A 23: Poster: Atomic clusters (with MO)

Time: Tuesday 16:30–18:30 Location: Spree-Palais

A 23.1 Tue 16:30 Spree-Palais

Untersuchung einer Ringfalle zur Erzeugung von mehrfach negativ geladenen Metallclustern — •Stefan Knauer[1], Gerrit Marx[1], Lutz Schweikhard[1] und Robert Wolf[2] — [1]Institut für Physik, Universität Greifswald, Felix-Hausdorff-Str. 6, 17489 Greifswald — [2]MPI-K, Saupfercheckweg 1, 69117 Heidelberg

Die Coulombbarrieren und Elektronenbindungsenergien von mehrfach negativ geladenen Metallclustern sind experimentell weitestgehend unerforscht. Da diese in der Natur nicht vorkommen, müssen sie in Laboren erzeugt werden. Dies wird bisher mit einer Kombination aus einer Clusterquelle und Ionenfallen verschiedener Art realisiert [1]. Ein Zugang zur Höhe der Coulombbarrieren ist die Erzeugung von negativen Ladungszuständen bei definierten Elektronenenergien. Dies benötigt ein feldfreies Volumen, das die Wechselwirkung mit Elektronen zulässt, aber gleichzeitig die Speicherung von Clustern ermöglicht. In Greifswald wurde dafür eine Multipol-Ionenfalle, eine sog. Ringfalle [2], aufgebaut. Einfach negativ geladene Cluster werden in einer Magnetronquelle [3] erzeugt, gelangen in das Fallenvolumen und werden anschließend durch Elektronen-Cluster Kollisionen in einen erhöhten Ladungszustand versetzt. Die Reaktionsprodukte können anschließend mittels Flugzeitmassenspektroskopie untersucht werden. In diesem Beitrag werden der Aufbau und die Funktionsweise der Ringfalle vorgestellt.

[1] F. Martinez et al., AIP Conf. Proc. 1521, (2013) 230.
[2] Gerlich et al., Adv. Chem. Phys. 82 (1992) 1.
[3] H. Haberland et al., Z. Phys. D, 20 (1991) 413.

A 23.2 Tue 16:30 Spree-Palais

Setup and characterisation of a THz-radiation source for a field-driven streaking experiment with rare gas clusters — •Jan Lahl[1], Bernd Schütte[2], Tim Oelze[1], Arnaud Rouzée[2], Marc Vrakking[2], and Maria Krikunova[1] — [1]TU Berlin, Institut für Optik und Atomare Physik, Berlin, Germany — [2]Max-Born Institut, Berlin, Germany

Novel light sources like high harmonics generation have triggered a wide range of experiments for studies of light-matter interaction. We are especially interested in electron dynamics in rare gas clusters initiated by extreme-ultraviolet pulses. A field-driven streak camera maps the temporal structure of the electron wave packet into a momentum distribution which can by experimentally measured. For the dynamics on a fs-timescale electric field oscillation periods in sub-ps range (THz frequency) are required. The THz radiation is generated in a LiNbO3 crystal based on optical rectification using near-infrared (NIR) fs-pulses. To meet the phase-matching condition the NIR pulse fronts are tilted by a diffraction grating. Characterisation of the THz is accomplished by electro-optic sampling in a ZnTe crystal. The intensity distribution of a beforehand splitted part of the same NIR beam is analysed with respect to the direction of its polarisation after passing the crystal. Due to its high intensity the THz radiation alters the polarisation of the crystal non-linearly which results in a deviation of the measured intensity distribution. The setup of the THz source will be shown as well as results of the characterisation. An outlook on the intended application in the streaking experiment will be presented.

A 23.3 Tue 16:30 Spree-Palais

Strong scattering in laser-driven rare-gas clusters — •Merten Siegfried, Christian Peltz, and Thomas Fennel — Institute of Physics, University of Rostock

Rare-gas clusters under intense laser pulses are rapidly transformed into finite nanoplasmas. Though main features of the underlying microscopic plasma dynamics can be well described by molecular dynamics (MD) simulations including rate equations for atomic ionization [1], the microscopic treatment of collisions remains a challenge. Electron-atom collisions are often neglected completely though they can be essential to account for the important electron emission processes, such as electron surface backscattering observed at dielectric nanospheres [2]. Also elastic electron-ion scattering is vastly underestimated in MD models using effective soft-core Coulomb potentials as the short-range interaction, primarily responsible for strong collisions, is regularized. We propose a microscopic scheme to re-introduce the missing scattering from the short-range electron-atom/ion interaction as local collisions. A detailed analysis of the impact of elastic electron-atom/ion scattering on the excitation dynamics of medium-sized Argon clusters in intense near-infrared laser fields will be presented.

[1] T. Fennel et al., Rev. Mod. Phys. **82**, 1793 (2010)
[2] S. Zherebtsov et al., Nature Phys. **7**, 656 (2011)

A 23.4 Tue 16:30 Spree-Palais

Microscopic description of single-shot diffractive imaging of clusters via the dyadic Green's function approach — •Katharina Sander, Christian Peltz und Thomas Fennel — Institute of Physics, University of Rostock

The availability of intense femtosecond laser pulses in the XUV and soft X-ray regime from free-electron lasers (FELs) has made it possible to investigate the structure and dynamics of nanosystems via single-shot diffractive imaging experiments, as recently demonstrated with single clusters [1]. However, standard Mie theory is not applicable to model the scattering of non-spherical systems. Therefore, a more general microscopic approach has been developed, that describes light scattering of clusters on an atomic level via dyadic Green's functions. This method can be applied to arbitrary cluster shapes and to strong non-equilibrium states such as internal plasmonic excitation of cluster electrons. As a first application of this model we examine the possibility to image the recently predicted internal plasma waves in clusters induced by a short infrared laser pulse [2]. Our analysis supports, that the ultrafast dynamical movement of the plasma waves can be extracted from the time-resolved scattering pictures. As a second scenario, we investigate the scattering of strongly absorbing silver clusters. For strongly non-spherical geometries the effect of absorption is analyzed by comparing the full Green's function solution to the result of the first Born approximation.

[1] T. Gorkhover *et al.*, Phys. Rev. Lett. **108**, 245005, (2012)
[2] C. Varin *et al.*, Phys. Rev. Lett. **108**, 175007, (2012)

A 23.5 Tue 16:30 Spree-Palais

Electron spectra of size selected rare gas clusters in intense XUV radiation — •Jan P. Müller[1], Leonie Flückiger[1], Bruno Langbehn[1], Maria Müller[1], Daniela Rupp[1], Mario Sauppe[1], Anatoli Ulmer[1], Sven Toleikis[2], Stefan Düsterer[2], and Thomas Möller[1] — [1]Institut für Optik und Atomare Physik, TU Berlin, Hardenbergstr. 36, 10623 Berlin — [2]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22603 Hamburg,Germany

The interaction between rare gas clusters and intense XUV light pulses provided by FEL reveals an complex and ultrafast dynamics. Size selected measurements are able to dinsentangle the dynamics for clusters having different cluster sizes or interacting with different local intensities within the FEL focus (1). Electron spectra are extremely well suited to investigate properties of the nanoplasma building up within the cluster, as well as the change of the binding energies of the core level during interaction. In addition to the ion spectra already investigated, they are signatures for the underlying interaction process. Up to now averaged electron spectra are available (2), size selected measurements are strongly desirable. In this contribution results from a beamtime at FLASH are presented, where xenon clusters were irradiated by FEL pulses with a wavelength of 13.5 nm.

(1) Gorkhover, T. et al. Phys. Rev. Lett., 108 (2012) 245005
(2) Bostedt, C. et al. , Phys. Rev. Lett., 100 (2008) 133401

A 23.6 Tue 16:30 Spree-Palais

Porosity and surface roughness of free SiO_2 nanoparticlesl studied by wide angle X-ray scattering — •Burkhard Langer[1], Christian Goroncy[1], Christopher Raschpichler[1], Thoralf Lischke[2], Bernhard Wassermann[1], Christina Graf[1], and Eckart Rühl[1] — [1]Physikalische Chemie, Freie Universität Berlin — [2]Max-Planck-Institut für Mikrostrukturphysik, Halle

Silica nanoparticles which consist of an amorphous network of SiO_2 containing pores in the nanometer range (1-10) nm are used as a model system to study their porosity and roughness by wide angle X-ray scattering. The particles are prepared with a porous layer of an adjustable thickness between 5 and 50 nm. Dispersions of such nanoparticles are evaporated into a continuous aerodynamically focused free nanoparticle beam crossing a synchrotron radiation beam from BESSY II. The scattered X-ray intensity is detected over a wide angle range by an MCP detector which can be rotated between 10° and 170° around the interaction region [1]. Comparison of the X-ray scattering intensities with model calculations provides novel information on the surface roughness, porosity, and possible contributions of solvent in the pores. While the angle dependent X-ray scattering intensity of nanoparticles with a smooth surface follows clearly the $(qR)^{-4}$ power law given by Mie theory, nanoparticles with a rough surface and core-shell nanoparticles show a different behavior. Deviations from the pure Mie theory will be discussed in terms of the surface roughness compared to the incident X-ray wavelength.

[1] H. Bresch *et al.*, Faraday Discussions, **137**, 389 (2008).