A 51: Interaction with VUV and X-ray light III

Time: Friday 10:30–12:00 Location: BEBEL E42

A 51.1 Fri 10:30 BEBEL E42

Electron beam ion traps at ultrabrilliant light sources — •Sven Bernitt[1,2], René Steinbrügge[1], Jan Rudolph[1,3], Sascha Epp[4], and José Ramon Crespo López-Urrutia[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]IOQ, Friedrich-Schiller-Universität, Jena, Germany — [3]IAMP, Justus-Liebig-Universität, Gießen, Germany — [4]Max Planck Advanced Study Group, CFEL, Hamburg, Germany

Many plasma properties are determined by the interaction of highly charged ions with photons. In the VUV and X-ray spectral region usually only the time reversed processes were accessible. With the newest generation of ultrabrilliant light sources it is now possible to directly study photonic interactions. Results obtained with the transportable electron beam ion trap FLASH-EBIT [1] will be presented. It was used to provide targets of various highly charged ion species for synchrotrons (BESSY II, PETRA III) and free-electron lasers (FLASH, LCLS). By resonantly exciting VUV and X-ray transitions and detecting subsequent fluorescence as well as changes in the ion charge state it was possible to precisely measure transition energies, line widths, and properties of resonant photoionization. Our experiments provide valuable data for astrophysics and test general atomic theory [2,3].

[1] S. W. Epp et al., Phys. Rev. Lett. 98, 183001 (2007). [2] S. Bernitt et al., Nature 492, 225 (2012). [3] J. K. Rudolph et al., Phys Rev. Lett. 111, 103002 (2013).

A 51.2 Fri 10:45 BEBEL E42

Raman scattering of x-rays by heavy hydrogen-like ions — Thorsten Jahrsetz[1,2], Stephan Fritzsche[3,4], and •Andrey Surzhykov[4] — [1]Physikalisches Institut, Universität Heidelberg — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [3]Theoretisch-Physikalisches Institut, Universität Jena — [4]Helmholtz-Institut Jena

The scattering of photons on atoms, ions or molecules may lead to an excitation of the target. In atomic physics, this so-called Raman scattering was studied mainly for light neutral atoms. Advances in electron beam ion traps (EBITs), brilliant x-ray sources, and x-ray detector technology, allow nowadays an experimental investigation of inelastic x-ray scattering by heavy highly-charged ions. In such experiments relativistic, higher-multipole and even QED effects can be examined in detail. To support these future studies, we performed a theoretical analysis of Raman scattering of x-ray photons by heavy hydrogen-like ions [1].

We used second-order perturbation theory and a relativistic Greens function approach to evaluate the (total) scattering cross-section, the angular distribution of the photons, and the polarization of the ion after the scattering process. Special attention was paid to inelastic scattering involving the $1s_{1/2} \to 2s_{1/2}$, the $1s_{1/2} \to 2p_{1/2}$, and the $1s_{1/2} \to 2p_{3/2}$ transitions in H, Xe^{53+}, and U^{91+} targets.

[1] T. Jahrsetz et. al. in preparation

A 51.3 Fri 11:00 BEBEL E42

Lyman emission after Core Excitation of Water vapor — •LTAIEF BEN LTAIEF, ANDREAS HANS, PHILIPP SCHMIDT, PHILIPP REISS, ANDRE KNIE, and ARNO EHRESMANN — Institut für Physik and Center for Interdisciplinary Nanostructure Science and Technology, Universität Kassel, Heinrich-Plett Straße 40, D-34132 Kassel, Germany

The deexcitation channels of neutral hydrogen atoms after core excitation of gaseous water molecules by synchrotron radiation were studied using dispersed VUV fluorescence spectroscopy. The ionization yield and the intensity of several Lyman emission lines were measured as a function of exciting photon energy in the region of O1s excitations of water (532 eV - 542 eV). The population of the Lyman series (n≥3 as initial state) mirrors the excitation of different Rydberg states in the molecule.

A 51.4 Fri 11:15 BEBEL E42

Photon-photon coincidence in the EUV regime for very large gas pressures after dissociation of hydrogen molecules in superexcited states into neutral fragments — •Philipp Schmidt[1], Philipp Reiss[1], André Knie[1], Arno Ehresmann[1], Kouichi Hosaka[2], Yuko Nakanishi[2], Ken-ichi Shiino[2], and Noriyuki Kouchi[2] — [1]Institut für Physik and Center for Interdisciplinary Nanostructure Science and Technology, Universität Kassel, Heinrich-Plett-Straße 40, 34132 Kassel, Germany — [2]Department of Chemistry, Tokyo Institute of Technology, Meguro-ku, Tokyo 152, Japan

The time dependent fluorescence intensity in the EUV regime of molecular hydrogen after photoexcitation with an energy of 33.66 eV has been measured with a photon-photon coincidence setup starting at 2 Pa up to very high pressures of 150 Pa. At this energy, the resonant excitation of the superexcited Q_2 $^1\Pi$ (1) state leads to neutral dissociation into hydrogen atoms, where both atoms can be excited with principal quantum numbers of $n = 2$ and $n = 3$. The angular correlation function, coincidence time spectra as well as individual detector intensity has been analysed in this large pressure region with respect to possible entanglement effects between the neutral fragments by using the $2p$-$1s$ decay by Ly-α emission.

A 51.5 Fri 11:30 BEBEL E42

Diffraction Effects in the Molecular-Frame Photoelectron Angular Distributions of Halomethanes. — •Cedric Bomme[1], Denis Anielski[1,2], Sadia Bari[1], Benjamin Erk[1], Rebecca Boll[1,2], Evgeny Savelyev[1], Jens Kienitz[1], Nele Mueller[1], Thomas Kierspel[1], Sebastian Trippel[1], Jochen Kuepper[1], Jens Viefhaus[1], Mauro Stener[3], Piero Decleva[3], and Daniel Rolles[1] — [1]Deutsches Elektronen-Synchrotron(DESY), Hamburg, Germany. — [2]Max-Planck-Institut f. Kernphysik, Heidelberg, Germany. — [3]Universita' di Trieste, Trieste, Italy

We have measured the molecular-frame photoelectron angular distributions (MFPADs) for inner-shell photoionization of the halomethanes CH3F, CH3I, and CF3I in the gas-phase. Using our new double-sided velocity map imaging (VMI) spectrometer optimized for electron-ion coincidence measurements of high-kinetic energy electrons, we are able to determined MFPADs for photoelectrons up to 300 eV. For these high kinetic energies, the MFPADs are dominated by diffraction effects that encode information on the molecular geometry in the MFPADs.

A 51.6 Fri 11:45 BEBEL E42

Angular Distribution of Fluorescence Transitions in XeII obtained by Photon-Induced Fluorescence Spectroscopy after Excitation with Synchrotron Radiation — •Philipp Reiss[1], Christian Ozga[1], Witoslaw Kielich[1], Stefan Klumpp[2], André Knie[1], and Arno Ehresmann[1] — [1]Institut für Physik and Center for Interdisciplinary Nanostructure Science and Technology, Universität Kassel, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany — [2]Institute for Experimental Physics, University of Hamburg Faculty of Mathematics, Informatics and Natural Sciences Department of Physics, Luruper Chaussee 149, D22761 Hamburg, Germany

Xenon with its high number of electrons and their manifold interactions is a commonly used sample for the study of quantum-mechanical electron-correlative effects.

In this experiment, Photon-Induced Fluorescence Spectroscopy has been used to determine fluorescence excitation cross-sections and the angular distribution of the fluorescence from selected transitions after excitation of the XeI ground state to the doubly excited state [Kr] $5s^2$ $5p^4$ $(^3P_2)$ nl n^*l^* with narrow-band synchrotron radiation and its subsequent autoionization into XeII $5p^46p$ satellite states.

The fluorescence angular distribution shows an exciting-photon energy dependent variation. Thereby, the calculation of alignment and orientation parameters for certain electronic states in XeII and an electron partial wave analysis is feasible [Schill et. al., J. Phys. B. 36, L57 (2003)].