A 16 Atomic Clusters and Cold Atoms II

Zeit: Mittwoch 10:15–12:15 Raum: HU 3075

Fachvortrag A 16.1 Mi 10:15 HU 3075

Modell für eine Quantenreflexionsfalle — •Alexander Jurisch und Harald Friedrich — Physik-Department, Technische Universität München, 85747 Garching bei München

Fällt ein atomares Wellenpaket auf eine Oberfläche ein, so wird es mit einer bestimmten Wahrscheinlichkeit *quanten*reflektiert, *bevor* es die Oberfläche erreicht. Als Funktion der Energie verhält sich die Quantenreflexionswahrscheinlichkeit wie $P_R(E \to 0) \to 1$. Quantenreflexion ist ein universeller und unempfindlicher Mechanismus, der ultrakalte Atome von einer Oberfläche fernhält. Diese Eigenschaft ist bei der Konstruktion atom-optischer Elemente wichtig und kann auch zur Konstruktion einer Falle verwendet werden.

Unter realistischen Annahmen wird das Verhalten eines atomaren Wellenpaketes in einer Quantenreflexionsfalle behandelt. Dabei werden insbesondere die Zeitabhängigkeit des Zerfalls des Wellenpaketes und seine Abkühlung untersucht.

Referenzen:

T. A. Pasquini, Y. Shin, C. Sanner, M. Saba, A. Schirotzek, D. E. Pritchard and W. Ketterle, arXiv.org/abs/cond-mat/0405530, 2004

A. Jurisch, H. Friedrich, Phys. Rev. **70**, 032711, 2004

Fachvortrag A 16.2 Mi 10:30 HU 3075

Cosmic inflation and Bose-Einstein condensates — •Ralf Schützhold — TU Dresden

Within our present standard model of cosmology, basically all inhomogeneities – including the seeds for the formation of structures such as our galaxy – originate from quantum fluctuations of the so-called inflaton field in the very early universe. The mechanism for the amplification of these quantum fluctuations can be reproduced for phonons within Bose-Einstein condensates under appropriate external conditions and could be measurable with present-day technology. This provides an opportunity to simulate exotic quantum effects of the very early universe in the laboratory.

Fachvortrag A 16.3 Mi 10:45 HU 3075

UV-visible Fluorescence of 2p-excited argon clusters — •Roman Flesch[1], Ioana Bradeanu[1], Michael Meyer[2], and Eckart Rühl[1] — [1]Institut f. Physikalische Chemie, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — [2]L.U.R.E., Centre Universitaire Paris-Sud, Batiment 209D, F-91898 Orsay Cedex, France

Fluorescence of 2p-excited argon clusters in the wavelength range between 150 nm and 650 nm is measured by using for primary excitation tunable soft-X-ray undulator radiation between 240 eV and 270 eV at the UE-52-PGM beamline of the storage ring BESSY. Two complementary sets of experiments are performed: (a) Fluorescence yields show the highest intensity from clusters in the 2p-continuum. Weaker intensity comes from exciton formation in the pre-edge regime. Such shape of the fluorescence yield indicates that predominantly doubly charged argon clusters lead to emission of ultraviolet fluorescence photons; (b) Dispersed fluorescence spectra are recorded in the 200-600-nm range where the clusters are excited in the Ar 2p-continuum. A broad fluorescence continuum is found which is centered between 250 and 300 nm. The origin of this continuous emission is discussed with respect to possible relaxation mechanisms of core-excited clusters.

Fachvortrag A 16.4 Mi 11:00 HU 3075

Correlation in the Ion and Electron Emission from Silver Nanoparticles after Exposure to Strong Laser Fields — •Paul Radcliffe, Tilo Döppner, Christian Schaal, Josef Tiggesbäumker, and Karl-Heinz Meiwes-Broer — Institut für Physik, Universität Rostock, Universitätsplatz 3. 18051 Rostock

In the interaction between intense laser light and metallic systems, collective excitations play an important role. So far nothing is known about the kinetic energy of the emitted electrons when samll particles are exposed to laser intensities in the region from 10^{13} – 10^{14}W/cm^2. In a dual pulse experiment we have investigated the correlation between the ion and electron emission dynamics.

For the first time detailed time and energy–resolved electron spectra were measured. A striking time dependence of the ionization efficiency and electron emission is seen for Ag nanoparticles. We obtain electron energies of up to 350 eV and charge states up to $z = 13$ which are much higher compared to the single atom interaction. The dynamics of the fast electrons was found to have an almost one–to–one correspondence with the generation of highly charged ions.

Fachvortrag A 16.5 Mi 11:15 HU 3075

Semiclassical calculations of dual-pulse excitation of simple metal clusters — •Thomas Fennel and Josef Tiggesbäumker Karl-Heinz Meiwes-Broer — Universität Rostock, Universitätsplatz 3, 18051 Rostock

Motivated by recent measurements the time-dependent response of silver clusters have been explored theoretically within the dual-pulse excitation scheme for optical wavelengths ($\lambda = 800nm$) [1]. Based on semiclassical time-dependent density-functional theory a microscopic simulation of the cluster dynamics is used to investigate the laser cluster interaction [2]. In accordance with the experimental results a strong dependence on the pulse delay is found for the ionization efficiency of the cluster. The major mechanism behind this effect is the known plasmon enhanced ionization, which remains efficient even for laser photon energies far below the the collective resonance of the cluster groundstate. The delay-dependence of the coupling of the second pulse to the cluster as well as patterns within electron spectra are are extracted form the calculations, for linearly and circular polarized pulses respectively. Key features, such as timescales for resonant coupling and maximum kinetic energies of the emittesd electrons are estimated in dependence of the laser intensity.

[1] T. Döppner, Th. Fennel, Th. Diederich, J. Tiggesbäumker and K.-H. Meiwes-Broer, submitted to *Phys. Rev. Lett.*, 2004

[2] T. Fennel, G.F. Bertsch, and K.-H. Meiwes-Broer, *Eur. Phys. J. D* **29**, 367 (2004)

Fachvortrag A 16.6 Mi 11:30 HU 3075

Post-Collision Interaction of Free Van der Waals Clusters — •Ioana L. Bradeanu[1], Hiroyuki Setoyama[2], Takaki Hatsui[3], Nobuhiro Kosugi[2], and Eckart Rühl[1,2] — [1]Institut für Physikalische Chemie, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — [2]Institute for Molecular Science, Myodaiji, Okazaki, 444-8585, Japan — [3]The Graduate University for Advanced Studies, Myodaiji, Okazaki, 444-8585, Japan

The line shapes of photoelectron spectra of atoms and molecules depend in the core-level excitation regime strongly on the core hole lifetime. In the regimes above the core ionization energies there is additional asymmetric broadening, which is due to the interaction between the photoelectron and the Auger electrons. This is commonly known as post-collision interaction (PCI). PCI is investigated in free, variable size krypton and argon clusters near the Kr3d-and Ar2p-ionization energies. The experimental photoelectron spectra are fitted by using a formalism which is known to be valid even close to core ionization thresholds of atoms. The peak shapes are convoluted with a Gaussian in order to account for the experimental resolution. It is found that the asymmetry, which is due to PCI, is characteristically smaller for clusters than for isolated atoms. Moreover, there is less asymmetry for bulk-sites than for surface-sites in variable size rare gas clusters. We rationalize these results in terms of a mechanism, which is based on the classical model of post-collision interaction.

Fachvortrag A 16.7 Mi 11:45 HU 3075

Attosecond measurement and control of electronic motion — •K. O'Keeffe, M. Kitzler, and M. Lezius — Photonics Institute, Vienna Technical University, Gusshausstr. 27/387, Vienna, 1040 AUSTRIA

Control over the absolute phase between the carrier and the envelope of a laser pulse creates sufficient temporal precision to enter the attosecond domain. This temporal precision is based on the fact that in few cycle fields atoms preferentially ionize within an attosecond time window: Electrons are liberated with "attosecond" precision. Recent Stereo-ATI measurements [1] have proven that electrons are preferentially ejected into distinct solid angles, depending on the phase. Momentum transfer of the returning electron onto the remaining ion core was also measured [2]. For future attosecond experiments such rescattering processes are an interesting subject. Typical rescattering scenarios contain most of the

necessary ingredients to trace back the trajectories of electrons. Control over the motion of attosecond wavepakets asks for precision control over laser fields, which is optically feasible. Measurement of electron motion, however, asks for a complete diagnostic of the momentum transfer during rescattering. This is possible using momentum microscopy (COLTRIMS). We will demonstrate that we have developed the necessary tools for attosecond measurement and control.

[1] G.G. Paulus et al., Phys. Rev. Letters 91(25) 253004 (2003)
[2] X. Liu et al.,Phys. Rev. Letters, in print (2004)

Fachvortrag

A 16.8 Mi 12:00 HU 3075

Solid State Valence Electron Distributions of C_{70} examined by photoelectron intensity variations — •Sanja Korica[1], Axel Reinköster[1], Daniel Rolles[1], Jens Viefhaus[1], Markus Braune[1], Uwe Becker[1], and Burkhard Langer[2] — [1]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany — [2]Max-Born-Institut, Max-Born-Str. 2a, 1248 Berlin, Germany

We have performed high resolution measurements of emitted photoelectrons from the valence shell of solid C_{70} to derive branching ratios and partial cross sections. Our PES results give evidence for photon energy dependent oscillations in the partial photoionization cross sections of the two highest occupied molecular orbitals HOMO and HOMO-1. The results are compared with advanced ab initio theoretical calculations [1] based on the local density approximation (LDA). The characteristic oscillations are analysed in terms of geometrical properties, the analysis is based on the Fourier transform of the cross section oscilalations. We compare our results for amorphous condensed phase C_{70} with corresponding measurements of the free molecules.

[1] P. Decleva, private communication