A 2: Interaction with VUV and X-Ray Light I

Zeit: Montag 10:45–12:30 Raum: VMP 6 HS-E

Hauptvortrag A 2.1 Mo 10:45 VMP 6 HS-E
Angular distributions and continuous intensity behavior in multi-photon processes — •Markus Braune[1], Axel Reinköster[1], Jens Viefhaus[2], Sanja Korica[1], and Uwe Becker[1] — [1]Fritz-Haber-Insitut der MPG, 14195 Berlin — [2]DESY, 22607 Hamburg

Using angle-resolved photoelectron spectroscopy at the FLASH facility we were able to distinguish various sequential and simultaneous pathways of multi-photon double-ionization of rare gases. The results show that sequential double-ionization is the dominant process if the required photon energy threshold is exceeded. The photoelectron angular distributions of these multi-photon processes differ from a distribution of a dipole transition showing contributions of higher order Legendre polynomials. The corresponding higher order parameters β_4 could be determined and compared to recent calculations [1,2]. Especially for argon and krypton, these predict a dramatic change in the β_4-values at a photon energy around 50eV due to the Cooper minimum in the cross section. Surprisingly, this effect depends on the coupling of the ionic final states. A substantial variation of β_4 is in fact observed in our preliminary data analysis of the sequential double ionization of krypton.

For very short time delays between the steps of sequential double-ionization a dynamical screening effect is theoretically predicted which should give rise to continuous photoelectron intensity between the pair of photoelectron lines caused by the sequential process. So far, only weak indications of such a screening effect is found in our helium data.

Fachvortrag A 2.2 Mo 11:15 VMP 6 HS-E
Lepton Pair Production in High-Frequency Laser Fields — •Carsten Müller, Carlus Deneke, and Christoph H. Keitel — Max-Planck-Institut für Kernphysik, Heidelberg

The production of electron-positron and muon-antimuon pairs in high-frequency laser fields via few-photon absorption is considered. It is assumed that an intense xuv or x-ray laser pulse collides head-on with a relativistic ion beam. We study the generation of free e^+e^- pairs, free $\mu^+\mu^-$ pairs, and bound-free e^+e^- pairs, where in the latter case the electron is born in a low-lying atomic orbit of the projectile nucleus. Effects resulting from the finite nuclear size, the nuclear recoil, excited atomic shells, and the laser's polarization state are examined.

[1] C. Müller, C. Deneke, and C. H. Keitel, Phys. Rev. Lett. 101, 060402 (2008).
[2] C. Deneke and C. Müller, Phys. Rev. A 78, 033431 (2008).
[3] C. Müller, submitted (arXiv:0811.0976)

A 2.3 Mo 11:45 VMP 6 HS-E
Jitter-compensated time-resolved ion spectrometry at FLASH — •Maria Krikunova[1], Theophilos Maltezopoulos[1], Armin Azima[1], Moritz Schlie[1], Ulrike Frühling[2], Patrick Rüdiger[1], Harald Redlin[2], Roland Kalms[1], Marek Wieland[1], and Markus Drescher[1] — [1]Institut für Experimentalphysik, Universität Hamburg, Luruper Chausee 149, 22761 Hamburg, Germany — [2]HASYLAB at DESY, Notkestrasse 85, 22607 Hamburg, Germany

Photoionisation of deep atomic shells creates inner vacancies followed by a complex sequence of multi-electron relaxation processes via transient states. Recent XUV-pump/laser-probe ion spectrometry experiments using a HHG source allowed real time studies of electron relaxation dynamics in noble gas atoms. The much higher intensity of XUV pulses from the Free electron LASer in Hamburg (FLASH) holds out the prospect of extending this technique to more dilute species. This, however, calls for an improvement of the temporal resolution. Currently, the XUV/laser timing is subject to a jitter of a few hundred fs. In order to compensate for these fluctuations, we have developed a correlation technique based on XUV-induced reflectivity changes on a semiconductor surface. Applying this tool, we were able to perform a jitter-compensated time resolved ion-spectrometry experiment, identifying intermediate state dynamics in Xe atoms upon excitation of the 4d-shell with 93 eV XUV pulses and probing with 400 nm laser pulses. The results of this study reveal the current temporal resolution limit of pump-probe experiments utilizing XUV- and laser pulses from FLASH.

A 2.4 Mo 12:00 VMP 6 HS-E
Beobachtung des Tunnelns von Elektronen durch Doppler-Elektronenspektroskopie — •Rainer Hentges[1,2], Burkhard Langer[3], Oliver Kugeler[4,5], Uwe Hergenhahn[4], Arno Ehresmann[1] und Uwe Becker[2] — [1]Universität Kassel — [2]Fritz-Haber-Institut der MPG — [3]Freie Universität Berlin — [4]Max-Planck-Institut für Plasmaphysik — [5]Helmholtz-Zentrum Berlin

Die Spiegelsymmetrie homonuklearer zweiatomiger Moleküle führt zum periodischen Ladungsdichte-Transfer aller Molekülorbital bildenden Elektronen zwischen den Positionen ihrer ununterscheidbaren Kerne. Dieser symmetrieinduzierte Tunneleffekt ist bisher noch nicht in der Zeit-Domäne nachgewiesen worden, da die Paritätserhaltung der elektromagnetischen Wechselwirkung *quantum beat* Experimente mittels nichtkoinzident nachgewiesener Elektronen ausschließt. Der Nachweis des Elektronen-Tunnelns wurde daher bisher immer über die komplementäre Messung der Aufspaltung der geraden und ungeraden Symmetriezustände geführt. Wir zeigen hier die erste quasi-zeitaufgelöste Messung des Tunnel-Effekts von Elektronen in homonuklearen zweiatomigen Molekül durch den hochaufgelösten Nachweis von Elektronen, die von einem dissoziierenden Molekül dopplerverschoben emittiert werden. Diese rot/blau verschobenen Elektronenlinien werden bezüglich der Achse ihrer Emittermoleküle richtungaufgelöst nachgewiesen. Die Intensität der Elektronen, die mit der falschen Verschiebung in die falsche Richtung fliegen ist ein indirektes Maß für die Tunnelzeit der Elektronen in Form einer „Sanduhr“-Messung.

A 2.5 Mo 12:15 VMP 6 HS-E
Two photon double ionization of He^+: autocorrelation of soft x-ray FEL pulses — •Björn Siemer[1], Sebastian Roling[1], Rolf Mitzner[1,2], Tino Noll[2], Andrei Sorokin[3], Mathias Richter[3], Kai Tiedtke[4], Wolfgang Eberhardt[2], and Helmut Zacharias[1] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität, 48149 Münster — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Glienicker Straße 100, 14109 Berlin — [3]PTB, Abbe-Str. 2-12, 10578 Berlin — [4]DESY, Notkestr. 85, 22603 Hamburg

In order to perform jitter-free X-ray pump and probe experiments at the Free Electron Laser in Hamburg (FLASH) as well as to characterize the temporal structure of its high power pulses a novel beam splitter and delay unit (autocorrelator) has been designed and constructed. Based on geometrical beam splitting by a mirror edge the apparatus covers the XUV energy range up to photon energies of 200 eV providing a total delay of about 20 picoseconds with sub-femtosecond resolution. As a first test the pulse length of the FEL pulses has been measured at 24 nm. While the nonlinear autocorrelation in the UV and visible regions is a well established method to determine the duration of laser pulse there is a lack of efficient nonlinear detection processes in the soft X-ray regime. In this first experiments the pulse length of the FEL pulses provided at 24 nm are measured by double ionization of He, yielding a duration of (30 ± 5) fs.