast molecular dynamics with <10 fs and ~0.01 Å resolutions.

09.Wed.C.3 11:15 ---------- Contributed

Atomic-scale imaging of aligned polyatomic molecules with recollision electron diffraction

Michael G. Pullen[1], Benjamin Wolter[1], Matthias Baudisch[1], Michael Hemmer[1], Arne Senftleben[2], Claus Schroeter[2], Robert Moshammer[2], Joachim Ullrich[2,3], Anh Thu Le[4], Chii Dong Lin[4], Jens Biegert[1,5]; *[1]ICFO-Institut de Ciencies Fotoniques, Spain; [2]Max-Planck-Institut für Kernphysik, Germany; [3]Physikalisch-Technische Bundesanstalt, Germany; [4]J. R. Macdonal Laboratory, Kansas State University, USA; [5]ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain.*

ABSTRACT We present accurate extraction of multiple bond lengths for aligned and anti-aligned C_2H_2 using recollision electron diffraction. We measure bond lengths of1.20±0.06Å (C≡C) and 1.06±0.08Å (C-H).

09.Wed.C.4 11:30 ---------- Contributed

Probing Elastic Rescattering through Half-Cycle Cutoffs in Above-Threshold Ionization Spectra

Henning Geiseler[1], Nobuhisa Ishii[1], Keisuke Kaneshima[1], Teruto Kanai[1], Jiro Itatani[1]; *[1]Institute for Solid State Physics, University of Tokyo, Japan.*

ABSTRACT We observe photoelectron spectra from above-threshold

characterized using nonlinear ultrafast THz spectroscopy. Efficient carrier heating by the THz field reduces carrier scattering, yet, counter-intuitively, simultaneously suppresses the high-frequency conductivity of graphene.

09.Wed.B.5 **11:45** ---------- Contributed

Resonant antiferromagnetic spin wave excitation by terahertz magnetic near-field with split ring resonator

Yu Mukai[1], Hideki Hirori[1], Takafumi Yamamoto[1], Hiroshi Kageyama[1], Koichiro Tanaka[1]; *[1]Kyoto University, Japan.*

ABSTRACT A spin wave of $HoFeO_3$ was excited by a terahertz magnetic near-field of a split ring resonator. The quantitative analysis shows that the spin wave was excited by the resonantly enhanced magnetic field.

09.Wed.B.6 **12:00** ---------- Contributed

Ultrafast modulation of polarization amplitude by terahertz fields in electronic-type organic ferroelectrics

Tatsuya Miyamoto[1], Daiki Hata[1], Koukichi Fujimoto[1], Hiromichi Yamakawa[1], Takeshi Morimoto[1], Masato Sotome[1], Hiroyuki Yada[1], Noriaki Kida[1], Sachio Horiuchi[2,3], Hiroshi Okamoto[1]; *[1]Department of Advanced Materials Science, The University of Tokyo, Japan; [2]FLEC, AIST, Japan; [3]CREST, JST, Japan.*

ABSTRACT Using strong terahertz fields, we succeeded in rapidly modulating ferroelectric polarizations in electronic-type ferroelectrics of molecular crystals, TTF-CA and croconic acid. Polarization modulations are attributable to collective inter- or intra-molecular charge-transfers induced by terahertz field.

09.Wed.B.7 **12:15** ---------- Contributed

Ultrafast photoinduced terahertz dynamics of topological insulator $(Bi_{1-x}In_x)_2Se_3$

Sim Sangwan[1], Matthew Brahlek[2], Nikesh Koirala[2], Soonyoug Cha[1], Seongshik Oh[2,3], Hyunyong Choi[1]; *[1]School of Electrical and Electronic Engineering, Yonsei University, Republic of Korea; [2]Rutgers Center for Emergent Materials and Department of Physics and Astronomy, Rutgers the State University of New Jersey, USA; [3]Institute for Advanced Materials, Devices and Nanotechnolog, Rutgers the State University of New Jersey, USA.*

ABSTRACT We present ultrafast terahertz dynamics in topological insulator $(Bi_{1-x}In_x)_2Se_3$. We find that photogenerated electrons suppress the increase of scattering at high temperature. The surface-bulk interaction strongly depends on the dynamic condition of topological phase transition.

ionization of xenon using carrier-envelope phase-stabilized few-cycle pulses at 1.6 μm. The signature of elastic rescattering is imprinted on the spectra, and through careful analysis we successfully retrieve the electron-ion backscattering cross section.

09.Wed.C.5 **11:45** ---------- Contributed

Controlling Fragmentation Reactions of Polyatomic Molecules with Impulsive Alignment

Xinhua Xie[1], Katharina Doblhoff-Dier[2], Huailiang Xu[1,3], Stefan Roither[1], Markus Schöffler[1], Daniil Kartashov[1], Sonia Erattuphuza[1], Tim Rathje[4], Gerhard G. Paulus[4,5], Kaoru Yamanouchi[6], Andrius Baltuška[1], Stefanie Gräfe[2], Markus Kitzler[1]; *[1]Photonics Institute, Vienna University of Technology, Austria; [2]Institute for Physical Chemistry, Friedrich-Schiller University Jena, Germany; [3]State Key Laboratory on Integrated Optoelectronics, Jilin University, China; [4]Institute of Optics and Quantum Electronics, Friedrich-Schiller University Jena, Germany; [5]Helmholtz Institute Jena, Germany; [6]Department of Chemistry, The University of Tokyo, Japan.*

ABSTRACT We experimentally and theoretically demonstrated effective control of molecular ionization and fragmentation in strong laser fields with impulsive alignment of a molecule. Channel selective control over molecular fragmentation reactions can be realized.

09.Wed.C.6 **12:00** ---------- Contributed

Attosecond spatial control of electron wave packet emission dynamics

Li Zhang[1], Xinhua Xie[1], Stefan Roither[1], Yueming Zhou[2], Peixiang Lu[2], Xiaojun Liu[3], Daniil Kartashov[1], Markus Schöffler[1], Dror Shafir[4], Paul B. Corkum[4], Andrius Baltuska[1], Igor Ivanov[5], Anatoli Kheifets[5], André Staudte[4], Markus Kitzler[1]; *[1]Photonics Institute, Vienna University of Technology, Austria; [2]Wuhan National Laboratory for Optoelectronics and School of Physics, Huazhong University of Science and Technology, China; [3]State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, Chinese Academy of Sciences, China; [4]Joint Laboratory for Attosecond Science of the National Research Council and the University of Ottawa, Canada; [5]Research School of Physical Sciences, The Australian National University, Australia.*

ABSTRACT Using orthogonally polarized two-color laser fields on neon and coincidence momentum imaging we gain access to the Coulomb influence in single ionization on sub-cycle times, and demonstrate a strong electron-electron anti-correlation in double ionization.

09.Wed.C.7 **12:15** ---------- Contributed

Photoionization Time Delay in Molecular Hydrogen

Sebastian Heuser[1], Mazyar Sabbar[1], Robert Boge[1], Claudio Cirelli[1], Ursula Keller[1]; *[1]ETH Zurich, Switzerland.*

ABSTRACT We extract the photoionization time delay difference between argon and molecular hydrogen with two complementary interferometric measurement techniques using attosecond pulses. The methods show different results, calling for different theoretical interpretations of the experimental observations.

Room A **14:00-15:45**

09.Wed.D Structural Dynamics

Presider: Eberhard Riedle *(Ludwig-Maximillians-Universität Munchen, Germany)*

09.Wed.D.1 14:00 Contributed

Time-resolved X-ray absorption and emission spectroscopy on ZnO nanoparticles in solution

Christopher J. Milne[1], Jakub Szlachetko[1,5], Tom Penfold[1], Fabio Santomauro[2], Alexander Britz[3], Wojciech Gawelda[3], Gilles Doumy[4], Anne Marie March[4], Steven H. Southworth[4], Jochen Rittmann[2], Majed Chergui[2], Rafael Abela[1]; *[1]SwissFEL, Paul Scherrer Institut, Switzerland; [2]Laboratoire de Spectroscopie Ultrarapide, Ecole Polytechnique Federale de Lausanne, Switzerland; [3]European XFEL GmbH, Germany; [4]Atomic, Molecular and Optical Physics Group, Argonne National Laboratory, USA; [5]Institute of Physics, Jan Kochanowski University, Poland.*

ABSTRACT We have performed time-resolved resonant X-ray emission spectroscopy after UV photoexcitation of a colloidal solution of ZnO nanoparticles. The results point to electron trapping sites located at oxygen vacancies in the lattice.

09.Wed.D.2 14:15 Contributed

Tracking Electronic and Molecular Structural Dynamics during Dissociation of the Photocatalyst $Mn_2(CO)_{10}$ via Time-Resolved X-Ray Spectroscopy

Hana Cho[1,2], Kiryong Hong[2], Mathew L. Strader[1], Jae Hyuk Lee[1], Robert W. Schoenlein[1], Nils Huse[3], Tae Kyu Kim[2]; *[1]Ultrafast X-ray Science Lab, Chemical Sciences Division, Lawrence Berkeley National Laboratory, USA; [2]Department of Chemistry, Pusan National University, Republic of Korea; [3]Max Planck Research Department for Structural Dynamics, University of Hamburg & Center for Free Electron Laser Science, Germany.*

ABSTRACT The molecular structure dynamics and transient valence charge distribution during the photo-dissociation of the photocatalyst $Mn_2(CO)_{10}$ are revealed via time-resolved x-ray spectroscopy at the Mn K-edge, combined with quantum chemistry simulations.

09.Wed.D.3 14:30 Contributed

Excited State Structural Dynamics Probed with Time-Resolved Sulfur K-edge X-ray Absorption Spectroscopy

Matthew Ross[1], Benjamin E. Van Kuiken[1], Mathew L. Strader[2], Amy Cordones-Hahn[3], Hana Cho[3], Robert W. Schoenlein[3], Tae Kyu Kim[4], Munira Khalil[1]; *[1]Department of Chemistry, University of Washington, USA; [2]SLAC National Accelerator Laboratory, USA; [3]Chemical Sciences Division, Lawrence Berkeley National Laboratory, USA; [4]Department of Chemistry, Pusan National University, Republic of Korea.*

ABSTRACT Time-Resolved X-ray absorption spectroscopy at the sulfur K-edge (~2.4 keV) is used to monitor structural dynamics following excited state proton transfer in an organosulfur molecule. The timescales of electronic structural relaxation are solvent dependent.

09.Wed.D.4 14:45 Contributed

Tuning of isomerization rates in indigo-based photoswitches

Elena Samoylova[1], Benjamin Maerz[1], Sandra Wiedbrauk[2], Sven Oesterling[2], Henry Dube[2], Regina de Vivie-Riedle[2], Wolfgang Zinth[1]; *[1]Department of Physics, Ludwig-Maximilians-University, Germany; [2]Department of Chemistry, Ludwig-Maximilians-University, Germany.*

ABSTRACT Ultrafast excited-state dynamics in indigo-based photochromic compounds was studied with the transient absorption spectroscopy and ab initio calculations. We demonstrated an approach of adjusting excited state relaxation routes and photoisomerization rates for applications where fast photoswitching is needed.

09.Wed.D.5 15:00 Contributed

Charge Migration and Molecular Dissociation Following Multiphoton Multiple Ionization of Iodine-Substitute Molecules by X-Ray Free-Electron Laser Pulses from SACLA

Koji Motomura[1], Edwin Kukk[1,2], Kiyonobu Nagaya[3,4], Satoshi Ohmura[3], Hironobu Fukuzawa[1,4], Shin-ichi Wada[5,4], Subhendu Mondal[1], Tetsuya Tachibana[1], Yuta Ito[1], Ryosuke Koga[5], Tsukasa Sakai[3], Kenji Matsunami[3], Artem Rudenko[6], Christophe Nicolas[7], XiaoJing Liu[7], Catalin Miron[7], Yizhu Zhang[8], Yuhai Jiang[8], Jianhui Chen[9], Anand Mailam[10], Dong Eon Kim[10], Kensuke Tono[11], Yuichi Inubushi[4], Takaki Hatsui[4], Makina Yabashi[4], Hirohiko Kono[12], Makoto Yao[3], Kiyoshi Ueda[1,4]; *[1]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan; [2]Department of Physics and Astronomy, University of Turku, Finland; [3]Department of Physics, Kyoto University, Japan; [4]RIKEN SPring-8 Center, Japan; [5]Department of Physical Science, Hiroshima University, Japan; [6]Department of Physics, Kansas State University, USA; [7]Synchrotron SOLEIL, France; [8]Shanghai Advanced Research Institute, Chinese Academy of Sciences, China; [9]Shanghai Institute of Applied Physics, Chinese Academy of*

Sciences, China; [10]Department of Physics, CASTECH, MPC-AS, POSTECH, Republic of Korea; [11]Japan Synchrotron Radiation Research Institute (JASRI), Japan; [12]Department of Chemistry, Tohoku University, Japan.

ABSTRACT We have studied charge migration and dissociation in iodine-contained molecules using XFEL from SACLA and applying the ion momentum coincidence technique to fragmentation of highly charged molecular ions produced via XFEL at the iodine site.

09.Wed.D.6 **15:15** ---------- Contributed

Signatures of Conical Intersection Mediated Relaxation Dynamics in Time-Resolved Broadband Raman Detection

Benjamin Fingerhut[1], Konstantin E. Dorfman[2], Shaul Mukamel[2]; *[1]Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie, Germany; [2]Chemistry, University of California, Irvine, USA.*

ABSTRACT Ab-Initio simulations of Raman signals reveal the excited state deactivation mechanism of uracil. The signals provide sub-molecular sensitivity of out-of-plane displacements during conical intersection mediated relaxation and properly describe the time-resolution of the techniques.

09.Wed.D.7 **15:30** ---------- Contributed

Femtosecond Electron Diffraction Study of the Spin Crossover Dynamics of Crystalline $[Fe^{II}(bpy)_3][PF_6]_2$

Yifeng Jiang[1], Donald Kelloway[2], Meng Gao[2], Lai Chung Liu[2], Cheng Lu[2], Wojciech Gawelda[3], Dwayne Miller[1,2]; *[1]Physics and Chemistry, Max Planck Institute for the Structure and Dynamics of Matter, University of Hamburg, Centre for Free Electron Laser Science, DESY, Germany; [2]Physics and Chemistry, University of Toronto, Canada; [3]European XFEL GmbH, Germany.*

ABSTRACT The atomic motions involved in spin crossover dynamics of crystalline $[Fe^{II}(bpy)_3][PF_6]_2$ are investigated by femtosecond electron diffraction (FED). The experiment was performed by an ultrabright femtosecond electron source using 3.0×10^5 electrons per pulse with 400 fs temporal instrument response function.

Exhibition Hall **15:45-17:15**

09.Wed.P3 Poster Session III

09.Wed.P3.1

Terahertz imaging with optical resolution by femtosecond laser filament in air

Weiwei Liu[1], Jiayu Zhao[1], Lanjun Guo[1]; *[1]Nankai University, China.*

ABSTRACT We introduce a superresolution resolution THz imaging technique which uses the THz radiation generated by a femtosecond laser filament in air as the probe, based on the fact that the femtosecond laser filament forms a waveguide for the THz wave in air.

09.Wed.P3.2

Recombination-induced autoionization process in rare-gas clusters

Bernd Schuette[1], Mathias Arbeiter[2], Thomas Fennel[2], Filippo Campi[3], Marc J. J. Vrakking[1], Arnaud Rouzée[1]; *[1]Max-Born-Institut, Germany; [2]Universität Rostock, Germany; [3]Lund University, Sweden.*

ABSTRACT We investigate electron-ion recombination to excited states in atomic clusters exposed to intense NIR and XUV pulses, which leads to a yet undiscovered autoionization mechanism as a consequence of multiple recombination processes.

09.Wed.P3.3

Multiphoton Multiple Ionization of Rare-Gas Atoms and Clusters by X-Ray Free-Electron Laser Pulses from SACLA

Hironobu Fukuzawa[1,2], Koji Motomura[1], Tetsuya Tachibana[1], Zoltan Jurek[3], Sang-Kil Son[3], Per Johnsson[4], Kiyonobu Nagaya[5,2], Marco Siano[6], Shin-ichi Wada[7,2], Subhendu Mondal[1], Miku Kimura[1], Yuta Ito[1], Tsukasa Sakai[5], Kenji Matsunami[5], Hironori Hayashita[7], Jumpei Kajikawa[7], XiaoJing Liu[8], Emmanuel Robert[8], Catalin Miron[8], Raimund Feifel[9], Edwin Kukk[10], Benedikt Rudek[11,12], Benjamin Erk[11,12], Lutz Foucar[11,13], Jonathan P. Marangos[6], Kensuke Tono[14], Yuichi Inubushi[2], Takaki Hatsui[2], Makina Yabashi[2], Beata Ziaja[3,15], Robin Santra[3,16], Makoto Yao[5], Kiyoshi Ueda[1,2]; *[1]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan; [2]RIKEN SPring-8 Center, Japan; [3]Center for Free-Electron Laser Science (CFEL), DESY, Germany; [4]Department of Physics, Lund University, Sweden; [5]Department of Physics, Kyoto University, Japan; [6]Blackett Laboratory, Imperial College London, United Kingdom; [7]Department of Physical Science, Hiroshima University, Japan; [8]Synchrotron SOLEIL,*

France; [9]Department of Physics and Astronomy, Uppsala University, Sweden; [10]Department of Physics and Astronomy, University of Turku, Finland; [11]Max-Planck Advanced Study Group at CFEL, Germany; [12]Max-Planck-Insitut für Kernphysik, Germany; [13]Max-Planck-Insitut für medizinische Forschung, Germany; [14]Japan Synchrotron Radiation Research Institute (JASRI), Japan; [15]Institute of Nuclear Physics, PAS, Poland; [16]Department of Physics, University of Hamburg, Germany.

ABSTRACT We have investigated multiphoton multiple ionization dynamics of rare-gas atoms and clusters by 5 keV and 5.5 keV x-ray free-electron laser (XFEL) pulses provided by a new XFEL facility, SACLA in Japan.

09.Wed.P3.4

Attosecond Frequency Resolved Momentum Imaging of Two-photon Dissociative Ionization Dynamics of Nitrogen Molecule

Tomoya Okino[1], Yusuke Furukawa[1], A. Amani Eilanlou[1], Yasuo Nabekawa[1], Eiji J. Takahashi[1], Kaoru Yamanouchi[2], Katsumi Midorikawa[1]; *[1]RIKEN, Japan; [2]University of Tokyo, Japan.*

ABSTRACT Two-photon dissociative ionization processes of nitrogen molecule are investigated with attosecond nonlinear Fourier transformation spectroscopy. The frequency resolved momentum images extracted from delay dependent momentum images showed attosecond nonlinear response of nitrogen molecule.

09.Wed.P3.5

Photoelectron angular distributions in EUV+IR two-color near-threshold ionization of Ne and He

Subhendu Mondal[1], Hironobu Fukuzawa[1,2], Koji Motomura[1], Tetsuya Tachibana[1], Kiyonobu Nagaya[2,3], Tsukasa Sakai[3], Kenji Matsunami[3], Satoshi Yase[3], Makoto Yao[3], Shin-ichi Wada[2,4], Hironori Hayashita[4], Norio Saito[2,5], Carlo Callegari[6], Kevin Prince[6], Catalin Miron[7], Patrick O'Keeffe[8], Paola Bolognesi[8], Lorenzo Avaldi[8], Mitsuru Nagasono[2], Tadashi Togashi[2,9], Makina Yabashi[2], Kenichi L. Ishikawa[10], Andrey Kazansky[11], Nikolay Kabachnik[1,12], Kiyoshi Ueda[1,2]; *[1]Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Japan; [2]RIKEN SPring-8 Center, Japan; [3]Department of Physics, Kyoto University, Japan; [4]Department of Physics, Hiroshima University, Japan; [5]National Institute of Advanced Industrial Science and Technology, Japan; [6]Elettra-Sincrotrone, Italy; [7]Synchrotron SOLEIL, France; [8]CNR-Istituto di Metodologie Inorganiche e dei Plasmi, Italy; [9]Japan Synchrotron Radiation Research Institute, Japan; [10]Photon Science Center, The University of Tokyo, Japan; [11]Basque Foundation for Science, Spain; [12]Skobelsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Russian Federation.*

ABSTRACT Photoelectron angular distributions (PADs) dependence on the time-delay between EUV-FEL and IR laser pulses is observed for ionization of Ne. PADs for Rydberg excited one- and two-IR photon above-threshold ionization of He are measured.

09.Wed.P3.6

Controlling attosecond electron wave packet in a molecule

Hiromichi Niikura[1]; *[1]Applied Physics, Waseda University, Japan.*

ABSTRACT We control and identify the two-channel interference and the attosecond electron wave packet in polyatomic molecules by using two-dimensional high-harmonic spectra emitted from aligned molecules using the orthogonally polarized, two color laser fields.

09.Wed.P3.7

High-order Harmonics Fourier Transform Spectroscopy of Two-Photon Dissociative Ionization of Hydrogen Molecules

Yusuke Furukawa[1], Tomoya Okino[1], Yasuo Nabekawa[1], A. Amani Eilanlou[1], Eiji J. Takahashi[1], Kaoru Yamanouchi[2], Katsumi Midorikawa[1]; *[1]RIKEN Center for Advanced Photonics, Japan; [2]The University of Tokyo, Japan.*

ABSTRACT We have investigated two-photon dissociative ionization processes induced by high-order harmonic generation pulses with Fourier transform spectroscopy. Delay-dependent kinetic energy distribution of fragment ions reveals dissociative ionization dynamics of hydrogen molecules.

09.Wed.P3.8

Experimental Evidence of Light Induced Conical Intersections in Dissociation of Diatomic Molecules

Adi Natan[1,2], Matthew R. Ware[1,2], Philip H. Bucksbaum[1,2]; *[1]Stanford PULSE Institute, SLAC National Accelerator Laboratory, USA; [2]Physics, Stanford University, USA.*

ABSTRACT We present evidence for the effect of light induced conical intersections in strong field photodissociation of H_2^+, manifested in angular distribution modulations that result from the topological singularity induced by intense laser pulses.

09.Wed.P3.9

Photomechanical effects on femtosecond-laser ablation of fused silica studied using time-resolved reflectivity

Takayuki Kumada[1], Hiroshi Akagi[1], Ryuji Itakura[1], Tomohito Otobe[1], Atsushi Yokoyama[1]; *[1]Japan Atomic Energy Agency, Japan.*

ABSTRACT We observed oscillation of time-resolved reflectivity of femtosecond-laser-ablated fused silica. We ascribe the oscillation to the interference between probe pulses reflected from a sample surface and a thin layer produced by the photomechanical effect.

09.Wed.P3.10

Investigation of vibrational dynamics by femtosecond time-resolved CARS

Yuanqin Xiia[1], Zhao Yang[1], Sheng Zhang[2], Ping He[3], Zhiwei Dong[1], Deying Chen[1], Zhonghua Zhang[1]; *[1]National Key Laboratory of Science and Technology on Tunable Laser, Harbin Institute of Technology, China; [2]Department of Physics, Harbin Institute of Technol, China; [3]College of Foundation Science, Harbin University of Commerce, China.*

ABSTRACT We report the femtosecond time-resolved CARS in BBO crystal, ethanol, cresyl violet 670 and pyrromethene 650 using the various degrees of freedom such as the timing, polarization and wavelengths of the laser pulses.

09.Wed.P3.11

The primary photosynthetic energy conversion in bacterial reaction centers - Stepwise electron transfer and the effect of elevated exposure levels

Pablo Nahuel Dominguez[1], Matthias Himmelstoss[1], Jeff Michelmann[1], Florian Lehner[1], Alastair Gardiner[2], Richard Cogdell[2], Wolfgang Zinth[1]; *[1]Lehrstuhl für BioMolekulare Optik, Ludwig-Maximilians-Universität, Germany; [2]Institute of Molecular Cell and Systems Biology, University of Glasgow, United Kingdom.*

ABSTRACT The primary reaction in photosynthetic reaction centers from Rhodobacter sphaeroides is investigated for different experimental conditions. Agreement with stepwise electron transfer via a reduced bacteriochlorophyll was observed at low excitation rates.

09.Wed.P3.12

Ultrafast E to Z Photoisomerization of Chiral Biomimetic Molecular Switches

Moussa Gueye[1], Stefan Haacke[1], Stefania Fusi[2], Massimo Olivucci[2,3], Etienne Gindensperger[4], Jérémie Léonard[1]; *[1]IPCMS, CNRS - Université de Strasbourg, France; [2]Dipartimento di Chimica, Università degli Studi di Siena,, Italy; [3]Chemistry Department, Bowling Green State University, USA; [4]Laboratoire de Chimie Quantique, Institut de Chimie, CNRS - Université de Strasbourg, France.*

ABSTRACT Transient absorption spectroscopy on chiral biomimetic molecular switches reveals a critical and novel influence of methyl substitutions on the photoreaction speed and on the observation of vibrational coherence in both isomerization directions.

09.Wed.P3.13

Femtosecond Vibrational Spectroscopic Study on Photoexcitation Dynamics of DNO-bound Myoglobin

Taegon Lee[1], Seongchul Park[1], Manho Lim[1]; *[1]Pusan National University, Republic of Korea.*

ABSTRACT Time-resolved vibrational spectra of DNO-bound myoglobin showed instantaneous bleach that decays on a picosecond time scale, suggesting that most of the photoexcited MbDNO undergoes picosecond geminate rebinding of DNO to Mb after its immediate deligation.

09.Wed.P3.14

Toward Ultrafast In Situ X-Ray Studies of Interfacial Photoelectrochemistry

Stefan Neppl[1,2], Yi-Sheng Liu[3], Chenghao Wu[4,6], Andrey Shavorskiy[2], Ioannis Zegkinoglou[2], Tyler Troy[2], Daniel S. Slaughter[2], Musa Ahmed[2], Anton S. Tremsin[5], Jinghua Guo[3], Per-Anders Glans[3], Miquel Salmeron[4], Hendrik Bluhm[2], Oliver Gessner[1,2]; *[1]Ultrafast X-ray Science Laboratory, Lawrence Berkeley National Laboratory, USA; [2]Chemical Sciences Division, Lawrence Berkeley National Laboratory, USA; [3]Advanced Light Source, Lawrence Berkeley National Laboratory, USA; [4]Materials Sciences Division, Lawrence Berkeley National Laboratory, USA; [5]Space Sciences Laboratory, University of California, USA; [6]Department of Chemistry, University of California, USA.*

ABSTRACT Picosecond time-resolved in situ X-ray absorption and X-ray photoelectron spectroscopy techniques for atomic site-specific real-time studies of interfacial photoelectrochemistry are developed. First experiments monitor electronic dynamics of dye-sensitized nanocrystals and at hematite-electrolyte interfaces.

09.Wed.P3.15

Elementary Electron and Ion Dynamics in Ionized Liquid Water

Jialin Li[1], Zhaogang Nie[1], Yi Ying Zheng[1], Shuo Dong[1], Zhi-Heng Loh[1]; *[1]School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore.*

ABSTRACT Polarization-resolved femtosecond coherence spectroscopy is used to observe the dealignment of the injected electron, hole orbital motion, solvent reorganization, and ballistic proton transport in ionized liquid water. The lifetime of the H_2O^+ cation is also determined.

09.Wed.P3.16

Ultrafast IR Spectroscopy of O-H Stretching Modes in 2-Naphthol-Acetonitrile Photoacid-Base Complexes

Brian T. Psciuk[1], Mirabelle Prémont-Schwarz[2], Benjamin Koeppe[2], Sharon Keinan[3], Dequan Xiao[1,4], Victor S. Batista[1], Erik T.J. Nibbering[2]; *[1]Department of Chemistry, Yale University, USA; [2]Max Born Institut fuer Nichtlineare Optik and Kurzzeitspektroskopie, Germany; [3]Department of Chemistry, Ben-Gurion University of the Negev, Israel; [4]Department of Chemistry & Chemical Engineering, University of New Haven, USA.*

ABSTRACT The O-H stretching mode is a direct hydrogen-bond probe. In a combined femtosecond IR spectroscopic and quantum chemical approach, we demonstrate how this local marker directly reflects charge distribution changes induced in photoexcited photoacid-base complexes.

09.Wed.P3.17

Intense Field Ionization of C_2H_2 and $^{12}C^{13}CH_2$ Aligned in Field-free Space

Hirokazu Hasegawa[1], Yuki Ikeda[2], Kotaro Sonoda[1], Takahiro Sato[2], Atsushi Iwasaki[2], Kaoru Yamanouchi[2]; *[1]Department of Integrated Sciences, University of Tokyo, Japan; [2]Department of Chemistry, University of Tokyo, Japan.*

ABSTRACT Intense field ionization of nonadiabatically aligned C_2H_2 was investigated by a pump-probe technique. The yield of parent ions revealed that the ionization occurs preferentially when the molecular axis is perpendicular to the laser polarization direction.

09.Wed.P3.18

Survival of Nuclear Coherences for a Series of Internal Conversions in Free Base Tetraphenylporphyrin

So Young Kim[1], Sangkyu Kim[2], Taiha Joo[1]; *[1]Department of Chemistry, POSTECH, Republic of Korea; [2]Department of Chemistry, KAIST, Republic of Korea.*

ABSTRACT The stepwise internal conversions in free base tetraphenylporphyrin generate coherent nuclear wave-packets in both Q states. Theory and experiment show that the observed wave-packet motions involve out-of-plane vibration of the porphyrin ring that is strongly coupled to internal conversions.

09.Wed.P3.19

Ultrafast Intramolecular Charge Transfer Process of Asymmetric 9,9'-Bianthryl derivative in Ionic Liquid

Eisuke Takeuchi[1], Masayasu Muramastu[1], Tetsuro Katayama[1,2], Syoji Ito[1], Yutaka Nagasawa[1,2], Hiroshi Miyasaka[1,2]; *[1]Osaka university, Japan; [2]Japan Science and Technology Agency (JST), Japan.*

ABSTRACT Femtosecond transient absorption spectroscopy revealed that initial ultrafast charge transfer process of asymmetric 10-cyano-9,9'-bianthryl in ionic liquid occurs in the sub-100 femtosecond domain which is much faster than that of symmetric 9,9'-bianthryl.

09.Wed.P3.20

Ultrafast Dynamics of a Bistable Intramolecular Proton Transfer Switch

Julia Bahrenburg[1], Michal F. Rode[2], Andrzej L. Sobolewski[2], Friedrich Temps[1]; *[1]Institute of Physical Chemistry, Germany; [2]Institute of Physics, Poland.*

ABSTRACT The stepwise formation of the proton transfer product of a bistable molecular switch was unambiguously revealed by femtosecond fluorescence and absorption spectroscopy. The interpretation was supported by ab initio excited-state calculations.

09.Wed.P3.21

Decomposition of Cyclohexane Ion Induced by Intense Femtosecond Laser Fields

Takao Yamazaki[1], Reika Kanya[1], Kaoru Yamanouchi[1]; *[1]Department of Chemistry, School of Science, The University of Tokyo, Japan.*

ABSTRACT Decomposition of cyclohexane cations induced by an intense femtosecond laser field was investigated by ion trap time-of-flight mass-spectrometry. Laser intensity dependences of the yields of fragment ions revealed decomposition pathways producing the respective fragment ions.

09.Wed.P3.22

Attosecond Stimulated X-ray Raman Probes of Energy and Electron Transfer in Porphyrin Dimers and Proteins

Yu Zhang[1], Jason D. Biggs[1], Daniel Healion[1], Konstantin E. Dorfman[1], Weijie Hua[1], Shaul Mukamel[1]; [1]*University of California, Irvine, USA.*

ABSTRACT Energy and electron transfer processes in molecular complexes can be measured at unprecedented spatial and temporal resolution by novel X-ray spectroscopy techniques. Multidimensional broadband X-ray signals are simulated for a metalloporphyrin dimer and a Re-modified azurin model system of long-range biological electron transfer.

09.Wed.P3.23

Ultrafast Coulomb Explosion of Formaldehyde in 7 and 35 fs Intense Laser Fields Studied by Triple Ion-Coincidence Momentum Imaging

Chien-Ming Tseng[1], Akitaka Matsuda[1,2], Mizuho Fushitani[1,2], Akiyoshi Hishikawa[1,2]; [1]*Institute for Molecular Science, National Institutes of Natural Sciences, Japan;* [2]*Nagoya University, Japan.*

ABSTRACT Ultrafast three-body Coulomb explosion of formaldehyde (H_2CO) in intense laser fields has been studied. The pulse duration dependence of the Newton plot of the fragment ions revealed the ultrafast molecular dynamics in the dication states.

09.Wed.P3.24

Interpreting Coherence Beats in Numerically Exact Simulations of 2D Electronic Spectra

Daniele Monahan[1], Lukas Whaley-Mayda[1], Akihito Ishizaki[2], Graham R. Fleming[1]; [1]*Chemistry, University of California, USA;* [2]*Institute for Molecular Science, National Institutes of Natural Sciences, Japan.*

ABSTRACT Coherence beats are simulated in a numerically exact hierarchy method treatment of an electronic heterodimer coupled to a vibration and bath. We vary coupling parameters to analyze the lifetimes and contributions from different Liouville pathways.

09.Wed.P3.25

Elucidation and Control of Ultrafast Intramolecular Charge Transfer Dynamics of Marine Photosynthetic Pigments

Daisuke Kosumi[1], Takayuki Kajikawa[2], Satoshi Okumura[2], Koki Yano[2], Mitsuru Sugisaki[1], Kazuhiko Sakaguchi[1], Shigeo Katsumura[2], Hideki Hashimoto[1]; [1]*Osaka City University, Japan;* [2]*Kwansei Gakuin University, Japan.*

ABSTRACT Ultrafast Intramolecular Charge Transfer (ICT) state dynamics of fucoxanthin have been investigated by femtosecond pump-probe measurements. A modification of conjugated polyene chain length of fucoxanthin enabled us to clarify and control an ICT character.

09.Wed.P3.26

Ultrafast energy and charge transfer processes in a flexible molecular triad designed for organic photovoltaics

Thomas Roland[1], Li Liu[1], Elodie Heyer[2], Adrian Ruff[3], Sabine Ludwigs[3], Raymond Ziessel[2], Stefan Haacke[1]; [1]*DON, CNRS - IPCMS, France;* [2]*LCOSA, CNRS - ICPEES, France;* [3]*IPOC, Stuttgart University, Germany.*

ABSTRACT A detailed spectro-temporal analysis of the ultrafast transient absorption and fluorescence signals allows deciphering multiple energy and charge transfer processes in a light-harvesting molecular triad designed as photo-sensitizing unit featuring a novel BODIPY compound.

09.Wed.P3.27

Influence of Intramolecular Hydrogen Bonding on the Photodynamics of 2-(1-Ethynylpyrene)-Adenosine (PyA)

Peter Trojanowski[1], Christian Grünewald[2], Franziska Graupner[3], Markus Braun[1], Andreas J. Reuss[1], Joachim W. Engels[2], Josef Wachtveitl[1]; [1]*Institute of Physical and Theoretical Chemistry, Johann Wolfgang Goethe-University, Germany;* [2]*Institute of Organic Chemistry and Chemical Biology, Johann Wolfgang Goethe-Universität, Germany;* [3]*Faculty of Physics, Center for Integrative Protein Science, Ludwig Maximilians University Munich, Germany.*

ABSTRACT We report on the influence of intramolecular hydrogen bonding between the 2'OH group of ribose and adenine in 2-(1-ethynylpyrene)-adenosine (PyA) on the ultrafast dynamics, by comparing PyA with its deoxy derivate (PydA).

09.Wed.P3.28

Exciton dynamics in Cu-doped InAs colloidal quantum dots

Chunfan Yang[1], Itay Gdor[1], Yorai Amit[2], Adam Faust[2], Uri Banin[2], Sanford Ruhman[1]; *[1]The Institute of chemistry and Farkas Center for Light Induced Processes Hebrew University, Israel; [2]The institute of Chemistry and the Center for Nanoscience and Nanotechnology Hebrew University, Israel.*

ABSTRACT Femtosecond transient absorption spectroscopy has been used to investigate the exciton dynamics in native and Cu-doped InAs quantum dots from three respects: 1) Auger recombination; 2) hot exction cooling; 3) absorption cross section.

09.Wed.P3.29

Nonlinear Carrier Dynamics in Semi-Metal Bismuth Induced by Intense Terahertz Field

Kotaro Araki[1], Yasuo Minami[1], Thang D. Dao[2,3], Tadaaki Nagao[2,3], Jun Takeda[1], Masahiro Kitajima[4,5], Ikufumi Katayama[1]; *[1]Yokohama National University, Japan; [2]National Institute for Materials Science, Japan; [3]Japan Science and Technology Agency, Japan; [4]LxRay Co. Ltd, Japan; [5]National Defense Academy, Japan.*

ABSTRACT We investigated nonlinear carrier response of semi-metal bismuth under intense terahertz pulse illumination. By applying the intense terahertz field, the transmittance increases more than 10 %, indicating an increase of the effective mass.

09.Wed.P3.30

A nanoscale vacuum-tube diode triggered by few-cycle laser pulses

Takyua Higuchi[1], Peter Hommelhoff[1]; *[1]Lehrstuhl fuer Laserphysik, Friedrich-Alexander-Universitaet Erlangen-Nuernberg, Germany.*

ABSTRACT We propose and demonstrate a nanoscale vacuum-tube diode consisting of two metal nano-tips as an ultrafast electronic device employing pulsed electrons emitted by few-cycle photoemission.

09.Wed.P3.31

Collapse and revival of large-amplitude coherent phonons: polarization interference versus quantum beats

Oleg Misochko[1], Michael V. Lebedev[1], Kunie Ishioka[2]; *[1]Institute of Solid State Physics, Russian Academy of Sciences, Russian Federation; [2]National Institute for Materials Science, Japan.*

ABSTRACT We report femtosecond time-resolved measurements of lattice dynamics in Bi made at helium temperature over a wide range of excitation levels. We demonstrate that the collapse/revival of large-amplitude A_{1g} coherent phonons is a polarization interference arising due to laterally inhomogeneous excitation

09.Wed.P3.32

Magnetically induced Lattice Dynamics in a Magnetoelectric Antiferromagnet Cr_2O_3

Tomohisa Nishimoto[1], Takeshi Moriyasu[1], Toshiro Kohmoto[1]; *[1]Kobe University, Japan.*

ABSTRACT We studied the optically induced lattice dynamics in a magnetoelectric antiferromagnet Cr_2O_3 by polarization spectroscopy. The observed divergence behavior of the relaxation rate at the Néel temperature suggests the correlation between lattice and spin fluctuations.

09.Wed.P3.33

Exciton recombination dynamics in type II CdTe-Cu_{2-x}Te nano heterostructures with excitonic and plasmonic properties

Ilka Kriegel[1,2], Andreas Wisnet[4], Ajay R. Kandada[5], Francesco Scotognella[3], Francesco Tassone[5], Christina Scheu[4], Hui Zhang[6], Alexander O. Govorov[6], Jessica Rodríguez-Fernández[1,2], Jochen Feldmann[1,2]; *[1]Photonics and Optoelectronics Group, Department of Physics and CeNS, Ludwig-Maximilians-Universität München, Munich, Germany; [2]Nanosystems Initiative Munich (NIM), Germany; [3]Dipartimento di Fisica, Politecnico di Milano, Italy; [4]Department of Chemistry and CeNS, Ludwig-Maximilians-Universität München, Gabon; [5]CNST of IIT@POLIMI, Iceland; [6]Department of Physics and Astronomy, Ohio University, USA.*

ABSTRACT A faster exciton recombination dynamics in type II CdTe-Cu_{2-x}Te nano-heterostructures occurs with increasing the size of the Cu_{2-x}Te subdomain. We suggest that an Auger mediated recombination pathway due to the free carriers in the vacancy-doped Cu_{2-x}Te subunit is the main reason for the faster dynamics.

09.Wed.P3.34

Anomalous phase change process in $[(GeTe)_2/(Sb_2Te_3)]_{20}$ superlattice observed by coherent phonon spectroscopy

Kotaro Makino[1], Yuta Saito[1], Kirill Mitrofanov[1], Junji Tominaga[1], Alexander Kolobov[1], Takashi Nakano[1], Paul Fons[1], Muneaki

Hase[2]; [1]*Nanoelectronics Research institute, National Institute of Advanced Industrial Science, Japan;* [2]*Institute of Applied Physics, University of Tsukuba, Japan.*

ABSTRACT The temperature-dependent ultrafast lattice dynamics of topological $(GeTe)_2/(Sb_2Te_3)$ superlattice phase change memory material was investigated. By comparing with Ge-Sb-Te alloy, a clear contrast suggesting the unique phase change behavior was found.

09.Wed.P3.35

Coherent ultrafast magnetization dynamics non-resonantly induced in cobalt by an intense Terahertz transient

Fernando Ardana[1,2], Carlo Vicario[1], Peter Derlet[1], Barati Tudu[3], Jan Luning[3], Christoph P. Hauri[1,2]; [1]*Paul Scherrer Institut, Switzerland;* [2]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [3]*UPMC, France.*

ABSTRACT We demonstrate non-resonant magnetization dynamics in the ferromagnetic cobalt thin film induced by a record high-field Terahertz pulse. The magnetization dynamics are coherent and exactly follow the THz carrier oscillations.

09.Wed.P3.36

Ab Initio Solution of Structural Dynamics with Ultrafast Electron Diffraction and Charge Flipping

Lai Chung Liu[1,2], Meng Gao[1,2], Yifeng Jiang[2], Cheng Lu[1], Manabu Ishikawa[3], Hideki Yamochi[3], Dwayne Miller[1,2]; [1]*Physics, University of Toronto, Canada;* [2]*Max Planck Institute for the Structure and Dynamics of Matter, Germany;* [3]*Research Center for Low Temperature and Materials Sciences, Kyoto University, Japan.*

ABSTRACT Ultrafast electron diffraction is used to probe the photoinduced structural dynamics of single crystal $(EDO\text{-}TTF)_2PF_6$ with femtosecond time resolution. Structure factor phases at key time points are solved ab initio using the charge-flipping method.

09.Wed.P3.37

Velocity Map Imaging of Electrons Strong-Field Photoemitted from Si-Nanotip

Hong Ye[1,2], Jens M. Kienitz[1,3], Shaobo Fang[1,3], Sebastian Trippel[1], Michael Swanwick[4], Phillip D. Keathley[5], L. F. Velásquez-García[4], Giovanni Cirmi[1,3], Giulio Rossi[1,2], Arya Fallahi[1,3], Oliver D. Mücke[1,3], Jochen Küpper[1,2], Franz X. Kärtner[1,5]; [1]*Center for Free-Electron Laser Science, Deutsches Elektronen-Synchrotron DESY, Germany;* [2]*Physics Department, University of Hamburg, Germany;* [3]*The Hamburg Centre for Ultrafast Imaging, Germany;* [4]*Microsystems Technology Laboratories, Massachusetts Institute of Technology, USA;* [5]*Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, USA.*

ABSTRACT We observe for the first time electron velocity/momentum distribution of three-photon ionization and strong-field photoemission from Si-nanotip arrays using solid-state velocity map imaging.

09.Wed.P3.38

Quantum interference between electron-phonon coupled states in bulk gallium arsenide

Kazutaka Nakamura[1,2], Shingo Hayashi[1,2], Keigo Kato[1,2], Katsura Norimatsu[1,2], Masaki Hada[1,3], Yosuke Kayanuma[1,2]; [1]*Tokyo Institute of Technology, Japan;* [2]*CREST-JST, Japan;* [3]*PRESTO-JST, Japan.*

ABSTRACT We observed quantum interference between electron-phonon coupled states in a bulk GaAs by using two phase-locked femtosecond pulses and found that the electronic coherence remains within ~ 45 fs even at room temperature.

09.Wed.P3.39

Laser-Induced Plasma Dynamics Imaged by Femtosecond In-Line Holography

Neeke Rothe[1], Christoph Merschjann[1], Conrad Schuster[1], Thomas Fennel[1], Stefan Lochbrunner[1]; [1]*Institute of Physics, University of Rostock, Germany.*

ABSTRACT The microplasma evolution in 30nm Au-foils driven by 800nm pump pulses is imaged via in-line holography using delayed 400nm probe pulses. Time-resolved optical properties are extracted via numerical inversion of scattering images.

09.Wed.P3.40

Photoinduced insulating of layered organic metal driven by strong electric field of 1.5-cycle, 7 fs infrared pulse

Shinichiro Iwai[1,2], Takahiro Ishikawa[1], Yuto Sagae[1], Yota Naito[1], Junichi Ichimura[1], Yohei Kawakami[1], Hirotake Itoh[1,2], Sumio Ishihara[1], Kaoru Yamamoto[3], Kyuya Yakushi[4], Takahiko Sasaki[5,2], Hideo Kishida[6,2], Kenji Yonemitsu[7]; [1]*Physics, Tohoku University, Japan;* [2]*CREST, JST, Japan;* [3]*Applied Physics, Okayama Science University, Japan;* [4]*Toyota Physical and Chemical Research, Japan;* [5]*Institute for Materials Research, Tohoku University, Japan;* [6]*Applied Physics, Nagoya University, Japan;* [7]*Physics, Chuo University, Japan.*

ABSTRACT Photoinduced metal to insulator (M-I) change are driven by coherent electron oscillation under strong electric filed (10 MV/cm) of 1.5-cycle (7 fs) near infrared light. Threshold for the M-I change decrease near the M-I transition temperature.

09.Wed.P3.41

Ultrafast optical modulation of efficiently-generated terahertz-wave in charge ordered organic ferroelectrics

Hirotake Itoh[1,2], Keisuke Itoh[1], Kazuki Goto[1], Junichi Ichimura[1], Yota Naito[1], Kaoru Yamamoto[3], Kyuya Yakushi[4], Hideo Kishida[5,2], Shinichiro Iwai[1,2]; *[1]Department of Physics, Tohoku University, Japan; [2]JST, CREST, Japan; [3]Department of Physics, Okayama University of Science, Japan; [4]Toyota Physical and Chemical Research Institute, Japan; [5]Department of Applied Physics, Nagoya University, Japan.*

ABSTRACT Terahertz-wave generation in organic ferroelectrics α-$(ET)_2I_3$ is over 70 times more efficient than prototypical ZnTe. Ultrafast (< 0.1 ps) and sensitive (~ 40 %) photoresponse of the terahertz wave results from strongly-correlated electrons therein.

09.Wed.P3.42

Ultrafast dynamics in epitaxial silicene on Ag(111)

Eugenio Cinquanta[1], Stefano Dal Conte[2], Daniele Chiappe[1], Carlo Grazianetti[1], Marco Fanciulli[1,3], Alessandro Molle[1], Giulio Cerullo[2,4], Salvatore Stagira[4], Francesco Scotognella[4], Caterina Vozzi[2]; *[1]Laboratorio MDM, IMM-CNR, Italy; [2]Institute for Photonics and Nanotechnologies, CNR, Italy; [3]Dipartimento di Scienza dei Materiali, Università degli Studi di Milano-Bicocca, Italy; [4]Department of Physics, Politecnico di Milano, Italy.*

ABSTRACT Ultrafast transient reflectivity measurements were performed in epitaxial 4x4 silicene grown on Ag(111). Comparison with bulk silicon and silver response highlighted the occurrence of peculiar photo-physical mechanisms, suggesting a metallic-like behavior in silicene.

09.Wed.P3.43

Electric and Magnetic Responses in Nonlinear Terahertz Metamaterials

Harold Y. Hwang[1,2], Nathaniel C. Brandt[1], Kebin Fan[2], Xin Zhang[2], Richard D. Averitt[3], Keith Nelson[1]; *[1]Massachusetts Institute of Technology, USA; [2]Department of Mechanical Engineering, Boston University, USA; [3]Department of Physics, Boston University, USA.*

ABSTRACT We report THz electric and magnetic field-induced nonlinear responses in metamaterial structures. We demonstrate air breakdown in SiNx metamaterials with THz electric fields, and highly nonlinear responses in 3D silicon metamaterials with THz magnetic fields.

09.Wed.P3.44

Extreme Ultraviolet Transient Grating Measurement of Insulator-Metal Transition Dynamics of VO_2

Emily F. Sistrunk[1], Jakob Grilj[1,2], Jaewoo Jeong[3], Mahesh G. Samant[3], Alexander X. Gray[4], Hermann A. Durr[4], Stuart S. Parkin[3], Markus Gühr[1]; *[1]Stanford PULSE Institute, SLAC National Accelerator Laboratory, USA; [2]Laboratory of Ultrafast Spectroscopy, Ecole Polytechnique Federal de Lausanne, Switzerland; [3]IBM Almaden Research Center, USA; [4]Stanford Institute for Materials and Energy Sciences, SLAC National Accelerator Laboratory, USA.*

ABSTRACT We demonstrate spectrally resolved transient grating spectroscopy in the extreme ultraviolet near the M-edge of vanadium dioxide. Time-dependent measurements of the ultrafast photo-induced insulator-to-metal transition disentangle pure electronic response from electron-phonon coupling and thermal effects.

09.Wed.P3.45

Laser streaking of free-electron pulses at 25 keV

Alexander Gliserin[1,2], Friedrich O. Kirchner[1,2], Matthew Walbran[1,2], Ferenc Krausz[1,2], Peter Baum[1,2]; *[1]Max-Planck-Institute of Quantum Optics, Germany; [2]Ludwig-Maximilians-Universität, Germany.*

ABSTRACT We demonstrate an optical-field-driven streak camera for temporal characterization of ultrashort free-electron pulses with sub-ångström de Broglie wavelength. This metrology reveals duration, chirp, and coherence of diffraction-capable electron pulses and potentially offers attosecond resolution.

09.Wed.P3.46

Isolating Quantum Coherence using Coherent Multi-dimensional Spectroscopy with Spectrally Shaped Pulses

Jonathan O. Tollerud[1], Christopher R. Hall[1], Jeffrey A. Davis[1]; *[1]Swinburne University of Technology, Australia.*

ABSTRACT We demonstrate how spectral shaping in coherent multidimensional spectroscopy can isolate specific signal pathways and directly access quantitative details. We identify, isolate and analyse weak coherent coupling between spatially separated excitons in asymmetric double quantum-wells.

09.Wed.P3.47

Few-Cycle Laser Pulse induced Plasmon Assisted Thermionic Injection in Metal-Insulator-Metal Junctions

Matthias Hensen[1], Dominik Differt[1], Ingo Heesemann[2], Felix Becker[1], Adelheid Godt[2], Detlef Diesing[3], Walter Pfeiffer[1]; *[1]Fakultät für Physik, Universität Bielefeld, Germany; [2]Fakultät für Chemie, Universität Bielefeld, Germany; [3]Fakultät für Chemie, Universität Duisburg-Essen, Germany.*

ABSTRACT Gold nanoparticles on a metal-insulator-metal junction locally enhance the absorption of few cycle laser pulses. The locally heated electron gas leads to thermionic emission exceeding multiphoton emission and allows detection of single nanoparticles.

09.Wed.P3.48

Transient-grating Stark Spectroscopy

Anton Loukianov[1], Jie Pan[1], Jennifer P. Ogilvie[1], Daniel E. Wilcox[1]; *[1]Physics and Biophysics, University of Michigan, USA.*

ABSTRACT We describe a novel nonlinear spectroscopy that combines the high signal-to-noise of heterodyne-detected transient-grating spectroscopy with Stark spectroscopy, enabling sensitive detection of charge transfer kinetics. We demonstrate the method on the carotenoid fucoxanthin.

09.Wed.P3.49

High flux table-top ultrafast soft X-ray source generated by high harmonic generation

Nicolas Thiré[1], Bruno E. Shmidt[1], Sylvain Fourmeaux[1], Samuel Beaulieu[1], Vincent Cardin[1], Matteo Negro[2], Jean-Claude Kieffer[1], Caterina Vozzi[2], François Légaré[1]; *[1]INRS-EMT / ALLS, Canada; [2]Istituto di Fotonica e Nanotecnologie, CNR, Italy.*

ABSTRACT Intense, few-cycle infrared laser pulses centered at 1.8 µm wavelength, coupled to a new gas cell design, are employed to drive high harmonic generation with high flux down to the soft X-ray regime.

09.Wed.P3.50

Design and Implementation of a Flexible Beamline for fs Electron Diffraction Experiments

Giulia Fulvia Mancini[1]; *[1]ICMP, EPFL, Switzerland.*

ABSTRACT We report the design and implementation of a table-top apparatus for Ultrafast Electron Diffraction in transmission and reflection geometry at 30 keV. From a light-electrons cross-correlation experiment the overall temporal resolution is estimated around 300 fs for bunches containing up to 10^5 electrons at 20 kHz repetition rate.

09.Wed.P3.51

4-fs pulses, single-shot, high dynamic and long temporal range self-referenced spectral interferometry measurement

Thomas Oksenhendler[1], Andrea Trabattoni[2], Sunilkumar Anumula[2], Giuseppe Sansone[2], Gabriel Tempea[3], Francesca Calegari[2], Mauro Nisoli[2]; *[1]FASTLITE Ultrafast Sci Instrumentation, France; [2]Department of Physics, Plitecnico di Milano, Italy; [3]Femtolasers Produktions GmbH, Austria.*

ABSTRACT 4-fs, 1.9-mJ, pulses measurement with 40dB dynamic on +/- 500-fs temporal range was implemented by single-shot Self-Referenced Spectral Interferometry method. The experimental results agree well with pulse reconstruction from streaking with isolated attosecond pulses.

09.Wed.P3.52

High-Speed Carrier-Envelope Phase Control in a 10 kHz, mJ-Class Amplifier

Fabian Lücking[1], Vincent Crozatier[2], Andreas Assion[1]; *[1]Femtolasers Produktions GmbH, Austria; [2]Fastlite, France.*

ABSTRACT We present a fast spectrometer enabling the carrier-envelope phase measurement of every single shot emitted by a 10 kHz, mJ-class amplifier. Using a free parameter in the feed-forward stabilization technique, we demonstrate arbitrary phase control and closed-loop integrated phase noise on seed oscillator level (98 mrad, 100000 shots, 50 s).

09.Wed.P3.53

Fiber-Slab-Pumped OPCPA for XUV-Based Time-Resolved Photoelectron Spectroscopy at 500 kHz Repetition Rate

Michele Puppin[1], Yunpei Deng[1], Oliver Prochnow[2], Jan Matyschok[2,3], Thomas Binhammer[2], Uwe Morgner[3], Martin Wolf[1], Ralph Ernstorfer[1]; *[1]Physical Chemistry, Fritz-haber Institut, Germany; [2]VENTEON Laser Technologies, Germany; [3]Institute of Quantum Optics, Leibniz Universitaet Hannover, Germany.*

ABSTRACT A passive optically-synchronized OPCPA based on a combination of fiber and slab pump lasers is presented. We demonstrate 30 µJ, sub-20 fs, 780 nm pulses at 500 kHz repetition rate, suitable for high harmonic generation.

09.Wed.P3.54

Vector Pulse Shaped Ultrafast Plasmon Based on Response Functions Measured for Orthogonally Polarized Excitation

Yuta Masaki[1], Miyuki Kusaba[1], Kazunori Toma[1], Fumihiko Kannari[1]; [1]*Electronics and Electrical Engineering, Keio University, Japan.*

ABSTRACT For spatiotemporal vector pulse control of local plasmon at gold nanostructures, we measure plasmon response functions for orthogonally polarized ultrafast excitation. By shaping the vector pulse of excitation laser, we arbitrary shape plasmon vector pulses.

09.Wed.P3.55

Manipulation of optical field emitted from autoionizing transition stimulated by isolated attosecond pulse

Hiroki Mashiko[1], Tomohiko Yamaguchi[1,2], Katsuya Oguri[1], Akira Suda[2], Hideki Gotoh[1]; [1]*Optical Science Lab., NTT Basic Research Laboratories, Japan;* [2]*Physics, Tokyo University of Science, Japan.*

ABSTRACT We temporally manipulated optical field emitted from autoionizing transition stimulated by isolated attosecond pulse. The controlled optical field has approximately 1-eV bandwidth, which corresponds to approximately 2 fs duration.

09.Wed.P3.56

Single Quantum Emitter Spectroscopy with Visible Sub-10 fs Pulses

Alexander Weigel[1], Aleksandar Sebesta[1], Philipp Kukura[1]; [1]*Physical and Theoretical Chemistry, University of Oxford, United Kingdom.*

ABSTRACT We present a novel white light source providing sub-10 fs visible pulses with MHz repetition rates and apply it in femtosecond pulse pair experiments on single quantum emitters.

09.Wed.P3.57

2 MHz tunable non collinear optical parametric amplifiers with pulse durations down to 6 fs

Julien Nillon[1,2], Olivier Cregut[1], Christian Bressler[2], Stefan Haacke[1]; [1]*Institut de Physique et Chimie des Matériaux de Strasbourg, University of Strasbourg - CNRS, France;* [2]*European XFEL, Germany.*

ABSTRACT We present a 2 MHz non collinear optical parametric amplifier for high repetition rate time resolved X-ray or optical spectroscopy, with pulse durations down to 6,0 fs and energies in the 30 - 800 nJ range.

09.Wed.P3.58

Tilted Transmission Grisms for Pulse Compression with Dispersion Control Up to the Fourth Order

Nicolas Forget[1], Stéphanie Grabielle[1], Pierre Tournois[1]; [1]*FASTLITE, France.*

ABSTRACT We demonstrate a grism compressor designed to compensate the second, third and fourth order dispersions of a 1.5m SF57 stretcher at 800nm.

09.Wed.P3.59

Towards oscillator driven strong-field experiments using high-energy modelocked thin-disk lasers

Clara J. Saraceno[1,2], Florian Emaury[1], Cinia Schriber[1], Andreas Diebold[1], Matthias Golling[1], Thomas Sudmeyer[2], Ursula Keller[1]; [1]*ETH Zurich, Switzerland;* [2]*University of Neuchatel, Switzerland.*

ABSTRACT We present latest pulse energy and average power scaling of modelocked thin-disk lasers. Efficient compression in a gas-filled Kagome-type hollow-core--PCF at high-average power is demonstrated, resulting in a unique high-repetition-rate source for strong-field experiments.

09.Wed.P3.60

Above-Millijoule Optical Waveforms Compressible to Sub-fs Using Induced-Phase Modulation in a Neon-Filled Hollow-Core Fiber

Shaobo Fang[1,2], Hong Ye[1,3], Giovanni Cirmi[1,2], Giulio Rossi[1,3], Shih-Hsuan Chia[1,3], Oliver D. Mücke[1,2], Franz X. Kärtner[1,4]; [1]*Center for Free-Electron Laser Science, Germany;* [2]*The Hamburg Center for Ultrafast Imaging, Germany;* [3]*Physics Department, University of Hamburg, Germany;* [4]*Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, USA.*

ABSTRACT We demonstrate 1.7-mJ optical waveforms based on induced-phase modulation for generating sub-femtosecond optical pulses. Using custom-designed double-chirped mirrors and a spatial light modulator, such optical waveforms will become a versatile tool for strong-field attoscience.

Room A **17:15-19:00**

09.Wed.E Time-resolved Imaging

Presider: Marcos Dantus *(Michigan State University, United States)*

09.Wed.E.1 17:15 Invited

Imaging Lattice Dynamics in Individual Nanocrystals

Jesse N. Clark[1,8], Loren Beitra[1], Gang Xiong[1], Andrew Higginbotham[2], David Fritz[3], Henrik Lemke[3], Diling Zhu[3], Matthieu Chollet[3], Garth Williams[3], Marc Messerschmidt[3], Brian Abbey[4], Ross Harder[5], Alexander Korsunsky[6,7], Justin Wark[2], Ian Robinson[1,7]; *[1]London Centre for Nanotechnology, United Kingdom; [2]Department of Physics, University of Oxford, United Kingdom; [3]Linac Coherent Light Source, SLAC National Accelerator Laboratory, USA; [4]Department of Physics, La Trobe University, Australia; [5]Advanced Photon Source, USA; [6]Department of Engineering Science, University of Oxford, United Kingdom; [7]Research Complex at Harwell, United Kingdom; [8]Stanford PULSE Institute, Stanford University, USA.*

ABSTRACT We report imaging of coherent acoustic phonons on the picosecond time scale within a single nanocrystal using an X-ray free-electron laser. Our results allow unprecedented comparison with predictive models and observation of the vibrational modes.

09.Wed.E.2 17:45 Contributed

Ultrafast Dynamics of Individual, Isolated Nanoparticles and Nanoplasmas in Intense Laser Fields

Daniel Hickstein[1], Franklin Dollar[1], Jim A. Gaffney[2], Mark E. Foord[2], George M. Petrov[3], Brett B. Palm[4], Jennifer L. Ellis[1], Chengyuan Ding[1], Ellen Keister[1], Stephen B. Libbey[2], Jose L. Jimenez[4], Henry Kapteyn[1], Margaret Murnane[1], Wei Xiong[1]; *[1]Department of Physics, JILA - University of Colorado and NIST, USA; [2]Physics Division, Lawrence Livermore National Laboratory, USA; [3]Plasma Physics Division, Naval Research Laboratory, USA; [4]Department of Chemistry, University of Colorado and CIRES, USA.*

ABSTRACT We combine an aerodynamic lens with a velocity-map-imaging spectrometer to make the first measurements of shock wave generation and ultrafast dynamics in individual nanoplasmas, confirming a decade of theoretical predictions.

09.Wed.E.3 18:00 Contributed

Visualization of ultrafast electron dynamics using time-resolved photoemission electron microscopy

Keiki Fukumoto[1,2], Yuki Yamada[1,2], Takashi Matsuki[1,2], Ken Onda[1,3], Tomohiro Noguchi[1], Raisei Mizokuchi[1], Shunri Oda[1], Shin-ya Koshihara[1,2]; *[1]Tokyo Institute of Technology, Japan; [2]JST-CREST, Japan; [3]JST-PRESTO, Japan.*

ABSTRACT We constructed a TR-PEEM which can directly image the photo-generated electron dynamics in semiconductor on nm and fs scales. Carrier transport properties relating to device performance, carrier lifetime, drift velocity and mobility, are investigated.

09.Wed.E.4 18:15 Contributed

Real space and real time observation of plasmon wavepacket dynamics in single gold nanorod

Yoshio Nishiyama[1], Tetsuya Narushima[1], Kohei Imura[2], Hiromi Okamoto[1]; *[1]Photo-Molecular Science, Institute for Molecular Science, Japan; [2]School of Advanced Science and Engineering, Waseda University, Japan.*

ABSTRACT We applied ultrafast time-resolved near-field optical microscopy to spatio-temporal observation of plasmon dynamics in a gold nanorod. We found prominent changes of transient near-field images as time evolves, indicating coherent excitation of multiple plasmon modes.

09.Wed.E.5 18:30 Contributed

Visualization of Charge Carrier Motion in Semiconductor Nanowires with Ultrafast Pump-Probe Microscopy

Michelle Gabriel[1], Erik Grumstrup[1], Justin Kirschbrown[1], Christopher Pinion[1], Joseph Christesen[1], David Zigler[1], Emma Cating[1], James Cahoon[1], John Papanikolas[1]; *[1]Univ of North Carolina at Chapel Hill, USA.*

ABSTRACT Femtosecond pump-probe microscopy is used to directly visualize the diffusion of photogenerated charge carriers in undoped silicon nanowires, as well as charge separation in a nanowire encoded with an axial p-type/intrinsic/n-type (p-i-n) junction.

09.Wed.E.6 18:45 Contributed

Single-nanoparticle Phase Transitions Visualized by Ultrafast Electron Microscopy

Renske van der Veen[1,2], Antoine Tissot[3], Andreas Hauser[3], Oh-Hoon Kwon[1], Ahmed Zewail[1]; *[1]California Institute Of Technology, USA; [2]Deutsches Elektronen Synchrotron (DESY), Germany; [3]University of Geneva, Switzerland.*

ABSTRACT We use ultrafast electron microscopy (UEM) to visualize the spin-crossover dynamics of single, isolated metal-organic framework nanocrystals. The approach reported here has potential applications in other nanosystems undergoing (bio)chemical transformations.

Thursday, July *10*

Room A **08:30-10:15**

10.Thu.A Strong THz Field Phenomena in Solids

Presider: Koichiro Tanaka *(Kyoto University, Japan)*

10.Thu.A.1 **08:30** ---------- Invited

Higgs Mode and Terahertz Nonlinear Optics in Superconductors

Ryo Shimano[1], Ryusuke Matsunaga[1], Yuki Hamada[1], Arata Sugioka[1], Hiroyuki Fujita[1], Kazumasa Makise[2], Yoshinori Uzawa[3], Hirotaka Terai[1], Zhen Wang[2], Naoto Tsuji[1], Hideo Aoki[1]; *[1]Department of Physics, The University of Tokyo, Japan; [2]National Institute of Information and Communication Technology, Japan; [3]National Astronomical Observatory of Japan, Japan.*

ABSTRACT By using intense terahertz pulses, we investigated the ultrafast coherent light-matter interaction of s-wave superconductors. We observed the Higgs amplitude mode and demonstrated the coherent terahertz nonlinear transient phenomena in superconductors.

10.Thu.A.2 **09:00** ---------- Contributed

Observation of Floquet-Bloch states on the surface of a topological insulator

Yihua Wang[1,2], Hadar Steinberg[2], Pablo Jarillo-Herrero[2], Nuh Gedik[2]; *[1]Physics, Stanford University, USA; [2]Physics, MIT, USA.*

ABSTRACT Photon dressed surface bands of topological insulators exhibit band gaps at avoided crossings. Circularly polarized photons induce an additional gap at the Dirac point, which is a signature of broken time-reversal symmetry on the surface.

10.Thu.A.3 **09:15** ---------- Invited

Phase-locked Multi-THz High-Harmonic Generation by Dynamical Bloch Oscillations in Bulk Semiconductors

Matthias Hohenleutner[1], Olaf Schubert[1], Fabian Langer[1], Benedikt Urbanek[1], Christoph Lange[1], Ulrich Huttner[2], Daniel Golde[2], Torsten Meier[3], Mackillo Kira[2], Stephan W. Koch[2], Rupert Huber[1]; *[1]Department of Physics, University of Regensburg, Germany; [2]Department of Physics, University of Marburg, Germany; [3]Department of Physics, University of Paderborn, Germany.*

ABSTRACT Ultra-intense and CEP-stable waveforms in the multi-THz range control dynamical Bloch oscillations and interband polarization in bulk GaSe, leading to the emission of all-coherent high-order harmonics covering 12.7 optical octaves from THz to VIS regimes.

10.Thu.A.4 **09:45** ---------- Contributed

Field-induced dynamics of correlated electrons in LiH and $NaBH_4$

Vincent Juvé[1], Marcel Holtz[1], Flavio Zamponi[1], Michael Woerner[1], Thomas Elsaesser[1], Andreas Borgschulte[2]; *[1]Max-Born-Institut Berlin, Germany; [2]Laboratory for Hydrogen and Energy (EMPA), Swiss Federal Laboratories for Materials Testing and Research, Switzerland.*

ABSTRACT Femtosecond x-ray powder diffraction maps electron density in response to a strong electric field. In LiH, electron correlations lead to an electron transfer from Li to H while $NaBH_4$ shows a transfer from BH_4^- to Na^+.

10.Thu.A.5 **10:00** ---------- Contributed

Ultrafast Insulator-Metal Transition in VO_2 Driven by Intense Multi-THz Pulses

Alexander Grupp[1], Bernhard Mayer[1], Christian Schmidt[1], Jannis Oelmann[1], Robert E. Marvel[2], Richard F. Haglund[2], Alfred Leitenstorfer[1], Alexej Pashkin[1]; *[1]Department of Physics and Center for Applied Photonics, University of Konstanz, Germany; [2]Department of Physics and Astronomy, Vanderbilt University, USA.*

ABSTRACT We demonstrate a non-thermal metallization of VO_2 induced by a non-resonant excitation at frequencies around 25 THz. An ultrafast switching time of 80 fs comprises only two cycles of the driving multi-THz field.

Room A **10:45-12:30**

10.Thu.B Novel Ultrafast Spectroscopy in Solids

Presider: Kazutaka Nakamura
(Tokyo Institute of Technology, Japan)

10.Thu.B.1 10:45 ---------- Contributed

Magnetic Circular Dichroism probed using High Harmonics

Patrick Grychtol[1], Ofer Kfir[2], Ronny Knut[1,3], Emrah Turgut[1], Dmitriy Zusin[1], Dimitar Popmintchev[1], Tenio Popmintchev[1], Hans Nembach[3], Justin M. Shaw[3], Avner Fleischer[2,4], Henry Kapteyn[1], Margaret Murnane[1], Oren Cohen[2]; *[1]Department of Physics and JILA, University of Colorado, USA; [2]Solid State Institute and Physics Department, Technion, Israel; [3]Electromagnetics Division, National Institute of Standards and Technology, USA; [4]Department of Physics and Optical Engineering, Ort Braude College, Israel.*

ABSTRACT We demonstrate the first generation and phase matching of circularly-polarized high harmonics, which are bright enough for magnetic circular dichroism measurements at the M absorption edges of the magnetic materials Fe, Co and Ni.

10.Thu.B.2 11:00 ---------- Contributed

Towards the Absolute Timing of Photoemission from Condensed Matter Systems

Marcus Ossiander[1,2], Johann Riemensberger[1,2], Martin Schäffer[1,2], Michael Gerl[1,2], Agustin Schiffrin[3,4], Johannes V. Barth[1], Ferenc Krausz[2,5], Reinhard Kienberger[1,2], Peter Feulner[1], Stefan Neppl[1,6]; *[1]Physik-Department, Technische Universität München, Germany; [2]LAP, Max-Planck-Institut für Quantenoptik, Germany; [3]Quantum Matter Institute, University of British Columbia, Canada; [4]Department of Physics and Astronomy, University of British Columbia, Canada; [5]Fakultät für Physik, Ludwig-Maximilians-Universität München, Germany; [6]Ultrafast X-Ray Science Laboratory, Lawrence Berkeley National Lab, USA.*

ABSTRACT We introduce a viable scheme for measuring the absolute duration of photoemission from solids. It employs an atomic chronograph on the surface during attosecond streaking spectroscopy. First experimental results on a tungsten(110) surface are presented.

10.Thu.B.3 11:15 ---------- Contributed

Delayed Core-Level Photoemission from the van der Waals Crystal WSe_2

Fabian Merschjohann[1], Sergej Neb[1], Peter Bartz[1], Matthias Hensen[1], Christian Strüber[1], Sebastian Fiechter[2], Norbert Müller[1], Walter Pfeiffer[1], Ulrich Heinzmann[1]; *[1]Fakultät für Physik, Universität Bielefeld, Germany; [2]Institut für Solare Brennstoffe, Helmholtz Zentrum Berlin, Germany.*

ABSTRACT Attosecond time-resolved XUV streaking experiments are reported for cleaved WSe_2 surfaces. The photoemission from Se 3d and W 4f core levels occurs delayed by 50 attoseconds with respect to the valence band emission.

Room B **10:45-12:30**

10.Thu.C Microscopy and Dielectrics

Presider: Jesse Clark
(London Centre for Nanotechnology, United Kingdom)

10.Thu.C.1 10:45 ---------- Contributed

Two-dimensional molecular imaging by coherent Raman spectroscopy with quadrature phase modulation

Takayuki Suzuki[1], Yuki Obara[1], Kana Kiman[1], Kazuhiko Misawa[1]; *[1]Department of Applied Physics, Tokyo Univ of Agriculture and Technology, Japan.*

ABSTRACT We improved phase sensitive method for CARS spectroscopy. The improvement enables us to construct CARS spectra only from 4 raw spectra. We successfully obtain two-dimensional image of small anesthetic molecules without label molecules.

10.Thu.C.2 11:00 ---------- Contributed

Simultaneous Selective Two-Photon Microscopy Using MHz Rate Pulse Shaping and Quadrature Detection of the Time-Multiplexed Signal

Ilyas Saytashev[1], Bingwei Xu[3], Marshall T. Bremer[2], Marcos Dantus[1,2]; *[1]Department of Chemistry, Michigan State University, USA; [2]Department of Physics and Astronomy, Michigan State University, USA; [3]Biophotonic Solutions Inc., USA.*

ABSTRACT We demonstrate a method for simultaneous fast selective two-photon excited fluorescence (TPEF) microscopy imaging of two different fluorophores using quadrature detection of the signal from a single PMT detector.

10.Thu.C.3 11:15 ---------- Invited

Infrared Pump-Probe Imaging and Spectroscopy with 10nm Resolution

Sergiu Amarie[1], Martin Wagner[2], Michael Goldfla[2], Zhe Fei[2], Wenzhong Bao[4,5], Aleksandr Rodin[3], Michael Fogler[2], Antonio Castro Neto[3], Fritz Keilmann[6], Dimitri Basov[2]; *[1]Neaspec GmbH, Germany; [2]Department of Physics, University of California, USA; [3]Department of Physics, Boston University, USA; [4]Materials Research Science and Engineering Center, University of Maryland, USA; [5]Department of Physics and Astronomy, University of California, USA; [6]Department of Physics, Ludwig-Maximilians-University and Center for Nanoscience, Germany.*

ABSTRACT We introduce pump–probe sub-diffraction infrared imaging and spectroscopy with 100fs temporal and 10nm spatial resolution. On graphene single-layers, we demonstrate time-resolved access to local optical conductivity at technologically relevant mid-infrared frequencies

10.Thu.B.4 **11:30** ---------- Contributed

Attosecond Pump-Probe Measurement of an Auger Decay

Antoine Moulet[1], Julien B. Bertrand[1], Arohi Jain[2], Manish Garg[1], Tran Trung Luu[1], Alexander Guggenmos[1,2], Stefan Pabst[3,4], Ferenc Krausz[1,2], Eleftherios Goulielmakis[1]; *[1]Max-Planck-Institut für Quantenoptik, Germany; [2]Physics, Ludwig-Maximilians-Universität, Germany; [3]Center for Free-Electron Laser Science, DESY, Germany; [4]Physics, University of Hamburg, Germany.*

ABSTRACT We characterize the Auger decay of core-shell excitations in Krypton atoms in an all-photonic fashion, using a novel attosecond EUV pump - attosecond optical probe scheme. An intuitive model, where the optical field acts as a temporal amplitude and phase gate on the EUV excited dipole, is used to retrieve the Auger core-hole decay time.

10.Thu.B.5 **11:45** ---------- Contributed

Controlling the motion of strong-field, few-cycle photoemitted electrons in the near-field of a sharp metal tip

Petra Gross[1,2], Björn Piglosiewicz[1,2], Slawa Schmidt[1,2], Doo Jae Park[1,2], Jan Vogelsang[1,2], Jörg Robin[1,2], Cristian Manzoni[3], Paolo Farinello[3], Giulio Cerullo[3], Christoph Lienau[1,2]; *[1]Institut für Physik, Carl von Ossietzky Universität, Germany; [2]Center of Interface Science, Carl von Ossietzky Universität, Germany; [3]Dipartimento di Fisica, Politecnico di Milano, Italy.*

ABSTRACT We report on the experimental observation of pronounced carrier-envelope-phase effects on strong-field photoemission of electrons from nanometric gold tips and present a new way to steer and control the motion of electrons around metallic nanoparticles.

10.Thu.B.6 **12:00** ---------- Contributed

Injection of CEP-controllable Current in Wide-bandgap Semiconductors: Effects of the Screening Field

Stanislav Kruchinin[1], Tim Paasch-Colberg[1], Nicholas Karpowicz[1], Agustin Schiffrin[1,2], Vladislav S. Yakovlev[1,3], Ferenc Krausz[1,3]; *[1]Laboratory for Attosecond Physics, Max Planck Institute of Quantum Optics, Germany; [2]Max Planck - UBC Centre for Quantum Materials University of British Columbia, Canada; [3]Ludwig Maximilian University of Munich, Germany.*

ABSTRACT A multiphoton mechanism of ultrafast current injection and control in GaN is studied. Analysis has shown that screening field of free charge carriers determines the field amplitude scaling law and strongly affects the charge-balancing phase.

10.Thu.B.7 **12:15** ---------- Contributed

Coherent control over two-dimensional lattice vibrational trajectories in α-quartz using polarization pulse shaping

Masaaki Sato[1], Takuya Higuchi[2,3], Makoto Kuwata-Gonokami[3,4], Kazuhiko Misawa[1,5]; *[1]Department of Applied Physics, Tokyo University of Agriculture and Technology, Japan; [2]Department of Applied Physics, The University of*

10.Thu.C.4 **11:45** ---------- Contributed

Simultaneous Spatial and Temporal Focusing of Femtosecond Laser Pulses for Directly Writing Optical Waveguides in Pr^{3+} doped ZBLAN Glass

Yusuke Yamanaka[1], Kenichi Hirosawa[1], Fumihiko Kannari[1]; *[1]Keio University, Japan.*

ABSTRACT We present characteristics of optical waveguides in Pr:ZBLAN glass using simultaneous spatial and temporal focusing (SSTF). SSTF realizes smaller laser-modified region with a long working distance, which brings flexibility and better quality in waveguide fabrication.

10.Thu.C.5 **12:00** ---------- Contributed

Non-instantaneous polarization decay in dielectric media

Michael Hofman[1], Carsten Bree[1], Matthias Hoffmann[2], Ayhan Demircan[2], Tamas Nagy[2], Detlef Ristau[2,3], Uwe Morgner[2,3], Simon Birkholz[4], Susanta K. Das[4], Martin Bock[4], Rüdiger Grunwald[4], Janne Hyyti[5], Thomas Elsaesser[4], Gunter Steinmeyer[4,5]; *[1]Weierstrass-Institut für Angewandte Analysis und Stochastik, Germany; [2]Laserzentrum Hannover, Germany; [3]Leibniz-Universität Hannover, Germany; [4]Max Born Institute, Germany; [5]Optoelectronics Research Centre, Finland.*

ABSTRACT We demonstrate experimental evidence for non-instantaneous polarization decay in dielectrics. The few-femtosecond relaxation times agree favorable with solutions of the time-dependent Schrödinger equation and relate to resonances of the quantum mechanical dipole.

10.Thu.C.6 **12:15** ---------- Contributed

Investigation of Laser-Induced Currents in Large-Band-Gap Dielectrics

Sabine Keiber[1,2], Tim Paasch-Colberg[1], Alexander Schwarz[1,2], Olga Razskazovskaya[1], Elena Fedulova[1], Özge Sağlam[3], Clemens Jakubeit[1], Shawn Sederberg[1], Péter Dombi[1], Nicholas Karpowicz[1], Ferenc Krausz[1,2]; *[1]Max-Planck-Institut für Quantenoptik, Germany; [2]Fakultät für Physik, Ludwig-Maximilians-Universität, Germany; [3]Physik-Department, Technische Universitat München, Germany.*

ABSTRACT Applying few-cycle laser pulses to dielectrics increases their ac-polarizability, allowing for switching currents at the frequency of light. We report on the dependence of these ultrafast currents on material band gap and sample geometry.

Tokyo, Japan; [3]Department of Physics, The University of Tokyo, Japan; [4]Photon Science Center, The University of Tokyo, Japan; [5]Interdisciplinary Research Unit in Photon-nano Science, Tokyo University of Agriculture and Technology, Japan.

ABSTRACT We applied polarization pulse shaping to control the trajectory of two-dimensional vibrational motion in α-quartz. Polarization twisted pulses were used to impart peudorotational motion of the degenerate E-symmetry optical phonon mode selectively through impulsive stimulated Raman scattering.

Room A **14:00-15:45**

10.Thu.D Excited State Dynamics

Presider: Regina de Vivie-Riedle *(Ludwig-Maximillians-Universität Munchen, Germany)*

10.Thu.D.1 **14:00** ---------- Invited

Ultrafast Intersystem Crossing in SO_2 and Nucleobases

Sebastian Mai[1], Martin Richter[1], Philipp Marquetand[1], Leticia González[1]; *[1]Institute of Theoretical Chemistry, University of Vienna, Austria.*

ABSTRACT Mixed quantum-classical dynamics simulations show that intersystem crossing between singlet and triplet states in SO_2 and in nucleobases takes place on an ultrafast time decay (few 100 fs), directly competing with internal conversion.

10.Thu.D.2 **14:30** ---------- Contributed

Distinctive Spectral Features of Exciton and Excimer States in the Ultrafast Electronic Deactivation of the Adenine Dinucleotide

Mayra C. Stuhldreier[1], Katharina Röttger[1], Friedrich Temps[1]; *[1]Christian-Albrechts Universität zu Kiel, Germany.*

ABSTRACT We report the observation of distinctive spectro-temporal signatures of delocalized exciton vs. relaxed, weakly bound excimer states in the ultrafast electronic deactivation after UV photoexcitation of the adenine dinucleotide followed by transient absorption spectroscopy.

10.Thu.D.3 **14:45** ---------- Contributed

Quantum Dynamics of Molecular Reactions Directed by Explicit Solvent Environment

Sebastian Thallmair[1], Julius Zauleck[1], Regina de Vivie-Riedle[1]; *[1]Ludwig-Maximilians-Universität, Germany.*

ABSTRACT We present the first method that combines molecular quantum dynamics of the solute with classical molecular dynamics of the solvent. Its mechanical impact on the ultrafast internal motions is decisive for the reaction outcome.

10.Thu.D.4 **15:00** ---------- Contributed

Photoinduced charge transfer occurs naturally in DNA

Dominik B. Bucher[1,2], Bert M. Pilles[1], Thomas Carell[2], Wolfgang Zinth[1]; *[1]BioMolecular Optics and Center for Integrated Protein Science, Ludwig-Maximilians-Universität München, Germany; [2]Center for Integrated Protein Science at the Department of Chemistry, Ludwig-Maximilians-Universität München, Germany.*

ABSTRACT We show by femtosecond IR spectroscopy that excited states in oligonucleotides decay with high yields by charge transfer to delocalized charged radicals. For the 6-4 lesion, charge transfer protects the DNA from Dewar formation.

10.Thu.D.5 **15:15** ---------- Contributed

Probing Ultrafast Structural Dynamics of Photoactive Yellow Protein with Femtosecond Time-Domain Raman Spectroscopy

Hikaru Kuramochi[1], Satoshi Takeuchi[1,2], Kento Yonezawa[3], Hironari Kamikubo[3], Mikio Kataoka[3], Tahei Tahara[1,2]; *[1]Molecular Spectroscopy Laboratory, RIKEN, Japan; [2]Ultrafast Spectroscopy Research Team, RIKEN Center for Advanced Photonics (RAP), Japan; [3]Graduate School of Materials Science, Nara Institute of Science and Technology, Japan.*

ABSTRACT Ultrafast dynamics of photoactive yellow protein was investigated by time-resolved impulsive stimulated-Raman spectroscopy. Time-Domain vibrational data revealed rapid change of the hydrogen-bonding structure in the excited state and vibrational structure of the first ground-state intermediate.

10.Thu.D.6 **15:30** Contributed

Towards Direct Measurement of Ultrafast Vibrational Energy Transfer in Proteins

Henrike Müller-Werkmeister[1,2], Martin Essig[1], Patrick Durkin[3], Nediljko Budisa[3], Jens Bredenbeck[1]; *[1]Institute for Biophysics, University of Frankfurt, Germany; [2]Chemistry, University of Toronto, Canada; [3]Chemistry, Berlin Institute of Technology, Germany.*

ABSTRACT Vibrational energy transfer (VET) within a molecule can be investigated in great detail by ultrafast IR spectroscopy. We report on progress towards mapping of VET pathways in proteins using unnatural amino acids as site-specific probes.

Friday, July *11*

Room A **08:30-10:15**

11.Fri.A Vibrational Dynamics

Presider: Tahei Tahara *(RIKEN, Japan)*

11.Fri.A.1 **08:30** ---------- Contributed

Hydrogen Bond Enhancement of Fermi Resonances Explored with Ultrafast IR Two-Colour Pump-Probe and 2D-IR Spectroscopy

Christian Greve[1], Rene Costard[1], Henk Fidder[1], Erik T.J. Nibbering[1]; [1]*Max Born Institut fuer Nichtlineare Optik und Kurzzeitspektroskopie, Germany.*

ABSTRACT Ultrafast polarisation-resolved 2D-IR mapping the fundamental and first overtone N-H stretching manifolds, and two-colour IR pump-probe experiments following transient population dynamics characterize a key role of a Fermi resonance with the NH_2-bending in aniline-dimethylsulfoxide complexes.

11.Fri.A.2 **08:45** ---------- Contributed

Site-Addressable Polymer Dynamics Probed with 2D-IR

Laura Kiefer[1], John T. King[1], Kevin J. Kubarych[1]; [1]*Chemistry, University of Michigan, USA.*

ABSTRACT A polymer consisting of transition metal carbonyl sites enables dynamical readout of ultrafast structural fluctuations in dilute, concentrated, and thin film conditions. 2D-IR spectroscopy and coarse grained simulations reveal distinct dynamics of the ends.

11.Fri.A.3 **09:00** ---------- Contributed

Room-Temperature studies of Electronic Coherences in Two-Dimensional Nanostructures

Gregory D. Scholes[1], Elsa Cassette[1], Ryan Pensack[1], Benoit Mahler[1]; [1]*University of Toronto, Canada.*

ABSTRACT We use two-dimensional electronic spectroscopy to study the lineshapes and linewidths of excitons in colloidal nanoplatelets at room temperature and the coherences induced by the superposition of the two first excitonic states.

11.Fri.A.4 **09:15** ---------- Contributed

Vibrational Coherence Reveals the Role of Dark Multiexciton States in Ultrafast Singlet Exciton Fission

Akshay Rao[1], Artem Bakulin[2], Dassia Egorova[4], Alex Chin[1], Donatas Zigmantas[3], Sarah Morgan[1]; [1]*University of Cambridge, United Kingdom;* [2]*FOM Institute, Netherlands;* [3]*Lund University, Sweden;* [4]*Christian-Albrechts-Universität zu Kiel, Germany.*

ABSTRACT We use 2D electronic photon-echo spectroscopy to study ultrafast singlet exciton fission in pentacene. Our observations and analysis of vibronic coherences provide insight to the role played by dark multiexcitonic states in mediating fission.

11.Fri.A.5 **09:30** ---------- Contributed

Controlling Excitations of Coupled Vibrations by Shaped Mid-Infrared Pulses

Jumpei Tayama[1], Naoki Wakabayashi[1], Satoshi Ashihara[1]; [1]*Tokyo Univ of Agriculture and Technology, Japan.*

ABSTRACT Mid-infrared pulse shaping was utilized for controlling excitations of coupled vibrations in metal di-carbonyls. Excitation into the combination state was maximized by simultaneous controls over vibrational ladder climbing and quantum mechanical multi-path interference.

11.Fri.A.6 **09:45** ---------- Contributed

Snapshots of sub-picosecond dynamics in heme-proteins captured by Femtosecond Stimulated Raman Scattering

Tullio Scopigno[1], Carino Ferrante[1], Emanuele Pontecorvo[1], Giovanni Batignani[1]; [1]*Universita degli Studi di Roma La Sapienza, Italy.*

ABSTRACT The reaction pathway in photoexcited hemeproteins (ligand dissociation, energy redistribution and structural dynamics) has been unraveled by Femtosecond Stimulated Raman Scattering. The possible existence of short living intermediates as opposed to vibrational relaxation is discussed.

11.Fri.A.7 **10:00** ---------- Contributed

Observation of the Dark State in Ruthenium Complexes Using Femtosecond Infrared Vibrational Spectroscopy

Ken Onda[1,2], Tatsuhiko Mukuta[1], Sei'ichi Tanaka[1], Kei Murata[3], Akiko Inagaki[2,4]; *[1]Graduate School of Science and Engineering, Tokyo Institute of Technology, Japan; [2]PRESTO, Japan Science and Technology Agency, Japan; [3]Chemical Resources Laboratory, Tokyo Institute of Technology, Japan; [4]Graduate School of Science and Engineering, Tokyo Metropolitan University, Japan.*

ABSTRACT We comprehensively studied the excited states of prototypical ruthenium complexes using time-resolved infrared vibrational spectroscopy and found a band assigned to the dark 3MC (metal centered) state, which plays an important role for their photofunctions.

Room A **10:45-12:30**

11.Fri.B XFEL and High-order Harmonic Spectroscopy

Presider: Tomoya Okino *(RIKEN, Japan)*

11.Fri.B.1 **10:45** ---------- Contributed

Disentangling structural and dynamical effects via multidimensional high harmonic spectroscopy

Barry D. Bruner[1], Hadas Soifer[1], Matteo Negro[3], Michele Devetta[3], Davide Facciala[2], Caterina Vozzi[3], Salvatore Stagira[2], Sandro De Silvestri[2], Nirit Dudovich[1]; *[1]Physics of Complex Systems, Weizmann Institute of Science, Israel; [2]Dipartimento di Fisica, Politecnico di Milano, Italy; [3]Instituto di Fotonica e Nanotecnologie, CNR, Italy.*

ABSTRACT Extending the dimensionality of high harmonic generation (HHG) measurements has the potential to reconstruct structural features in molecules and resolve multielectron dynamics on attosecond time scales. We demonstrate that structural and dynamical effects in molecules can be unambiguously distinguished using multidimensional HHG techniques.

11.Fri.B.2 **11:00** ---------- Contributed

High-order harmonic light source at megahertz for double photoemission spectroscopy of correlated electrons

Cheng-Tien Chiang[1,2], Andreas Trützschler[1,2], Michael Huth[1], Frank O. Schumann[1], Jürgen Kirschner[1,2], Wolf Widdra[2,1]; *[1]Max Planck Institute of Microstructure Physics, Germany; [2]Institute of Physics, Martin-Luther-Universitaet Halle-Wittenberg, Germany.*

ABSTRACT We develop high-order harmonic generation at repetition rates up to 1 MHz using an ytterbium-fiber laser and demonstrate the first laboratory double photoemission experiments with high-order harmonics to study strongly correlated materials.

11.Fri.B.3 **11:15** ---------- Contributed

Probing xenon electronic structure by two-color driven high-order harmonic generation

Matteo Negro[1], Davide Faccialà[2], Barry D. Bruner[3], Michele Devetta[1], Sandro De Silvestri[2], Nirit Dudovich[3], Stefan Pabst[4], Robin Santra[4,5], Hadas Soifer[3], Salvatore Stagira[2], Caterina Vozzi[1]; *[1]Institute for Photonics and Nanotechnologies, CNR, Italy; [2]Physics Department, Politecnico di Milano, Italy; [3]Department of Physics of Complex Systems, Weizmann Institute of Science, Israel; [4]Center for Free-Electron Laser Science, DESY, Germany; [5]Department of Physics, University of Hamburg, Germany.*

ABSTRACT We studied the two-color HHG emission from xenon in the giant resonance spectral region. We found a substantial departure from the behavior expected for the single-active-electron picture which could be ascribed to electron correlation effects.

11.Fri.B.4 **11:30** ---------- Contributed

Attosecond control of electron emission from atoms and the relative phase of even and odd harmonics in an Attosecond Pulse Train

Guillaume M. Laurent[1,2], Wei Cao[1], Itzik Ben-Itzhak[1], C. Lew Cocke[1]; *[1]James R. Macdonald Laboratory, Physics Department, Kansas State University, USA; [2]Research Laboratory of Electronics, Massachusetts Institute of Technology, USA.*

ABSTRACT We demonstrate that electron emission from atoms can be controlled on an attosecond time scale, and that such emission provides information on the phase of consecutive odd and even harmonics in the attosecond pulse train.

11.Fri.B.5 **11:45** ---------- Contributed

Attosecond Tunneling Interferometry

Oren Pedatzur[1], Gal Orenstein[1], Hadas Soifer[1], Barry D. Bruner[1], Nirit Dudovich[1]; *[1]Weizmann Institute of Science, Israel.*

ABSTRACT By applying a weak perturbation to HHG we modulate the tunneling barrier in subcycle timescale. This gives rise to nontrivial temporal interference between consecutive attosecond bursts. The extracted interference patterns reveal nonadiabatic tunneling dynamics within the 160 as ionization window.

11.Fri.B.6 **12:00** ---------- Invited

Femtosecond Time-Resolved X-ray-Induced Isomerization

Philip H. Bucksbaum[1], Chelsea Liekhus-Schmaltz[1], Vladimir Petrovic[1], Ian Tenney[1]; [1]*PULSE Institute, Stanford University, USA.*

ABSTRACT We investigated rapid proton migration in acetylene induced by 10 fs 400 eV x-rays, and probed with a second delayed x-ray pulse. Dynamics are revealed through delay-dependent fragmentation momenta.

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