First light on 3d photoionization of multiply charged xenon ions: a new photon-ion merged beam setup at PETRA III


1Institut für Atom- und Molekülphysik, Universität Giessen, 35392 Giessen, Germany
2Institut für Experimentalphysik, Universität Hamburg, 22761 Hamburg, Germany
3Institut für Chemie und Biochemie, Freie Universität Berlin, 14195 Berlin, Germany
4Institut für Kernphysik, Goethe-Universität Frankfurt, 60438 Frankfurt am Main, Germany
5FS-PE, DESY, 22607 Hamburg, Germany
6Max-Planck-Institut für Kernphysik, Heidelberg, 69117 Heidelberg, Germany
7Physikalisch-Technische Bundesanstalt, 38116 Braunschweig, Germany
*Permanent Address: ATOMKI, Debrecen, Hungary
Stefan.Schippers@physik.uni-giessen.de

The Photon-Ion Spectrometer at PETRA III, PIPE, is an experimental setup for studying interactions of photons with charged particles [1, 2]. Target species are provided in the form of ion beams. Ion masses up to q x 50000 u at energies of q x 2.4 keV can be accommodated for q-fold charged ions. Possible target species are atomic and molecular ions or electrically charged clusters, fullerenes, biomolecules and nanoparticles. Photoionization and photofragmentation will be studied. Photoions, photo-fragments, photoelectrons and photon-induced fluorescence light will be observed. PIPE is a permanent end station of the Variable Polarization XUV beamline P04 at PETRA III.

P04 is designed to provide synchrotron radiation at energies 250 eV to 3000 eV with a photon flux of 10^{12} photons per second at 0.01% bandwidth; 10^{13} photons per second are possible at lower resolution. The photon beam diameter in the merged-beam interaction region of PIPE is less than 1 mm. In a first experiment relative cross sections were determined for several channels of multiple ionization hν + Xe^{q+} → Xe^{(q+n)+} + ne (n = 2, 3, 4, 5) associated with Coster-Kronig and Auger cascades following the initial creation of a 3d vacancy. An example for the experimental results obtained is shown in figure 1. Along the xenon isonuclear sequence the resonance structure drastically changes from broad features at the 3d edge for Xe+ ions to relatively narrow resonances at the higher charge states.

References:

Figure 1. Photoionization yield of Xe^{7+} ions produced from Xe^{5+} parent ions by synchrotron radiation with energies near the 3d ionization threshold.