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

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Synopsis A photon-ion merged beam endstation has been set up at the variable polarization XUV-beamline P04 of PETRA III in Hamburg. In a commissioning experiment first results could be obtained for multiple photoionization of Xe^{q+} ions (q=1,2,..,5) at photon energies around the 3d ionization threshold.

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 $q \times 50000$ u at energies of $q \times 2.4$ keV can be accomodated 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. Photo-ions, photo-fragments, photoelectrons and photon-induced fluorescence light will be observed. PIPE is a permanent endstation 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

$$h\nu + \mathrm{Xe}^{q+} \rightarrow \mathrm{Xe}^{(q+n)+} + n\mathrm{e} \quad n = 2, 3, 4, 5 \quad (1)$$

associated with Koster-Cronig 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.

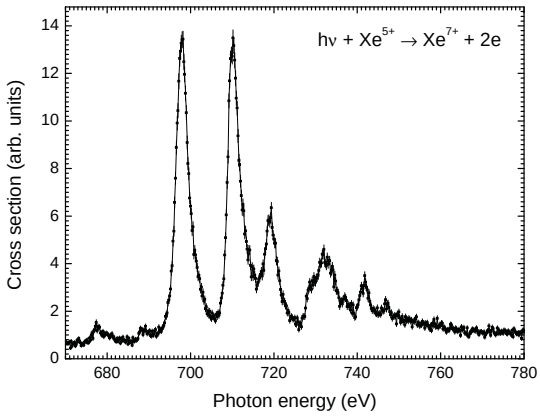

Figure 1. Photoionization yield of Xe^{7+} ions produced from Xe^{5+} parent ions by synchrotron radiation with energies near the 3d ionization threshold.

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