MO 23: Atomic Clusters III (with A)

Time: Thursday 14:00–16:00 Location: F 303

Invited Talk MO 23.1 Th 14:00 F 303

The hydrated electron studied by fs-photoelectron spectroscopy — •Andrea Lübcke, Franziska Buchner, Nadja Heine, Thomas Schultz, and Ingolf Volkmar Hertel — Max-Born-Insitut, Max-Born-Strasse 2A, 12489 Berlin

Despite decades of intensive research, the nature of the hydrated electron (including its dynamic) is still controversially discussed. We use fs-photoelectron spectroscopy of a liquid jet of aqueous NaI solution to gain new insight into this matter. The solvated electron is generated by photodetachment from the iodide anion with UV laser pulses (6.20 eV) via a charge transfer to solvent process. A delayed laser pulse (4.65 eV) is used to probe the evolution of this electron.

For the first time we measured fs-photoelectron spectra of the solvated electron. We observe a quasi-instantaneous increase of the electron signal followed by a rapid shift of the spectrum caused by solvation of the electron. The signal decays on timescales of several hundred ps to ns due to recombination and/or diffusion. The binding energy of the solvated electron in a 100 mmol NaI solution is determined to be 3.3 eV.

Invited Talk MO 23.2 Th 14:30 F 303

Surface Quantum Optics: from Casimir-Polder forces to optical near-fields — •Sebastian Slama — Physikalisches Institut, Tübingen, Germany

Surface Quantum Optics is a new field of physics which combines ultracold atoms with solid surfaces. Such systems show very interesting features like for example the occurrence of Casimir Polder forces by which the atoms are typically attracted towards the surface. The attraction between surface and atom is based on the interaction of fluctuating dipoles, which are excited mainly by electric vacuum field fluctuations. Such forces are one of the few examples where the vacuum energy leads to measurable effects and therefore can be used for tests of QED. Measurements of Casimir-like forces have gained enormous interest in the last few years. Our group recently directly measured the Casimir-Polder force in the so-called transition regime. This was achieved by balancing the unknown surface potential with the known dipole potential of an evanescent wave. Such potentials are steep enough to compensate Casimir forces at distances of only a few hundred nanometers from the surface. Even smaller distances could be reached when the optical near-field is enhanced by surface plasmon resonances. These are collective excitations of electrons in a thin metal film on the surface. By structuring the metal film the optical near field can also be shaped in the transverse direction above the surface. This technique allows generating optical nanopotentials for nano-traps and elements for atom-optics on the surface.

MO 23.3 Th 15:00 F 303

Characteristics of High Energy Velocity Map Imaging (HEVMI) spectrometer designed to study the Coulomb explosion from clusters. — •Slawomir Skruszewicz, Johannes Passig, Andreas Przystawik, Nguyen Xuan Truong, Josef Tiggesbäumker, and Karl-Heinz Meiwes-Broer — Institut für Physik, Universität Rostock, Universitätsplatz 3,18051 Rostock, Germany

Angular resolved photoelectron spectroscopy is a key method to gain deeper insight into the strong-field photoionization and electron dynamics 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]. The modified five-electrode HEVMI configuration, designed to resolve photoelectrons with kinetic energy up to 1 keV has been tested using the photoionization of Ne atoms with high energy photons (20 - 600 eV) at DESY DORIS III facility. The experimental results prove the applicability of the system to measure photoelectrons with kinetic energy up to 550 eV and created by a continuous radiation sources. As a first application of the HEVMI spectrometer we present results of experiments performed on Ag clusters exposed to intense fs-laser pulses which show anisotropic photoelectron emission [2].

[1] A. T. J. B. Eppink and D. H. Parker, Rev. Sci. Instr. 68, 3447 (1997).

[2] Th. Fennel et al., Phys. Rev. Lett. 98, 143401 (2007).

MO 23.4 Th 15:15 F 303

Untersuchung der Transferionisation und des doppelten Elektroneneinfangs mit Heliumdimeren — •Jasmin Titze[1], Markus Schöffler[2], Nasine Neumann[1], Hong-Keun Kim[1], Florian Trinter[1], Markus Waitz[1], Jörg Voigtsberger[1], Matthias Odenweller[1], Birte Ullrich[1], Robert Wallauer[1], Lutz Foucar[4], Katharina Kreidi[3], Till Jahnke[1], Achim Czasch[1,5], Lothar Ph. H. Schmidt[1], Robert Grisenti[1], Ottmar Jagutzki[1,5], Reinhard Dörner[1] und Horst Schmidt-Böcking[1] — [1]Institut für Kernphysik Frankfurt, Goethe-Universität Frankfurt, Max-von-Laue-Str. 1, 60438 Frankfurt — [2]Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße1, 64291 Darmstadt — [4]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [5]RoentDek Handels GmbH, c/o Institut für Kernphysik, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

Heliumdimere stellen das am weitesten gebundene atomare System dar. Seine Größe ist mit der eines DNA Moleküls vergleichbar. In Stößen mit Alphateilchen bei Projektilenergien von 150 keV/u wurde die Zerfallsdynamik von Heliumdimeren untersucht. Es wurden hierzu zwei Reaktionskanäle gleichzeitig vermessen, der doppelte Elektroneneinfang und die Transferionsation. Als Messtechnik wurde die COLTRIMS-Technik (COLd Target Recoil Ion Momentum Spectroscopy)verwendet. In den Ergebnissen zeigen sich 3 voneinander unterscheidbare Zerfallsprozesse.

MO 23.5 Th 15:30 F 303

Steplike intensity threshold behavior in extreme ionization of laser-driven Xe clusters — •Thomas Fennel[1], Tilo Döppner[1], Jan-Philippe Müller[1], Andreas Przystawik[1], Sebastian Göde[1], Josef Tiggesbäumker[1], Karl-Heinz Meiwes-Broer[1], Charles Varin[2], Lora Ramunno[2], and Thomas Brabec[2] — [1]Institute of Physics, University of Rostock, Germay — [2]Department of Physics, University of Ottawa, Canada

Highly charged Xe^{q+} ion generation up to $q = 23$ is observed in Xe_N embedded in helium nanodroplets and exposed to intense femtosecond laser pulses (λ=800 nm). Laser intensity resolved measurements show that the high-q ion generation starts sharply at an unexpectedly low threshold intensity of about 10^{14} W/cm^2. Above threshold, the Xe ion charge spectrum saturates quickly and changes only weakly for higher laser intensities. Good agreement between these observations and a molecular dynamics analysis [1] allows us to identify the mechanisms responsible for the highly charged ion production and the surprising intensity threshold behavior of the ionization process [2]: (i) rapid inner ionization of Xe to high-q states through an EII-avalanche sparked by TI of Xe atoms which is supported by an early plasmon resonance of the He shell and (ii) suppression of charge recombination by resonant heating of the Xe cluster. We find that resonant heating of the Xe cluster is less important for strong inner ionization but is the key to conserving the charge state distribution produced by avalanching.

[1] T. Fennel et al., Phys. Rev. Lett. 99, 233401 (2007)

[2] T. Döppner et al., submitted (2009)

MO 23.6 Th 15:45 F 303

Direct observation of fullerene plasmon oscillations in momentum space — •Sanja Korica[1], Burkhard Langer[2], Axel Reinköster[1], Markus Braune[1], and Uwe Becker[1] — [1]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin-Dahlem, Germany — [2]Institut für Chemie und Biochemie, Freie Universität Berlin, Berlin-Dahlem, Germany

An extended spherical object which gives rise to standing wave oscillations is C_{60} [1]. We performed new near threshold measurements for C_{60} in order to reveal the corresponding threshold behavior. The result was a surprise. The extension of the high energetic sinusoidal behavior to lower energies uncovers a phase jump of $\pi/2$ in the plasmon excitation region [2]. By subtraction of the extended regular oscillation from the experimental data we could unfold the oscillatory behavior of the plasmon excitations directly in momentum space for the first time. In addition, after subtraction of the plasmon oscillation the shell thickness dependent beating behavior of the partial cross sections was exhibited much more clearly than demonstrated before. This shows, that Cohen and Fano's formula [3] provides a very good measure for determining the large scale coherent photoionization behavior as prerequisite for the derivation of energetically more restricted kinds of behavior such as the plasmon oscillations exhibited directly in momentum space for the first time here.

[1] Xu Y B, Tan M Q and Becker U, Phys. Rev. Lett. **76**, 3538 (1996).
[2] Scully S W et al., Phys. Rev. Lett. **94**, 65503 (2005).
[3] Cohen H D and Fano U, Phys. Rev. **150**, 30 (1966).