A 31: Interaction with intense laser pulses III: VUV and X-ray light

Zeit: Freitag 14:00–15:45 Raum: 3D

A 31.1 Fr 14:00 3D

Ion Recombination and Delayed Expansion Dynamics of Rare Gas Clusters exposed to Intense XUV Laser Pulses — •Matthias Hoener[1], Heiko Thomas[1], Christoph Bostedt[1], Ekaterina Eremina[1], Lasse Landt[1], Hubertus Wabnitz[2], Rolf Treusch[2], Rubens de Castro[3], and Thomas Möller[1] — [1]IOAP, TU Berlin, Germany — [2]Hasylab at DESY, Hamburg, Germany — [3]LNLS, Campinas, Brazil

We have studied the ionisation processes of core – shell cluster systems exposed to intense XUV laser pulses up to 10^{14} W/cm^2 from the FLASH free electron laser. A strong size dependence of ionisation processes is observed for XeAr clusters. Charged fragments from the Xe core are almost absent in the mass spectra of large XeAr clusters ($< N >= 4000$). At the same time Ar ions up to 4+ are present. We propose that only the Ar surface layers disintegrate by coulomb explosion while atoms in the cluster core recombine and the expansion is delayed. The delayed expansion may have significant implications for future imaging experiments in the XUV and x-ray regime, since it can relax the restriction of x-ray pulse length given by the time when radiation damage sets in. The findings are compared to recent theoretical predictions.

A 31.2 Fr 14:15 3D

Streuexperimente an Clustern mit hochintensiver Strahlung des FLASH - FEL — •Daniela Rupp[1], Marcus Adolph[1], Ekatarina Eremina[1], Heiko Thomas[1], Matthias Hoener[1], Hubertus Wabnitz[2], Rolf Treusch[2], Christoph Bostedt[1] und Thomas Möller[1] — [1]IOAP - Technische Universität Berlin — [2]Hasylab at DESY

Streuexperimente sind eine erprobte Methode zur Bestimmung der Struktur von Materie. Durch die hochintensiven und ultrakurzen Laserpulse von Freie-Elektronen-Lasern kann nun erstmalig die Struktur von Nano-Objekten mittels Einzelschuss-Experimenten bestimmt werden. Hierbei wird die Auflösungsgrenze durch die Wellenlänge des Lasers von derzeit 13,7 nm am FLASH und zukünftig wenigen Angstrom am XFEL bestimmt.

In ersten Experimenten wurden die Pulse des FLASH an Xenonclustern mit Durchmessern im Bereich der Wellenlänge (13 bis 35 nm) gestreut. Die entstandenen Streubilder wurden mit auf der Mietheorie basierenden Simulationen verglichen und die Clustergrößen bestimmt. Anpassungen der optischen Konstanten in der Theorie an die gemessenen Streubilder lassen Rückschlüsse auf die Elektronendynamik des Clusters im Laserfeld zu. Die bisherigen Ergebnisse sind vielversprechend im Hinblick auf geplante Pump-Probe-Experimente in denen die dritte Harmonische des FEL als Probe-Puls die Dynamik der Coulombexplosion auflösen und die zeitliche Entwicklung von Clustergröße und Brechzahl bestimmen soll.

A 31.3 Fr 14:30 3D

Impulsspektroskopie an kleinen Clustern — •Sebastian Schorb, Matthias Hoener, Rainer Unterumsberger, Heiko Thomas, Thomas Möller und Christoph Bostedt — IOAP - Technische Universität Berlin

Spektroskopie mit COLTRIMS (cold target recoil ion momentum spectroscopy) Detektoren erlaubt detaillierte Untersuchungen der Fragmentation von Molekülen und Clustern, bei der die vektoriellen Impulse aller entstehenden ionischen Fragmente und Elektronen im vollen Raumwinkel gemessen werden. Wir untersuchen die Fragmentation von van-der-Waals Clustern und molekularen Diamanten nach Anregung mit weicher Röntgenstrahlung. Edelgascluster zeigen je nach Verhältnis von Coulomb- zu Oberflächenenergie ein charakteristisches Fragmentationsmuster, was im Rahmen des klassischen Tröpfchenmodells als Fission bzw. Explosion des Clusters interpretiert werden kann. Für die Untersuchung von Diamantclustern wurde eine Überschallexpansionsquelle konzipiert, die es ermöglicht, einen kalten Strahl von Diamantoiden für spektroskopische Untersuchungen zu erzeugen. Diese kovalenten Clustersysteme zeigen für resonante Anregungen ein charakteristisches Fragmentationsmuster. Das Fragmentationsverhalten beider Systeme wird verglichen und diskutiert.

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A 31.4 Fr 14:45 3D

Angular Resolved Photoemission from C_{60} in Intense Laser Fields — •Slawomir Skruszewicz, Nguyen Xuan Truong, Johannes Passig, Thomas Fennel, Andreas Przystawik, Josef Tiggesbäumker, and Karl-Heinz Meiwes-Broer — Institut of Physics, University of Rostock

Angular resolved photoelectron spectroscopy is a key method to gain deeper insight into the strong-field photoionization of complex systems, such as multi-electron atoms, molecules, and clusters. A powerful and direct technique for the simultaneous measurement of the energy and angular distribution of the photoelectrons is offered by Velocity Map Imaging spectrometry [1]. In order to resolve electrons with up to 1 keV kinetic energy we have developed a modified five-electrode setup. As a system benchmark we have analyzed the emission spectra from Xe atoms for fs laser excitation and find clear signatures from above-threshold, tunnel-, as well as atomic double ionization - in agreement with earlier studies [2,3]. As the first application of the system we have studied the angular resolved photoemission from C_{60} as a function of laser pulse length and laser intensity. We found signatures for above-threshold ionization and evidence for contributions of intermediate Rydberg levels [4,5].

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A 31.5 Fr 15:00 3D

Two-Color Photoionization using High Intensity Extreme-UV Free Electron Laser (FLASH) and Near-IR Laser Pulses — •S. Duesterer[1], P. Radcliffe[1], W. B. Li[1], A. Azima[1], J. Dardis[2], P. Hough[2], K.D. Kavanagh[2], J. T. Costello[2], D. Glijer[3], D. Cubaynes[3], and M. Meyer[3] — [1]Hamburger Synchrotronstrahlungslabor HASYLAB at Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, D-22607 Hamburg, Germany — [2]National Center for Plasma Science and Technology, Dublin City University, Dublin, Ireland and School of Physical Sciences, Dublin City University, Dublin 9, — [3]LIXAM/CNRS, UMR 8624 Centre Universitaire Paris-Sud, Bâtiment 350, F-91405 Orsay Cedex, France

Two-photon two-color ionization of rare gases has been measured using an experimental system designed for single-shot photoelectron spectroscopy on free atoms and molecules at the Free Electron Laser in Hamburg (FLASH at DESY). Characteristic sidebands appear in the photoelectron spectra when the optical (Ti:Saph laser: 100 fs, 800 nm) and the FEL pulses overlap spatially and temporally. The cross-correlation curve points to a 250 fs rms jitter between the two sources at the experiment. Our experimental results agree well with theoretical models of the two-color-ATI process and provide more detailed insights into atomic photoionization dynamics.

A 31.6 Fr 15:15 3D

Nonresonant inelastic x-ray scattering as a tool to study soft x-ray absorption edges using hard x rays: giant dipole resonances in barium and iodine compounds — •Christian Sternemann[1], Henning Sternemann[1], John S. Tse[2], and Metin Tolan[1] — [1]Fakultät Physik / DELTA, Technische Universität Dortmund, Dortmund, Germany — [2]Department of Physics & Engeneering Physics, University of Saskatchewan, Saskatoon, Canada

Giant dipole resonances are collective excitations which can be found in systems ranging from atoms, clusters to solids. These phenomena are usually studied by soft x-ray absorption, photoelectron and electron energy loss spectroscopy. With the advent of third generation synchrotron radiation sources, nonresonant inelastic x-ray scattering of core shell excitations became a prominent tool to study truly bulk sensitive shallow absorption edges with high energy photons. This technique is not only restricted to dipole transitions but can access final states of different symmetry employing its momentum transfer dependence. Especially, low energy excitations can be studied under high pressure. Giant resonances were measured in barite, several complex barium-silicon compounds and iodine-silicon clathrate. For the barium compounds the shape of the giant resonance is modulated depending on the environment the resonating barium atoms are embedded in.

The onset of the resonance could be measured within a high pressure environment for the structure I barium intercalated silicon clathrate. Moreover, for iodine-silicon clathrate it was observed that the resonance is strongly suppressed for high momentum transfers.

A 31.7 Fr 15:30 3D

Autocorrelation Experiments with Soft X-ray FEL Pulses — R. Mitzner[2], W. Eberhardt[1], M. Neeb[1], T. Noll[1], M. Richter[3], S. Roling[2], M. Rutkowski[2], B. Siemer[2], A. Sorokin[3], K. Tiedtke[4], and •H. Zacharias[2] — [1]BESSY GmbH, Albert-Einstein-Str. 15,12489 Berlin, Germany — [2]Physikalisches Institut, Universität Münster, D-48149 Münster, Germany — [3]PTB, Abbe_Str. 2-12,D-10587 Berlin, Germany — [4]DESY, Nottkestr.85, 22603 Hamburg, Germany

We report first direct measurements of the average coherence time and temporal pulse length of soft X-ray fs pulses from the free-electron laser at DESY (FLASH) by means of linear and nonlinear autocorrelation.