

Sunday, July 18, 3:00 p.m.–6:00 p.m. Registration Open, Lobby

Sunday, July 18, 6:30 p.m.–7:30 p.m. Welcome Reception, Rooftop Garden

Monday, July 19, 7:00 a.m.–5:30 p.m. Registration Open, Lobby

Opening Remarks

Monday, July 19
8:15 a.m.–8:30 a.m.

MA • Electron and X-Ray Diffraction

Monday, July 19
8:30 a.m.–10:15 a.m.
Majed Chergui; École Polytechnique Fédérale de Lausanne, Switzerland, *Presider*

MA1 • 8:30 a.m.

Invited

Femtosecond Molecular Photocrystallography, *Hubert Jean-Ruel, Meng Gao, Ryan R. Cooney, Cheng Lu, Germán Sciaini, Dwayne R. J. Miller; Univ. of Toronto, Canada.* Femtosecond electron diffraction is used to directly observe the cooperative structural changes associated with the order-to-order phase transition of photochromic molecular crystals, involving classic cyclization and cycloreversion reaction mechanisms.

MA2 • 9:00 a.m.

Ultrafast Order Parameter Melting in a 2-D Charge Density Wave 1T-TaS₂ Probed by Femtosecond Electron Diffraction, *Maximilian Eichberger¹, Hanjo Schäfer¹, Marina Krumova¹, Jure Demsar¹, Helmuth Berger², Gustavo Moriena³, German Sciaini³, Dwayne R. J. Miller³; ¹Univ. of Konstanz, Germany, ²École Polytechnique Fédérale de Lausanne, Switzerland, ³Univ. of Toronto, Canada.* We present the first study of the order parameter dynamics in a Charge-Density-Wave system utilizing femtosecond electron diffraction. The results reveal an ultrafast suppression of the CDW order, whose recovery proceeds on the picosecond timescale.

MA3 • 9:15 a.m.

Ultrafast Electron Diffraction from Aligned Molecules, *Martin Centurion¹, Peter Reckenthaeler², Ferenc Krausz², Ernst Fillp; ¹Univ. of Nebraska at Lincoln, USA, ²Max-Planck-Inst. für Quantenoptik, Germany.* We present experimental results on ultrafast electron diffraction from transiently aligned molecules in the absence of external (aligning) fields. The molecules are aligned selectively through a photodissociation reaction using a femtosecond laser pulse.

MA4 • 9:30 a.m.

Single-Shot, Femtosecond Electron Diffraction, *Peter Pasmans, Thijs van Oudheusden, Marieke de Loos, Bas van der Geer, Arjan Klessens, Jom Luiten; Eindhoven Univ. of Technology, Netherlands.* High-quality electron diffraction patterns can be recorded in a single sub-picosecond shot by using radio-frequency compression techniques to overcome the Coulomb expansion of the required electron bunches. First single-shot diffraction measurements are presented.

MA5 • 9:45 a.m.

X-Ray Powder Diffraction with Femtosecond Time Resolution, *Flavio Zamponi, Zunaira Ansari, Jens Dreyer, Michael Woerner, Thomas Elsaesser; Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany.* Transient electronic charge density maps with 30 picometer spatial and 100 femtosecond temporal resolution derived from Debye Scherrer experiments unravel for the first time a concerted electron and proton transfer in hydrogen-bonded (NH₄)₂SO₄ crystals.

MA6 • 10:00 a.m.

Ultrafast Lattice Dynamics in FeRh during a Laser-Induced Magnetic Phase Transition, *Uladzimir Shymanovich¹, Wei Lu¹, Matthieu Nicoul^{1,2}, Alexander Tarasevitch¹, Dietrich von der Linde¹, Klaus Sokolowski-Tinten¹; ¹Univ. Duisburg-Essen, Germany, ²Univ. Köln, Germany.* Time-resolved X-ray diffraction is used to study the lattice response of FeRh during a laser-driven anti-ferromagnetic to ferromagnetic phase transition. The experiments reveal a fast and a slow component in the induced expansion dynamics.

10:15 a.m.–10:45 a.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

10:15 a.m.–4:15 p.m. Exhibits Open, Erickson/Carroll/Sinclair Rooms

MB • Single-Cycle Pulse Generation

Monday, July 19

10:45 a.m.–12:30 p.m.

Franz X. Kärtner; MIT, USA, *Presider***MB1 • 10:45 a.m.**

Approaching the Full Octave: Noncollinear Optical Parametric Chirped Pulse Amplification with Two-Color Pumping, Christian Homann¹, Daniel Herrmann^{1,2}, Raphael Tautz^{2,3}, Laszlo Veisz², Ferenc Krausz^{2,4}, Eberhard Riedle¹; ¹LS für BioMolekulare Optik, Ludwig-Maximilians-Universität München, Germany, ²Max-Planck-Institut für Quantenoptik, Germany, ³LS für Photonik und Optoelektronik, Ludwig-Maximilians-Universität München, Germany, ⁴LS für Laserphysik, Ludwig-Maximilians-Universität München, Germany. We amplify ultrabroadband spectra (580-1000 nm) to mJ energies by applying different pump wavelengths in subsequent stages of a NOPCPA chain. As proof-of-principle we compress pulses composed by this new technique close to their Fourier-Limit.

MB2 • 11:00 a.m.

Generation of Single-Cycle Light Pulses with Compact Er: Fiber Technology, Günther Krauss, Tobias Hanke, Alexander Sell, Stefan Eggert, Rupert Huber, Alfred Leitenstorfer; Univ. of Konstanz, Germany. Based on a two-branch Er:fiber laser system we demonstrate the synthesis of 4.3 fs pulses, corresponding to single cycles of light in the telecom frequency band.

MB3 • 11:15 a.m.

Towards CEP Stable, Single-Cycle Pulse Compression with Bulk Material, Bruno E. Schmidt^{1,2}, Pierre Béjot³, Andrew D. Shiner², Philippe Lassonde¹, Carlos Trallero-Herrero², Jean-Pierre Wolf⁴, David M. Villeneuve², Jean-Claude Kieffer¹, Paul B. Corkum², François Légaré¹; ¹INRS, Canada, ²Joint Lab for Atto-Second Science, Univ. of Ottawa and Natl. Res. Council Canada, Canada, ³Univ. de Bourgogne, France, ⁴Univ. de Genève, Switzerland. We demonstrate both experimentally and numerically that self-steepening during propagation in a hollow-fiber followed by linear propagation through glass in the anomalous dispersion enables pulse compression down to 1.6 cycles at 1.8 μm wavelength.

MB4 • 11:30 a.m.

Phase-Locked Single-Cycle Pulses in the Multi-THz Range with Peak Electric Fields Exceeding 10 MV/cm, Friederike Junginger¹, Alexander Sell¹, Olaf Schubert¹, Bernhard Mayer¹, Daniele Brida², Marco Marangoni², Giulio Cerullo², Rupert Huber¹, Alfred Leitenstorfer¹; ¹Univ. of Konstanz, Germany, ²Politecnico di Milano, Italy. Single-cycle idler transients covering the 6-60 THz frequency window with peak amplitudes exceeding 10 MV/cm are generated by parametric amplification of 1.3- μm pulses in GaSe. The temporal trace of the phase-stable waveform is detected electro-optically.

MB5 • 11:45 a.m.

Self-Referenced Oscillator Pulse Train with Constant Carrier-Envelope-Offset Phase, Stefan Rausch^{1,2}, Thomas Binhammer³, Anne Harth^{1,2}, Uwe Morgner^{1,2,4}; ¹Inst. of Quantum Optics, Leibniz Univ. Hannover, Germany, ²Ctr. for Quantum Engineering and Space-Time Res. (QUEST), Germany, ³VENTEON Laser Technologies GmbH, Germany, ⁴Laser Zentrum Hannover, Germany. We present an oscillator pulse train stabilized to carrier-envelope-offset frequency zero with 65 attosecond timing jitter. The excellent locking performance is verified by recording the interference of more than 10^{10} pulses in an out-of-loop interferometer.

MC • 0-D and 1-D Quantum Systems

Monday, July 19

10:45 a.m.–12:30 p.m.

Antoinette J. Taylor; Los Alamos Natl. Lab, USA, *Presider***MC1 • 10:45 a.m.**

Ultrafast Few-Fermion Optoelectronics of a Single Quantum Dot, Markus Zecherle¹, Claudia Ruppert¹, Emily C. Clark², Jonathan J. Finley², Markus Betz^{1,3}; ¹Physik-Dept., Technischen Univ. München, Germany, ²Walter Schottky Inst., Technischen Univ. München, Germany, ³Experimentelle Physik, Technische Univ. Dortmund, Germany. Population dynamics, excited biexciton states, excitonic and conditional biexcitonic Rabi oscillations in a single quantum dot embedded in a photodiode are investigated combining pump-probe techniques with a sensitive photocurrent readout.

MC2 • 11:00 a.m.

Linewidth and Coupling of Interfacial GaAs Quantum Dots Measured with Optical Two-Dimensional Fourier Transform Spectroscopy, Galan Moody¹, Mark E. Siemens¹, Alan D. Bristow¹, Xingcan Dai¹, Denis Karaiskaj¹, Allan S. Bracker², Dan Gammon², Steven T. Cundiff¹; ¹JILA, NIST, Univ. of Colorado, USA, ²NRL, USA. Optical two-dimensional Fourier-transform spectroscopy is used to study interfacial GaAs quantum dots (QDs). We extract the temperature dependence of the QD homogeneous linewidth and energy relaxation from quantum well excitons to the lower energy QDs.

MC3 • 11:15 a.m.

Probing Biexcitons in Quantum Dots Using Femtosecond Pump/Probe and Two Dimensional Electronic Spectroscopy, Pooja Tyagi¹, Katherine Stone², Daniel Turner², Samuel Sewall¹, Keith Nelson², Patanjali Kambhampati¹; ¹McGill Univ., Canada, ²MIT, USA. We report on the electronic structure of biexcitons in CdSe quantum dots using state-selective femtosecond pump/probe spectroscopy. The pump/probe experiments are compared to direct probing of biexcitons via two-dimensional electronic spectroscopy.

MC4 • 11:30 a.m.

Hot Carrier Dynamics in Lead Sulfide Nanocrystals, Byungmoon Cho, William K. Peters, Robert J. Hill, Trevor L. Courtney, David M. Jonas; Univ. of Colorado, USA. Hot carriers in PbS nanocrystals are directly probed. The data are consistent with bulk-like small, high velocity electron and hole wavepackets that initially feel little or no quantum confinement, except for collisions with the surface.

MC5 • 11:45 a.m.

Ultrafast Excitation Energy Transfer in Small Carbon Nanotube Aggregates, Larry Lüer¹, Jared Crochet², Tobias Hertel², Giulio Cerullo³, Guglielmo Lanzani⁴; ¹Madrid Inst. of Advanced Studies, IMDEA Nanociencia, Spain, ²Univ. of Würzburg, Germany, ³Politecnico di Milano, Italy, ⁴Italian Inst. of Technology, Italy. Ultrafast inter-tube exciton transfer in small aggregates of carbon nanotubes is studied by femtosecond spectroscopy with degenerate broadband pulses. After separation of population dynamics from coherent effects, transfer times below 10 fs are obtained.

MB • Single-Cycle Pulse Generation—Continued**MB6 • 12:00 p.m.**

Adiabatic Frequency Conversion of Ultrafast Pulses, *Haim Suchowski¹, Barry D. Bruner¹, Ady Arie², Yaron Silberberg¹; ¹Weizmann Inst. of Science, Israel, ²Tel Aviv Univ., Israel*. A method for efficient frequency conversion of ultrafast pulses is demonstrated using an adiabatic aperiodically poled KTP crystal. We produce broadband blue pulses centered at 450 nm by upconverting 30 fs pulses in the near-IR.

MB7 • 12:15 a.m.

Temporal and Spatial Lensing with an Intense Single-Cycle Terahertz Pulse, *Yuzhen Shen, G. L. Carr, James B. Murphy, Thomas Y. Tsang, Xijie Wang, Xi Yang; Brookhaven Natl. Lab, USA*. We demonstrate that an intense subpicosecond single-cycle terahertz pulse in an electro-optic medium can act as a temporal and spatial lens to phase modulate and focus a co-propagating ultrashort laser pulse.

MC • 0-D and 1-D Quantum Systems—Continued**MC6 • 12:00 p.m.**

Ultrafast Measurement of Mid-Infrared Internal Exciton Transitions of Separated Single-Walled Carbon Nanotubes, *Jigang Wang^{1,2}, Matt. W. Graham³, Yingzhong Ma³, Graham R. Fleming³, Robert. A. Kaindl²; ¹Dept. of Physics and Astronomy, Ames Lab, Iowa State Univ., USA, ²Materials Sciences Div., Lawrence Berkeley Natl. Lab, USA, ³Univ. of California at Berkeley and Physical Biosciences Div., Lawrence Berkeley Natl. Lab, USA*. We report ultrafast mid-infrared studies of individualized semiconducting carbon nanotubes. Transient spectra of (6,5) and (7,5) nanotubes evidence a photoinduced resonance around 200 meV, associated with intra-excitonic transitions that reflect quasi-1-D exciton formation and dynamics.

MC7 • 12:15 p.m.

Two-Dimensional Electronic Spectroscopy of Semiconducting Single-Walled Carbon Nanotubes, *Matthew W. Graham¹, Tessa R. Calhoun¹, Alex A. Green², Mark C. Hersam², Graham R. Fleming¹; ¹Univ. of California at Berkeley, USA, ²Northwestern Univ., USA*. Application of 2-D Fourier transform electronic spectroscopy for semiconducting SWNTs is demonstrated to decongest complex exciton dynamics. Analysis provides the E_{22} homogeneous linewidth, and elucidates the role of vibrational and multi-exciton states in population relaxation.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

NOTES

MD • High Harmonic Generation

Monday, July 19

2:00 p.m.–3:45 p.m.

*Andrius Baltuska; Vienna Univ. of Technology, Austria, Presider***MD1 • 2:00 p.m.****Invited**

High Harmonic Generation by High Energy OPA Source, *E. J. Takahashi, P. Lan, Y. Nabekaw, Katsumi Midorikawa; RIKEN, Japan.* We have demonstrated efficient generation of water-window X-ray harmonics by using an IR parametric source in neutral rare-gas media. Generation of isolated attosecond pulses by mixing IR and 800 nm laser fields is also discussed.

MD2 • 2:30 p.m.

Short Wavelength Generation at High Repetition Rate by Direct High Harmonic Generation, *Steffen Hädrich^{1,2}, Jan Rothhardt^{1,2}, Manuel Krebs¹, Stefan Nolte¹, Jens Limpert^{1,2}, Andreas Tümmermann^{1,2,3}; ¹Friedrich-Schiller-Univ. Jena, Germany, ²Helmholtz-Inst. Jena, Germany, ³Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* Short wavelength generation by direct high harmonic generation of high repetition rate fiber laser based systems is presented. We show possibilities for peak power enhancement, pulse shortening and increased conversion efficiency.

MD3 • 2:45 p.m.

Power Scaling of High-Repetition-Rate HHG, *Arman Cingöz¹, Dylan C. Yost¹, Jun Ye¹, Axel Ruehl², Martin Fermann², Ingmar Hartl²; ¹JILA, NIST, Univ. of Colorado, USA, ²IMRA America, Inc., USA.* We report on cavity-enhanced HHG with a frequency comb delivering 120-fs pulses and 80-W average power at 154-MHz repetition rates. With 5-kW average intracavity powers, average HHG powers beyond the microwatt level have been achieved.

MD4 • 3:00 p.m.

High Power Femtosecond Frequency Comb for Intracavity High Harmonic Generation, *Jane Lee, Justin Paul, R. Jason Jones; Univ. of Arizona, USA.* We report on a high power (~6.5 Watts) Ti:sapphire based frequency comb (50MHz) generating ~25 microjoule pulses inside an enhancement cavity. Intracavity high-harmonic generation produces over 2.5 microwatts integrated power from 73 to 53 nm.

MD5 • 3:15 p.m.

XUV Frequency Comb Spectroscopy, *Christoph Gohle^{1,2}, Dominik Z. Kandula¹, Tjeerd J. Pinkert¹, Wim Ubachs¹, Kjeld S. E. Eikema¹; ¹Laser Ctr. Vrije Univ., Netherlands, ²Ludwig-Maximilians-Univ., Germany.* We report the first demonstration of frequency comb metrology at extreme ultraviolet wavelengths (XUV), based on parametric amplification and high-harmonic generation of frequency comb pulses, which results in an 8-fold improved helium ionization potential.

MD6 • 3:30 p.m.

Temporal Gating Based on Electron Wavepacket Diffusion for XUV Supercontinuum Generation, *Francesca Calegari¹, Caterina Vozzi¹, Matteo Negro¹, Fabio Frassetto², Luca Poletto², Paolo Villoresi², Giuseppe Sansone¹, Mauro Nisoli¹, Sandro De Silvestri¹, Salvatore Stagira¹; ¹Politecnico di Milano CNR-IFN, Italy, ²Univ. di Padova CNR-IFN, Italy.* We demonstrate experimentally and theoretically a gating technique based on the electron wavepacket diffusion for the generation of a broadband XUV continuum exploiting the combination of infrared and visible driving pulses in a two-color scheme.

3:45 p.m.–4:15 p.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

ME1

Spatio-Temporal Characterization of Single-Order High Harmonic Pulses Separated by Pulse-Front-Tilt Compensator, *Motohiko Ito, Yoshimasa Kataoka, Taro Sekikawa*; Dept. of Applied Physics, Hokkaido Univ., Japan. Extreme ultraviolet single-order harmonic pulses, separated by a pulse-front-tilt compensator, were spatially and temporally characterized to have a spot size of 58 μm at focus and a pulse duration of 47 fs.

ME2

Femtosecond Laser-Induced Ionization/Dissociation of Amino Acids and Their Derivatives, *Christine L. Kalcic, Gavin E. Reid, Marcos Dantus*; Michigan State Univ., USA. Ultrafast photodissociation mass spectra are presented for the protonated amino acids and their derivatives. The spectral library is used to better understand the mechanism by which a Ti:Sapphire laser activates trapped ions to induce fragmentation.

ME3

Chirped-Probe-Pulse Femtosecond Coherent Anti-Stokes Raman Scattering for Single-Laser-Pulse Flame Temperature Measurements, *Daniel R. Richardson¹, Robert P. Lucht¹, Waruna D. Kulatilaka², Sukesh Roy², James R. Gord³*; ¹Purdue Univ., USA, ²Spectral Energies, LLC, USA, ³AFRL, Wright Patterson Air Force Base, USA. Single-laser-pulse temperature measurements are made at 1000 Hz by femtosecond coherent anti-Stokes Raman scattering (CARS) with a chirped-probe-pulse. The temporal decay of the Raman coherence is mapped onto the frequency of the CARS signal.

ME4

Coherent Effects in the Carbonyl Containing Carotenoid Fucoxanthin, *Nina Gildenhoff, Kathi Gundermann, Claudia Büchel, Josef L. Wachtzeitl*; Goethe-Univ. Frankfurt, Germany. Coherent effects in the isolated carbonyl containing carotenoid fucoxanthin in various solvents and fucoxanthin within the fucoxanthin-chlorophyll protein were investigated using femtosecond transient absorption spectroscopy.

ME5

Ultrafast Excited-State Dynamics and Photochemistry of Base-off Adenosylcobalamin and n-Propylcobalamin, *Jian Peng, Roseanne J. Senson*; Univ. of Michigan, USA. UV-visible femtosecond transient absorption spectroscopy was used to investigate the photochemistry of base-off cobalamins. The results highlight the influence of the lower axial ligand on the electronic structure and the reactivity of the C-Co bond.

ME6

Femtosecond Photoisomerization Study on Azobenzene-Derivative Bound by DNA, *Tao Chen¹, Kazumasa Igarashi¹, Atsushi Yamaguchi¹, Naoya Nakagawa¹, Keisaku Yamane¹, Taiga Fujii², Hiroyuki Asanuma², Mikio Yamashita¹*; ¹Dept. of Applied Physics, Hokkaido Univ. and CREST-JST, Japan, ²Graduate School of Engineering, Nagoya Univ. and CREST-JST, Japan. First observation of femtosecond absorbance change in azobenzene-derivative (AzD) bound by double-strand DNA, that by single-strand DNA and Azd shows trans-to-cis photoisomerization rate per pulse in the former is much lower than in the latter.

ME7

Relaxation Dynamics of 8'-Apo- β -Caroten-8'-al: Excitation Energy Dependence, *Yoonsoo Pang^{1,2}, Graham R. Fleming^{1,2}*; ¹Univ. of California at Berkeley, USA, ²Lawrence Berkeley Natl. Lab, USA. Infrared and visible transient absorption measurements of the carotenoid 8'-apo- β -caroten-8'-al following the direct S₁ excitation and the hot S₂ excitation show a distinct relaxation dynamics which generates a long-lived species.

ME8

Fulgides: Efficiency of the Ring-Opening Reaction Tuned by Optical Pre-Excitation, *Thomas Brust¹, Simone Draxler¹, Watson J. Lees², Karola Rück-Braun³, Markus Braun^{1,4}, Wolfgang Zinth¹*; ¹Ludwig-Maximilians-Univ. München, Germany, ²Florida Intl. Univ., USA, ³Technische Univ. Berlin, Germany, ⁴Goethe-Univ. Frankfurt, Germany. Multipulse femtosecond absorption experiments show that the quantum efficiency for ring-opening of indolylfulgides is strongly increased when a ring-closure reaction precedes by only a few picoseconds.

ME9

Femtosecond UV Studies of Relaxation Processes in Cytochrome C, *Andrea Cannizzo, Oliver Bräm, Cristina Consani, Frank van Mourik, Majed Chergui*; École Polytechnique Fédérale de Lausanne, Switzerland. UV Femtosecond fluorescence and transient-absorption studies of ferric and ferrous cytochrome-C are presented. We characterize their photocycles which are described in terms of a model based on electron metal-to-heme back-donation from occupied metal *d* orbitals.

ME10

Highly Efficient Energy Transfer in a Dyad with Orthogonally Arranged Transition Dipole Moments: Beyond the Limits of Förster? *Igor Pugliesi¹, Andreas Walter², Heinz Langhals², Eberhard Riedle¹*; ¹LS für BioMolekulare Optik, Ludwig-Maximilians-Univ. München, Germany, ²Dept. für Chemie, Ludwig-Maximilians-Univ. München, Germany. Perylene bisimide dyads mediate an ultrafast energy transfer contradicting the Förster approximation through their transition densities. The high monomeric fluorescence quantum yield leads to near unit efficiency making them suitable candidates for molecular electronic circuitry.

ME11

Unusually Rapid Energy Transfer and Internal Conversion in Xanthorhodopsin and Its Carotenoid Antenna, *Jingyi Zhu¹, Itay Gdor¹, Elena Smolensky², Noga Friedman², Mordechai Sheves², Sandford Ruhman¹*; ¹Hebrew Univ. of Jerusalem, Israel, ²Weizmann Inst. of Science, Israel. Internal conversion and energy transfer from S₂ of the salinixanthine antenna in xanthorhodopsin takes less than 30 fs, leading to lower singlets with rotated transition dipoles. This timescale questions models of resonant electronic energy transfer.

ME12

Uncovering Coherent and Incoherent Vibrational Interactions in a Transition Metal Mixed Valence Complex Using Femtosecond Two-Dimensional Infrared Spectroscopy, *Michael Lynch, Mark Cheng, Benjamin Van Kuiken, Stephanie Daifuku, Munira Khalil*; Univ. of Washington, USA. Femtosecond polarization-selective nonlinear infrared spectroscopies reveal a detailed molecular picture of coherent and incoherent vibrational relaxation dynamics of a cyano-bridged mixed valence complex in a polar solvent.

ME13

Monitoring the External Vibrational Control of Excitation-Energy Transfer Using Pump-Probe Polarization Spectroscopy, *Jason D. Biggs, Jeffrey A. Cina; Univ. of Oregon, USA.* We have developed a method for controlling electronic-excitation transfer in chromophore dimers using pulse-induced nuclear motion. We further developed the framework needed to simulate various nonlinear optical experiments on such systems.

ME14

Excitation Energy Dependence of the S1 and ICT State Dynamics in Marine Carotenoids Studied by Femtosecond One- and Two-Photon Pump-Probe Spectroscopy, *Daisuke Kosumi¹, Satoshi Maruta¹, Toshiyuki Kusumoto¹, Ritsuko Fujii¹, Mitsuru Sugisaki¹, Masahiko Iha², Harry A. Frank³, Hideki Hashimoto¹; ¹JST, CREST, Osaka City Univ., Japan, ²South Product Co. Ltd., Japan, ³Univ. of Connecticut, USA.* The ultrafast excited state dynamics of fucoxanthin in a polar solvent have been investigated by femtosecond one- and two-photon pump-probe spectroscopic measurements. Transient absorption spectra and their kinetics depend strongly on excitation energy.

ME15

Sensitizer Exchange Dynamics in Air and Solvent Filled Semiconductor Nanocavities, *Jouko E. I. Korppi-Tommola¹, Jan Helbing², Niko Humalampi¹, Matti Haukka³, Esben Andresen⁴, Peter Hamm²; ¹Univ. of Jyväskylä, Finland, ²Univ. Zürich, Switzerland, ³Univ. of Joensuu, Finland, ⁴Univ. Aix Marseille, France.* Multiple dye binding sites and their exchange in equilibrium in air and solvent filled sensitized titanium oxide nanocavities were identified by 2DIR spectroscopy. Binding geometry and flexibility may influence electron injection efficiency of solar cells.

ME16

Ultrafast Polarized Raman as a Probe of Solvation Shell Structure and Dynamics in Aqueous Salt Solutions, *Ismael A. Heisler, Stephen R. Meech; Univ. of East Anglia, UK.* An ultrafast diffractive optic transient grating experiment was used to record isotropic THz Raman spectra of aqueous ions. A low frequency mode, absent in pure water, associated with halide - water H-bond modes is reported.

ME17

Conserving Optical Coherence through the Conical Intersection during Retinal Isomerization in Bacteriorhodopsin, *Valentin L. Prokhorenko¹, Alexei Halpin¹, Leonid S. Brown², R. J. Dwayne Miller¹; ¹Univ. of Toronto, Canada, ²Univ. of Guelph, Canada.* Two-dimensional electronic spectroscopy of retinal isomerization in bacteriorhodopsin allows tracking the dynamics of the reaction coordinate. Optically induced coherence still persists even after 5 ps, where no excited-state population of the initial isomer is present.

ME18

Selective Excitation of Resonances in 2-D Fourier Transform Optical Spectroscopy with Tailored Pulse Shapes, *Patrick Wen, Dylan H. Arias, Daniel B. Turner, Keith A. Nelson; MIT, USA.* Shaped pulses, with phase windows and double amplitudes, are tailored for specific resonances in 2-D Fourier transform optical spectroscopy. Pulses, designed using Feynman pathway analysis, selectively enhance biexciton peaks in 2-D spectra of quantum wells.

ME19

Ultrafast Dynamics of Phosphate-Water Interactions in Hydrated DNA, *Lukasz Szyc, Ming Yang, Thomas Elsaesser; Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany.* Interactions between DNA and the surrounding water shell are mapped via the ultrafast response of the asymmetric phosphate stretching vibration $\nu_{AS}(\text{PO}_2)$. The water shell serves as the primary heat sink for excess energy.

ME20

Semiconductor Saturable Absorbers for Ultrafast THz Signals, *Matthias C. Hoffmann¹, Dmitry Turchinovich²; ¹Max-Planck Res. Dept. for Structural Dynamics, Univ. of Hamburg, Germany, ²DTU Fotonik, Dept. of Photonics Engineering, Technical Univ. of Denmark, Denmark.* We demonstrate saturable absorber behavior of n-type semiconductors in the THz frequency range using nonlinear THz spectroscopy. Further, we observe THz pulse shortening and increase of the group refractive index at high field strengths.

ME21

Conductivity in Dye-Sensitized TiO₂ Probed by Optical-Pump THz-Probe Spectroscopy, *Jan C. Brauer, Joël Teuscher, Angela Punzi, Jacques-Edouard Moser; École Polytechnique Fédérale de Lausanne, Switzerland.* Employing optical-pump THz-probe spectroscopy we have investigated the photo-induced conductivity dynamics in dye-sensitized mesoporous anatase films as well as the influence of dye aggregates on the injection dynamics.

ME22

Compact and Widely Tunable Sub-50 fs Laser Source with 30 mW to 300 mW Output Power at 44 MHz Repetition Rate for Nonlinear Spectroscopy Applications, *Bernnd Metzger, Andy Steinmann, Felix Hoos, Sebastian Pricking, Harald Giessen; 4th Physics Inst., Univ. of Stuttgart, Germany.* We pump tapered fibers with a novel Yb:KGW oscillator and compress different spectral parts of the supercontinuum using a simple prism sequence to generate tunable sub-50 fs pulses in the visible and near IR.

ME23

Non-Collinear Optical Parametric Amplification of near-IR Pulses in KTiOPO₄ at a High Repetition Rate, *Oleksandr Isaienko^{1,2}, Eric Borguet¹, Peter Voehringer²; ¹Temple Univ., USA, ²Inst. for Physical and Theoretical Chemistry, Univ. of Bonn, Germany.* We demonstrate broadband non-collinear optical parametric amplification of near-IR pulses in bulk KTiOPO₄ pumped with 800-nm pulses at 250-kHz repetition rate. Conversion efficiencies of ~20% are achieved when employing two subsequent NOPA stages.

ME24

Synthesis of Subfemtosecond Periodic Waveforms, *Han-Sung Chan^{1,2}, Zhi-Ming Hsieh³, Wei-Hong Liang^{1,2}, A. H. Kung^{2,4}, Chao-Kuei Lee⁵, Ru-Pin Pan¹, Lung-Han Peng³; ¹Natl. Chiao Tung Univ., Taiwan, ²Academia Sinica, Taiwan, ³Natl. Taiwan Univ., Taiwan, ⁴Natl. Tsing Hua Univ., Taiwan, ⁵Natl. Sun Yat-Sen Univ., Taiwan.* Periodic optical waveforms of arbitrary shape in the femtosecond and subfemtosecond time scale are synthesized from a comb generated by molecular modulation.

ME25

Continuum Generation in Laser Host Materials towards Table-Top OPCPA, *Maximilian Bradler, Peter Baum, Eberhard Riedle; LS für BioMolekulare Optik, Ludwig-Maximilians-Univ. München, Germany.* We demonstrate white-light generation in seven previously unutilized laser host materials with up to ps pump pulses. Only μJ pulses are necessary for stable continua with smooth, plateau-like spectra from deep UV to the infrared.

ME26

Characterization of Isolated Attosecond Pulses with Ultrabroad Bandwidth, *Sabih D. Khan, Michael Chini, Steve Gilbertson, Zenghu Chang; Dept. of Physics, Kansas State Univ., USA.* We report a new technique for attosecond pulse characterization based on interference of quantum transitions induced by single infrared photons.

ME27

Generation and Amplification of 400 nm Band Picosecond Optical Pulses by GaInN Laser Diodes, *Rintaro Koda¹, Tomoyuki Oki^{1,2}, Takao Miyajima¹, Hideki Watanabe¹, Masaru Kuramoto^{1,2}, Masao Ikeda^{1,2}, Hiroyuki Yokoyama²;* ¹Advanced Materials Labs, Sony Corp., Japan, ²New Industry Creation Hatchery Ctr., Tohoku Univ., Japan. We demonstrate the generation of 20W peak power, 3ps optical pulses using a combination of a GaInN-based, mode-locked laser diode and an optical amplifier. A strong nonlinear phase shift over 4π has also been observed.

ME28

Linear Characterization of Attosecond Pulses, *Oren Raz, Osip Schwartz, Dan Oron, Nirit Dudovich; Weizmann Inst. of Science, Israel.* We propose a linear method for characterizing attosecond pulses. The method is based on the polarization state of each spectral component, and some a-priori knowledge about the measured pulse: Gaussian (or faster) decay in time.

ME29

Harmonic Continua by Chirp Assisted Polarization Gating, *Mirko Holler, Florian Schapper, Thomas Remetter, Lukas Gallmann, Ursula Keller; ETH Zürich, Switzerland.* We demonstrate a new scheme to generate harmonic continua starting with 12 fs laser pulses based on polarization gating. The effectiveness of the gating method is confirmed by an SFA calculation.

ME30

Strategies for Scatter Removal in Two-Dimensional Electronic Spectroscopy in the Pump-Probe Geometry, *Kristin L. M. Lewis, Jeffrey A. Myers, Franklin Fuller, Patrick F. Tekavec, Jennifer P. Ogilvie; Univ. of Michigan, USA.* We present experimental strategies for removing scatter from multiple sources in two dimensional electronic spectroscopy in the pump-probe geometry. Uncorrected, pump-pump scatter and phase-matched pump-probe signals can distort 2-D peak shapes, complicating their interpretation.

ME31

Optically-Pumped SESAM for Fast Switching between Continuous Wave and Passively Mode Locked Regimes of a Femtosecond Pulse Cr⁴⁺:forsterite Laser, *Christopher G. Leburn, Christian T. A. Brown, Wilson Sibbett; Univ. of St Andrews, UK.* We report on fast switching between continuous-wave mode-locked and continuous-wave operation of a Cr⁴⁺:forsterite femtosecond laser operating at 1300 nm, by means of a GaInNAs SESAM that is optically excited by an external diode laser.

ME32

Full Control of Polarization Shaped Pulses Using a Phase-Locked Mach-Zehnder Interferometer, *Masaaki Sato, Takayuki Suzuki, Kazuhiko Misawa; Tokyo Univ. of Agriculture and Technology, Japan.* We achieved reliable and stable generation of pulses with all possible polarization states by a Mach-Zehnder pulse shaper stabilized using an external laser diode. We generated and measured chiral pulses with twisted polarizing orientation.

ME33

Carrier-Envelope Phase Stabilized Soliton-Effect Compressed Sub-Two-Cycle Pulse Source, *Alexandra A. Amorim^{1,2}, Luis M. Bernardo¹, Franz X. Kärtner³, Helder Crespo¹;* ¹IFIMUP and IN - Inst. of Nanoscience and Nanotechnology, Dept. de Física, Faculdade de Ciências, Univ. do Porto, Portugal, ²Dept. de Física, Inst. Superior de Engenharia do Porto, Portugal, ³Dept. of Electrical Engineering and Computer Science and Res. Lab of Electronics, MIT, USA. We present a simple and efficient scheme for generating carrier-envelope phase stabilized sub-two-cycle pulses based on soliton-effect self-compression of standard femtosecond laser pulses in millimeter-long highly-nonlinear photonic crystal fibers.

ME34

Strong HOMO Signature in High Order Harmonics Driven in CO₂ by a Few-Cycle 1.5 μm Parametric Source, *Caterina Vozzi¹, Matteo Negro¹, Francesca Calegari¹, Fabio Frassetto², Mauro Nisoli¹, Luca Poletto², Giuseppe Sansone¹, Paolo Villoresi², Sandro De Silvestri¹, Salvatore Stagira¹;* ¹Politecnico di Milano, Italy, ²Univ. di Padova, Italy. High order harmonics driven by an ultrafast IR parametric source were generated in aligned CO₂; the experimental results present a clear spectral minimum related to the HOMO structure.

ME35

Below-Threshold High-Order Harmonics Probed with Aligned Molecules, *Hadas Soifer¹, Pierre Botheron², Dror Shafir¹, Adi Diner¹, Oren Raz², Barry Bruner¹, Yann Mairesse², Bernard Pons², Nirit Dudovich¹;* ¹Weizmann Inst. of Science, Israel, ²Univ. de Bordeaux 1-CNRS-CEA, France. We present a new approach to probe the High-Harmonic Generation process. We use aligned molecules to study below-threshold harmonics and identify two distinct contributions to the emitted harmonics.

ME36

Electron Release Times in Double Ionization by Elliptically Polarized Laser Pulses, *Adrian N. Pfeiffer¹, Claudio Cirelli¹, Mathias Smolarski¹, Ursula Keller¹, Reinhard Dörner²;* ¹ETH Zürich, Switzerland, ²Inst. für Kernphysik, Johann Wolfgang Goethe Univ., Germany. We explore the possibility to measure the electron release times in double ionization by elliptically polarized laser pulses and provide experimental results for a 30-fs and a 5-fs laser pulse.

ME37

Direct Frequency Comb Spectroscopy in a Linear Paul Trap, *Anne Lisa Wolf^{1,2}, Jonas Morgenweg¹, Steven van den Berg², Wim Ubachs¹, Kjeld S. E. Eikema¹;* ¹Vrije Univ., Netherlands, ²Van Swinderen Lab, Netherlands. Direct frequency comb spectroscopy is demonstrated for ions in a Paul trap for the first time. We measured a single-photon transition at 394 nm in a crystal of calcium ions with 0.5 MHz accuracy.

ME38

Observation of High Energy Protons Ejected from Small Polyatomic Molecules in Laser Induced Fragmentation, *Stefan Roither¹, Xinhua Xie¹, Daniil Kartashov¹, Li Zhang¹, Huailiang Xu², Atshushi Iwasaki², Markus Schöffler³, Georg Reider¹, Reinhard Dörner³, Kaoru Yamanouchi², Andrius Baltuška¹, Markus Kitzler¹*; ¹Photonics Inst., Vienna Univ. of Technology, Austria, ²Dept. of Chemistry, School of Science, Univ. of Tokyo, Japan, ³Inst. für Kernphysik, J. W. Goethe Univ. Frankfurt, Germany. Remarkably high energies of protons ejected from three different species of small polyatomic molecules during laser-induced fragmentation are observed using coincidence momentum spectroscopy. The results imply that the responsible field-driven dynamics are a general phenomenon.

ME39

Quantized Extrinsic Piezoelectricity in Quantum Dots Revealed by Coherent Acoustic Phonons, *Pooja Tyagi, Ryan Cooney, Samuel Sewall, D. M. Sagar, Jonathan Saari, Patanjali Kambhampati*; McGill Univ., Canada. Employing real time observation of coherent acoustic phonons, we demonstrate a novel extrinsic piezoelectric response of quantum dots, that is quantized, tunable and an order of magnitude larger than their intrinsic piezo response.

ME40

Nanocalization of Ultrashort Time-Reversed Pulses in Random Nanoparticle Assemblies, *Dominik Differt¹, F. Javier García de Abajo², Walter Pfeiffer¹, Christian Strüber¹, Dmitri V. Voronine¹*; ¹Univ. of Bielefeld, Germany, ²Inst. de Optica, Spain. Localization of time-reversed optical fields in random nano-assemblies is investigated. It is shown that a structural hierarchy of the scatterers (i.e., the presence of a far-field reverberation chamber) improves the nanocalization of time-reversed waves.

ME41

Transient Reversal of a Peierls-Transition: Extreme Phonon Softening in Laser-Excited Bismuth, *Wei Lu¹, Matthieu Nicol^{1,2}, Uladzimir Shymanovich¹, Alexander Tarasevitch¹, Martin Kammler¹, Michael Horn von Hoegen¹, Dietrich von der Linde¹, Klaus Sokolowski-Tinten¹*; ¹Univ. Duisburg-Essen, Germany, ²Univ. Köln, Germany. Laser-excited coherent optical phonons in Bismuth were investigated using time-resolved X-ray diffraction. The observed extreme softening of the excited A_{1g} -mode presents strong indication that the Peierls-

distortion defining the equilibrium structure of Bismuth is transiently reversed.

ME42

Noncollinear Broadband Terahertz-Pump—Terahertz-Probe Spectroscopy of Semiconductors, *Matthias C. Hoffmann, Vikaran Khanna, Andrea Cavalleri*; Max-Planck Res. Dept. for Structural Dynamics, Univ. of Hamburg, Germany. Saturated absorption and intervalley scattering in n-type semiconductors were observed using noncollinear THz-pump—THz probe spectroscopy with ultrabroadband probe pulses.

ME43

Electron-Phonon Coupling in Cuprate High-Temperature Superconductors Determined from Femtosecond Electron Relaxation Rates, *Christoph Gadermaier¹, Alexander S. Alexandrov^{2,3}, Viktor V. Kabanov¹, Primoz Kusar¹, Tomaz Mertelj¹, Xin Yao⁴, Cristian Manzoni⁵, Daniele Brida⁶, Giulio Cerullo⁵, Dragan Mihailovic¹*; ¹Complex Matter Dept., Jozef Stefan Inst., Slovenia, ²Dept. of Physics, Loughborough Univ., UK, ³Jozef Stefan Inst., Slovenia, ⁴Dept. of Physics, Shanghai Jiao Tong Univ., China, ⁵Natl. Lab for Ultrafast and Ultraintense Optical Science, INFN-CNR, Dept. di Fisica, Politecnico di Milano, Italy. The strong electron-phonon interaction in cuprate superconductors determined from femtosecond electron relaxation times suggest a fundamental importance of phonons and in particular polaronic effects in the high-temperature superconductivity mechanism.

ME44

3-D Magnetization and Anisotropy Dynamics in Thin Iron Films Studied with Time-Resolved Magneto-Optical Kerr Effect, *Ettore Carpane¹, Eduardo Mancini¹, Claudia Dallera¹, Ezio Puppin², Sandro De Silvestri¹*; ¹INFN-CNR, Dept. di Fisica, Politecnico di Milano, Italy, ²CNISM, Dept. di Fisica, Politecnico di Milano, Italy. We investigated the three-dimensional dynamics of the magnetization vector launched by a short laser pulse in thin Fe films. Our experiment provides the direct evidence of the phenomenological mechanism triggering the magnetization precession.

ME45

Withdrawn

ME46

Coherent Polarons in Ferromagnetic $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$, *Michael Först¹, Cristian Manzoni¹, Stefan Kaiser¹, Yasuhide Tomioka², Yoshinori Tokura³, Andrea Cavalleri¹*; ¹Max-Planck Res. Group for Structural Dynamics, Univ. of Hamburg, Germany, ²Correlated Electron Engineering Group, AIST, Japan, ³Dept. of Applied Physics, Univ. of Tokyo, Japan. Polarons, mixed modes of solids comprising electronic and lattice excitations, underpin the electronic properties of strongly-correlated oxides. We demonstrate their coherent formation in ferromagnetic $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$, enabled via direct lattice excitation in the mid-infrared.

ME47

Nonlinear Josephson Effect in High-T_c Cuprates, *A. Dienst¹, M. C. Hoffmann², D. Fausti², S. Pyon³, T. Takayama³, H. Takagi^{3,4}, A. Cavalleri^{1,2}*; ¹Univ. of Oxford, UK, ²Max-Planck Dept. for Structural Dynamics, Univ. of Hamburg, Germany, ³Univ. of Tokyo, Japan, ⁴RIKEN Advanced Science Inst., Japan. The high-temperature superconductor $\text{La}_{1.84}\text{Sr}_{0.16}\text{CuO}_4$ is excited with high intensity terahertz pulses tuned to the 1.9-terahertz Josephson Plasma Resonance. The strong interlayer tunneling current modulates the microscopic properties of the superconductor.

ME48

Ultrafast Resonant Soft X-Ray Scattering in Manganites: Direct Measurement of Time-Dependent Orbital Order, *Henri Ehrke^{1,2,3}, Raanan I. Tobey^{1,2}, Simon Wall^{1,2}, Stuart A. Cavill³, D. Prabhakaran¹, Andrew T. Boothroyd¹, Michael Gensch⁴, P. Reutter⁵, Alexandre Revcolevschi⁵, Sarnjeet S. Dhesi³, Andrea Cavalleri^{1,2}*; ¹Univ. of Oxford, UK, ²Max-Planck Dept. for Structural Dynamics, Univ. of Hamburg, Germany, ³Diamond Light Source, UK, ⁴Helmholtz Zentrum Berlin, Germany, ⁵Lab de Physico-Chimie de l'Etat Solide, Univ. Paris Sud, France. We present ultrafast resonant soft-X-ray diffraction measurements of time-dependent orbital order in the single-layer-manganite $\text{La}_{0.5}\text{Sr}_{1.5}\text{MnO}_4$. These experiments reveal the appearance of a metastable phase with reduced ordering, different from any thermal state of the system.

ME49

Configuration Extraction of Coulomb-Induced Nonlinearities in Semiconductor Quantum Wells, *Ryan P. Smith¹, Andrew C. Funk¹, Jared K. Wahlstrand¹, Steven T. Cundiff¹, Johannes T. Steiner², Martin Schafer², Mackillo Kira², Stephan W. Koch²*; ¹JILA, NIST, Univ. of Colorado, USA, ²Dept. of Physics and Material Sciences Ctr., Philipps-Univ., Germany. We report quantitative spectrally-resolved transient absorption in GaAs quantum wells. Microscopic modeling extracts many-body configurations and attributes effects to observed spectra. Our techniques allow investigation of the effects of light statistics on many-body interactions.

ME50

Femtosecond Study of Photodoping Phenomena in a Parent Compound of a High-Temperature Superconductor, *Markus Beyer¹, Kyungwan Kim¹, Viktor Kabanov^{2,3}, Hanjo Schäfer¹, Gennady Logvenov⁴, Ivan Bozovic⁴, Jure Demsar^{1,2,3}*; ¹Physics Dept. and Ctr. of Applied Photonics, Univ. Konstanz, Germany, ²Zukunftskolleg, Univ. Konstanz, Germany, ³Complex Matter Dept., Jozef Stefan Inst., Slovenia, ⁴Brookhaven Natl. Lab, Condensed Matter and Materials Science, USA. We present the first spectrally-resolved study of the femtosecond dynamics in La₂CuO₄, the undoped parent-compound of the high-temperature superconductor. The data reveal strong band-gap renormalization and the appearance of in-gap states attributed to photo-doping.

ME51

Coherent Control of the Selected Excited State by Two-Color Multipulse Excitation, *Kenta Abe¹, Ryosuke Nakamura^{1,2}, Hideki Hashimoto^{2,3}, Masayuki Yoshizawa^{1,2}*; ¹Tohoku Univ., Japan, ²JST, CREST, Japan, ³Osaka City Univ., Japan. The selected excited state is controlled by combination of the first pump pulse generating the target state and the second shaped pump pulse. Coherent vibrations can be induced even in the optically forbidden state.

ME52

Strongly Coupled Vibronic Modes Investigated by Means of Four-Wave Mixing Spectroscopy, *Mitsuru Sugisaki¹, Daisuke Kosumi¹, Keisuke Saito¹, Ritsuko Fujii¹, Richard J. Cogdell², Hideki Hashimoto¹*; ¹Osaka City Univ., Japan, ²Univ. of Glasgow, UK. Vibronic coherent oscillations of carotenoids have been investigated under various excitation conditions. It was found that coupled modes can be excited in the stimulated photon-echo configuration. A model that explains the results is discussed.

NOTES

MF • Water

Monday, July 19

4:45 p.m.–6:45 p.m.

R. J. Dwayne Miller; Univ. of Toronto, Canada, *Presider*

MF1 • 4:45 p.m.

Three-Dimensional Infrared Spectroscopy (3-D-IR) of Isotopically Substituted Liquid Water, *Sean Garrett-Roe¹, Fivos Perakis¹, Francesco Rao², Peter Hamm¹*; ¹Inst. of Physical Chemistry, Univ. of Zürich, Switzerland, ²Lab de Chimie Biophysique/ISIS, Univ. de Strasbourg, France. Three-dimensional infrared spectroscopy (3-D-IR) of isotopically substituted liquid water reveals heterogeneous dynamics on the 500-700 fs timescale. We attribute this behavior to local differences in the timescale of hydrogen-bond network rearrangements.

MF2 • 5:00 p.m.

Oriental Dynamics of Water Probed with 2-D-IR Anisotropy Measurements, *Krupa Ramasesha, Rebecca A. Nicodemus, Aritra Mandal, Andrei Tokmakoff*; MIT, USA. We use polarization-selective ultrafast 2-D IR infrared spectroscopy to probe joint orientational and spectral dynamics of HOD in D₂O. Our experiments show rapid reorientation concurrent with return of strained hydrogen bonds to a stable configuration.

MF3 • 5:15 p.m.

Water Dynamics near Hydrophobes: An Ultrafast Infrared Spectroscopy Study, *Artem A. Bakulin¹, Christian Petersen², Huib J. Bakker², Maxim S. Pshenichnikov¹*; ¹Univ. of Groningen, Netherlands, ²FOM-Inst. for Atomic and Molecular Physics, Netherlands. With 2-D IR and polarization-resolved pump-probe spectroscopy we observe a strong slowing-down of the hydrogen-bond and orientational dynamics of water near hydrophobic groups that scales with solute concentration and the size of the hydrophobic group.

MF4 • 5:30 p.m.

Ultrafast Conversions of Hydrogen-Bonded Structures in Liquid Water Observed via Femtosecond Soft X-Ray Spectroscopy, *Nils Huse¹, Haidan Wen², Hana Cho^{1,3}, Tae Kyu Kim³, Robert W. Schoenlein¹, Aaron M. Lindenberg^{2,4}*; ¹Lawrence Berkeley Natl. Lab, USA, ²SLAC Natl. Accelerator Lab, USA, ³Pusan Natl. Univ., Republic of Korea, ⁴Stanford Univ., USA. X-ray spectroscopic studies relate distinct spectral features to water molecules in loose and tight H-bond environments. Femtosecond X-ray measurements show that vibrational excitation/relaxation increases weakly H-bonded water at the direct expense of tightly H-bonded water.

MF5 • 5:45 p.m.

Hydrogen Bonds in Aqueous Hydrates: Experiment and Theory, *Jasper C. Werhahn¹, Stanislav Pandalov¹, George S. Fanourgakis², Hristo Iglev¹, Sotiris S. Xantheas²*; ¹Technical Univ. of Munich, Germany, ²Pacific Northwest Natl. Lab, USA. Systematic infrared pump-probe measurements on aqueous salt hydrates are combined with theoretical calculations of their structural and energetical parameters. We establish unambiguous correlations of the spectral and geometrical parameters of the aqueous hydrogen bond.

MG • Strongly Correlated Materials

Monday, July 19

4:45 p.m.–6:45 p.m.

Robert Schoenlein; Lawrence Berkeley Natl. Lab, USA, *Presider*

MG1 • 4:45 p.m.

Invited

Ultrafast Magnetism: Coherent Processes and Angular Momentum Transfer, *Jean-Yves Bigot, Christine Boeglin, Mircea Vomir, Valérie Halté, Eric Beaupaire*; CNRS, Univ. of Strasbourg, France. Understanding the induced demagnetization of magnetic metals interacting with femtosecond laser pulses necessitates taking into consideration the spin-orbit coupling. Here we explore the dynamics of this fundamental interaction in the presence of the laser field.

MG2 • 5:15 p.m.

CDW-Superlattice Suppression Probed in Time-Resolved XUV Photoemission at the Border of the Brillouin Zone, *Timm Rohwer, Stefan Hellmann, Martin Wiesenmayer, Christian Sohr, Ankatrin Stange, Bartosz Slomski, Lutz Kipp, Kai Rosnagel, Michael Bauer*; Christian-Albrechts Univ. zu Kiel, Germany. Time- and angle-resolved XUV-photoemission at the border of the first Brillouin zone is employed to monitor the ultrafast suppression of a (2x2x2) reconstruction characteristic for the charge density wave (CDW) phase in 1T-TiSe₂.

MG3 • 5:30 p.m.

Laser Induced CDW Melting in TiSe₂ Optical and X-Ray Time Resolved Study, *Ekaterina Vorobeva¹, Steven L. Johnson¹, Paul Beaud¹, Urs Staub¹, Raquel R. A. De Souza¹, Chris J. Milne^{1,2}, Gerhard Ingold¹, A. N. Titov^{3,4}*; ¹Paul Scherrer Inst., Switzerland, ²École Polytechnique Fédérale de Lausanne, Switzerland, ³Inst. of Metal Physics, Russian Acad. of Sciences, Russian Federation, ⁴Inst. of Metallurgy, Russian Acad. of Sciences, Russian Federation. Femtosecond laser and X-ray pump/probe measurements indicate an ultrafast laser induced structural phase transition in 1T-TiSe₂, mediated by an A_{1g} amplitude mode of a CDW.

MG4 • 5:45 p.m.

Photo-Induced Superconductivity in Charge Ordered LESCO (La_{1.8-x}Er_{0.2}Sr_xCuO₄, X=0.125), *Daniele Fausti^{1,2}, Raan Tobey³, Nicky Dean³, S. Pyon⁴, T. Takayama⁴, Hidenori Takagi⁴, Andrea Cavalleri^{1,3}*; ¹Max-Planck Group for Structural Dynamics, Univ. of Hamburg, Germany, ²Dept. of Physics, Clarendon Lab, Univ. of Oxford, UK, ³Dept. of Physics, Univ. of Oxford, UK, ⁴Dept. of Advanced Materials, Univ. of Tokyo, Japan. Photo-excitation of Cu-O vibrations with 17 μm wavelength pulses La_{1.8-x}Er_{0.2}Sr_xCuO₄ results in a quantum coherent state, revealed by the presence of a Josephson Plasma Resonance characteristic of layered superconductors.

MF • Water—Continued

MF6 • 6:00 p.m.

Template-Substrate Dynamics Studied by 2-DIR: A Random Merry-Go-Round of Water on a Crown, *Martin Olschewski, Stephan Knop, Jaane Seehusen, Jörg Lindner, Peter Vöhringer*; *Rheinische Friedrich-Wilhelms-Univ. Bonn, Germany*. Femtosecond two-dimensional infrared spectroscopy in the OH-stretching spectral region was used to unravel the ultrafast hydrogen-bond recognition dynamics within the prototypical supramolecular template-substrate complex of a water molecule and a crown ether.

MF7 • 6:15 p.m.

Mechanism for Indirect Photo-Ionization of Water Studied by Pump-Repump-Probe Spectroscopy, *Hristo Iglev, Martin K. Fischer, Alfred Laubereau*; *Technische Univ. München, Germany*. Three-pulse spectroscopy of water after excitation at 9.2 eV provides clear evidence for novel fast recombination channel. Comparison with similar data measured after photodetachment of aqueous hydroxide elucidates the mechanism of indirect photo-ionization of water.

MF8 • 6:30 p.m.

Ultrafast Vibrational Dynamics of Hydrated DNA Studied by Two-Dimensional Infrared Spectroscopy, *Ming Yang, Lukasz Szyt, Thomas Elsaesser*; *Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany*. 2-D infrared spectroscopy separates interacting NH stretching modes of DNA from OH stretching excitations of its water shell. DNA-water interactions slow down the structural dynamics of the hydration shell compared to bulk water.

MG • Strongly Correlated Materials—Continued

MG5 • 6:00 p.m.

Ultrafast Phonon and Quasiparticle Dynamics in Superconducting $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ Studied by Multi-THz Spectroscopy, *Michael Porer¹, Alexej Pashkin¹, Markus Beyer¹, Kyung Wan Kim^{1,2}, Christian Bernhard², Xin Yao³, Yoram Dagan⁴, Rudi Hackl⁵, Andreas Erb⁵, Jure Demsar^{1,6}, Alfred Leitenstorfer¹, Rupert Huber¹*; ¹*Dept. of Physics and Ctr. for Applied Photonics, Univ. of Konstanz, Germany*, ²*Dept. of Physics, Univ. of Fribourg, Switzerland*, ³*Dept. of Physics, Jiao Tong Univ., China*, ⁴*School of Physics and Astronomy, Tel Aviv Univ., Israel*, ⁵*Walther-Meißner-Inst., Germany*, ⁶*Complex Matter Dept., Josef Stefan Inst., Slovenia*. We probe the mid-infrared dielectric response of optimally doped $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ after 12-fs optical excitation to simultaneously trace quasiparticles and specific lattice modes. Our results identify an extremely non-thermal regime and highly selective electron-phonon coupling.

MG6 • 6:15 p.m.

Ultrafast Polaron Dynamics in Multiferroic LuFe_2O_4 , *J. Lee¹, D. Talbayev¹, C. L. Zhang², X. S. Xu³, S.-W. Cheong², A. J. Taylor¹, R. P. Prasankumar¹*; ¹*Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA*, ²*Dept. of Physics and Astronomy, Rutgers Univ., USA*, ³*Dept. of Chemistry, Univ. of Tennessee, USA*. Temperature-dependent femtosecond optical spectroscopy is used to track polaron dynamics in the spin and charge frustrated system LuFe_2O_4 , revealing the influence of charge and spin ordering on polaron excitation, redressing, and coupling to on-site excitations.

MG7 • 6:30 p.m.

Photoinduced Dynamics of a Quasi-1-D Organic Conductor over a Range from 10 fs to 100 ps, *Ken Onda¹, Sho Ogihara¹, Jiro Itatani², Tadahiko Ishikawa¹, Yoichi Okimoto¹, Shinya Koshihara¹, Xiangfeng Shao^{3,4}, Yoshiaki Nakano³, Hideki Yamochi³, Gunizi Saito⁵*; ¹*Tokyo Inst. of Technology, Japan*, ²*Univ. of Tokyo, Japan*, ³*Kyoto Univ., Japan*, ⁴*Lanzhou Univ., China*, ⁵*Meijo Univ., Japan*. We studied ultrafast photoinduced phase transition in the organic conductor $(\text{EDO-TTF})_2\text{PF}_6$ using a 10-fs broadband pulse and a picosecond narrowband pulse, and revealed the roles of coherent molecular vibrations and the charge melting process.

6:30 p.m.–7:30 p.m. ME • Poster Session I—Continued, Rooftop Garden

Tuesday, July 20, 7:30 a.m.–5:30 p.m. Registration Open, Lobby

TuA • Attosecond Pulse Generation

Tuesday, July 20

8:30 a.m.–10:15 a.m.

Katsumi Midorikawa; RIKEN, Japan, Presider

TuA1 • 8:30 a.m.

Invited

High-Energy Isolated Attosecond Pulses, Matteo Lucchini, Federico Ferrari, Francesca Calegari, Caterina Vozzi, Salvatore Stagira, Giuseppe Sansone, Mauro Nisoli, Politecnico di Milano, Italy. We demonstrate the generation of isolated sub-160-attosecond pulses with *on-target* pulse-energy of a few nanojoules, thus showing a pulse-energy enhancement from one to three orders of magnitude compared with the generating methods demonstrated so far.

TuA2 • 9:00 a.m.

Generation and Optimization of Isolated Attosecond Pulses, Phillip M. Nagel^{1,2}, Thomas Pfeifer³, Mark J. Abel^{1,2}, Marie J. Bell^{1,2}, Hiroki Mashiko^{1,2}, Annelise R. Beck^{1,2}, Colby P. Steiner^{1,2}, Joseph S. Robinson², Daniel M. Neumark^{1,2}, Stephen R. Leone^{1,2}; ¹Univ. of California at Berkeley, USA, ²Lawrence Berkeley Natl. Lab, USA, ³Max-Planck-Inst. for Nuclear Physics, Germany. Two techniques for generation and optimization of isolated attosecond pulses are demonstrated experimentally. Ionization gating is used to relax pulse duration and carrier-envelope phase (CEP) requirements, while CEP-scanning enables easy optimization of attosecond pulse contrast.

TuA3 • 9:15 a.m.

Bright, Coherent, Attosecond Soft X-Ray Harmonics Spanning the Water Window from a Tabletop Source, Ming-Chang Chen, Paul Arpin, Tenio Popmintchev, Michael Gerrity, Matt Seaberg, Bosheng Zhang, Dimitar Popmintchev, Alon Bahabad, Margaret Murnane, Henry Kapteyn; JILA, Univ. of Colorado at Boulder, USA. We generate fully spatially coherent, ultrafast soft X-ray beams in the water window region of the spectrum using phase matched high harmonic upconversion of a 2 μm driving laser.

TuA4 • 9:30 a.m.

Interplay between Gdd-Induced Polarization Gating and Ionization for Isolated Attosecond Pulse Generation from Multi-Cycle Driving Pulses, Carlo Altucci¹, Raffaele Velotta¹, Valer Tosa², Fabio Frassetto³, Luca Poletto³, Paolo Villoresi³, Caterina Vozzi⁴, Matteo Negro⁴, Francesca Calegari⁴, Sandro De Silvestri⁴, Salvatore Stagira⁴; ¹Univ. di Napoli Federico II, Italy, ²Natl. Inst. for R&D Isotopic and Molecular Technologies, Romania, ³Univ. di Padova, Italy, ⁴Politecnico di Milano, Italy. A new scheme is employed to generate single-shot XUV continua by 15-fs 800-nm pulses. Continua are due to the formation of a single attosecond pulse and attributed to the interplay between polarization and ionization gating.

TuA5 • 9:45 a.m.

Laser Driven Parametric Amplification of XUV and Soft-X-Rays in Neutral Gases, Jozsef Seres¹, Enikoe Seres¹, Daniel Hochhaus^{2,3,4}, Boris Ecker^{2,5,6}, Daniel Zimmer^{2,6}, Vincent Bagnoud², B. Aurand^{3,5,6}, B. Zielbauer^{2,5,6}, Thomas Kuehl^{2,5}, Christian Spielmann¹; ¹Friedrich-Schiller-Univ. Jena, Germany, ²GSI Helmholtz Ctr. for Heavy Ion Res., Germany, ³EMMI, Extreme Matter Inst., Germany, ⁴Johann-Wolfgang von Goethe-Univ., Germany, ⁵Johannes-Gutenberg-Univ. Mainz, Germany, ⁶Helmholtz Inst., Germany. We present the first theoretical description and also experimental evidence for the amplification of XUV and soft-X-ray radiation by parametric stimulated emission in neutral gases driven by near-IR laser pulses reaching small-signal-gain up to 8000.

TuA6 • 10:00 a.m.

Using Ion-Imaging to Study the Effect of Gouy Phase Shift and Wave-Front Distortions on Attosecond Pump-Probe Measurements, Niranjan Shivaram, Adam Roberts, Lei Xu, Arvinder Sandhu; Univ. of Arizona, USA. We utilize ion-imaging to perform a detailed characterization of the effects of Gouy phase mismatch and wave-front distortions on attosecond resolved, pump-probe measurements of XUV/IR and IR/IR ionization of He and Xe atoms.

10:15 a.m.–10:45 a.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

10:15 a.m.–4:15 p.m. Exhibits Open, Erickson/Carroll/Sinclair Rooms

TuB • Metamaterials and Plasmonics

Tuesday, July 20

10:45 a.m.–12:30 p.m.

Mark I. Stockman; Georgia State Univ., USA, *Presider***TuB1 • 10:45 a.m.**

Ultrafast All-Optical Coupling of Light to Surface Plasmons on Planar Gold Films, *Nir Rotenberg*, Markus Betz, Henry M. van Driel; Univ. of Toronto, Canada. We demonstrate that transient optical gratings generated by femtosecond near-infrared pulses can be utilized to couple visible light into surface plasmon polaritons on thin unstructured gold films. Pump-probe experiments reveal a 1.0 ps launch window.

TuB2 • 11:00 a.m.

Superconductor Terahertz Metamaterials, *Hou-Tong Chen*, Hao Yang, Quanxi Jia, Antoinette J. Taylor; Los Alamos Natl. Lab, USA. We demonstrate THz metamaterials comprised of high temperature superconducting film (YBa:Cu₃O₇) replacing the metal structure. They exhibit unique properties that are not achievable using metals, which may result in both interesting applications and underlying physics.

TuB3 • 11:15 a.m.

Radiative Coupling in Planar Metamaterials Studied by THz Time-Domain Spectroscopy, *Hannes P. Merbold*¹, Andreas Bitzer¹, Jan Wallauer², Hanspeter Helm², Markus Walther², Thomas Feuerer¹; ¹Inst. of Applied Physics, Univ. of Bern, Switzerland, ²Freiburg Materials Res. Ctr., Univ. of Freiburg, Germany. We employ near- and far-field measurements of single-cycle THz pulses and numerical simulations to investigate the influence of diffraction in metamaterial arrays. We find that radiative coupling leads to substantial modifications of the spectral response.

TuB4 • 11:30 a.m.

Ultrafast Pump-Probe Spectroscopy of a Dual-Band Negative Index Metamaterial, *Keshav M. Dani*¹, Zahyun Ku², Prashanth C. Upadhyaya¹, Rohit P. Prasankumar¹, S. R. J. Brueck², Antoinette J. Taylor¹; ¹Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA, ²Ctr. for High Technology Materials, Univ. of New Mexico, USA. We study the nonlinear optical response of a dual-band negative-index metamaterial with two-color pump-probe spectroscopy. We demonstrate the utility of the device as a nanoscale, structurally tunable, subpicosecond all-optical modulator.

TuB5 • 11:45 a.m.

Terahertz Radiation from Multiplexed Photo-Dember Currents, *Gregor Klatt*¹, Florian Hilsner¹, Wenchao Qiao¹, Raphael Gebis¹, Albrecht Bartels¹, Klaus Huska², Uli Lemmer², Georg Bastian³, Michael B. Johnston⁴, Milan Fischer⁵, Jérôme Fais⁵, Thomas Dekorsy¹; ¹Univ. of Konstanz, Germany, ²Univ. Karlsruhe, Germany, ³Univ. of Applied Sciences Trier, Germany, ⁴Univ. of Oxford, UK, ⁵ETH Zürich, Switzerland. We investigate a novel method to generate intense THz radiation by multiplexing coherent photo-Dember currents in a lateral geometry. These THz emitters are passive devices with a peak frequency at about 1.5 THz.

TuC • Optical Parametric Amplifiers

Tuesday, July 20

10:45 a.m.–12:30 p.m.

Sandro De Silvestri; Politecnico di Milano, Italy, *Presider***TuC1 • 10:45 a.m.**

Demonstration of Cavity-Enhanced Optical Parametric Chirped-Pulse Amplification System at High Repetition Rate, *Aleem M. Siddiqui*¹, Kyung-Han Hong¹, Jeffrey Moses¹, Jian Chen¹, F. Ömer Ilday², Franz X. Kärtner¹; ¹MIT, USA, ²Bilkent Univ., Turkey. First experimental demonstration of cavity-enhanced OPCPA at 78 MHz with <1 W of pump power is presented. For comparison, we demonstrated saturated gain in a single-pass experiment from 6-W Yb-fiber pump and Er-fiber signal sources.

TuC2 • 11:00 a.m.

96 kHz Fiber-Amplifier-Pumped Few-Cycle Pulse Optical Parametric Chirped Pulse Amplifier System, *Franz Tavella*^{1,2}, Arik Willner¹, Steffen Hädrich^{2,3}, Jan Rothhardt^{2,3}, Enrico Seise^{2,3}, Jens Limpert^{2,3}, Stefan Düstener^{1,2}, Holger Schlarb¹, Josef Feldhaus^{1,2}, Jörg Roßbach^{1,4}, Andreas Tünnermann^{2,3,5}; ¹Deutsches Elektronensynchrotron DESY, Germany, ²Helmholtz-Inst. Jena, Germany, ³Friedrich-Schiller-Univ. Jena, Germany, ⁴Univ. of Hamburg, Germany, ⁵Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany. An optical parametric chirped pulse amplifier with few-cycle pulses and high average power is demonstrated. This is the precursor of a system that will work at higher average power at the FLASH free electron laser.

TuC3 • 11:15 a.m.

The Development of Angularly-Dispersed Non-Collinear Optical Parametric Amplifier for Generation of High Power Optical Pulses in Monocycle Regime, *Keisaku Yamane*^{1,2}, Takashi Tanigawa^{1,2}, Taro Sekikawa^{1,2}, Mikio Yamashita^{1,2}; ¹Hokkaido Univ., Japan, ²Core Res. Evolutional Science and Technology, JST, Japan. We greatly improved our angularly-dispersed NOPA system and introduced a new stretcher for seed pulses. Consequently, we achieved the broadest gain bandwidth ranging from 500 to 1030 nm with output pulse energy of 45 µJ.

TuC4 • 11:30 a.m.

6 Cycle, 3.8 µJ, Mid-IR OPCPA at 100 kHz, *Olivier Chalus*¹, Alexandre Thai¹, Jens Biegert^{1,2}; ¹ICFO, Spain, ²ICREA, Spain. A mid-IR OPCPA generates 6 cycle pulses (67 fs at 3.1 µm) with compressed energy of 3.8 µJ at 100 kHz. The source is passively CEP stabilized through DFG.

TuC5 • 11:45 a.m.

Widely Tunable Infrared Pulse Generation up to 5 µm with Novel Optical Parametric Amplifiers at 100 kHz Repetition Rate, *Maximilian Bradler*, Eberhard Riedle, Christian Homann; LS für BioMolekulare Optik, Ludwig-Maximilians-Univ. München, Germany. Two-color pumping with strong pre-amplification and idler-seeding is demonstrated for efficient, broadband, tunable mid-infrared collinear optical parametric amplification. It is shown for low pump energies and high repetition rates, and implemented on various laser systems.

TuB • Metamaterials and Plasmonics—Continued

TuB6 • 12:00 p.m.

Localizing Few-Cycle Light Pulses in Space and Time in Random Dielectric Media, *Manfred Mascheck¹, Slawa Schmidt¹, Martin Silies¹, Parinda Vasa¹, David Leipold², Erich Runge², Kokoro Kitamura³, Takashi Yatsui³, Motoichi Ohtsu³, Christoph Lienau¹*; ¹*Inst. für Physik, Carl von Ossietzky Univ., Germany*, ²*Inst. für Physik und Inst. für Mikro- und Nanotechnologien, Technische Univ. Ilmenau, Germany*, ³*School of Engineering, Univ. of Tokyo, Japan*. We directly visualize, for the first time, the weak localization of light in both space and time in a disordered array of ZnO nanoneedles using a novel diffraction-limited second-harmonic microscope with few-cycle time resolution.

TuB7 • 12:15 p.m.

Anderson Localization of Single Cycle THz Pulses in Random Media, *Florian Enderli¹, Andreas Bitzer¹, Frank Scheffold², Thomas Feurer¹*; ¹*Inst. of Applied Physics, Univ. of Bern, Switzerland*, ²*Dept. of Physics, Univ. of Fribourg, Switzerland*. We present two approaches based on THz time domain spectroscopy and polaritonics to visualize Anderson localization in 2-D systems. In both femtosecond pump/probe experiments are used to observe single-cycle THz-pulses propagating through random media.

TuC • Optical Parametric Amplifiers—Continued

TuC6 • 12:00 p.m.

Invited

Cycle-Engineered Coherent Steering of Electrons with a Multicolor Optical Parametric Synthesizer, *Tadas Balčiūnas¹, Giedrius Andriukaitis¹, Aart J. Verhoeft¹, Oliver D. Mücke¹, Audrius Pugžlys¹, Andrius Baltuška¹, Darius Mikalauskas², Linas Giniūnas², Romualdas Danielius², Matthias Lezius³, Ronald Holzwarth^{3,4}*; ¹*Photonics Inst., Vienna Univ. of Technology, Austria*, ²*Light Conversion Ltd., Lithuania*, ³*Max-Planck-Inst. of Quantum Optics, Germany*, ⁴*Menlo Systems GmbH, Germany*. Directional electron generation asymmetry is measured using incommensurate-frequency multicolor pulses that are carrier-envelope-phase-locked. The demonstrated Yb-laser-pumped OPA technology produces a shot-to-shot-stable femtosecond field combining three carrier frequencies that can be set to an arbitrary ratio.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

NOTES

TuD • Chemical Reaction Dynamics

Tuesday, July 20

2:00 p.m.–3:45 p.m.

Eberhard Riedle; Ludwig-Maximilians-Univ. München, Germany, Presider

TuD1 • 2:00 p.m.

Invited

Tracking Ultrafast Chemical Reaction Dynamics Using Transient 2DIR Spectroscopy, Carlos R. Baiz, Robert McCanne, Jessica M. Anna, Kevin L. Kubarych; Univ. of Michigan, USA. Phototriggered reactions can be monitored in real time with bond-by-bond structural selectivity using multidimensional IR spectroscopy as a probe. We have applied this powerful approach to photoproduct orientational relaxation and geminate rebinding reactions.

TuD2 • 2:30 p.m.

Ultrafast Spin-State Conversion in Solvated Transition Metal Complexes Probed with Femtosecond Soft X-Ray Spectroscopy, Nils Huse¹, Hana Cho^{1,2}, Tae Kyu Kim², Lindsey Jamula³, James K. McCusker³, Frank M. F. de Groot⁴, Robert W. Schoenlein¹; ¹Lawrence Berkeley Natl. Lab, USA, ²Pusan Natl. Univ., Republic of Korea, ³Michigan State Univ., USA, ⁴Utrecht Univ., Netherlands. We report the first femtosecond soft X-ray spectroscopy of solvated transition-metal complexes: Structural dynamics mediate ultrafast spin-state conversion and symmetry-specific valence-charge localization. This study demonstrates the unique potential of ultrafast soft X-ray spectroscopy in solutions.

TuD3 • 2:45 p.m.

Time-Resolved X-Ray Emission Spectroscopy, György Vankó¹, Pieter Glatzel², Van-Thai Pham³, Rafael Abela⁴, Daniel Grolimund⁴, Camelia N. Borca⁴, Steven L. Johnson⁴, Chris Milne³, Wojciech Gawelda⁵, Andreas Galler⁵, Christian Bressler⁵; ¹KFKI Res. Inst. for Particle and Nuclear Physics, Hungary, ²KFKI Res. European Synchrotron Radiation Facility, France, ³École Polytechnique Fédérale de Lausanne, Switzerland, ⁴Paul-Scherrer Inst., Switzerland, ⁵European XFEL GmbH, Germany. We present ultrafast X-ray emission studies of photoexcited aqueous iron tris-bipyridine with 70 ps temporal resolution to monitor the spin state changes in this spin-crossover complex.

TuD4 • 3:00 p.m.

Solvated Electron Scavenging by Metal Cations: A Microscopic Picture Derived from the Transient Effect, Ulli Schmidhammer¹, Pascal Pernot¹, Pierre Jeunesse¹, Shigeo Murata², Mehran Mostafavi¹; ¹Lab de Chimie Physique, Univ. Paris Sud, France, ²AIST, Japan. The decay of the solvated electron generated by picosecond electron radiolysis is measured for highly concentrated oxidizers in a viscous solvent. Analyzing the non-exponential kinetics reveals molecular parameters of the reaction, particularly its distance distribution.

TuD5 • 3:15 p.m.

Ultrafast Generation of Aqueous Carbonic Acid, Katrin Adamczyk¹, Mirabelle Prémont-Schwarz¹, Dina Pines², Ehud Pines², Erik T. J. Nibbering¹; ¹Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany, ²Ben-Gurion Univ. of the Negev, Israel. We generate carbonic acid, a molecule of elusive nature, by ultrafast protonation of bicarbonate in aqueous solution, which follows the free energy reactivity correlation known for carboxylate anions, with an associated pK_a-value of 3.45 ± 0.15.

TuD6 • 3:30 p.m.

Molecular Reaction Dynamics of Excited-State Intramolecular Proton Transfer Revealed by Isotope Dependence, Junghwa Lee, Chul Hoon Kim, Taiha Joo; Dept. of Chemistry, Pohang Univ. of Science and Technology, Republic of Korea. Deuterium isotope dependence on the excited-state intramolecular proton transfer rate and nuclear wave packet motions was investigated by time-resolved fluorescence. High time resolution reveals the role of OH stretching motion on the proton transfer reaction.

3:45 p.m.–4:15 p.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

TuE1

Soft X-Ray Interferometer for Time-Resolved Diagnostics of Laser-Aided Nano-Fabrication, Tohru Suemoto¹, Kota Terakawa¹, Yasuo Minami¹, Yoshihiro Ochi², Noboru Hasegawa², Tetsuya Kawachi², Takuro Tomita³, Minoru Yamamoto³, Manato Deki³; ¹Inst. for Solid State Physics, Univ. of Tokyo, Japan, ²JAEA, Japan, ³Univ. of Tokushima, Japan. An interferometer is constructed utilizing 13.9 nm radiation from a plasma-based soft X-ray laser. Single-shot measurement with a time-resolution of 7 ps is performed to observe the initial stage of the ablation process in platinum.

TuE2

Systematic Study of Delay-Based Adaptive Coherent Control, Di Yang, Daan P. Sprünken, Alexander C.W. van Rhijn, Peter van der Walle, Ting Lee Chen, Herman L. Offerhaus, Jennifer L. Herek, Aliakbar Jafarpour; Univ. of Twente, Netherlands. We show five simultaneous fundamental improvements in adaptive ultrafast spectroscopy by estimating the group delay, rather than phase. Numerical results are confirmed by experiments, and issues such as generality and noise robustness are studied quantitatively.

TuE3

High-Power Wavelength-Tunable Ti:Sa Amplifier System for Ultra-Cold Electron Generation for Compact FELs, Christoph P. Hauri, Romain Ganter, Frederic Le Pimpec, Clemens Ruchert, Alexandre Trisorio; Paul Scherrer Inst., Switzerland. We demonstrate an ultra-stable high-power Ti:sapphire system with a tunable central wavelength in the IR and UV. The laser is used to generate ultra-cold electron bunches for driving future compact Free Electron Lasers.

TuE4

Energy Flow in the Light Harvesting Complex Manipulated by Pre-Excitation of the Energy Acceptor, Ryosuke Nakamura^{1,2}, Takuya Yoshioka¹, Kenta Abe¹, Shunnsuke Sakai³, Katsunori Nakagawa^{2,3}, Mamoru Nango^{2,3}, Hideki Hashimoto^{2,4}, Masayuki Yoshizawa^{1,2}; ¹Dept. of Physics, Graduate School of Science, Tohoku Univ., Japan, ²JST, CREST, Japan, ³Dept. of Life and Materials Engineering, Graduate School of Engineering, Nagoya Inst. of Technology, Japan, ⁴Dept. of Physics, Graduate School of Science, Osaka City Univ., Japan. Energy transfer from carotenoid is partially blocked by pre-excitation of the energy acceptor, bacteriochlorophyll *a*. By analyzing induced changes in energy flow, the energy transfer

and competing internal conversion dynamics in the complexes are elucidated.

TuE5

Coherent Control of Multidimensional Nonlinear Optical Signals with Shaped Laser Pulses, Dmitri V. Voronine¹, Darius Abramavicius², Shaul Mukamel²; ¹Univ. Bielefeld, Germany, ²Univ. of California at Irvine, USA. Multidimensional nonlinear optical signals with shaped laser pulses are simulated using closed-form expressions that contain pulse envelopes. Multiparameter coherent control using linear and higher-order chirp is applied to photosynthetic excitons to enhance weak cross peaks.

TuE6

Ultrafast Proton Transfer in Fluorescent and Photochromic Proteins, Andras Lukacs¹, Minako Kondo¹, Ismael A. Heisler¹, Atsushi Miyawaki², Hidekazu Tsutsui², Michael Towrie³, Gregory Greetham³, Peter J. Tonge⁴, Deborah Stoner-Ma⁴, Stephen R. Meech¹; ¹Univ. of East Anglia, UK, ²Lab for Cell Function Dynamics, RIKEN, Japan, ³Rutherford Appleton Lab, UK, ⁴Stony Brook Univ., USA. Transient IR and ultrafast fluorescence are used to probe primary processes in two proteins. S65T GFP exhibits proton transfer on a short H-bond, while transient IR probes primary photochemistry in the optical highlighter protein kikGR.

TuE7

Structurally-Sensitive Rebinding Dynamics of Solvent-Caged Radical Pairs: Exploring the Viscosity Dependence, Carlos R. Baiz, Robert McCanne, Kevin J. Kubarych; Univ. of Michigan, USA. Solvent-caged radical rebinding dynamics are studied using non-equilibrium 2-D IR and dispersed vibrational echo spectroscopy.

TuE8

Femtosecond Relaxation Dynamics of Core and Surface Localized Electronic States in Au₂₄PdL₁₈, Stephen A. Miller, Christina A. Fields-Zinna, Royce W. Murray, Andrew M. Moran; Univ. of North Carolina at Chapel Hill, USA. Femtosecond transient grating spectroscopies probe the relaxation dynamics of the monolayer protected clusters Au₂₄Pd(SCH₂CH₂Ph)₁₈ and Au₂₅(SCH₂CH₂Ph)₁₈⁻. The signals reveal an ultrafast internal conversion process between excited states spatially localized to the core and semiring moieties.

TuE9

A Peptide Capping Layer over Gold Nanoparticles, Marco Schade¹, Paul M. Donaldson¹, Alessandro Moretto², Claudio Toniolo², Peter Hamm¹; ¹Inst. of Physical Chemistry, Univ. of Zürich, Switzerland, ²Inst. of Biomolecular Chemistry, Padova Unit, CNR, Dept. of Chemistry, Univ. of Padova, Italy. We study gold nanoparticles capped with a layer of helical peptides. Energy transport through the peptides is initiated by exciting the plasmon resonance. 2-D-IR spectroscopy is used to gain structural information about the capping layer.

TuE10

Highly Exergonic Bimolecular Electron Transfer beyond Marcus Theory, the Importance of Molecular Structure and Dynamics, Bernhard Lang¹, Katrin Adamczyk², Natalie Banerji¹, Diego Villamaina¹, Jens Dreyer², Erik T. J. Nibbering², Eric Vauthey¹; ¹Univ. of Geneva, Switzerland, ²Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany. The combination of visible and mid infrared transient absorption yields a direct insight into structural dynamics and determination of distinct reaction pathways in highly exergonic electron transfer, asking for refinement of existing theories.

TuE11

Femtosecond Fluorescence up-Conversion Studies of Electron Injection in Dye Sensitized Solar Cells, Olivier Bräm, Andrea Cannizzo, Majed Chergui; École Polytechnique Fédérale de Lausanne, Switzerland. Short lived (≤ 30 fs) fluorescence of RuN719 dye adsorbed on TiO₂ semiconductor substrate shows a ~ 3 fold decrease in intensity compared to the non-injecting Al₂O₃ substrate, indicative of an injection time of about 3 fs.

TuE12

Photoswitching Cycle of a Nitro-Substituted Spiropyran: Ring-Opening and Ring-Closure Dynamics, Johannes Buback, Martin Kullmann, Patrick Nuernberger, Ralf Schmidt, Frank Würthner, Tobias Brixner; Univ. of Würzburg, Germany. We perform pump-repump-probe transient absorption experiments on a spiropyran-merocyanine system demonstrating a complete closed-form/open-form/closed-form photoswitching cycle. We provide first direct experimental proof of spiropyran-derived merocyanine ring closure and measure the ring-opening dynamics.

TuE13

Mapping Chirp Effects on Impulsive Vibrational Spectroscopy in Multidimensional Systems, *Amir Wand*, Shimshon Kallush, Ofir Shoshanim, Oshrat Bismuth, Ronnie Kosloff, Sanford Ruhman; Hebrew Univ. of Jerusalem, Israel. Experiment and theory applied to a range of polyatomics map chirp effects on impulsive vibrational spectroscopy. Pump detuning, solvent dissipation and mode displacements are factors determining the optimal chirp, as well as its inter-mode dependence.

TuE14

Time-Domain Raman Tracking of Ultrafast Flattening Distortion in Organometallic Complex, *Satoshi Takeuchi*¹, Munetaka Iwamura², Hidekazu Watanabe¹, Tahei Tahara¹; ¹RIKEN, Japan, ²Univ. of Toyama, Japan. We studied vibrational structures of the metal-to-ligand-charge-transfer state of Cu(I)-diimine complexes through wavepacket motions generated impulsively at various delay-times. The obtained “instantaneous” Raman data provided firm vibrational evidences for ultrafast nature of the flattening distortion.

TuE15

Excitation-Energy Dependence of Ultrafast Electron Injection from a Model Carotenoid, *Jacquelyn M. Burchfield*, Emily J. Glassman, Graham R. Fleming; Univ. of California at Berkeley, USA. Energy-dependent excitation to the second excited state of β -apo-8'-carotenoid acid bound to an electron-accepting nanoparticle reveals a second decay pathway allowing electron injection into basic nanoparticles from a lower-energy state available only under high-energy excitation.

TuE16

Multi-Dimensional Electronic Spectroscopy of J-Aggregates, *Dylan H. Arias*, Katherine W. Stone, Keith A. Nelson; MIT, USA. Multi-dimensional electronic spectroscopy, via spatiotemporal pulse-shaping, is used to study excitons in J-aggregates. Correlation spectra elucidate spectral diffusion while a two-quantum experiment reveals couplings between the first and second manifolds of exciton states.

TuE17

Can Retinal Isomerization in Bacteriorhodopsin Be Coherently Controlled in the Strong Field Limit? *Valentin I. Prokhorenko*¹, Alexei Halpin¹, Philip J. M. Johnson¹, Leonid S. Brown², *R. J. Dwayne Miller*¹; ¹Univ. of Toronto, Canada, ²Univ. of Guelph, Canada. We observe experimentally that the isomerization efficiency of bacteriorhodopsin increases by chirping the excitation pulses at moderate excitation levels. Under strong fields (>100 GW/cm²), the isomerization becomes corrupted, most likely from ionization of the protein.

TuE18

Ultrafast Vibrational Dynamics in Quasi-Linear Arrays of Hydrogen-Bonds Explored by 2DIR-Spectroscopy, *Stephan Knop*¹, Jaane Seehusen¹, Jörg Lindner¹, Dirk Schwarzer², Peter Vöhringer¹; ¹Rheinische Friedrich-Wilhelms-Univ., Germany, ²Max-Planck-Inst. für Biophysikalische Chemie, Germany. Femtosecond mid-infrared pump-probe and two-dimensional spectroscopy in the OH-stretching spectral region was used to elucidate the dynamics of vibrational energy relaxation and dynamic line broadening in artificial low-dimensional hydrogen-bond wires of different lengths.

TuE19

Band Filling Dynamics and Auger Recombination in Lead Sulfide Nanocrystals, *William K. Peters*, Byungmoon Cho, Robert J. Hill, Trevor L. Courtney, David M. Jonas; Univ. of Colorado at Boulder, USA. Pump energy dependent pump probe transients were recorded in lead sulfide nanocrystals. Band filling dynamics were observed on a few-hundred femtosecond timescale followed by Auger dynamics over tens to hundreds of picoseconds.

TuE20

Terahertz Radiation with a Continuous Spectral Bandwidth Reaching beyond 100 THz from a Laser-Induced Gas Plasma, *Volker Blank*, *Mark D. Thomson*, Hartmut G. Roskos; Physikalisches Inst., Johann Wolfgang Goethe-Univ., Germany. The generation of coherent terahertz radiation with a spectrum covering the range from below 1 THz to more than 100 THz is demonstrated, using an air-plasma with sub-20-fs two-color optical excitation.

TuE21

Toward Single-Cycle Pulse Generation in Single-Crystal Diamond, *MiaoChan Zhi*, Kai Wang, Alexei V. Sokolov; Texas A&M Univ., USA. We generate a broad band of frequency sidebands by focusing two infrared beams non-collinearly into diamond. We use a pulse shaper to adjust phases across the spectrum of 3 sidebands and obtain 13 fs pulses.

TuE22

Generation of Ultra-Short Gamma Ray Pulses via Laser Compton Scattering in UVSOR-II Electron Storage Ring, *Yoshitaka Taira*^{1,2}, Masahiro Adachi^{2,3}, Heisyun Zen^{2,3}, Takanori Tanikawa³, Naoto Yamamoto¹, Masato Hosaka¹, Yoshifumi Takashima¹, Kazuo Soda¹, Masahiro Katoh^{1,2,3}; ¹Graduate School of Engineering, Nagoya Univ., Japan, ²UVSOR, Inst. for Molecular Science, Natl. Inst.s of Natural Sciences, Japan, ³School of Physical Sciences, Graduate Univ. for Advanced Studies, Japan. We have generated laser Compton scattering gamma rays via head-on and horizontal 90-degree collision in an electron storage ring; this result will provide a tunable ultra-short gamma ray pulse source.

TuE23

Polarization Pulse Shaping Using Nonlinear Optical Processes, *Marco T. Seidel*, Suxia Yan, Zhengyang Zhang, *Howe-Siang Tan*; School of Physical and Mathematical Sciences, Nanyang Technological Univ., Singapore. We demonstrate a scheme for mid infrared polarization pulse shaping by using two perpendicularly oriented nonlinear optical processes in a near-interferometric stable beam geometry. This method can be generalized to produce ultraviolet polarization shaped pulse.

TuE24

The Evolution of Signal-to-Noise Ratio in Superfluorescence-Contaminated Optical Parametric Chirped-Pulse Amplification, *Cristian Manzoni*¹, *Jeffrey Moses*², Franz X. Kärtner², Giulio Cerullo¹; ¹Politecnico di Milano, Italy, ²MIT, USA. Using a numerical model consistent with quantum mechanics, we study the evolution of signal-to-noise ratio in chirped-pulse parametric amplification with significant quantum-noise contamination. For realistic amplifier parameters, noise performance can have order-of-magnitude dependence on design.

TuE25**Measuring Time Profiles of Ultraweak Ultrashort Pulses by Time Domain Superresolution,**

Osip Schwartz, Oren Raz, Ori Katz, Nirit Dudovich, Dan Oron; Dept. of Physics of Complex Systems, Weizmann Inst. of Science, Israel. We demonstrate an optical nonlinearity free ultrashort pulse characterization technique relying on spectral component localization in time domain. Ultraweak pulses in NIR to XUV range can be characterized with resolution depending only on integration time.

TuE26**Single-Shot Detection and Stabilization of Carrier Phase Drifts of Mid-IR Pulses,**

Cristian Manzoni, Michael Först, Henri Ehrke, Matthias C. Hoffmann, Andrea Cavalleri; Max-Planck Res. Group for Structural Dynamics, Univ. of Hamburg, Germany. We introduce a new scheme for single-shot characterization of the absolute-phase jitter of mid-IR pulses. The system detects phase drifts of self-phase stabilized sources; a control scheme compensating long-term drifts is also demonstrated.

TuE27

Ultrabroadband Optical Parametric Chirped-Pulse Amplifier in the Mid-Infrared Using Aperiodically Poled Mg:LiNbO₃, *Clemens Heese¹, Christopher R. Phillips², Lukas Gallmann³, Martin M. Fejer², Ursula Keller¹; ¹ETH Zürich, Switzerland, ²Stanford Univ., USA.* We present a new approach to amplification of few-cycle laser pulses in the mid-infrared spectral region using diode-pumped solid-state lasers. At 100-kHz repetition rate pulse energies of 1.5- μ J and durations of 75-fs are generated.

TuE28

Generation and Characterization of Phase and Amplitude Modulated Femtosecond UV Pulses, *Jens Möhring, Tiago Buckup, Marcus Motzkus; Univ. Heidelberg, Germany.* To enable flexible generation of femtosecond UV pulses in time resolved experiments we present a novel setup capable of generation, direct UV phase modulation and shaper assisted characterization of phase and amplitude modulated UV pulses.

TuE29

Mode-Locking of an Er:Yb:Glass Laser with Single Layer Graphene, *Chien-Chung Lee, Guillermo Acosta, Scott Bunch, Thomas R. Schibli; Univ. of Colorado, USA.* Pulses as short as 260fs have been generated in an Er:Yb:glass laser by saturable absorber mode-locking using

graphene as the only mode-locking mechanism. These novel saturable absorbers present a low-cost, ultra-broadband alternative to traditional SESAMs.

TuE30

Characterization of an Asynchronously Mode-Locked Erbium-Doped Fiber Laser Operating at 10GHz, *Camilla C. Dias, Eunezio A. De Souza; Univ. Presbiteriana Mackenzie, Brazil.* We investigated the dynamic operation of an asynchronous mode-locking EDFL at 10GHz as a deviation from the synchronous regime. We observed that the soliton shifts the central wavelength speeding up to stabilize the asynchronous mode-locking.

TuE31

Tunable Broadband Optical Generation via Giant Rabi Shifting in Micro-Plasmas, *Ryan Compton, Alex Filin, Dmitri A. Romanov, Mateusz Plewicki, Robert J. Levis; Temple Univ., USA.* A new coherent laser-source arising from giant time-dependent generalized Rabi shifting has been demonstrated. A 1 ps laser is transformed into a pulse with bandwidth corresponding to a 70 fs pulse via time-dependent Rabi shifting.

TuE32

Electron-Energy Resolved Measurement of the Cascaded Auger Decay in Krypton, *Aart J. Verhoeft, Alexander Mitrofanov¹, Xuan Trung Nguyen¹, Maria Krikunova², Nikolay Kabachnik², Markus Drescher², Andrius Baltuška¹; ¹Vienna Univ. of Technology, Austria, ²Univ. Hamburg, Germany.* The cascaded Auger decay following excitation with 92-eV soft-X-ray pulses from the 3p-subshell in Krypton has been energy- and time-resolved for the first time. The decay time of the $4s^{-1}4p^{-1}\eta p \rightarrow 4p^{2+}e$ transition is measured to be 50 ± 10 fs.

TuE33

Ultrafast, Element-Specific, Demagnetization Dynamics Probed Using Coherent High Harmonic Beams, *Stefan Mathias^{1,2}, Chan La-O-Vorakiat¹, Patrik Grychtol³, Roman Adam³, Mark Siemens¹, Justin M. Shaw⁴, Hans Nembach⁵, Martin Aeschlimann², Claus M. Schneider³, Tom Silva⁵, Margaret M. Murnane¹, Henry C. Kapteyn¹; ¹JILA, Univ. of Colorado, USA, ²Univ. of Kaiserslautern, Germany, ³Inst. of Solid State Res., Res. Ctr. Jülich, Germany, ⁴Electromagnetics Div., USA, ⁵NIST, USA.* High harmonics from a tabletop laser are used to probe ultrafast demagnetization of a compound material (Permalloy) with elemental selectivity. We achieve the highest time resolution, element-specific, measurements to date at 55 fs.

TuE34

Elliptical Dichroism of High Harmonics Emitted from Aligned Molecules, *Robynne M. Lock, Xibin Zhou, Margaret M. Murnane, Henry C. Kapteyn; JILA and Dept. of Physics, Univ. of Colorado, USA.* By analyzing the polarization of harmonics emitted by aligned molecules driven by elliptically-polarized driving laser fields, we observe a structure-dependent dichroism. This suggests that electron dynamics within the molecule influence high harmonic generation.

TuE35

Degree-of-Alignment Dependence of High-Order Harmonic Generation from CO₂ Molecules, *Kosaku Kato, Shinichirou Minemoto, Hirofumi Sakai; Dept. of Physics, Graduate School of Science, Univ. of Tokyo, Japan.* Degree-of-alignment dependence of high-order harmonic generation from CO₂ molecules shows that the harmonic orders at which the harmonic intensities are suppressed due to destructive interference remain almost same orders irrespective of different degrees of alignment.

TuE36

Manipulating the Dissociation of H₂ (D₂) by Phase-Stable Laser Pulses, *Manuel H. Kremer¹, Bettina Fischer¹, Bernhard Feuerstein¹, Vitor L. B. de Jesus², Vandana Sharma³, Christian Hofrichter¹, Artem Rudenko³, Uwe Thumm⁴, Claus Dieter Schröter¹, Robert Moshhammer¹, Joachim Ullrich¹; ¹Max-Planck-Inst. für Kernphysik, Germany, ²Inst. Federal de Educação, Ciência e Tecnologia do Rio de Janeiro (IFRJ), Brazil, ³Max-Planck Advanced Study Group at CFEL, Germany, ⁴James R. Macdonald Lab, Kansas State Univ., USA.* Fully differential data on H₂ (D₂)-dissociation in carrier-envelope-phase (CEP)stabilized 6fs laser pulses were recorded with a reaction microscope. By varying the CEP control over the proton emission direction, and, thus, the charge localization was achieved.

TuE37

IR-Assisted Ionization of He⁺/He⁺⁺ by Attosecond Extreme Ultraviolet (EUV) Radiation, *Predrag Ranitovic, C. W. Hogle, X. Zhou, M. M. Murnane, H. C. Kapteyn; JILA, Univ. of Colorado, USA.* High harmonics, in form of attosecond pulse trains, are used to coherently excite He⁺/He⁺⁺ states just below the He⁺/He⁺⁺ ionization threshold. IR-induced He⁺ yield shows evidence of sub-cycle modulation of atomic stark shift.

TuE38

Ultrafast Coherent Phonon Dynamics in Metallic Single-Walled Carbon Nanotubes, *Keiko Kato, Atsushi Ishizawa, Katsuya Oguri, Hideki Gotoh, Hidetoshi Nakano, Tetsuomi Sogawa; NTT Basic Res. Labs, NTT Corp., Japan.* We report the first observation of coherent phonons in separated metallic single-walled carbon nanotubes (SWCNTs). Due to structure-dependent electron-phonon couplings, radial breathing phonon mode is hardened with photo-carriers in metallic but not in semiconducting SWCNTs.

TuE39

Dynamics of Spin-Lattice Relaxation in Co₃Fe_{3-x}O₄ Nanocrystals, *Tai-Yen Chen, Chih-Hao Hsia, Hsiang-Yun Chen, Dong Hee Son; Texas A&M Univ., USA.* Spin-lattice relaxation rates in colloidal Co₃Fe_{3-x}O₄ nanocrystals were investigated as a function of size and Co content via pump-probe Faraday rotation measurements to investigate spin-lattice relaxation rate in nanoscale magnetic materials.

TuE40

Dynamic Electron Molecular Vibration (EMV) Interference during Photoinduced Metallization in Charge Ordered Organic Salt, *Yohei Kawakami¹, Takeshi Fukatsu¹, Hirotake Itoh^{1,2}, Shinichiro Iwai^{1,2}, Takahiko Sasaki^{2,3}, Kaoru Yamamoto⁴, Kyuya Yakushi⁴; ¹Dept. of Physics, Tohoku Univ., Japan, ²JST, CREST, Japan, ³Inst. for Materials Res., Tohoku Univ., Japan, ⁴Inst. for Molecular Science, Japan.* Interference between intermolecular electronic oscillation (period, 18 fs) and intramolecular vibration (22 fs) shows that excited state is initially dressed by the C=C vibration during the photoinduced insulator to metal transition in layered organic salt.

TuE41

Motional Narrowing of Phonon Spectrum Driven by Ultrafast Dielectric Fluctuation in Organic Dimer Mott Insulator, *Keisuke Itoh¹, Hideki Nakaya¹, Yohei Kawakami¹, Takeshi Fukatsu¹, Hirotake Itoh^{1,2}, Shinichiro Iwai^{1,2}, Takahiko Sasaki^{2,3}, Shingo Saito⁴; ¹Dept. of Physics, Tohoku Univ., Japan, ²JST, CREST, Japan, ³Inst. for Materials Res., Tohoku Univ., Japan, ⁴NICT, Japan.* Motional narrowing of phonon spectrum was observed in organic dimer Mott insulator, reflecting ultrafast dielectric fluctuation which is driven by flip of the dimer dipole. Moreover, this phonon is coherently induced by the electronic excitation.

TuE42

Dynamics of Coherent Phonons in Disordered Graphite, *Ikufumi Katayama¹, Sho Koga¹, Toru Shimada², Keiko Kato³, Shunichi Hishita³, Daisuke Fujita³, Jun Takeda¹, Masahiro Kitajima⁴; ¹Yokohama Natl. Univ., Japan, ²Free Univ. of Berlin, Germany, ³Natl. Inst. of Materials Science, Japan, ⁴Natl. Defense Acad., Japan.* High-frequency coherent phonons in Ar⁺-implanted graphite have been investigated with a 7.5 fs Ti:sapphire laser and electro-optic sampling method. Coherent oscillations of G- and D-modes are clearly observed with time-dependent frequency-shifts.

TuE43

Femtosecond Coherent Vibrational Relaxation in PVA Film Detected by Coherent Anti-Stokes Raman Spectroscopy, *Takanori Kozai, H. Miyagawa, N. Tsurumachi, S. Koshihara, S. Nakanishi, H. Itoh; Kagawa Univ., Japan.* Coherent vibrational relaxation is investigated for CH and OH stretch modes in PVA film by femtosecond coherent anti-Stokes Raman spectroscopy. The vibrational relaxation for CH mode is found faster than that for OH mode.

TuE44

Two-Dimensional Electronic Coherently Controlled Spectroscopy Reveals Long-Lived Induced Phase Memory, *Valentin I. Prokhorenko, Alexei Halpin, R. J. Dwayne Miller; Univ. of Toronto, Canada.* Using phase-shaped excitation pulses we measured 2-D electronic spectra of an organic dye and found that the specific pulse shapes affects the 2-D profiles even at very long waiting times (up to 100 ps).

TuE45

Dynamics of Carriers and the Influence of the Quantum Confined Stark Effect in ZnO/ZnMgO Quantum Wells, *Christopher R. Hall¹, Lap V. Dao¹, K. Koike², S. Sasa², H. H. Tan³, M. Inoue², Mitsuki Yano², Chenuvatti Jagadish³, Jeffrey A. Davis¹; ¹Swinburne Univ. of Technology, Australia, ²Osaka Inst. of Technology, Japan, ³Australian Natl. Univ., Australia.* We reveal the dynamics of carrier-induced screening of the internal electric field in ZnO quantum wells. By controlling the potential profile of the quantum wells we demonstrate the ability to tune the excited state lifetimes.

TuE46

Interplay between the Electronic and Lattice Parts of the Order Parameter in a 1-D Charge Density Wave System Probed by Femtosecond Spectroscopy, *Hanjo Schäfer¹, Viktor Kabanov^{2,3}, Markus Beyer¹, Katica Biljakovic⁴, Jure Demsar^{1,3}; ¹Univ. Konstanz, Germany, ²Univ. Konstanz, Slovenia, ³Jozef Stefan Inst., Slovenia, ⁴Inst. of Physics, Croatia.* Utilizing the time-dependent-Ginzburg-Landau model we show that numerous phonon modes appearing below critical-temperature in a one-dimensional charge-density-wave originate from linear coupling of the electronic part of the order parameter to the phonons at modulation wavevector.

TuE47

30-fs Hole-Transfer Dynamics in Polymer/PCBM Bulk Heterojunction, *Artem A. Bakulin¹, Jan C. Hummelen², Paul H. M. van Loosdrecht¹, Maxim S. Pshenitchnikov¹; ¹Zernike Inst. for Advanced Materials, Univ. of Groningen, Netherlands, ²Stratingh Inst. for Chemistry, Univ. of Groningen, Netherlands.* Methanofullerene PCBM is used in the majority of modern plastic photovoltaic devices. Using visible-IR ultrafast spectroscopy we resolve the 30-fs hole-transfer following PCBM excitation and show that PCBM exciton harvesting depends on the blend morphology.

TuE48

The Effect of Pulse Chirp on Two-Dimensional Fourier Transform Spectra, *Patrick F. Tekavec, Jeffrey A. Myers, Kristin L. M. Lewis, Franklin Fuller, Jennifer P. Ogilvie; Univ. of Michigan, USA.* We investigate the effect of pulse chirp on the shape of absorptive 2-D electronic spectra. We present calculations on a model system as well as experimental results on an organic dye molecule.

TuE49

Spin Dynamics Excited with Mid-Infrared Femtosecond Laser Pulses, *Amani Zaghdoud, Mircea Vomir, Michele Albrecht, Marie Barthelemy, Jean-Yves Bigot; Univ. de Strasbourg, France.* We have studied the spins and charges dynamics of ferromagnetic thin films excited with ultra-short mid-infrared laser pulses. We show that the demagnetization still occurs even for small perturbations around the Fermi level.

TuE50

Coherent Phonons in Oxide Superlattices Observed by Optical and X-Ray Pump-Probe Techniques, *Marc Herzog*¹, *Roman Shayduk*², *Wolfram Leitenberger*¹, *Renske M. van der Veen*^{3,4}, *Christopher J. Milne*^{3,4}, *Steven L. Johnson*³, *Ionela Vrejoiu*⁵, *Marin Alexe*⁵, *Dietrich Hesse*⁵, *Matias Bargheer*¹; ¹Univ. of Potsdam, Germany, ²Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany, ³Paul Scherrer Inst., Switzerland, ⁴École Polytechnique Fédérale de Lausanne, Switzerland, ⁵Max-Planck-Inst. für Mikrostrukturphysik, Germany. We investigated the generation and propagation of coherent phonons in an oxide superlattice of SrRuO₃ and SrTiO₃. The rich dynamics resulted in drastic modulations of various Bragg peaks on a 1-ps timescale.

TuE51

The Structural Evolution of Photochromic Reaction in Spirooxazine Traced with Sub-40fs Transient Absorption Spectroscopy, *R. Sai Santosh Kumar*¹, *Larry Lüer*², *Guglielmo Lanzani*¹; ¹Ctr. for Nano Science and Technology, Politecnico di Milano, Italy, ²Madrid Inst. for Advanced Studies, IMDEA Nanociencia, Spain. Using sub-40fs transient absorption spectroscopy we trace the structural evolution of a substituted photochromic spiro-phenanthro-oxazine molecule from the spectral changes in the time domain, and by studying coherent oscillations in the frequency domain.

TuE52

Momentum Imaging of Three-Body Fragmentation Pathways in Polyatomic Molecules, *Li Zhang*¹, *Stefan Roither*¹, *Xinhua Xie*¹, *Daniil Kartashov*¹, *Atshushi Iwasaki*², *Huailiang Xu*², *Markus Schöffler*³, *Georg Reider*¹, *Reinhard Dörner*³, *Kaoru Yamanouchi*², *Andrius Baltuška*¹, *Markus Kitzler*¹; ¹Photonics Inst., Vienna Univ. of Technology, Austria, ²Dept. of Chemistry, School of Science, Univ. of Tokyo, Japan, ³Inst. für Kernphysik, J. W. Goethe Univ. Frankfurt, Germany. Using coincidence momentum spectroscopy we show that the external laser field's properties driving the internal molecular dynamics have negligible influence on the decision to follow a given fragmentation pathway in three-body fragmentation of polyatomic molecules.

NOTES

TuF • Shaped Pulses

Tuesday, July 20

4:45 p.m.–6:30 p.m.

Marcus Motzkus; *Philipps Univ. Marburg, Germany, Presider*

TuF1 • 4:45 p.m.

High-Finesse Dispersion-Free Cavities for Broadband Filtration of Laser Comb Lines, *Li-Jin Chen¹, Guoqing Chang¹, Chih-Hao Li², Alex Glenday², Andrew J. Benedick¹, David F. Phillips², Ronald L. Walsworth², Franz X. Kärtner¹*; ¹MIT, USA, ²Harvard-Smithsonian Ctr. for Astrophysics, Harvard Univ., USA. Dispersion-free cavities using dielectric mirrors with complementary dispersion are proposed for broadband filtration of laser comb lines. The technique enables us to implement a green astro-comb with 40GHz spacing for calibration of astronomical spectrographs.

TuF2 • 5:00 p.m.

Grism-Based Pulse Shaper for Line-by-Line Control of More than 600 Comb Lines, *Matthew S. Kirchner^{1,2}, Scott A. Diddams²*; ¹Univ. of Colorado, USA, ²NIST, USA. We construct a line-by-line pulse shaper using a grism dispersive element and achieve control of over six hundred 21 GHz comb lines. The 13.4 THz bandwidth is the largest ever controlled in a line-by-line manner.

TuF3 • 5:15 p.m.

Programmable High Resolution Broadband Pulse Shaping Using a 2-D VIPA-Grating Pulse Shaper with a Liquid Crystal on Silicon (LCOS) Spatial Light Modulator, *V. R. Supradeepa, Daniel E. Leaird, Andrew M. Weiner*; *Purdue Univ., USA*. We demonstrate programmable spectral shaping with simultaneous broad-bandwidth (>40nm) and high-resolution (<4GHz) using a 2-D VIPA-Grating pulse-shaper with a LCOS SLM. The apparatus is capable of scaling to bandwidths of 100s of nm with sub-GHz resolution.

TuF4 • 5:30 p.m.

Shaped Sub-20 fs UV Pulses: Handling Spatio-Temporal Coupling, *Nils Krebs, Rafael A. Probst, Eberhard Riedle*; *LS für BioMolekulare Optik, Ludwig-Maximilians-Univ. München, Germany*. Based on acousto-optical shaping performed directly in the UV spectral range, we demonstrate that correct beam focusing is essential to get fully wavelength tunable, nearly Fourier limited as well as complex structured sub-20 fs pulses.

TuF5 • 5:45 p.m.

Linear Characterization of Ultrafast Nonlinear Spatiotemporal Dynamics, *Daniel E. Adams¹, Thomas A. Planchon², Jeff A. Squier¹, Charles G. Durfee¹*; ¹Colorado School of Mines, USA, ²Howard Hughes Medical Inst., USA. We use time-domain Spatially and Spectrally Resolved Interferometry (SSRI) to characterize nonlinear lensing, cross-polarized wave generation and ionization induced defocusing. SSRI yields t- and ω -dependent wavefronts and can measure ultrafast material response.

TuG • Transient Biomolecular Structures

Tuesday, July 20

4:45 p.m.–6:30 p.m.

Peter Hamm; *Univ. Zürich, Switzerland, Presider*

TuG1 • 4:45 p.m.

Light-Switchable HTI-Peptides: Ultrafast Structural Changes and Coupling between the Electronically Excited Chromophore and Amide Groups, *Nadja Regner¹, Teja T. Herzog¹, Karin Haiser¹, Christian Hoppmann², Jörg Sauermann³, Karola Rueck-Braun², Martin Engelhard³, Thorben Cordes^{1,4}, Wolfgang Zinth¹*; ¹Ludwig-Maximilians-Univ., Germany, ²Technische Univ. Berlin, Germany, ³Max-Planck-Inst. for Molecular Physiology, Germany, ⁴Dept. of Physics and Biological Physics, Univ. of Oxford, UK. Hemithioindigo (HTI) is used as a structural trigger for attached peptides. Ultrafast, directly driven and slower, allosteric structural changes are induced by the HTI switch. Pronounced electronic interactions occur between the HTI and amino acids.

TuG2 • 5:00 p.m.

Mapping GFP Structural Evolution during Excited-State Proton Transfer with Femtosecond Stimulated Raman, *Chong Fang, Renee R. Frontiera, Rosalie Tran, Richard A. Mathies*; *Univ. of California at Berkeley, USA*. We use femtosecond stimulated Raman spectroscopy to view transient structural changes of the photoexcited GFP-chromophore, identifying low-frequency ring-wagging motions that gate excited-state proton transfer. Mechanistic insights on reactive systems require structural probing with femtosecond resolution.

TuG3 • 5:15 p.m.

Excited State Dynamics in Variable-Length DNA A Tracts Reflect Base Stacking Disorder and Not Exciton Delocalization, *Charlene Su¹, Bern Kohler²*; ¹Ohio State Univ., USA, ²Montana State Univ., USA. Excited states in single-stranded all-adenine oligonucleotides decay to long-lived charge transfer states if the bases are well stacked, while poor base stacking found near the ends of the strand leads to monomer-like nonradiative decay.

TuG4 • 5:30 p.m.

Distinguishing between Two and Three-State Equilibrium Folding with Three-Pulse Photon Echo Peak Shift (3PEPS) Spectroscopy, *Zhaochuan Shen¹, Emily Gibson², Ralph Jimenez¹*; ¹JILA, NIST, Univ. of Colorado, USA, ²Dept. of Physics, Univ. of Colorado, USA. We investigate the equilibrium unfolding of Zn-cytochrome c by three-pulse photon echo peak shift spectroscopy. The wavelength dependence of the asymptotic peak shift reveals a bimodal inhomogeneous distribution function characteristic of two-state unfolding.

TuG5 • 5:45 p.m.

Picosecond Time-Resolved Resonance Raman Investigation of Primary Structural Transition of the Heme Induced by Nitric Oxide Rebinding, *Sergei G. Kruglik^{1,2}, Byung-Kuk Yoo¹, Stefan Franzen³, Marten H. Vos², Jean-Louis Martin^{1,3}, Michel Negre¹*; ¹Lab d'Optique et Biosciences, École Polytechnique, France, ²Lab Acides Nucléiques et Biophotonique, Univ. Pierre et Marie Curie, France, ³North Carolina State Univ., USA. We probed the heme iron motion for several proteins, measuring the evolution of the iron-histidine Raman intensity in picosecond range. The movement of the iron towards the planar heme after nitric oxide binding is retarded.

TuF • Shaped Pulses—Continued

TuF6 • 6:00 p.m.

Coherent Control of a Single Molecule, *Daan Brinks*¹, *Fernando D. Stefan*², *Florian Kulzer*³, *Richard Hildner*¹, *Niek F. van Hulst*^{1,4}; ¹ICFO, Spain, ²Univ. de Buenos Aires, Argentina, ³Univ. Lyon 1, France, ⁴ICREA, Spain.

Coherent control of single molecules at room-temperature is exploited to investigate conformational disorder between chemically identical molecules. Highly efficient control is achieved by adapting the excitation field to each specific molecule in its local nano-environment.

TuF7 • 6:15 p.m.

Coherent Raman Microscopy with a Fiber-Format Femtosecond Laser Oscillator, *Alessio Gambetta*, *Vikas Kumar*, *Giulia Grancini*, *Dario Polli*, *Cristian Manzoni*, *Roberta Ramponi*, *Giulio Cerullo*, *Marco Marangoni*; *Politecnico di Milano, Italy*. A novel highly simplified architecture for Coherent Raman Scattering microscopy (CARS and SRS) is demonstrated, where multiple tunable narrowband picosecond pulses are generated by spectral compression of femtosecond pulses emitted by a compact Er-fiber oscillator.

TuG • Transient Biomolecular Structures—Continued

TuG6 • 6:00 p.m.

Ultrafast Multidimensional Infrared Spectroscopy of Transient Structures - New Insights into the FeFe [Hydrogenase] Enzyme Reaction Mechanism, *Gerald M. Bonner*¹, *Andrew I. Stewart*¹, *Joseph A. Wright*², *Spyridon Kaziannis*¹, *Stefano Santabarbara*¹, *Ian P. Clark*³, *Gregory M. Greetham*³, *Michael Towrie*³, *Anthony W. Parker*³, *Christopher J. Pickett*², *Neil T. Hunt*¹; ¹Univ. of Strathclyde, UK, ²Univ. of East Anglia, UK, ³STFC Rutherford Appleton Lab, UK. The structures of intermediate species pertaining to the reaction mechanism of the FeFe[hydrogenase] enzyme are investigated using ultrafast transient-2-D-IR and pump-probe methods. 2-D-IR spectroscopy provides additional insights into the vibrational dynamics of the active site.

TuG7 • 6:15 p.m.

Protein Structure Determination in Complex Environments Using 2-D IR Spectroscopy, *Chris T. Middleton*, *Ann Marie Woys*, *Yu-Shan Lin*, *Allam S. Reddy*, *Wei Xiong*, *Juan J. de Pablo*, *James L. Skinner*, *Martin Zanni*; *Univ. of Wisconsin at Madison, USA*. We apply isotope labelling, molecular dynamics simulations and 2-D IR spectroscopy to the membrane bound antibiotic peptide ovispirin. From the 2-D lineshapes, we ascertained the peptide secondary structure and orientation in the bilayer.

6:30 p.m.–7:30 p.m. TuE • Poster Session II—Continued, Rooftop Garden

NOTES

Wednesday, July 21, 8:00 a.m.–5:00 p.m. Registration Open, Lobby

WA • Optical Antennas and Nanosystems

Wednesday, July 21

8:30 a.m.–10:15 a.m.

Keith Nelson; MIT, USA, *President*

WA1 • 8:30 a.m.

Invited

High Harmonics Generation by Plasmonic Resonance of Metal Nanostructures and Its Applications, *Seung-Woo Kim, Joonhee Choi, Seungchul Kim, In-Yong Park; KAIST, Republic of Korea*. 3-D nanostructures are designed and tested as the plasmonic waveguide to enhance the incident femtosecond laser for the high harmonics generation of EUV radiation.

WA2 • 9:00 a.m.

Deterministic Control of Subwavelength Field Localization in Plasmonic Nanoantennas, *Martin Aeschlimann¹, Michael Bauer², Daniela Bayer¹, Tobias Brixner³, Stefan Cunovic⁴, Alexander Fischer¹, Pascal Melchior¹, Walter Pfeiffer⁴, Martin Rohmer¹, Christian Schneider¹, Christian Strüber⁴, Philip Tuchscherer³, Dmitri V. Voronine⁴; ¹Univ. of Kaiserslautern, Germany, ²Univ. Kiel, Germany, ³Univ. Würzburg, Germany, ⁴Univ. Bielefeld, Germany*. Subwavelength photoemission localization and switching in plasmonic bowtie nanoantennas is achieved experimentally. Analytic and adaptive control schemes are investigated, and agreement between both approaches is demonstrated.

WA3 • 9:15 a.m.

Strong-Field Photoelectron Emission From Metal Nanostructures, *Reiner Bormann, Max Gulde, Alexander Weismann, Sergey Yalunin, Claus Ropers; Univ. of Göttingen, Germany*. Photoelectron emission from metallic nanotips is studied experimentally and theoretically in the strong-field regime. The passage from multiphoton to tunnel emission is clearly resolved, and explained in terms of a one-dimensional quantum mechanical treatment.

WA4 • 9:30 a.m.

Terahertz Near-Field Imaging of Electric and Magnetic Resonances in Plasmonic High Frequency Devices, *Andreas Bitzer^{1,2}, Jan Wallauer¹, Hannes Merbold², Florian Enderli², Thomas Feurer², Hanspeter Helm¹, Markus Walther¹; ¹Univ. of Freiburg, Germany, ²Univ. of Bern, Switzerland*. We report a terahertz near-field imaging approach providing spatially resolved measurements of amplitude, phase, and polarization of the electric field. Using this approach we extract the microscopic near-field signatures in plasmonic devices and planar metamaterials.

WA5 • 9:45 a.m.

Few-Femtosecond Time-Domain Optical Response Function Reconstruction of a Plasmonic Nanostructure, *Xiaoji G. Xu¹, Kseniya S. Deryckx¹, Alexandria Anderson¹, Günter Steinmeyer², Markus Raschke¹; ¹Univ. of Washington, USA, ²Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany*. Femtosecond plasmonic response function of individual metallic nanostructures is obtained with precise phase and amplitude from second-harmonic correlation measurement and spectrogram analysis. Dephasing rate of $\tau = 20$ fs at the Drude limit is obtained.

WA6 • 10:00 a.m.

Few-Cycle Nonlinear Optics with Single Plasmonic Nanoantennas, *Tobias Hanke, Günther Krauss, Daniel Träutlein, Alfred Leitenstorfer, Rudolf Bratschitsch; Dept. of Physics and Ctr. for Applied Photonics, Univ. of Konstanz, Germany*. Optical antennas are excited resonantly with sub-10-fs pulses in the near infrared. Intense third harmonic emission allows measurement of a sub-cycle plasmon dephasing time of 2 fs, demonstrating efficient radiation coupling of these broadband nanodevices.

10:15 a.m.–10:45 a.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

10:15 a.m.–4:15 p.m. Exhibits Open, Erickson/Carroll/Sinclair Rooms

WB • Molecular Electron Correlation

Wednesday, July 21

10:45 a.m.–12:30 p.m.

Graham R. Fleming; Lawrence Berkeley Natl. Lab, USA, Presider

WB1 • 10:45 a.m.

Selective Nonlinear Response-Preparation in the Electronic Ground-State by Means of Degenerate Four-Wave-Mixing, *Jan P. Kraack, Tiago Backup, Marcus Motzkus; Univ. Heidelberg, Germany.* Femtosecond Degenerate Four-Wave-Mixing was employed to selectively prepare vibrational coherence-dynamics in electronic ground-states of bio-physically active chromophores. The method can be used to determine pure vibrational coherence evolution in the ground-state.

WB2 • 11:00 a.m.

Wave Packet Reconstruction on Unknown Potential Surfaces by Two-Colour Non-Linear Wave Packet Interferometry, *Heide N. Ibrahim¹, Craig Chapman², Hiroyuki Katsuki¹, Jeffrey A. Cina², Kenji Ohmori¹; ¹Natl. Inst.s of Natural Sciences, Japan, ²Dept. of Chemistry and Oregon Ctr. for Optics, Univ. of Oregon, USA.* The reconstruction of quantum mechanical states on weakly characterized potential energy surfaces by two-colour non-linear wave packet interferometry is presented and surveyed for the (well-known) model system Iodine in a jet.

WB3 • 11:15 a.m.

Visible Two-Dimensional Spectroscopy with sub-7 fs Pulses Uncovers Ultrafast Electron-Phonon Coupling Dynamics, *Franz Milota¹, Tomas Mančal², Vladimír Lukeš³, Alexandra Nemeth⁴, Jaroslav Sperling⁴, Harald F. Kauffmann^{4,5}, Jürgen Hauer⁴; ¹Lehrstuhl für BioMolekulare Optik, Ludwig-Maximilians-Univ. München, Germany, ²Inst. of Physics, Faculty of Mathematics and Physics, Charles Univ., Czech Republic, ³Dept. of Chemical Physics, Slovak Technical Univ., Slovakia, ⁴Dept. of Physical Chemistry, Univ. of Vienna, Austria, ⁵Ultrafast Dynamics Group, Faculty of Physics, Vienna Univ. of Technology, Austria.* Electronic two-dimensional spectroscopy with sub-7 fs resolution with the aid of simulations and quantum chemistry reveals the time scale and underlying dynamics of electron-phonon coupling, internal vibrational redistribution, and double quantum resonances in solvated Zinc-Phthalocyanine.

WB4 • 11:30 a.m.

Measurement of Electron Correlation Using Two-Dimensional Electronic Double-Quantum Coherence Spectroscopy, *Vanessa M. Huxter^{1,2}, Jeongho Kim^{2,3}, Gregory D. Scholes²; ¹Univ. of California at Berkeley, USA, ²Univ. of Toronto, Canada, ³KAIST, Republic of Korea.* Two-dimensional electronic double-quantum coherence spectroscopy (2-D-DQCS) is a vibrationally sensitive, background-free measure of the electronic correlations between double and single excited states. 2-D-DQCS measurements of organic dye molecules including wavelength and solvent dependence are reported.

WB5 • 11:45 a.m.

The Influence of Homoconjugation on Ultrafast Dynamics in Cyclohexa-1,4-diene, *Oliver Schalk, Andrey E. Boguslavskiy, Michael S. Schuurman, Albert Stolow; Steacie Inst. of Molecular Sciences, Natl. Res. Council Canada, Canada.* The influence of homoconjugation on ultrafast dynamics of cyclohexa-1,4-diene was investigated by time-resolved photoelectron spectroscopy in comparison with cyclohexene. While little influence is seen on excited states, both molecules exhibit clearly different ground state dynamics.

WC • Novel Ultrafast Techniques

Wednesday, July 21

10:45 a.m.–12:30 p.m.

Thomas Feurer; Univ. of Bern, Switzerland, Presider

WC1 • 10:45 a.m.

Frequency-Domain Streak Camera for Ultrafast Imaging of Evolving Luminal Velocity Objects, *Zhengyan Li, Rafal Zgadaj, Xiaoming Wang, Stephen Reed, Yang Zhao, Michael C. Downer; Dept. of Physics, Univ. of Texas at Austin, USA.* We supplement Frequency-Domain Holography with a Frequency-Domain Streak Camera to capture the time evolution of luminal velocity refractive index structures in a single shot. A single spectrometer acquires all data.

WC2 • 11:00 a.m.

Compact and Low-Cost Fs Diode-Pumped Cr:Colquiriite Laser Technology, *James G. Fujimoto, Umit Demirbas, Duo Li, Andrew Benedick, Gale S. Petrich, Jonathan R. Birge, Jing Wang, Sheila Nabanja, Leslie A. Kolodziejki, Alphan Sennaroglu, Franz X. Kärtner; MIT, USA.* Diode-pumped femtosecond Cr:Colquiriite lasers are a versatile, low-cost complementary technology to Ti:Sapphire. Modelocked tuning of >100-nm, GHz repetition-rates and timing jitters of 156 attoseconds (10 kHz–10 MHz) are demonstrated from different Cr:Colquiriite laser implementations.

WC3 • 11:15 a.m.

Fast Fe-Doped ZnO Scintillator for Accurate Synchronization of Femtosecond Pulses from XFEL and Conventional Ultrafast Laser, *Toshihiko Shimizu^{1,2}, Kohei Yamano^{1,2}, Tomoharu Nakazato^{1,2}, Kohei Sakai¹, Nobuhiko Sarukura^{1,2}, Dirk Ehrentauf³, Tsuguo Fukuda³, Mitsuru Nagasono², Tadashi Togashi², Shinichi Matsubara^{2,4}, Kensuke Tono², Atsushi Higashiya², Makina Yabashi², Hiroaki Kimura^{2,4}, Haruhiko Ohashi^{2,4}, Tetsuya Ishikawa²; ¹Inst. of Laser Engineering, Osaka Univ., Japan, ²RIKEN, Japan, ³WPI Advanced Inst. for Materials Res., Tohoku Univ., Japan, ⁴Japan Synchrotron Radiation Res. Inst., Japan.* The luminescence rise time of a Fe-doped ZnO X-ray scintillator was measured to be less than 4 ps. This allows timing control between XFEL pulses and femtosecond lasers to within a few picosecond accuracy.

WC4 • 11:30 a.m.

Time-Resolved Vibrational Circular Dichroism and Optical Rotation with Ultrashort Laser Pulses, *Mathias Bonmarin, Jan Helbing; Univ. Zürich, Switzerland.* We present recent progress in enhancing chiral vibrational signals using ellipsometric methods and broad band detection for the improvement of our first transient vibrational circular dichroism measurements.

WC5 • 11:45 a.m.

Atmospheric Pressure Femtosecond Laser Imaging Mass Spectrometry, *Yves Coello, A. Daniel Jones, Tissa C. Gunaratne, Marcos Dantus; Michigan State Univ., USA.* We present a novel imaging mass spectrometry technique using femtosecond laser pulses to ablate and ionize the sample at ambient conditions with improved lateral resolution (1µm), as demonstrated here with an image of vegetable cells.

WB • Molecular Electron Correlation—Continued**WB6 • 12:00 p.m.**

Femtosecond Dynamics of Small Molecules Excited Studied with Vacuum-Ultraviolet Pulse Pairs, *Thomas K. Allison*^{1,2}, *Travis W. Wright*³, *Adam M. Stooke*¹, *Champak Khurmi*², *Jeroen van Tilborg*², *Yanwei Liu*², *Roger W. Falcone*^{1,2}, *Ali Belkacem*²; ¹Univ. of California at Berkeley, USA, ²Lawrence Berkeley Natl. Lab, USA, ³Univ. of California at Davis, USA. We use a split mirror interferometer to combine two colors of a high order harmonic source with variable delay. We report on the photodissociation dynamics of O₂ and C₂H₄ excited at 160 nm.

WB7 • 12:15 p.m.

The Photoprotective Properties of Adenine: Time-Resolved Photoelectron Spectroscopy at Different Excitation Wavelengths, *Susanne Ullrich*, *N. L. Evans*, *Hui Yu*, *A. N. Brouillette*; Univ. of Georgia, USA. Competing deactivation pathways in Adenine are identified using wavelength-dependent time-resolved photoelectron spectroscopy. Excited state lifetimes associated with $\pi\pi^* \rightarrow n\pi^* \rightarrow$ ground state relaxation decrease with increasing excitation energies and an additional pathway is accessible around 6eV.

WC • Novel Ultrafast Techniques—Continued**WC6 • 12:00 p.m.**

Differential Multiphoton Microscopy, *Jeffrey Squier*, *Jeff Field*, *Erich Hoover*, *Eric Chandler*, *Michael Young*, *Dawn Vitek*; Colorado School of Mines, USA. High-speed nonlinear imaging systems capable of dynamically imaging differences in depth, excitation polarization, excitation wavelength, beam shape, and pulse shape with single element detection are presented for the first time.

WC7 • 12:15 p.m.

Label-Free Live Brain Imaging with Ultrafast Nonlinear Microscopy, *Stefan Witte*, *Adrian Negrean*, *Johannes C. Lodder*, *Guilherme T. Silva*, *Christiaan P. J. de Kock*, *Huibert D. Mansvelder*, *Marloes L. Groot*; Vrije Univ. Amsterdam, Netherlands. We demonstrate that third-harmonic generation microscopy using an ultrafast optical parametric oscillator is a powerful technique for imaging live brain tissue with sub-cellular resolution, without the need for fluorescent dyes.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)**NOTES**

WD • Photosynthesis

Wednesday, July 21

2:00 p.m.–3:45 p.m.

Ralph Jimenez; JILA, USA, Presider

WD1 • 2:00 p.m.

Invited

Quantum-Coherent Energy Transfer in Marine Algae at Ambient Temperature via Ultrafast Photon Echo Studies, *Cathy Y. Wong, Hoda Hossein-Nejad, Carles Curutchet, Gregory D. Scholes; Univ. of Toronto, USA*. Experiments using two-dimensional photon echo spectroscopy reveal that electronic excitations are coherently coupled in a family of light-harvesting antenna proteins isolated from marine cryptophyte algae, thereby influencing energy transfer.

WD2 • 2:30 p.m.

Towards Understanding the Role of Coherent Dynamics in Natural Light-Harvesting, *Jan Olšina, František Šanda, Tomáš Mančal; Faculty of Mathematics and Physics, Charles Univ. in Prague, Czech Republic*. Specially tailored projection operator is proposed to improve theoretical description of a molecular system driven by fluctuating light. Coherent dynamics predicted by different theoretical methods are compared.

WD3 • 2:45 p.m.

Optimization of the Fast Charge Separation in Artificial Photosynthesis for Efficient Transport, *Benjamin P. Fingerhut¹, Wolfgang Zinth², Regina de Vivie-Riedle¹; ¹Dept. Chemie und Biochemie, Ludwig-Maximilians-Univ. München, Germany, ²BioMolekulare Optik, Fakultät für Physik, Ludwig-Maximilians-Univ. München and Ctr. for Integrated Protein Science München, Germany*. The concepts of bacterial photosynthesis are extended to the design of artificial photochemical devices. With multi-objective genetic algorithms we reveal the energetic, morphologic and kinetic requirements of an optimized charge-separating unit coupled to diffusive transport.

WD4 • 3:00 p.m.

Signatures of Quantum Exciton Transport in Two-Dimensional Coherent Optical Signals of Photosynthetic Complexes, *Darius Abramavicius, Shaul Mukamel; Univ. of California at Irvine, USA*. We present simulations of two dimensional spectra in the photosynthetic reaction center of photosystem II that clearly establish wavelike energy transport at room temperature. This transport mechanism survives decoherence due to the fluctuating protein environment.

WD5 • 3:15 p.m.

Two-Dimensional Electronic Spectroscopy of the Qy Band of Photosystem II Reaction Centers, *Jeffrey A. Myers, Kristin L. M. Lewis, Franklin Fuller, Patrick F. Tekavec, Jennifer P. Ogilvie; Univ. of Michigan, USA*. We present two-dimensional electronic spectroscopy studies on the dynamics of D1-D2 cyt.b559 reaction center complexes from plant photosystem II at 77 K. Our two-dimensional spectra are compared with models based on current theory.

WD6 • 3:30 p.m.

Elucidation of Electronic Structure and Quantum Coherence in LHCII with Polarized 2-D Spectroscopy, *Gabriela S. Schlau-Cohen^{1,2}, Tessa R. Calhoun^{1,2}, Naomi S. Ginsberg^{1,2}, Matteo Ballottari³, Roberto Bassi³, Graham R. Fleming^{1,2}; ¹Univ. of California at Berkeley, USA, ²Lawrence Berkeley Natl. Lab, USA, ³Univ. of Verona, Italy*. Polarized, broadband two-dimensional electronic spectroscopy is performed on light harvesting complex II. The results both reveal spectral features which can experimentally test site energies for the first time and also isolate quantum coherence signals.

3:45 p.m.–4:15 p.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

WE • Attosecond Spectroscopy I

Wednesday, July 21

4:15 p.m.–5:45 p.m.

Ursula Keller; ETH Zürich, Switzerland, *Presider*

WE1 • 4:15 p.m.

Attosecond Transient Absorption Spectroscopy for Real-Time Observation of Valence Electron Motion, *Adrian Wirth*¹, *Eleftherios Goulielmakis*¹, *Zhi-Heng Loh*^{2,3}, *Robin Santra*^{4,5}, *Nina Rohringer*⁶, *Vladislav S. Yakovlev*⁷, *Sergey Zherebtsov*¹, *Thomas Pfeifer*^{2,3}, *Abdallah M. Azzeer*⁸, *Matthias F. Kling*¹, *Stephen R. Leone*^{2,3}, *Ferenc Krausz*^{1,7}; ¹Max-Planck-Inst. für Quantenoptik, Germany, ²Univ. of California at Berkeley, USA, ³Chemical Sciences Div., Lawrence Berkeley Natl. Lab, USA, ⁴Argonne Natl. Lab, USA, ⁵Dept. of Physics, Univ. of Chicago, USA, ⁶Lawrence Livermore Natl. Lab, USA, ⁷Dept. für Physik, Ludwig-Maximilians-Univ., Germany, ⁸Physics and Astronomy Dept., King Saud Univ., Saudi Arabia. Combining attosecond technology and X-ray absorption spectroscopy further expands the horizon of attosecond science. In a proof-of-principle experiment we traced valence electron motion in real time and completely reconstructed the strong-field initiated spin-orbit wavepacket coherence.

WE2 • 4:30 p.m.

Visualizing Electron Rearrangement in Space and Time during the Transition from a Molecule to Atoms, *Wen Li*^{1,2}, *Agnieszka A. Jaroń-Becker*¹, *Craig W. Hogle*¹, *Vandana Sharma*¹, *Xi Bin Zhou*¹, *Andreas Becker*¹, *Henry C. Kapteyn*¹, *Margaret M. Murnane*¹; ¹JILA and Dept. of Physics, Univ. of Colorado, USA, ²Dept. of Chemistry, Wayne State Univ., USA. Using strong field ionization and time-resolved reaction microscope techniques, we visualize both in space and time the dynamical evolution of the electrons as a molecular bond ruptures, and discover new aspects to the electronic dynamics.

WE3 • 4:45 p.m.

Pump-Control Experiments to Enhance the Electron Localizability in Dissociating H₂ with Phase-Stable Laser Pulses, *Bettina Fischer*¹, *Manuel H. Kremer*¹, *Vandana Sharma*¹, *Bernold Feuerstein*¹, *Thomas Pfeifer*¹, *Vitor L. B. de Jesus*², *Christian Hofrichter*¹, *Artem Rudenko*³, *Uwe Thumm*⁴, *Claus Dieter Schröter*¹, *Robert Moshhammer*¹, *Joachim Ullrich*¹; ¹Max-Planck-Inst. für Kernphysik, Germany, ²Inst. Federal de Educação, Ciência e Tecnologia do Rio de Janeiro, Brazil, ³Max-Planck Advanced Study Group at CFEL, Germany, ⁴James R. Macdonald Lab, Kansas State Univ., USA. The first two-pulse measurements with carrier-envelope-phase (CEP) stabilized laser pulses on H₂ were recorded with a reaction microscope. The role of a coherent wave packet in the dissociating H₂⁺ for the charge localization is investigated.

WE4 • 5:00 p.m.

High-Order Harmonic Generation from Aligned Molecules with Intense Femtosecond 800- and 1300-nm Pulses, *Shinichirou Minemoto*, *Kosaku Kato*, *Hirofumi Sakai*; Univ. of Tokyo, Japan. Harmonic intensities from aligned CO₂ molecules measured as a function of pump-probe delay with 800- and 1300-nm pulses modulate out of phase with ion yields at the same harmonic photon energies, supporting two-center interference picture.

WE5 • 5:15 p.m.

Ultrafast Hydrogen Migration in Allene in Intense Laser Fields: Evidence in Three-Body Coulomb Explosion, *Huailiang Xu*, *Tomoya Okino*, *Kaoru Yamanouchi*; Univ. of Tokyo, Japan. Ultrafast hydrogen migration in allene (CH₂=C=CH₂) occurring within 20 fs in intense laser fields was investigated by coincidence momentum imaging. The ultrafast spread of the distribution of a proton covering the entire molecule was visualized.

WE6 • 5:30 p.m.

Observation of Optical Bullets Formed in Laser-Driven Plasma Bubble Accelerators, *P. Dong*¹, *S. A. Reed*¹, *S. A. Yi*¹, *S. Kalmykov*¹, *G. Shvets*¹, *N. H. Matlis*², *C. McGuffey*³, *S. S. Bulanov*³, *V. Chvykov*³, *G. Kalintchenko*³, *K. Krushelnick*³, *A. Maksimchuk*³, *T. Matsuoka*³, *A. G. R. Thomas*³, *V. Yanovsky*³, *M. C. Downer*¹; ¹Univ. of Texas at Austin, USA, ²Lawrence Berkeley Natl. Lab, USA, ³Ctr. for Ultrafast Optical Science, Univ. of Michigan, USA. Laser-driven plasma "bubble" accelerators, which produce mono-energetic electron beams, are shown to reshape co-propagating probe pulses into optical "bullets" that visualize the bubble directly.

7:30 p.m.–9:30 p.m. Conference Dinner, Anderson/Hoaglund Rooms

Thursday, July 22, 8:00 a.m.–5:00 p.m. Registration Open, Lobby

ThA • Attosecond Spectroscopy II

Thursday, July 22

8:30 a.m.–10:15 a.m.

Kaoru Yamanouchi; Univ. of Tokyo, Japan, Presider

ThA1 • 8:30 a.m.

Invited

High Harmonic Spectroscopy of Small Molecules: Waiting for HODO, Y. Mairesse¹, J. Higuette¹, N. Dudovich², D. Shafir², B. Fabre¹, E. Mevel¹, E. Constant¹, D. Villeneuve³, P. Corkum³, S. Patchkovskii³, M. Yu. Ivanov⁴, Z. Walters⁵, O. Smirnova⁵, Olga Smirnova⁵; ¹Univ. Bordeaux 1, France, ²Weizmann Inst. of Science, Israel, ³Natl. Res. Council Canada, Canada, ⁴Imperial College London, UK, ⁵Max-Born-Inst., Germany. We use high harmonic spectroscopy to characterize the attosecond dynamics of multi-electron re-arrangement during strong-field ionization of molecules. We reconstruct the relative phase between different ionization continua to characterize the hole left upon ionization.

ThA2 • 9:00 a.m.

Driving Electronic Wavepackets by Attosecond Half-Cycle Pulses, Xinhua Xie¹, Stefan Roither¹, Daniil Kartashov¹, Li Zhang¹, Emil Persson², Stefanie Gräfe², Markus Schöffler³, Matthias Lezius⁴, Georg Reider¹, Reinhard Dörner³, Joachim Burgdörfer², Andrius Baltuška¹, Markus Kitzler¹; ¹Photonics Inst., Vienna Univ. of Technology, Austria, ²Inst. for Theoretical Physics, Vienna Univ. of Technology, Austria, ³Inst. für Kernphysik, J. W. Goethe Univ. Frankfurt, Germany, ⁴Max-Planck Inst. for Quantum Optics, Germany. We study the feasibility of using attosecond half-cycle pulses for quantum control of electron wavepacket motion. Measured strong asymmetries in electron-momentum-spectra are explained by quantum simulations to result from excited state dynamics and Coulomb effects.

ThA3 • 9:15 a.m.

Attosecond Transient Absorption around the Ionization Threshold of Helium, Florian Schapper¹, Mirko Holler¹, Paula Rivière², Lukas Gallmann¹, Ulf Saalmann², Jan-Michael Rost², Ursula Keller¹; ¹ETH Zürich, Switzerland, ²Max-Planck-Inst. for the Physics of Complex Systems, Germany. We observe theoretically and experimentally the IR-assisted absorption of an attosecond pulse train in a helium gas target. The transmitted photon yield is modulated on an attosecond time-scale, and a spectrally localized emission occurs.

ThA4 • 9:30 a.m.

Investigating Two-Photon Double Ionization of D₂ by XUV-Pump / XUV-Probe Experiments at Flash, Oliver Herrwerth¹, Yuhai H. Jiang², Artem Rudenko³, Jhon F. Pérez-Torres⁴, Lutz Foucar³, Moritz Kurka², Kai U. Kühnel², Michael Toppin², Etienne Plésiat⁴, Fernando Morales⁴, Fernando Martín⁴, Till Jahnke⁵, Reinhard Dörner⁵, Jose L. Sanz-Vicario⁶, Joan van Tilborg⁷, Ali Belkacem⁷, Michael Schulz⁸, Kiyoshi Ueda⁹, Theo J. M. Zouros¹⁰, Stefan Dusterer¹¹, Rolf Treusch¹¹, Claus D. Schröter², Matthias Lezius¹, Matthias F. Kling¹, Robert Moshhammer², Joachim Ullrich²; ¹Max-Planck-Inst. für Quantenoptik, Germany, ²Max-Planck-Inst. für Kernphysik, Germany, ³Max-Planck Advanced Study Group at CFEL, Germany, ⁴Dept. de Química C-9, Univ. Autónoma de Madrid, Spain, ⁵Inst. für Kernphysik, Univ. Frankfurt, Germany, ⁶Inst. de Física, Univ. de Antioquia, Colombia, ⁷Lawrence Berkeley Natl. Lab, USA, ⁸Univ. of Missouri, USA, ⁹Inst. of Multidisciplinary Res. for Advanced Materials, Tohoku Univ., Japan, ¹⁰Dept. of Physics, Univ. of Crete, Greece, ¹¹DESY, Germany. Using a novel split-mirror set-up attached to a Reaction Microscope at the Free electron LASer in Hamburg (FLASH) we demonstrate an XUV-pump - XUV-probe experiment by tracing the ultra-fast nuclear wave-packet motion in the D₂⁺.

ThA5 • 9:45 a.m.

Ultrafast Control of Fragmentation Pathways of Soft X-Ray Driven Dissociation of Triatomic N₂O Molecules, Xibin Zhou, Predrag Ranitovic, Craig Hogle, Margaret Murnane, Henry Kapteyn; JILA and Dept. of Physics, Univ. of Colorado, USA. Ultrashort X-ray pulses initiate a coulomb explosion of N₂O through two distinct fragmentation pathways, corresponding to breaking an NN or NO bond. The branching ratio between these channels is controlled using a 30fs infrared pulse.

ThA6 • 10:00 a.m.

Molecular Processes Controllable by Electron Dynamics, Philipp von den Hoff, Regina de Vivie-Riedle; Dept. Chemie, Ludwig-Maximilians-Univ., Germany. Based on our calculations, we elucidate the role of light driven electron wavepacket motion for the control of molecular processes. We highlight the system requirements defining the time window for electronic coherence and efficient control.

10:15 a.m.–10:45 a.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

10:15 a.m.–4:15 p.m. Exhibits Open, Erickson/Carroll/Sinclair Rooms

ThB • Light Driven Dynamics in Biomolecules

Thursday, July 22

10:45 a.m.–12:30 p.m.

Sandy Ruhman; Hebrew Univ. of Jerusalem, Israel, *Presider***ThB1 • 10:45 a.m.**

Vibrationally-Mediated Dynamics in β -Carotene Probed with Broadband 2-D Electronic Spectroscopy, *Tessa R. Calhoun*^{1,2}, *Jeffrey A. Davis*³, *Graham R. Fleming*^{1,2}; ¹Univ. of California at Berkeley, USA, ²Lawrence Berkeley Natl. Lab, USA, ³Swinburne Univ. of Technology, Australia. Competing electronic pathways exhibiting energy dependence across a single vibronic excitation are observed in β -carotene for the first time with broadband two-dimensional electronic spectroscopy at 77K. The origins and implications of these features are discussed.

ThB2 • 11:00 a.m.

Coherent Multidimensional Spectroscopies Refine the Energy Level Scheme of β -Carotene, *Niklas Christensson*¹, *Franz Milota*¹, *Alexandra Nemeth*¹, *Harald F. Kauffmann*^{1,2}, *Jürgen Hauer*¹; ¹Dept. of Physical Chemistry, Univ. of Vienna, Austria, ²Ultrafast Dynamics Group, Faculty of Physics, Vienna Univ. of Technology, Austria. Electronic single- and double-quantum coherence spectroscopy (1Q- and 2Q-2D) of β -carotene reveals the energetic position, transition strength and spectral properties of a novel excited state above S_2 with a transition in the visible spectral region.

ThB3 • 11:15 a.m.

Coherent Effects in Carotenoids, *Jeffrey A. Davis*¹, *Evelyn Cannon*¹, *Lap V. Dao*¹, *Peter Hanaford*¹, *Keith A. Nugent*², *Harry M. Quiney*²; ¹Swinburne Univ. of Technology, Australia, ²Univ. of Melbourne, Australia. Long-lived vibrational coherences in carotenoids are enhanced when the carotenoid is within the LH2 light-harvesting complex. Electronic coherence of the bright transition is also made observable in LH2, revealing new details of excited state evolution.

ThB4 • 11:30 a.m.

Direct Observation of the Conical Intersection in cis-trans Photoisomerization of Rhodopsin, *Dario Polli*¹, *Piero Alto*², *Oliver Weingart*³, *Philipp Kukura*⁴, *Katelyn Spillane*⁵, *Cristian Manzoni*¹, *Daniele Brida*¹, *Gaia Tomasello*², *Giorgio Orlandi*², *Richard A. Mathies*⁵, *Marco Garavelli*², *Giulio Cerullo*¹; ¹Politecnico di Milano, Italy, ²Univ. di Bologna, Italy, ³Univ. Duisburg-Essen, Germany, ⁴ETH Zürich, Switzerland, ⁵Univ. of California at Berkeley, USA. High-time-resolution broadband pump-probe spectroscopy of rhodopsin reveals loss of reactant and appearance of photoproduct features within ≈ 100 fs, which are signatures of a wavepacket moving through a conical intersection. Experiments are supported by molecular dynamics simulations.

ThB5 • 11:45 a.m.

Coherent Torsional Motion and Isomerization Dynamics across a Conical Intersection, *Julien Briand*¹, *Jérémy Léonard*¹, *Vinizio Zanirato*², *Massimo Olivucci*³, *Stefan Haacke*¹; ¹Univ. Strasbourg - IPCMS, France, ²Univ. di Ferrara, Italy, ³Bowling Green State Univ., USA. The ultrafast isomerisation dynamics of indanylidene-pyrroline photo-switches show evidence for vibrational coherences along the reaction coordinate. We observe, to our knowledge for the first time, a dependence of wavepacket decoherence on the isomerization direction.

ThC • Quantum Coherence Correlations

Thursday, July 22

10:45 a.m.–12:30 p.m.

Alfred Leitenstorfer; Univ. Konstanz, Germany, *Presider***ThC1 • 10:45 a.m.****Invited**

Coherent Measurements of High-Order Electronic Correlations in GaAs Quantum Wells, *Daniel Turner*, *Keith A. Nelson*; MIT, USA. Multidimensional high-order coherent spectroscopy reveals correlations among more than two excitons. Features in the fifth-order and seventh-order spectra allow us to measure the extent of exciton correlations in a semiconductor nanostructure.

ThC2 • 11:15 a.m.

Two-Quantum Coherences in Optical Two-Dimensional Fourier Transform Spectroscopy, *Steven Cundiff*¹, *Denis Karaiskaj*¹, *Xingcan Dai*¹, *Lijun Yang*², *Alan D. Bristow*¹, *Marten Richter*², *Richard P. Mirin*³, *Shaul Mukamel*²; ¹JILA, NIST, Univ. of Colorado, USA, ²Univ. of California at Irvine, USA, ³NIST, USA. We present optical two-dimensional Fourier transform spectra for the pulse sequence sensitive to two-quantum coherences. In semiconductors, two-quantum coherences occur due to biexcitons and many-body effects, in a potassium vapor, they arise from atomic interactions.

ThC3 • 11:30 a.m.

Coherent Energy Transport between Coupled Quantum Wells Studied by Two-Dimensional Terahertz Spectroscopy, *Wilhelm Kuehn*¹, *Klaus Reimann*¹, *Michael Woerner*¹, *Thomas Elsaesser*¹, *Rudolf Hey*²; ¹Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany, ²Paul-Drude-Inst. für Festkörper Elektronik, Germany. A coupled quantum well system is extensively studied by fully phase-resolved 2-D intersubband spectroscopy. We observe prominent oscillatory features, caused by a coherent LO-phonon mediated charge transport between both wells within 120fs.

ThC4 • 11:45 a.m.

Ultrafast THz Response of Few-Layer Epitaxial Graphene, *Hyunyoung Choi*¹, *Ferenc Borondics*¹, *David A. Siegel*^{1,2}, *Shuyun Zhou*^{1,2}, *Michael C. Martin*¹, *Alessandra Lanzara*^{1,2}, *Robert A. Kaindl*¹; ¹Lawrence Berkeley Natl. Lab, USA, ²Univ. of California at Berkeley, USA. Ultrafast measurements of few-layer epitaxial graphene are reported along with its equilibrium optical conductivity. We observe transient THz electrodynamic consistent with photoexcited holes in a dense Dirac electron plasma, which recombine on a picosecond timescale.

ThB • Light Driven Dynamics in Biomolecules—Continued

ThB6 • 12:00 p.m.

Time-Energy Map of Photoelectron Angular Anisotropy for Investigation of Ultrafast Internal Conversion, *Takao Fujii*^{1,2}, *Yoshi-Ichi Suzuki*^{1,2,3}, *Takuya Horio*^{1,2,3}, *Toshinori Suzuki*^{1,2,3}; ¹CREST, JST, Japan, ²RIKEN, Japan, ³Kyoto Univ., Japan. Ultrafast internal conversion of pyrazine through a conical intersection was observed by photoelectron imaging with 22 fs time-resolution. The 2-D time-energy map of the photoelectron angular anisotropy revealed a clear signature of the internal conversion.

ThB7 • 12:15 p.m.

Dynamic Vibrational Stark Spectroscopy: Measuring the Solvent Response in Ultrafast Charge-Transfer Reactions, *Carlos R. Baiz*, *Kevin J. Kubarych*; *Univ. of Michigan, USA*. We present the first implementation of dynamic vibrational Stark-effect spectroscopy and demonstrate its use as a probe of non-equilibrium dynamics in phototriggered charge-transfer reactions.

ThC • Quantum Coherence Correlations—Continued

ThC5 • 12:00 p.m.

Controlling “Mottness” in a Correlated Electron System via Coherent Vibrational Excitation, *Stefan Kaiser*¹, *Ra’anan I. Tobey*², *Nicky Dean*², *Cristian Manzoni*¹, *Hiroshi Okamoto*³, *Jun’ya Tsutsumi*³, *Tatsuo Hasegawa*³, *Andrea Cavalleri*^{1,2}; ¹Univ. of Hamburg, Germany, ²Dept. of Physics, Univ. of Oxford, Clarendon Lab, UK, ³AIST, Japan. Control of onsite electronic wavefunctions is achieved in the organic conductor (BEDT-TTF)-F₂TCNQ by resonant excitation of localized molecular vibrational modes of the BEDT molecule. In this way, the onsite two-particle Coulomb repulsion can be modulated.

ThC6 • 12:15 p.m.

All-Optical Coherent Control of Electrical Currents in Single GaAs Nanowires, *Claudia Ruppert*¹, *Sebastian Thunich*¹, *Gerhard Abstreiter*², *Anna Fontcuberta i Morral*^{2,3}, *Alexander W. Holleitner*², *Markus Betz*^{1,4}; ¹Technische Univ. München, Germany, ²Walter-Schottky-Inst., Technische Univ. München, Germany, ³Lab des Matériaux Semiconducteurs. Inst. des Matériaux, École Polytechnique Fédérale de Lausanne, Switzerland, ⁴Technische Univ. Dortmund, Germany. A phase-stable superposition of femtosecond pulses and their second harmonic induces ultrashort microampere current bursts in single unbiased GaAs nanowires. Current injection relies on quantum interference of one- and two-photon absorption pathways.

12:30 p.m.–2:00 p.m. Lunch Break (on your own)

NOTES

ThD • Vibrational Coherence and Energy Transport

Thursday, July 22

2:00 p.m.–3:45 p.m.

Gregory Scholes; Univ. of Toronto, Canada, *Presider***ThD1 • 2:00 p.m.**

Ultrafast Coupled Electronic and Lattice Dynamics in Exciton Self-Trapping: Correlation of the Localization Length and Acoustic Phonon Dynamics, J. G. Mance, F. X. Morrissey, A. D. Van Pelt, S. L. Dexheimer; Washington State Univ., USA. We probe the dynamics of exciton self-trapping using femtosecond impulsive excitation techniques. We find a low frequency oscillatory response consistent with coherent acoustic phonon generation, with an acoustic wavelength that scales with exciton localization length.

ThD2 • 2:15 p.m.**Invited**

Vibrational Energy Transport in Peptides and Proteins, Peter Hamm¹, Marco Schade¹, Ellen H. G. Backus¹, Alessandro Moretto², Claudio Toniolo²; ¹Inst. of Physical Chemistry, Univ. of Zürich, Switzerland, ²Inst. of Biomolecular Chemistry, Padova Unit, CNR, Dept. of Chemistry, Univ. of Padova, Italy. We investigate the vibrational energy flow in 3₁₀-helical peptide structures. Several local heaters reveal very similar results, indicating that energy randomizes very quickly. Nevertheless, intra-site IVR slows down vibrational energy transport on the picosecond timescale.

ThD3 • 2:45 p.m.

Multiply Excited Vibrational States of Docking-Site CO Simultaneously Observed with Ground-State Bleach after Photolysis from Heme Proteins, Patrick Nuernberger, Kevin F. Lee, Adeline Bonvalet, Jean-Louis Martin, Marten H. Vos, Manuel Joffre; Lab d'Optique et Biosciences, École Polytechnique, France. We simultaneously observe ultrafast ligand dissociation and docking-site absorption in carboxy-heme proteins. Highly sensitive visible pump/infrared probe spectroscopy reveals multiply excited vibrational states exhibiting distinct differences for hemoglobin and FixL.

ThD4 • 3:00 p.m.

Ultrafast Dynamics of the BLUF Mutant dAppA Q63E Revealed by TRIR and Fluorescent Upconversion, Andras Lukacs¹, Allison Haigney², Minako Kondo¹, Richard Brust², Greg Greetham³, Mike Towrie³, Peter J. Tonge², Stephen R. Meech¹; ¹School of Chemistry, Univ. of East Anglia, UK, ²Dept. of Chemistry, Stony Brook Univ., USA, ³Central Laser Facility, Rutherford Appleton Lab, UK. Primary processes in blue light sensing proteins are investigated by ultrafast vibrational and fluorescence spectroscopy. A major role for modulation of H-bonded interaction between flavins and a critical Q63 residue are revealed through mutagenesis.

ThD5 • 3:15 p.m.

Initial Relaxation Dynamics of Retinal Protonated Schiff-Bases Determined by Pump Degenerate Four Wave Mixing, Tiago Buckup, Jan P. Kraack, Marcus Motzkus; Univ. Heidelberg, Germany. Initial relaxation-dynamics of photo-excited all-trans retinal protonated Schiff-bases were investigated with Pump-Degenerate Four Wave Mixing. It is presented that low-frequency modes are excitable only within a short time of relaxation from the Franck-Condon point.

ThD6 • 3:30 p.m.

Deciphering Excited State Evolution in Halorhodopsin with Stimulated Emission Pumping, Oshrat Bismuth¹, Pavel Komm¹, Noga Friedman², Tamar Eliash², Mordechai Sheves², Sanford Ruhman¹; ¹Hebrew Univ., Israel, ²Weizmann Inst. of Science, Israel. Femtosecond pump, NIR dump experiments demonstrate that contrary to previous reports, nonexponential internal conversion in Natronomonas pharaonis Halorhodopsin doesn't reflect bifurcation in the fluorescent state to short lived reactive, and slowly decaying non reactive populations.

3:45 p.m.–4:15 p.m. Coffee Break/Exhibits, Erickson/Carroll/Sinclair Rooms

ThE1

Pulse Shaper Based Strategies for Selective Single-Beam CARS Spectroscopy, Paul Wrzesinski, Dmitry Pestov, Vadim Lozovoy, Marcos Dantus; *Michigan State Univ., USA*. The use of chirp, sinusoidal and binary phase shaping for mode-specific excitation in single-beam CARS is experimentally evaluated in terms of signal-to-background and selectivity. The advantages and disadvantages of each pulse shaping scheme are discussed.

ThE2

Ultrafast Optical Response of Lead Lanthanum Zirconium Titanate Ceramics, Atsushi Sugita, Masashi Morimoto, Yoshimasa Kawata, Naoki Wakiya, Hisao Suzuki; *Shizuoka Univ., Japan*. We will report ultrafast optical response of lead lanthanum zirconium titanate ceramics. The photo-induced birefringence was by approximately 20 times larger than that of SiO₂, while its optical response was shorter than 70 fs.

ThE3

Optical Magnetic Field Detection: Intracavity Phase Interferometry, Andreas Schmitt-Sody, Koji Masuda, Andreas Velten, Jean-Claude Diels; *Dept. of Physics and Astronomy, Univ. of New Mexico, USA*. A new approach to magnetometry is demonstrated. Using intracavity phase to frequency conversion a sensitivity of 10nT corresponding to a polarization rotation of 2×10^{-9} rad can be achieved, using a short TGG crystal as sensing element.

ThE4

Coherent Nuclear Motion of Blue Copper Protein; Plastocyanin: Comparing LMCT and d-d Excitation, Yutaka Nagasawa¹, Kenji Fujita¹, Tetsuro Katayama¹, Yukihide Ishibashi¹, Hiroshi Miyasaka¹, Teruhiro Takabe², Satoshi Nagao³, Shun Hirota³; ¹*Osaka Univ., Japan*, ²*Meijo Univ., Japan*, ³*Nara Inst. of Science and Technology, Japan*. Ultrafast transient absorption measurement was carried out for a blue copper protein, plastocyanin, with excitation at LMCT (597 nm) and d-d band (895 nm). Franck-Condon and Herzberg-Teller type coherent nuclear oscillations were observed.

ThE5

Determining Chlorophyll Orientation in the CP29 Light Harvesting Complex with Arithmetic Polarized 2-D Electronic Spectroscopy, Naomi S. Ginsberg^{1,2}, Jeffrey A. Davis³, Matteo Ballottari⁴, Yuan-Chung Cheng⁵, Roberto Bassi⁴, Graham R. Fleming^{1,2}; ¹*Lawrence Berkeley Natl. Lab, USA*, ²*Univ. of California at Berkeley, USA*, ³*Swinburne Univ. of Technology, Australia*, ⁴*Univ. of Verona, Italy*, ⁵*Natl. Taiwan Univ., Taiwan*. The relative orientation of chlorophyll transition dipole moments in the light harvesting complex CP29 is determined directly from experimental measurements of a set of polarized two-dimensional electronic spectra in combination with polarization tensor relations.

ThE6

Ultrafast Excited State Dynamics in Genomic DNA, Kimberly de La Harpe¹, Bern Kohler²; ¹*Ohio State Univ., USA*, ²*Montana State Univ., USA*. Excited electronic states in a genomic DNA sequence containing all four DNA bases were studied using femtosecond transient absorption spectroscopy. Long-lived excited states observed in each single strand separately are conserved in the duplex DNA.

ThE7

Induced Fit and Ultrafast Vibrational Dynamics in Host-Guest-Chemistry Explored by 2DIR-Spectroscopy, Britta Valentin, Stephan Knop, Martin Olschewski, Jörg Lindner, Peter Vöhringer; *Rheinische Friedrich-Wilhelms-Univ. Bonn, Germany*. Femtosecond two-dimensional infrared spectroscopy in the NH- and CH-stretching spectral region was used to unravel structural details and the vibrational energy flow in the supramolecular host-guest complex of an ammonium cation and a cryptand.

ThE8

fs-Fluorescence Measurements of the Adenine Dinucleotide: Direct Observation of the Excimer State, Mayra C. Stuhldreier, Carmen Schüler, Joscha Kleber, Friedrich Temps; *Inst. für Physikalische Chemie, Christian-Albrechts-Univ. zu Kiel, Germany*. Femtosecond time-resolved fluorescence measurements on the adenine dinucleotide d(pApA) revealed wavelength-dependent, complex excited-state relaxation dynamics via monomer-like and via excimer states, depending on the degree of base stacking.

ThE9

Ultrafast Photochemistry of Mercury Dithizonates, Heinrich Schwöerer¹, Karel von Eschwege², Gurthwin Bosman¹, Patrizia Krok¹, Jeanet Conradie²; ¹*Laser Res. Inst., Stellenbosch Univ., South Africa*, ²*Dept. of Chemistry, Univ. of the Free State, South Africa*. We investigate the photoreaction of mercury dithizonate, and find an ultrafast radiationless reaction into the syn and anti configuration with almost equal probability, which is interpreted by a conical intersection between excited and ground state.

ThE10

Dynamic Solvent Effects on Equilibrium Isomerization: Kramers Theory Revisited with 2DIR Chemical Exchange, Jessica M. Anna, Kevin J. Kubarych; *Univ. of Michigan, USA*. Using ultrafast two dimensional infrared chemical exchange spectroscopy we monitored the equilibrium exchange between two dicobalt octacarbonyl isomers in linear alkane solvents. Results were inconsistent with a Markovian hydrodynamic viscosity implicating Kramers-Hubbard and/or frequency-dependent friction.

ThE11

The Influence of Solvent and Chirp on the Excited State Dynamics of 7-Dehydrocholesterol in Solution, Kuo-Chun Tang, Kenneth G. Spears, Roseanne J. Sension; *Univ. of Michigan, USA*. UV-visible femtosecond transient absorption spectroscopy and UV pulse shaping were used to probe the excited state dynamics of 7-dehydrocholesterol (provitamin D₃) in solution.

ThE12

Separating Sub-Ensembles on Ultrafast Timescales: Multiple-Population Period Transient Spectroscopy (MUPPETS), Champak Khurmi, Mark A. Berg; *Univ. of South Carolina, USA*. Multidimensional incoherent spectroscopy has analogs of echoes, stimulated echoes, hole-burning and correlation spectroscopy. These MUPPETS methods disentangle complex, nonexponential kinetics. A pathway formulation extends MUPPETS to many processes and systematically treats high-order transient gratings.

ThE13

Ultrafast Intramolecular Charge Transfer (ICT) Dynamics of 4-(Dimethylamino) Benzonitrile (DMABN), *Myeongkee Park, Chulhoon Kim, Taiha Joo*; Dept. of Chemistry, Pohang Univ. of Science and Technology, Republic of Korea. Formation times of intramolecular charge-transfer (ICT) state of 4-(dimethylamino)benzonitrile (DMABN) in acetonitrile are resolved by time constants of 30 fs, 180 fs, and 2.7 ps, denoting the ICT state can be created through multi ways.

ThE14

The First Picoseconds in the Life of Benzhydryl Cations: Ultrafast Generation and Chemical Reactions, *Christian F. Sailer¹, Benjamin P. Fingerhut², Johannes Ammer², Christoph Nolte², Igor Pugliesi¹, Herbert Mayr², Regina de Vivie-Riedle², Eberhard Riedle¹*; ¹LS für BioMolekulare Optik, Ludwig-Maximilians-Univ. München, Germany, ²Dept. Chemie, Ludwig-Maximilians-Univ. München, Germany. For benzhydryl chloride compounds we observe that photodissociation only leads to radical pairs. The typically observed cations are formed by subsequent electron transfer. Reactions of cations in neat alcohols can then occur within 2.6 ps.

ThE15

Ultrafast Molecular Planarization through a Conical Intersection, *Jenny Clark¹, Giovanni Cirmi², Guglielmo Lanzani²*; ¹Camendish Labs, Univ. of Cambridge, UK, ²Politecnico di Milano, Italy. Pump-push-probe experiments on fluorene-heptamer in solution reveal ultrafast planarization of the molecular backbone, within 200 fs, at variance with typical time scale of 40 ps. This suggests relaxation through a conical intersection.

ThE16

New Insights into the Excited State Relaxation Network of Carotenoids, *Tiago Buckup, Marie S. Marek, Marcus Motzkus*; Ruprecht-Karls-Univ. Heidelberg, Germany. By applying DFWM and pump-DFWM to lycopene and β -carotene detailed knowledge about the internal conversion between the S₂ and S₁ state is gained. An additional very fast dynamics directly after excitation of S₂ is discussed.

ThE17

Solvent Dependent Spectral Diffusion in Hydrogen Bonding Environments, *John T. King, Kevin Kubarych*; Univ. of Michigan, USA. The spectral diffusion of Mn₂(CO)₁₀ in hydrogen bonding solvents was studied using ultrafast two-dimensional infrared spectroscopy. In a series of alcohols with increasing chain length, the dynamics of hydrogen bonding environments can be selectively studied.

ThE18

Ultrafast, Protein-Based All-Optical Switching, *Zsuzsanna Heiner¹, László Fábán¹, Mark Mero², Miklós Kiss³, Károly Osvay³, András Dér¹*; ¹Inst. of Biophysics, Hungarian Acad. of Sciences, Hungary, ²HAS Res. Group of Laser Physics, Hungarian Acad. of Sciences, Hungary, ³Dept. of Optics and Quantum Electronics, Univ. of Szeged, Hungary. A picosecond all-optical switch based on the bR-K transition of the photocycle of the chromoprotein bacteriorhodopsin is demonstrated by an integrated optical waveguide structure. The results are expected to have implications for fast telecommunication.

ThE19

Generation of Stable and Clean 8-fs Pulses at 400nm in a Hollow Fiber for UV Pump-Probe Experiment, *Jun Liu^{1,2}, Kotaro Okamura^{1,2}, Yuichiro Kida^{1,2}, Takahiro Teramoto^{1,2}, Takayoshi Kobayashi^{1,2,3,4}*; ¹Univ. of Electro-Communications, Japan, ²JST, Japan, ³Natl. Chiao Tung Univ., Taiwan, ⁴Osaka Univ., Japan. Stable and clean 8-fs pulses at 400 nm were obtained using a beam pointing stabilizer before a hollow-fiber compressor and a prism pair together with a deformable mirror system for dispersive compensation.

ThE20

Measuring the Spatiotemporal Field of Diffracting and Non-Diffracting Ultrashort Pulses, *Pamela Bowlan¹, Madis Löhms², Peeter Piksaro², Heli Valtna-Lukner², Peeter Saari², Rick Trebino¹*; ¹Georgia Tech, USA, ²Univ. of Tartu, Estonia. Using SEA TADPOLE, we directly measure the spatiotemporal field of pulses after diffracting off of simple apertures observing the “boundary wave pulses”. We also measure the spatiotemporal field of non-diffracting, superluminal Bessel-X pulses.

ThE21

Characterization of High-Frequency, Quantum-Limited Timing Jitter in Stretched-Pulse and Soliton, Passively-Modelocked Fiber Lasers, *Jonathan A. Cox, Amir H. Nejadmalayeri, Franz X. Kärtner*; MIT, USA. We measured the timing jitter, with unprecedented sensitivity and bandwidth, between pairs of similar 80MHz stretched-pulse and 200MHz soliton, passively mode-locked lasers with 400pJ pulse energy, to be 7.3fs and 4.6fs [10kHz, 10MHz], respectively.

ThE22

Single-Dispersive-Element Pulse Compressor, *Vikrant K. Chauhan, Pamela Bowlan, Jacob Cohen, Rick Trebino*; Georgia Tech, USA. We introduce an ultrashort-laser-pulse compressor that is compact and automatically aligned for distortion-free output. It uses a single prism and a single grating, and it compensates for significant material dispersion up to third order.

ThE23

Simply Measuring Many-Picosecond Ultrashort Pulses with High Spectral Resolution, *Jacob Cohen, Pamela Bowlan, Vikrant Chauhan, Rick Trebino*; Georgia Tech, USA. We introduce three new techniques for measuring relatively long and very complex ultrashort pulses, allowing the measurement of pulses as long as 120ps with 39fs resolution.

ThE24

Few-Cycle OPCPA System with More than 1μJ at 143kHz, *Marcel Schultze¹, Thomas Binhammer², Andy Steinmann¹, Guido Palmer¹, Moritz Emons¹, Uwe Morgner^{1,3}*; ¹Leibniz Univ. Hannover, Germany, ²Venteon Laser Technologies GmbH, Germany, ³Laser Zentrum Hannover (LZH), Germany. An OPCPA system delivering 8.8 fs pulses with 1.3 μJ of energy at 143 kHz repetition rate is presented. Pump and seed for the parametric amplification are simultaneously generated by a broadband Ti:sapphire oscillator.

ThE25

Completely Characterizing Single Attosecond Pulses by the Modified Spectral Phase Interferometry, *Jiangfeng Zhu*^{1,2}, *Shaobo Fang*^{1,2}, *Keisaku Yamane*^{1,2}, *Tao Chen*^{1,2}, *Mikio Yamashita*^{1,2}; ¹Dept. of Applied Physics, Hokkaido Univ., Japan, ²Core Res. for Evolutional Science and Technology, JST, Japan. Complete characterization of single attosecond pulses by the modified spectral phase interferometry is presented considering the frequency-dependent spectral shear. The results show no principle limitation of characterizing arbitrary short single attosecond pulses.

ThE26

High-Order Harmonic Generation by Few-Cycle Pulses from Filamentation, *Daniel S. Steingrube*^{1,2}, *Emilia Schulz*^{1,2}, *Thomas Binhammer*³, *Tobias Vockerodt*^{1,2}, *Uwe Morgner*^{1,2}, *Milutin Kovacev*^{1,2}; ¹Inst. für Quantenoptik, Leibniz Univ. Hannover, Germany, ²QUEST, Ctr. for Quantum Engineering and Space-Time Res., Germany, ³VENTEON Laser Technologies GmbH, Germany. High-order harmonics are generated in a semi-infinite gas cell by ultra-short pulses from a filament compressed to pulse duration of 7 fs. Harmonic spectra in different noble gases are obtained yielding a continuous structure.

ThE27

Bandwidth-Enhanced Noncollinear Optical Parametric Amplification via Anamorphic Pumping, *Philip J. M. Johnson*, *Valentyn I. Prokhorenko*, *R. J. Dwayne Miller*; Univ. of Toronto, Canada. We present a scheme for anamorphic pumping to enhance the amplified bandwidth in a single-pass blue-green NOPA, resulting in up to 100THz output. This represents a significant gain in amplified bandwidth over conventional focusing.

ThE28

Self-Trapping of Supercontinuum Generated by Femtosecond Pulses in a Noble Gas, *Trenton R. Ensley*, *Dmitry A. Fishman*, *Lazaro A. Padilha*, *Scott Webster*, *David J. Hagan*, *Eric W. Van Stryland*; CREOL, College of Optics and Photonics, Univ. of Central Florida, USA. We present an experimental and theoretical study of self-trapping that includes self-focusing and the production of plasma for supercontinuum generated in noble gases using ultra-short laser pulses.

ThE29

Advanced Compton Scattering Light Source R&D at LLNL, *Felicie Albert*, *Scott G. Anderson*, *Gerry G. Anderson*, *Andy J. Bayramian*, *Shawn M. Betts*, *Tak S. Chu*, *David J. Gibson*, *Roark A. Marsh*, *Michael J. Messerly*, *Miroslav Y. Shverdin*, *Sheldon S. Wu*, *Fred V. Hartemann*, *Craig W. Siders*, *Christopher P. J. Barty*; Lawrence Livermore Natl. Lab, USA. We report the design and current status of a monoenergetic laser-based Compton scattering 0.5-2.5 MeV γ -ray source. Previous nuclear resonance fluorescence results and future linac and laser developments for the source are presented.

ThE30

Photoemission-Coherent Auger Decay, *Aart J. Verhoeft*, *Alexander Mitrofanov*¹, *Xuan Trung Nguyen*¹, *Maria Krikunova*², *Markus Drescher*², *Armin Scrinzi*^{1,3}, *Andrius Baltuška*¹; ¹Vienna Univ. of Technology, Austria, ²Univ. Hamburg, Germany, ³Ludwig-Maximilians-Univ. München, Germany. In the presence of an IR-field, high-energy Auger-electrons are emitted with the same kinetic energy as IR-streaked electrons directly XUV-ionized from the 4s-subshell in Krypton. Interference of the two electronic wave-packets is experimentally observed.

ThE31

High Harmonic Generation for Study of Rotational Raman Coherence, *Lap Van Dao*, *Khuong Ba Dinh*, *Peter Hannaford*; Swinburne Univ. of Technology, Australia. The modulation of the intensity of phase-matched high-harmonic radiation from field-free aligned diatomic molecules due to changes of the nonlinear refractive index is used to determine rotational coherence in the ground state of molecules.

ThE32

Isolating Spectral Contributions from Local Field Effects in an Atomic Vapor Using Two-Quantum 2-D FT Optical Spectroscopy, *Katherine W. Stone*, *Keith A. Nelson*; MIT, USA. Two-quantum 2-D Fourier transform optical spectroscopy is used to separate the contributions of dipole-dipole interactions to the overall nonlinear optical response which isolates them from the atomic resonances in rubidium vapor that generated them.

ThE33

Coherent Control of Population Transfer in an Open Quantum System in the One-Photon Limit, *Valentin I. Prokhorenko*, *Philip J. M. Johnson*, *R. J. Dwayne Miller*; Univ. of Toronto, Canada. Using chirped excitation pulses on the level of ≤ 1 photon per field mode we are able to manipulate the excited state population of a dye molecule in a solvent by $\sim 4\%$.

ThE34

Space-Time Coupling in Femtosecond Scalar and Vector Pulse Shaping, *Franziska Frei*, *Reto Bloch*, *Thomas Feurer*; Inst. of Applied Physics, Univ. of Bern, Switzerland. We present analytical as well as experimental results of space-time coupling in femtosecond scalar and vector pulse shaping. In focusing geometry, the influence of space-time coupling on nonlinear light matter interaction is discussed.

ThE35

Non-Born-Oppenheimer Wavepacket Revivals in a Polyatomic Molecule, *Andrey E. Boguslavskiy*, *Dave Townsend*, *Michael S. Schuurman*, *Albert Stolow*; Steacie Inst. for Molecular Sciences, Natl. Res. Council Canada, Canada. Non-Born-Oppenheimer wavepacket revivals have been observed in 1,4-diazabicyclo[2.2.2]octane using time-resolved photoelectron spectroscopy. Upon photoexcitation, the wavepacket oscillates between the first two excited states for over 14 ps - a behavior only seen in diatomics before.

ThE36

Terahertz Generation via Two Color Photoionization in Pre-Formed Plasma, *Yong-Sing You*, *Ki-Yong Kim*; Univ. of Maryland, USA. The generation of terahertz radiation is examined when two-color laser fields are mixed in pre-formed plasma created by another laser pulse. The result confirms the key role of tunneling ionization in the terahertz generation mechanism.

ThE37

Photoconductivity in TiO₂ Nanotubes Measured by Time Resolved Terahertz Spectroscopy, *Christiaan Richter*, *Charles Schmuttenmaer*; Yale Univ., USA. Picosecond time resolved photoconductivity of TiO₂ single crystals, nanoparticles, and nanotubes is reported. Long range photoconductivity of both nanomaterials is impaired. The THz data reveal a very different microscopic mechanism reducing conductivity nanotubes vs. nanoparticles.

ThE38**Non-Degenerate Pump-Probe Spectroscopy of Single GaN Nanowires**, *Prashanth C. Upadhyay*¹, Julio A. Martinez², Qiming Li², George T. Wang², Brian S. Swartzentruber², Antoinette J. Taylor¹, Rohit P. Prasankumar¹; ¹Ctr. for Integrated Nanotechnologies, Los Alamos Natl. Lab, USA, ²Sandia Natl. Labs, USA. Spatially-resolved ultrafast transient absorption measurements on a single GaN nanowire give insight into carrier relaxation dynamics as a function of the probe polarization and position on the nanowire on a femtosecond timescale.**ThE39****Measurement of Effective Refractive Index Ellipse of LiNbO₃ Subwavelength Slab Waveguide for THz Phonon Polariton Wave**, *Chengliang Yang*¹, *Qiang Wu*¹, Christopher A. Werley², Jingjun Xu¹, Keith A. Nelson²; ¹Nankai Univ., China, ²MIT, USA. The propagation process of THz phonon polariton wave in 50 micrometer LiNbO₃ slab waveguide is recorded using polarization gating imaging system. The effective refractive indexes of different models are calculated from the dispersion curves.**ThE40**

Ultrafast Photoinduced Phase Conversion to a Metallic State in Quasi-One-Dimensional Platinum Complexes under Extremely High-Density Excitation, *Taro Kawano*¹, *Ikufumi Katayama*², *Taeho Shin*³, *Johanna Wolfson*³, *Keith A. Nelson*³, *Jun Takeda*¹; ¹Graduate School of Engineering, Yokohama Natl. Univ., Japan, ²Interdisciplinary Res. Ctr., Yokohama Natl. Univ., Japan, ³MIT, USA. Ultrafast photoinduced phase conversion from a charge-density wave state to a metallic state in quasi-one-dimensional platinum complexes is successfully demonstrated by single-shot pump-probe spectroscopy with dual echelons under extremely high-density excitation above 1 photon/platinum site.

ThE41

THz Kerr Effect in Relaxor Ferroelectrics, *Harold Y. Hwang*¹, *Matthias C. Hoffmann*², *Nathaniel C. Brandt*¹, *Keith A. Nelson*¹; ¹MIT, USA, ²Univ. of Hamburg, Germany. THz-induced optical birefringence was observed in the relaxor ferroelectrics KTN and KLTN. The dynamics observed may arise from the onset of ferroelectric nanodomains.

ThE42

Observation of THz Nonlinearity in CVD-Grown Graphene, *Harold Y. Hwang*, *Nathaniel C. Brandt*, *Hootan Farhat*, *Allen L. Hsu*, *Jing Kong*, *Keith A. Nelson*; MIT, USA. Nonlinear transmission experiments were performed on CVD-grown graphene. THz-induced transparency and nonlinear THz generation were observed at high THz field strengths.

ThE43

Coherent Nonlinear Response Surviving at Room Temperature Caused by Ultrafast Radiative Decay of Confined Excitons, *Masaaki Ashida*¹, *Masayoshi Ichimiya*^{1,2}, *Keita Mochizuki*¹, *Hideki Yasuda*³, *Hajime Ishihara*³, *Tadashi Itoh*¹; ¹Osaka Univ., Japan, ²Osaka Dental Univ., Japan, ³Osaka Prefecture Univ., Japan. Temperature dependence of degenerate four-wave mixing spectra of confined excitons in CuCl thin films was investigated. The nonlinear optical response was observed even at room temperature because of the ultrafast radiative decay.

ThE44

Ultrafast Dynamic Ellipsometry and Spectroscopies of Laser Shocked Materials, *Shawn McGrane*, *Cynthia Bolme*, *Von Whitley*, *David Moore*; Los Alamos Natl. Lab, USA. Ultrafast ellipsometry and transient absorption spectroscopies are used to measure material dynamics under extreme conditions of temperature, pressure, and volumetric compression induced by shock wave loading with a chirped, spectrally clipped shock drive pulse.

ThE45

Ultrafast Generation of Dense Dirac Fermions in Graphene Monolayer: Evidence for Three-Particle Coulomb Scattering, *Tianqi Li*, *Liang Luo*, *Myron Hupalo*, *Michael C. Tringides*, *Ligang Wang*; Dept. of Physics and Astronomy, Ames Lab, Iowa State Univ., USA. A power law dependence $I^{1/3}$ of the amplitude of femtosecond differential reflectivity in highly photo-excited graphene monolayer indicates three-particle decay, allowing for generation of dense Dirac fermions beyond phase space filling within 35 fs.

ThE46

Ultrafast Coherent High-Field Electron Transport in GaAs, *Wilhelm Kuehn*¹, *Peter Gaal*¹, *Klaus Reimann*¹, *Michael Woerner*¹, *Thomas Elsaesser*¹, *Rudolf Hey*²; ¹Max-Born-Inst. für Nichtlineare Optik und Kurzzeitspektroskopie, Germany, ²Paul-Drude-Inst. für Festkörper

Elektronik, Germany. With strong terahertz pulses we observe at $T=300\text{K}$ in GaAs coherent ballistic electron transport across half the Brillouin zone. At $T=80\text{K}$ we find additionally terahertz driven tunneling from the valence into the conduction band.

ThE47

Probing Electron Transfer in Polymer/Fullerene Blends Using Ultrahigh Time Resolution Coherent Vibrational Spectroscopy, *Sarah M. Falke*¹, *Daniele Brida*², *Giulio Cerullo*², *Christoph Lienau*¹; ¹Inst. für Physik, Carl von Ossietzky Univ. Oldenburg, Germany, ²Natl. Lab for Ultrafast and Ultraintense Optical Science, CNR-INFN, Politecnico di Milano, Italy. We report nonlinear optical spectra of polymer/fullerene-blends measured with unprecedented 10-fs-time resolution. Our results suggest that the photoinduced charge-generation in such blends proceeds via a hybrid electronic state delocalized over the polymer and fullerene moieties.

ThE48

Intermolecular Correlation Effects in the Electronic Relaxation Dynamics of Organic Single Crystals, *Brantley A. West*¹, *Jordan M. Womick*¹, *Ke Jie Tan*², *Laurie E. McNeil*¹, *Andrew M. Moran*¹; ¹Univ. of North Carolina at Chapel Hill, USA, ²Nanyang Technological Univ., Singapore. Nonlinear optical techniques are used to investigate the influence of specific thermally driven nuclear motions on <100 fs electronic relaxation processes in organic single crystals. Experiments and simulations suggest the importance of spatial correlated fluctuations.

ThE49

Light-Induced Modulation of Ferroelectric Polarization Probed Using Time-Resolved X-Ray Scattering, *Dan Daranciang*¹, *Haidan Wen*², *Matt Highland*³, *Brad Perkins*⁴, *Nathaniel Brandt*⁴, *Keith Nelson*⁴, *Jorgen Larsson*⁵, *Donald Walko*³, *Eric Dufresne*³, *Paul Fuoss*³, *Brian Stephenson*³, *Aaron Lindenberg*^{1,2}; ¹SLAC Natl. Accelerator Lab, USA, ²Stanford Univ., USA, ³Argonne Natl. Lab, USA, ⁴MIT, USA, ⁵Lund Univ., Sweden. Time-resolved X-ray diffraction techniques are used to visualize atomic-scale displacements within the unit cell of the nanoscale ferroelectric PbTiO₃. A picosecond all-optically-induced polarization modulation is observed, associated with a large-amplitude carrier-induced increase in the polarization.

Thursday, July 22

3:45 p.m.–6:00 p.m.

Rooftop Garden

ThE50

Molecular Vibrational Response of Ice Layers after Ultrashort-Laser Excitation of Metal Surfaces, *Juraj Bďžoch*¹, *Martin Wolf*^{1,2}, *Christian Frischkorn*¹; ¹Freie Univ. Berlin, Germany, ²Fritz-Haber-Inst. der Max-Planck-Gesellschaft, Germany. Electron injection into thin, crystalline D₂O layers on a Ru(001) surface after UV excitation has been investigated using broadband sum-frequency generation spectroscopy, whereby a signal enhancement by several orders of magnitude is observed.

ThE51

Probing Ultrafast Dynamics of 5f Electrons in Crystalline UO₂, *Yong Q. An*, *Antoinette J. Taylor*, *Tomasz Durakiewicz*, *George Rodriguez*; Los Alamos Natl. Lab, USA. We find the

lifetimes of photoexcited 5f electrons in crystalline UO₂, ~1.2 ns for midgap states and ~2 μs for upper Hubbard band states at low temperatures, identify magnetic transitions, and observe picosecond intraband relaxation.

ThE52

Conductivity Dynamics in the Correlated Metallic State of V₂O₃, *Mengkun Liu*¹, *Brian Pardo*¹, *Mumtaz M. Qazilbash*², *Sun J. Yun*³, *Byung G. Chae*³, *Bong J. Kim*³, *Dimitri N. Basov*², *Richard D. Averitt*¹; ¹Boston Univ., USA, ²Univ. of California at San Diego, USA, ³ETRI, Republic of Korea. We report on time resolved studies of V₂O₃ which undergoes a metal-insulator transition at ~150K. In metallic state, we observe coherent terahertz conductivity oscillations in hundred-picosecond time scale

following optical excitation with 35-fs 800nm pulses.

ThE53

One Dimensional Exciton Diffusion in J-Aggregates, *Henning Marciniak*¹, *Xue-Qing Li*², *Frank Würthner*², *Stefan Lochbrunner*¹; ¹Univ. of Rostock, Germany, ²Univ. of Würzburg, Germany. The annihilation dynamics of excitons in J-aggregates of substituted perylene bisimides is investigated by femtosecond absorption spectroscopy. The comparison with models shows that the excitons are only mobile along one dimension.

6:00 p.m.–8:00 p.m. Dinner Break (on your own)

8:00 p.m.–10:00 p.m. Postdeadline Papers Session

NOTES

Friday, July 23, 8:30 a.m.–12:00 p.m. Registration Open, Lobby

FA • Surfaces and Interfaces

Friday, July 23

8:30 a.m.–10:15 a.m.

Jean-Yves Bigot; CNRS, Univ. of Strasbourg, France, Presider

FA1 • 8:30 a.m.

Invited

Transient Electronic Structure of Solids and Surfaces Studied with Time- and Angle-Resolved Photoemission, *L. Rettig¹, R. Cortes^{1,2}, H. A. Dürr³, J. Fink³, U. Bovensiepen⁴, Martin Wolf^{1,2}; ¹Freie Univ. Berlin, Germany, ²Fritz-Haber-Inst. of the Max-Planck-Society, Germany, ³Helmholtz-Zentrum Berlin, Germany, ⁴Dept. of Physics, Univ. Duisburg-Essen, Germany. The dynamics of highly correlated materials are studied by femtosecond time- and angle-resolved photoemission spectroscopy. In the new FeAs based superconductors electron-phonon coupling plays a decisive role leading to strongly momentum dependent carrier relaxation.*

FA2 • 9:00 a.m.

Attosecond-Time-Resolved Studies of Electron Dynamics on Surfaces, Stefan Neppel¹, *Dietrich Menzel¹, Peter Feulner¹, Ralph Ernstorfer¹, Reinhard Kienberger¹, Adrian L. Cavalieri², Elisabeth Magerl², Michael Stanislawski², Nicholas Karpowicz², Ferenc Krausz²; ¹Technical Univ. of Munich, Germany, ²Max-Planck-Inst. of Quantum Optics, Germany. We report on time-resolved experiments to investigate the attosecond dynamics of photoelectrons generated by ultra-short XUV pulses on clean metal surfaces and in well-defined adsorbate-metal interfaces.*

FA3 • 9:15 a.m.

Nanoscale Imaging of the Interface Dynamics in Polymer Blends by Femtosecond Pump-Probe Confocal Microscopy, Dario Polli, *G. Grancini, T. Virgili, J. Clark, M. Celebrano, G. Lanzani, G. Cerullo; Politecnico di Milano, Italy. Pump-probe measurements of phase-separated conjugated-polymer films, combining 150-fs temporal and 300-nm spatial resolution, allow one to highlight “dynamical” interfaces, i.e. borders of phase-separated islands that behave differently in terms of transient absorption and relaxation dynamics.*

FA4 • 9:30 a.m.

Transient 2-D IR Spectroscopy of Charge Injection at Organic-Inorganic Interfaces, Wei Xiong, *Jennifer E. Laaser, Peerasak Paoprasert, Ryan A. Franking, Robert J. Hamers, Padma Gopalan, Matrin T. Zanni; Univ. of Wisconsin at Madison, USA. Transient 2-D IR spectroscopy suppresses the signal of free electrons injected at organic-inorganic interfaces, which dominate standard transient spectra. Consequently, vibrational features are better resolved, permitting study of charge injection from different conformations of dyes.*

FA5 • 9:45 a.m.

Ultrafast Phase Change in Ge₂Sb₂Te₅ Induced by Selective Excitation of Coherent Phonons, Kotaro Makino¹, *Junji Tominaga², Muneaki Hase¹; ¹Univ. of Tsukuba, Japan, ²AIST, Japan. We demonstrate ultrafast phase change from amorphous to crystalline state by selective excitation of coherent phonons in Ge₂Sb₂Te₅. We have observed phonon frequency shift corresponding to the structural change within 270 fs after photoexcitation.*

FA6 • 10:00 a.m.

Coherent Acoustic Phonons in Highly Oriented Bismuth Films Monitored by Femtosecond Electron Diffraction, Germán Sciaini¹, *Masaki Hada², Jiro Matsuo², Angelo Karantzis¹, Gustavo Moriena¹, R. J. Dwayne Miller¹; ¹Dept.s of Chemistry and Physics, and Inst. for Optical Sciences, Univ. of Toronto, Canada, ²Quantum Science Res. Ctr., Kyoto Univ., Japan. Femtosecond electron diffraction opens new vistas for determining elastic properties at nanoscale. We report on the detection of coherent acoustic phonons generated via fs laser photoexcitation in ultrathin (110)-highly oriented films of Bismuth.*

10:15 a.m.–10:45 a.m. Coffee Break, Foyer

FB • Strong Field Ionization Dynamics

Friday, July 23

10:45 a.m.–12:15 p.m.

Margaret Murnane; Univ. of Colorado, USA, Presider

FB1 • 10:45 a.m.

Invited

Attosecond Angular Streaking and Tunneling Delay Time in Strong Laser Field Ionization, P. Eckle, A. N. Pfeiffer, C. Cirelli, A. Staudte, R. Dörner, H. G. Muller, Ursula Keller; ETH Zürich, Switzerland. We use attosecond angular streaking to place an intensity-averaged upper limit of 12 attoseconds on the tunneling delay time in strong field ionization of a helium atom. This is much shorter than the Keldysh time.

FB2 • 11:15 a.m.

Optical Detection of Attosecond Ionization Dynamics in Transparent Solids, Alexander Mitrofanov¹, Aart J. Verhoeft¹, Evgenii E. Serebryannikov², Julien Lumeau³, Leonid B. Glebov³, Aleksei M. Zheltikov², Andrius Baltuška¹; ¹Vienna Univ. of Technology, Austria, ²M.V. Lomonosov Moscow State Univ., Russian Federation, ³Univ. of Central Florida, USA. We demonstrate an all-optical pump-probe technique to resolve attosecond ionization dynamics in transparent solids. First experimental evidence of attosecond ionization dynamics in different materials is presented, and compared to Kerr-nonlinearity and third harmonic generation.

FB3 • 11:30 a.m.

Anomalous Anisotropy in the Explosion of Rare-Gas Clusters Irradiated with Intense Few-Cycle Laser Pulses, Eva Skopalová¹, Yasin C. El-Taha¹, Amelle Zair¹, Matthias Hohenberger¹, Emma Springate², John W. G. Tisch¹, Roland A. Smith¹, Jonathan P. Marangos¹; ¹Imperial College London, UK, ²Central Laser Facility, UK. We report anomalous anisotropy in short pulse driven cluster explosions, with more energetic ions emitted in the direction perpendicular to the laser polarization. This anisotropy decreases and eventually reverts as the pulse length is increased.

FB4 • 11:45 a.m.

Intense Femtosecond X-Ray Photoionization Studies of Nitrogen - How Molecules Interact with Light from the LCLS, Matthias Hoener^{1,2}, Li Fang¹, Oleg Kornilov², Oliver Gessner², Nora Berrah¹; ¹Western Michigan Univ., USA, ²Lawrence Berkeley Natl. Lab, USA. Photoionization studies of molecular nitrogen have been performed using intense femtosecond X-ray pulses produced by the Linac Coherent Light Source. Partial ion yields and kinetic energy release spectra reveal a new regime of light-matter interaction.

FB5 • 12:00 p.m.

Molecular Orbital Imaging Using Strong-Field Driven Attosecond Emission, Stefan Haessler¹, Zsolt Diveki¹, Jeremie Caillat^{2,3}, Willem Boutu¹, Cecilia Giovanetti-Teixeira^{2,3}, Thierry Ruchon¹, Thierry Auguste¹, Pierre Breger¹, Alfred Maquet^{2,3}, Bertrand Carré¹, Richard Taieb^{2,3}, Pascal Salières¹; ¹CEA-Saclay, IRAMIS, France, ²UPMC Univ. Paris 06, France, ³CNRS, UMR, France. Advanced characterization of the attosecond emission from aligned N₂ molecules allows us to identify multi-orbital contributions to the generation process. Tomographic reconstruction of the corresponding electronic wavepacket is performed with Ångström-spatial and attosecond-temporal resolution.

Closing Remarks

Friday, July 23

12:30 p.m.–12:45 p.m.