A 30: Atomic Clusters III (joint session A/MO)

Time: Wednesday 14:00–15:30 Location: K 2.016

A 30.1 Wed 14:00 K 2.016

Single-shot electron imaging of helium nanoplasmas — •Dominik Schomas[1], Nicolas Rendler[1], Andreas Heidenreich[2,3], Thomas Pfeifer[4], Robert Mosshammer[4], and Marcel Mudrich[5] — [1]Physikalisches Institut, Albert-Ludwigs-University, Freiburg — [2]Kimika Fakultatea, Euskal Herriko Unibertsitatea (UPV/EHU) and Donostia International Physics Center (DIPC) — [3]IKERBASQUE, Basque Foundation for Science — [4]Max Planck Institute for Nuclear Physics, Heidelberg — [5]stronomDepartment of Physics and Ay, Aarhus University

Strong femtosecond laserfields can turn a helium nanodroplet into a highly charged nanoplasma. The initial ignition just needs a few electrons provided by tunnel ionization of helium or a dopant particle to start an avalanche of ionizations. The cluster is then completely within a few femtoseconds. Repulsion between ions leads to Coulomb explosion of the cluster and highly energetic ions and electrons are produced. We use the velocity map imaging (VMI) technique to measure the energy and angular distribution of the electrons, and a time-of-flight (TOF) spectrometer to collect the ions. One helium droplet produces enough signal to measure VMI and TOF spectra for individual helium droplets hit by single laser pulses. With pump-probe measurements we investigate the time evolution of the system.

A 30.2 Wed 14:15 K 2.016

Highly Charged Rydberg Ions from the Coulomb Explosion of Clusters — •Dzmitry Komar, Lev Kazak, Mohammed Almassarani, Karl-Heinz Meiwes-Broer, and Josef Tiggesbäumker — Institut für Physik, Universität Rostock, 18059 Rostock, Germany

Ion emission from a nanoplasma produced in the interaction of intense optical laser pulses with argon clusters is studied resolving simultaneously charge states and recoil energies. By applying appropriate static electric fields we observe that a significant fraction of the ions Ar^{q+} (q=1-7) have electrons with binding energies lower than 150 meV, i.e. $n_{Ryd} => 15$ levels are populated. Charge state changes observed on a microsecond time scale can be attributed to electron emission due to autoionizing Rydberg states, indicating that high-l Rydberg levels are populated as well. The experiments support theoretical predictions that a substantial fraction of delocalized electrons, which are bound with hundreds of eV to the nanoplasma after the laser exposure, fill up only meV bound ion states in the adiabatic expansion. We expect the process to be relevant for the long-term evolution of expanding laser-induced dense plasmas in general.

A 30.3 Wed 14:30 K 2.016

Size Dependent Ion Yields from NaCl Nanoarticles Ionized by Intense Femtosecond Laser Pulses — •Egill Antonsson, Felix Gerke, Lucia Merkel, Ina Halfpap, Burkhard Langer, and Eckart Rühl — Physical Chemistry, Freie Universität Berlin, D-14195 Berlin, Germany

Ionization of size selected nanoparticles by intense femtosecond laser pulses is studied by time-of-flight mass spectrometry. For NaCl nanoparticles (d=100-600 nm), a size dependent modulation in the ratio of the yields of Na^+ and Cl^+ ions is observed, although the stoichiometry of the nanoparticles is constant irrespective of size. The observed size dependent ion yields are interpreted in terms of a model, where the intense laser pulses create a nanoplasma and the ion yields of the constituent elemental ions in the nanoparticles are determined by the plasma temperature and the ionization potentials of the elements.

A 30.4 Wed 14:45 K 2.016

Size-dependent angular anisotropy in ion and electron emission of free NaCl nanoparticles excited by intense femtosecond laser pulses studied by Velocity Map Imaging spectroscopy — •Felix Gerke, Lucia Merkel, Egill Antonsson, and Eckart Rühl — Physikalische Chemie, Freie Universität Berlin, Takustr. 3, 14195 Berlin

We present results regarding the angular distribution of ions and electrons emitted from NaCl nanoparticles (d = 100-500 nm) during photoionization by intense femtosecond laser pulses obtained from Velocity Map Imaging (VMI) spectroscopy. The beam of a pulsed Ti:Sapphire laser (λ = 800 nm, E = 1.55 eV) is crossed in vacuum with a beam of free NaCl nanoparticles, that is focused by an aerodynamic lens, leading to ionization of the nanoparticles. Electrons and ions emitted from the nanoparticles are recorded by a VMI spectrometer. A size-dependent asymmetry in the electron and ion emission with respect to the propagation direction of the laser beam is observed. Here, more electron and ion emission is observed in the propagation direction of the laser pulses than in opposite direction. A comparison of electron and ion emission from nanoparticles of different size reveals the angular anisotropy, which is increasing with nanoparticle size. Furthermore, a comparison to model calculations simulating the internal electric field of the nanoparticles by means of the discrete dipole approximation is used to attribute the experimentally observed angular anisotropy to size-dependent non-isotropic internal electric fields in the nanoparticles.

A 30.5 Wed 15:00 K 2.016

Lasersheet nanoparticle imaging — •Lena Worbs[1,2], Amit Samanta[1], Daniel Horke[1,2], and Jochen Küpper[1,2,3] — [1]Center for Free-Electron Laser Science, DESY, Hamburg, Germany — [2]Center for Ultrafast Imaging, Universität Hamburg, Germany — [3]Department of Physics, Universität Hamburg, Germany

For coherent diffractive imaging of nanoparticles at free-electron lasers, sample delivery techniques and appropriate diagnostics have to be developed.

To characterize nanoparticle beams from aerodynamic cooling elements, e.g., aerodynamic lenses or buffer-gas cooling cells, a sheet of light is generated, and the scattered light of nanoparticles passing through the sheet is imaged with a microscope. Lasersheet imaging enables a full reconstruction of the transverse profile of the nanoparticle beam. Furthermore, it offers the opportunity to image the nanoparticle beam density without an additional setup, allowing the optimization of sample delivery methods.

A 30.6 Wed 15:15 K 2.016

Cold and controlled nanoparticle beams for single particle diffractive imaging — •Nils Roth[1], Salah Awel[1,2], Amit Samanta[1], Armando Estillore[1], Lena Worbs[1,2], Muhamed Amin[1], Karol Dlugolecki[1], Nicolai Pohlmann[1], Daniel Horke[1,2], and Jochen Küpper[1,2,3,4] — [1]Center for Free-Electron Laser Science, DESY, Hamburg, Germany — [2]Center for Ultrafast Imaging, Universität Hamburg, Germany — [3]Department of Physics, Universität Hamburg, Germany — [4]Department of Chemistry, Universität Hamburg, Germany

Coherent diffractive imaging at free-electron lasers promises to allow the reconstruction of the three-dimensional molecular structures of isolated particles at atomic resolution [1]. However, because of the typical low signal to noice ratio, this requires the collection of a large amount of diffraction patterns. Since every intercepted particle is destroyed by the intense x-ray pulse, a new and preferably identical sample particle has to be delivered into every pulse. Currently the inefficient delivery of particles and the correspondingly low number of strong diffraction patterns collected during typical beam times is one of the major limiting factors. With the aid of numerical simulations we developed new aerodynamic devices, such as aerodynamic lenses and buffer-gas cells, to produce cold and high-density beams of nanoparticles, *e.g.*, viruses. We benchmark developed injectors in our aerosol beam characterisation setup, using novel laser-based particle detection schemes.

[1] M. M. Seibert, et al, *Nature* **470**, 78 (2011).