A 16: Atomic Clusters

Zeit: Donnerstag 8:30–10:30 Raum: 3D

A 16.1 Do 8:30 3D

PES study of the photodetachement of water clusters — •Lei Ma, Kiran Majer, Raphael Kuhnen, Fabien Chirot, and Bernd von Issendorff — FMF, Freiburg, Deutschland

The photodetachement of size-selected water cluster anions have been investigated by photoelectron spectroscopy (PES). New features have been observed in the PES spectra for small water clusters ($(H_20_n)^-$, n = 15-25)and heavy-water clusters. In heavy-water clusters, and in some cold (10 K) water clusters, the spectra are consistent with the existence of different isomers. The difference of the electron binding energies in these isomers is in agreement with previous work[1], and could give useful information on the location of the excess electron inside or outside the cluster. This is an important issue for using water clusters as nano-scale analogue of the bulk hydrated electron.

Furthermore, the PES spectra of water clusters show evidence of resonant two-photon photodetachement for cluster as small as $(H_20_{20})^-$. This two photon process have been studied using femtosecond PES.

[1] Verlet *et al.*, Science **307**, 93 (2005)

A 16.2 Do 8:45 3D

Optical properties and electronic structure of ideal nanodiamonds — Lasse Landt[1], Kathrin Klünder[1], Jeremy Dahl[2], Bob Carlson[2], Thomas Möller[1], and •Christoph Bostedt[1] — [1]IOAP - Technische Universität Berlin — [2]MolecularDiamonds Technologies

Diamondoids can be considered the smallest possible cage-like subunits that can be excised from diamond lattice closing the gap between large hydrocarbon molecules and nanodiamonds. The optical and electronic properties of perfectly size- and structure-selected, neutral, and surface-passivated diamondoids ranging in size from 0.5 to 1 nm have been determined by means of PES, XAS, and optical absorption measurements. All data were taken from high purity samples in the gas phase revealing optical gap and band edges with near theoretical purity. We find that the optical properties of the perfectly size- and shape-selected nanocrystals exhibit strong shape dependence unlike band edges or ionization potentials which have also been determined. The observed isomeric dependencies of the optical gap will be discussed and first experimental data on the influence of targeted surface modification (e.g. thiols, alcohols) will be presented.

A 16.3 Do 9:00 3D

Heliumdimere untersucht in langsamen Stössen mit Ar^{2+} — •Jasmin Titze, Markus Schöffler, Hong-Keun Kim, Robert Grisenti, Lothar Schmidt, Nadine Neumann, Ottmar Jagutzki, Horst Schmidt-Böcking und Reinard Dörner — Johann Wolfgang Goethe-Universität, Frankfurt, Germany

Heliumdimere stellen das am weitesten gebundene atomare System dar; die Bindungslänge kann die von C60 übersteigen. In Stössen mit Ar^2+ bei Projektilenergien von 25 keV/u wurde die Zerfallsdynamik nach Elektroneneinfang (ein und zweifach) mittels der COLTRIMS-Technik (COLd Target Recoil Ion Momentum Spectroscopy) untersucht.

A 16.4 Do 9:15 3D

Energy absorption of composite clusters in intense laser fields — •Alexey Mikaberidze, Ulf Saalmann, and Jan-Michael Rost — Max Planck Institut für Physik komplexer Systeme, Dresden, Deutschland

Energy absorption of xenon clusters embedded in helium droplets from intense femtosecond laser pulses is studied theoretically. For sufficiently long pulses we find earlier and more efficient resonant energy absorption for the embedded xenon cluster than for the pure one in agreement with experiments [1]. This effect is due to a plasma resonance in the helium droplet initiated by the charged xenon core [2]. For ultrashort double pulses with variable delay (pump-probe technique) both plasma resonances, due to the helium droplet and the xenon cluster itself, are identified and the conditions are given [2] which should allow for an experimental observation of both resonances.

[1] T. Döppner *et al.*, Eur. Phys. J. D, **24**, 157 (2003).
[2] A. Mikaberidze, U. Saalmann, J. M. Rost, to be published (2007)

A 16.5 Do 9:30 3D

Higly charged ions from laser cluster interactions — •Thomas Fennel[1,2], Lora Ramunno[2], and Thomas Brabec[2] — [1]Institute of Physics, University of Rostock — [2]Center for Photonics, Ottawa

Today it is widely accepted that resonant plasmon excitations and efficient heating through inverse bremsstrahlung are the dominant mechanisms for the highly efficient absorption of intense IR femtosecond laser pulses by atomic cluster. From experiments it is known that independent of the type of material, intermediate and heavy atom clusters emit ions with high charge states of up q=20-30 already at moderate laser intensities between $10^{14} - 10^{15}$W/cm^2. This has been demonstrated e.g. for Xe_N, Pt_N, and Pb_N. The mechanisms underlying the generation of the measured high ionic charge states, however, is still under discussion. Our molecular dynamics analysis of Xe clusters identifies two physical mechanisms that contribute to this yet unexplained observation of extremely high ionic charge states at moderate laser intensity [1]. First, the local cluster electric field supports electron impact ionization and increases the highest ion charge state by up to 40%. Second, the ion charge distribution of the nanoplasma is only weakly affected by electron-ion recombination, as recombination is frustrated by the background electric fields typically used in ion detectors. This increases the highest charge state by up to 90%, as compared to the usually assumed recombination of all electrons trapped in the cluster potential. Both effects together augment the highest charge state by up to a factor of 2 and beyond, in reasonable agreement with experiments.

[1] T. Fennel *et* al., accepted for Phys. Rev. Lett., 2007

A 16.6 Do 9:45 3D

Elektron-Elektron-Stöße in Metall-Clustern bei der Wechselwirkung mit intensiven Laserpulsen — •Jörg Köhn, Thomas Fennel, Ronald Redmer und Karl-Heinz Meiwes-Broer — Institut für Physik, Universitätsplatz 1, Universität Rostock, 18051 Rostock

Eine leistungsfähige Methode zur zeitabhängigen Beschreibung von Metall-Clustern in intensiven Laserfeldern ist die Thomas-Fermi-Vlasov-Molekulardynamik. Die langreichweitige Coulombwechselwirkung der Elektronen wird dabei mit einem mittleren Feld beschrieben. Die Erweiterung des Modells zur Einbeziehung von Elektron-Elektron-Stößen kann mit einem Vlasov-Ühling-Uhlenbeck (VUU)-Schema erfolgen. Bisher wurden die dazu benötigten Streuquerschnitte mit Thomas-Fermi-Abschirmlängen für den Grundzustand des Clusters bestimmt. Nach der Wechselwirkung mit intensiven fs-Laserpulsen formt sich jedoch ein heißes, verdünntes Nanoplasma, in dem Stoßprozesse mit den Querschnitten aus dem Grundzustand nur unzureichend beschrieben werden können. Daher berechnen wir die Streuquerschnitte als Funktion der lokalen Temperatur und Dichte des Nanoplasmas. Die Ergebnisse der VUU-Simulationen zeigen eine verstärkte Energieabsorption bei nichtresonanter Laseranregung. Die Auswirkung auf Pump-Probe-Szenarien wird diskutiert.

A 16.7 Do 10:00 3D

Optimization of the ionization dynamics of clusters in intense laser fields — •nguyen xuan truong, tilo döppner, sebastian göde, andreas przystawik, josef tiggesbäumker, and karl heinz meiwes-broer — Universität Rostock, Fachbereich Physik, Universitätsplatz 3, 18051 Rostock

Xenon clusters embedded in helium droplets are exposed to intense laser fields. Recent work, ranging from the variation of laser pulse duration over dual pulse excitation to self-learning pulse shaping experiments, has confirmed the strong dependence of the highly charged atomic ions on the temporal pulse shape [1-3]. Expecially, it has been shown in both experiments and simulations that the pulse parameters for a certain charge state are different[1]. In this experiment we optimize the generation of a given atomic charge state using pulse modulator (Dazzler) and a Genetic Algorithm. First results are discussed and corroborated by simulations.

[1] Döppner *et al.*, Phys. Rev. Lett. **94**, 013401 (2005).
[2] Moore *et al.*, Appl. Phys. B **80**, 101 (2005).
[3] Martchenko *et al.*, Phys. Rev. A **72**, 053202 (2005).

A 16.8 Do 10:15 3D

Semiclassical approach to the dynamics of Gaussian wave packets in a system with a mixed phase space — •Christoph-Marian Goletz[1], Frank Grossmann[1], and Steven Tomsovic[2] — [1]TU Dresden, Germany — [2]WSU, Pullman, USA

The 2D coupled quartic oscillator is a convenient system for the analysis of mixed dynamics [1]. Using the semiclassical method according to Herman and Kluk [2] we examine the dynamics of a Gaussian wave packet originating in different regions of the phase space. We show that this propagation method is applicable to a wave packet starting in the regular region, at the border of a chaotic and regular region or, to some degree, in the chaotic region.

[1] O. Bohigas, S. Tomsovic and D. Ullmo, Phys. Rep., **223**, p. 43, 1993

[2] M. F. Herman and E. Kluk, Chem. Phys., **91**, p. 27, 1984