DAMOP11-2011-000343

Abstract for an Invited Paper
for the DAMOP11 Meeting of
the American Physical Society

**X-ray photoionization and resonant scattering of highly charged ions in the laboratory**

JOSE R. CRESPO LOPEZ-URRUTIA, Max-Planck-Institut fuer Kernphysik, 69117 Heidelberg

Photoionizing highly charged ions, which are characteristic of AGNs and x-ray binaries, has become possible in the laboratory by combining an electron beam ion trap (EBIT) with powerful x-ray sources. The method consists of superimposing the photon beam with a tight ensemble of trapped ions, that have been prepared in well defined charge states through electron impact ionization, and by subsequently analyzing their charge state evolution upon interaction with photons of varying energy. The EBIT ion areal density of $10^{10}$ ions/cm$^2$ is sufficient to allow for measurements of direct photoionization cross sections down to only 0.1 Mbarn. The energy determination of strong resonant transitions is possible to within 0.1 eV at 1 keV photon energy, limited by the current x-ray calibration standards in use, but statistical uncertainties of few ppm have been achieved for FeXIV and FeXV photoabsorption. Another feature of this technique is the possibility to extend resonant laser spectroscopy into the x-ray region through the use of free-electron lasers (FELs) reaching into this spectral range. Following EBIT investigations of the $2s - 2p$ transitions in Li-like FeXXIV at FLASH, the soft x ray FEL at DESY in Hamburg, Germany, we have carried out work into the keV region utilizing synchrotron radiation at BESSY II, HZB, Germany, and also performed experiments at LCLS, SLAC, Stanford. The superior peak flux of FELs suppresses background by orders of magnitude, and gives access to photonic interactions of highly charged ions in a spectral region hitherto beyond reach.