MO 15: Femtosecond Spectroscopy IV

Time: Wednesday 11:00–12:30 Location: F 102

Invited Talk MO 15.1 Wed 11:00 F 102

Lasing in Nitrogen Gas Induced by Femtosecond Filamentation — •Andrius Baltuska[1], Daniil Kartashov[1], Jens Möhring[2], Skirmantas Ališauskas[1], Giedrius Andriukaitis[1], Stefan Hässler[1], Audrius Pugžlys[1], Aleksei Zheltikov[3,4], Markus Motzkus[2], Misha Ivanov[5], and Olga Smirnova[5] — [1]Photonics Institute Vienna University of Technology, Vienna, Austria — [2]Physikalisch-Chemisches Institut University Heidelberg, Heidelberg, Germany — [3]Physics Department, Russian Quantum Center, International Laser Center, M.V. Lomonosov Moscow State University, Moscow, Russia — [4]Department of Physics and Astronomy, Texas A&M University, College Station, USA — [5]Max-Born Institute, Berlin, Germany

Harnessing ultraviolet nitrogen laser emission in air for the purpose of remote sensing has been a topic of numerous studies over the past decade. Unlike in the case of a conventional discharge-driven nitrogen laser, the possible lasing mechanisms are very different for remote excitation with intense femtosecond pulses that form filaments - long narrow channels of low-density cold plasma. New exciting possibilities in this field have arisen since the emergence of novel IR and Mid-IR femtosecond lasers in the past two years. In this talk, we will demonstrate various types of remotely-induced coherent emission, forward as well as backward, from neutral N2 and molecular cation, with and without inversion, which were obtained using single infrared pulses and adaptively shaped pulse trains. The role of free-electron plasma, phase-matched nonlinear wave mixing effects and molecular rotational dynamics will be examined.

MO 15.2 Wed 11:30 F 102

Observation and manipulation of electron dynamics in level systems — •Hendrike Braun, Dominik Pengel, Cristian Sarpe, Matthias Wollenhaupt, and Thomas Baumert — University of Kassel, Institute of Physics and CINSaT, D-34132 Kassel, Germany

The aim of coherent control is to guide a system from an initial state to a preselected target state. Therefore the final population in the target state is generally used as the observable. However, particularly in strong laser fields, the transient dynamics is strongly influenced by nonperturbative interactions such as level shifts. To this end we investigate the transient and final population electron dynamics in the potassium atom during the interaction with a strong resonant laser field. Femtosecond laser pulses are used to induce, control, and probe the electron motion in the level system. A carefully devised two-colour experiment allows for the investigation of the light induced energetic level shifts as well as the transient and final populations.

MO 15.3 Wed 11:45 F 102

Ultrafast X-Ray Diffraction Experiments on Crystalline DIABN via a Laser Driven Plasma Source — •Florian Trommer, Stefan M. Hofmann, Florian J. Lederer, Julian Schauseil, and Wolfgang Zinth — Chair for BioMolecular Optics, Ludwig-Maximilians-University Munich, Oettingenstr. 67, 80538 Munich, Germany

Information on the ultrafast behavior of molecules is most often obtained via spectroscopy. On the other hand, the structure of these molecules has been accessible through X-ray diffraction. Since the introduction of laser driven plasma sources, structure dynamics can also be studied on the femtosecond timescale. In our group we are currently implementing a Pump-Probe-experiment with visible Pump and X-ray Probe.

By using gallium arsenide we could characterise the X-ray source itself and develop techniques for optaining temporal and spatial overlap. The crucial issue in these measurements was to improve experimental precision and to find and eliminate sources of noise in order to approach the shot-noise limit. Finally the optimized setup is used to investigate 4-(Diisopropylamino)benzonitrile (DIABN) crystals[1].

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[1] M. Braun et al., Applied Physics A, **96**(1) 107 (2009)

MO 15.4 Wed 12:00 F 102

Ultrafast X-ray photoelectron spectroscopy studies of photoinduced electronic dynamics in dye sensitized semiconductor nanocrystals. — •Katrin Siefermann[1,2], Fabian Weise[1], Ming-Fu Lin[1], Camila Bacellar[1], Ali Belkacem[1], Thorsten Weber[1], Felix Sturm[1], Daniel Slaughter[1], Champak Khurmi[1], Travis Wright[1], Bob Schoenlein[1], Matthew Strader[1], Hana Cho[1], Robert Kaindl[1], Giacomo Coslovich[1], David Prendergast[1], Andrey Shavorskiy[1], Hendrik Bluhm[1], Jinghua Guo[1], Marcus Hertlein[1], Tolek Tyliszczak[1], Amy Cordones[3], Josh Vura-Weis[3], Stephen Leone[3], Daniel Neumark[3], Sheraz Gul[4], Jin Zhang[4], Nils Huse[5], Martin Beye[6], Anders Nilsson[7], Hirohito Ogasawara[7], Dennis Nordlund[7], Josh Turner[7], Bill Schlotter[7], Oleg Krupin[7], Michael Holmes[7], Mike Minitti[7], Joseph Robinson[7], Marc Messerschmidt[7], Phil Heimann[7], and Oliver Gessner[1] — [1]Lawrence Berkeley National Laboratory, Berkeley, USA — [2]Leibniz Institute of Surface Modification, Leipzig, Germany — [3]University of California Berkeley, USA — [4]University of California Santa Cruz, USA — [5]Center for Free Electron Laser Science, Hamburg, Germany — [6]Helmholtz Zentrum Berlin, Germany — [7]SLAC National Accelerator Laboratory, Stanford, USA

We present time-resolved X-ray photoelectron spectroscopy (TRXPS) as a tool to investigate ultrafast dynamics in complex systems in real time. In a proof-of-principle experiment at the Linac Coherent Light Source (LCLS) at SLAC, we monitored the photoinduced oxidation state change of a Ruthenium-based dye complex (N3) attached to zinc oxide nanocrystals. This system is a critical component of dye-sensitized solar cells. In our experiment, an ultrashort laser pulse with a center wavelength of 535 nm electronically excites the Ru dye complex. A time-delayed X-ray pulse centered at ∼850 eV is used to record the inner shell photoelectron spectrum of the sample in the region of the Ru $3d_{3/2,5/2}$ lines. Oxidation of the dye is detected at a pump-probe delay of ∼500 fs as a transient shift of the Ru 3d photoelectron lines by ∼2 eV toward higher binding energies. The experiment represents a first step toward an atomic site specific real-time picture of charge migration in dye sensitized solar cells and demonstrates the potential of time-resolved X-ray photoelectron spectroscopy (TRXPS) as a tool to investigate ultrafast electronic dynamics in complex systems.

MO 15.5 Wed 12:15 F 102

Signatures of attosecond dynamics in molecular dissociation — •Jesse Klei, Christian Neidel, Chung-Hsin Yang, Lukas Medisauskas, Misha Ivanov, and Marc Vrakking — Max-Born-Institut, Berlin

We report on attosecond time-resolved XUV-IR pump-probe measurements, investigating the dissociative ionization of N_2. Angular resolved photoion measurements of the N^+ fragments were performed using a velocity map imaging spectrometer (VMIS). The kinetic energy spectra of the fragment ions show a structure at low energies corresponding to the vibrational levels of the ionic $C_2\Sigma_u^+$ state of N_2. The photoion yield of these vibrational energies show a clear oscillation as a function of the time delay between the attosecond pulse train (APT) and its infrared (IR) driving laser, with an oscillation period equal to half the IR laser cycle. The phase of the oscillations of the vibrational energy bands show clear jumps with respect to each other. We discuss how these results show the effect of attosecond electronic coherence in femtosecond molecular dynamics.