A 11: Posters: Interaction with attosecond and VUV-light

Zeit: Dienstag 16:30–18:30 Raum: Poster C3

A 11.1 Di 16:30 Poster C3

Attosecond control of the electron position — •Paula Riviere, Camilo Ruiz, Andreas Becker, and Jan-Michael Rost — MPIPKS, Dresden

Attosecond pump-probe experiments are a promising tool for studying the structure and electron dynamics of atomic systems. With them, the control of ultrafast charge transfer between two nuclei in a dissociating molecule is possible. In this work we propose a theoretical scheme for such a process using realistic experimental parameters.

In this scheme, a pump-probe set of attosecond pulses is used to transfer charge between the two nuclei in a dissociative diatomic molecule (H_2^+, $r_0 \sim 40$ a.u.), The charge is initially located at one of the nuclei. The pump pulse can ionize the electron, which moves in the continuum until the probe pulse induces its reabsorption by the second nucleus, if the delay between the pulses is optimal.

We also propose a method for optimizing the absorption in the case of fixed delays, the usual experimental situation, by means of an infrared pulse, whose function is to accelerate or decelerate the electron as it covers the distance between the nuclei.

Finally, we present results for the case of an attosecond pulse train, in which the charge transfer is enhanced due to the consecutive effect of the different pulses.

Apart from the possibility of transferring charge between the nuclei, this process could also be useful to measure atomic distances.

A 11.2 Di 16:30 Poster C3

Pump-probe experiments combining an attosecond beamline with a reaction microscope — •Helga Rietz, Konstantinos Simeonidis, Ram Gopal, and Joachim Ullrich — Max-Planck-Institut für Kernphysik, 69117 Heidelberg

The rapid development of femtosecond lasers over the last decade has enabled the investigation of nuclear dynamics in molecules in unprecedented detail. Recently, laser pulses of only 7 fs combined with advanced multi-particle momentum imaging spectrometers, so-called reaction microscopes, lead to the direct observation of the vibration of H_2 and D_2 molecules. However, electronic motion in atoms or molecules occurs on timescales of tens to hundreds of attoseconds and is thus not accessible with conventional ultra-fast laser technology, where the lasers' wavelength limits the pulse length to about 4 fs. Therefore we use high harmonic generation (HHG), which provides an efficient way to produce attosecond pulses.

Here we present the setup of a new experiment which combines an HHG light source with a reaction microscope. The light-source is based on a commercially available femtosecond laser system, delivering pulses with a length of 25 fs. Further compression to below 6 fs is achieved via filamentation. In order to guarantee highest stability and, at the same time enable utmost flexibility, the whole HHG setup is housed in one single vacuum chamber containing all necessary optics, a gas target for HHG and an XUV-spectrometer. In a first experiment we plan to characterize the attosecond pulses by 4π-detection of the photoelectrons in single ionization of helium.

A 11.3 Di 16:30 Poster C3

Transferionіation und komplexe Elektronendynamik in He^+-He-Stössen bei 60 keV/u — •Markus Schöffler[1], Jasmin Titze[1], Lothar Schmidt[1], Ottmar Jagutzki[1], Sebastian Otranto[2], Ron Olson[2], Horst Schmidt-Böcking[1] und Reinard Dörner[1] — [1]Johann Wolfgang Goethe-Universität, Frankfurt, Germany — [2]University of Missouri, Rolla, USA

Im Allgemeinen, und vor allem bei hohen Projektilgeschwindigkeiten (v_P ¿3 a. u.), ist die Dynamik einer Transferionisation, unabhängig vom genauen Projektilpotenzial. Dies gilt ebenso bei mittleren Projektilgeschwindigkeiten um $v_P = 1{,}5$ a. u., sofern es sich um nackte Projektilionen, wie H^+ bzw. He^{2+} handelt. Mittels der Technologie des Reaktionsmikroskops bzw. COLTRIMS (COLd Targe Recoil Ion Momentum Spectroscopy) wurde der Einfluss eines Projektilelektrons auf die Reaktionsdynamik kinematisch vollständig untersucht.

A 11.4 Di 16:30 Poster C3

Collision dynamic in transfer excitation processes revisited — •Markus Schöffler, Jasmin Titze, Hong-Keun Kim, Lothar Schmidt, Ottmar Jagutzki, Horst Schmidt-Böcking und Reinard Dörner — Johann Wolfgang Goethe-Universität, Frankfurt, Germany

We have measured the projectile scattering angle dependency for different final states for single electron capture in proton-helium collisions at an incident energy of 300 keV. With this fully differential data set we are able to get new insights in the dynamic of electron capture processes in combination with target or projectile excitation.

A 11.5 Di 16:30 Poster C3

DIRAC package – A new version to study interaction of the ions with the radiation field — •Andrey Surzhykov[1,2] and Stephan Fritzsche[1,3] — [1]Max–Planck–Institut für Kernphysik, Heidelberg — [2]École Normale Supérieure, Paris — [3]Gesellschaft für Schwerionenforschung (GSI), Darmstadt

During the last five years, the Dirac program has been found to be an efficient and reliable computer–algebraic tool for dealing with the Coulomb wave and Green's functions as well as their integrals [1, 2]. Owing to its user–friendly interface, this package became accessible not only to a few experts in relativistic atomic theory, but also to many scientists who have to deal with atoms and ions only occasionally. Here, we present an extension of the Dirac program for studying the interaction of the hydrogen–like ions with the radiation filed. In particular, the new Maple procedures support the symbolic as well as numerical evaluation of a whole variety of *bound–bound* transition properties including decay rates, angular distributions and polarization of characteristic radiation. Moreover, the revised version of the program also allows to investigate (radiative) *bound–free* as well as *free–bound* electron transitions as reflected by photoionization and radiative recombination, respectively.

[1] A. Surzhykov *et al.*, Comput. Phys. Commun. **165** (2005) 139.
[2] S. Fritzsche *et al.*, Nucl. Instr. Meth. B **235** (2005) 140.

A 11.6 Di 16:30 Poster C3

Laser-induced nuclear probing and excitation in muonic atoms — •Atif Shahbaz[1], Carsten Müller[1], Thomas J. Bürvenich[2], and Christoph H. Keitel[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [2]Frankfurt Institute for Advanced Studies, Johann Wolfgang Goethe University, Ruth-Moufang-Str. 1, 60438 Frankfurt am Main

Muonic atoms represent a traditional tool for nuclear spectroscopy by applying atomic-physics techniques. In this contribution we consider a muonic atom exposed to a very strong laser field, where the muon becomes a dynamic probe of nuclear properties. We show that, as a consequence, effects of the finite nuclear mass and size are prominent in calculated high-order harmonic spectra from hydrogenlike muonic atoms [1]. The dependence of these effects on the laser parameters and the charge state of the binding nucleus is discussed [2]. The harmonic cutoff energies from muonic atoms can reach the MeV range, thus providing coherent γ-rays which could by applied to induce nuclear excitation.

[1] A. Shahbaz, C. Müller, A. Staudt, T.J. Bürvenich, and C.H. Keitel, PRL 98, 263901 (2007).
[2] A. Shahbaz, C. Müller, T.J. Bürvenich, and C.H. Keitel, in preparation.

A 11.7 Di 16:30 Poster C3

Two-photon induced double ionization of atoms at FLASH — •Moritz Kurka[1], Yuhai Jiang[1], Lutz Foucar[2], Artem Rudenko[1], Claus Dieter Schröter[1], Thorsten Ergler[1], Daniel Fischer[1], Jasmin Titzes[2], Till Jahnke[2], Markus Schöffler[2], Thorsten Weber[2], Reinhard Dörner[2], Alexander Dorn[1], Kai-Uwe Kühnel[1], Stefen Düsterer[3], Rolf Treusch[3], Michael Gensch[3], Sven Schössler[2], Tilo Havermeier[2], Mathias Smolarski[2], Kyra Cole[2], Robert Moshammer[1], and Joachim Ullrich[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg — [2]Institut für Kernphysik, Universität Frankfurt, D 60486 Frankfurt — [3]DESY, Notkestrasse 85, 22607 Hamburg

Two-photon double ionization (TP-DI) bridges the gap between single- and multi-photon double ionization regimes and, thus, is of decisive importance to advance non-linear quantum theories, particularly for non-sequential absorption of two photons. Recently, the most intense VUV laser source world-wide became operational, the free electron laser at

Hamburg (FLASH). It enables for the first time systematic studies of two-photon induced atomic and molecular fragmentation processes. In this poster, we will present very recent experimental results of recoil ion momentum distributions for the TP-DI of He and Ne at photon energies of 45 and 38 eV, respectively, as well as fully differential measurements for TP-DI of Ne at a photon energy of 45 eV employing the Heidelberg reaction microscope. These results, which might serve as benchmark data for theories, will be discussed in terms of electron emission pattern and possible double ionization mechanisms.

A 11.8 Di 16:30 Poster C3

Photoabsorbtion and Photoionization of Diatomic Molecules — •Irina Dumitriu and Alejandro Saenz — Humboldt-Universität zu Berlin, Institut für Physik, AG Moderne Optik, Hausvogteiplatz 5-7, D-10117, Berlin, Germany

The photoabsorbtion cross section of HeH^+ will be presented together with photoionization cross sections of the alkali dimer cations Li_2^+, Na_2^+, and $LiNa^+$. The latter have been calculated using two methods: a time-independent perturbative method and a time-dependent non-perturbative one. The photoabsorbtion of HeH^+ which is of interest for astrophysics and for the neutrino-mass experiments is currently drawing special attention because of the newly developed FEL experiment in Hamburg. The alkali dimer cations are presented as the first step to the photoionization of the alkali dimers, but they are also interesting in themselves since no *ab intio* data were available for their continuum spectra.

A 11.9 Di 16:30 Poster C3

Momentum-resolved photoemission of small atomic clusters — •Rainer Unterumsberger, Matthias Hoener, Sebastian Schorb, Heiko Thomas, Thomas Möller, and Christoph Bostedt — IOAP - Technische Universität Berlin

The investigation of photoionization and photofragmentation processes of rare-gas clusters with time-of-flight spectroscopy has lead to a rather detailed knowledge about their size-dependent electronic structure. However, comparably little is known about their angular photoemission characteristics. We have used a reaction microscopy akin COLTRIMS to investigate the photoemission of small to medium sized clusters in the near threshold regime. The photoelectrons could be detected in the full solid angle and their moment could be resolved. The data show that the photoemission of clusters becomes much more isotropic for increasing cluster sizes. The data is discussed and compared to recent angle-resolved tof experiments [Rolles, PRA 75, 031201 (2007)].

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