Linear polarization of x-ray transitions due to
dielectronic recombination in highly charged ions

H. Joerg¹, Z. Hu¹, H. Bekker², M. A. Blessenohl², D Hollain², S. Fritzsche³,⁴,
A. Surzhykov⁴, C. Shah¹, J. Crespo², and S. Tashenov¹

¹Department of Physics, University of Heidelberg, Heidelberg
²Max-Planck Institute for Nuclear Physics, Heidelberg
³Theoretisch-Physikalisches Institut, Friedrich-Schiller-University Jena, Jena
⁴Helmholtz-Institut Jena, Jena

Presenting Author: hjoerg@physi.uni-heidelberg.de

We report the first measurement of linear polarization of x rays emitted in the process of dielectronic
recombination (DR) into highly charged xenon ions. We observed that the polarization of x rays, following
the dielectronic capture exciting the state \[1s2s^22p_{1/2}\], is highly sensitive to the Breit interaction. The
experimental results for this transition rule out by 5σ calculations not taking the Breit interaction into
account. The latter accounts for retardation and magnetic contributions to the Coulomb repulsion between
electrons. The ions in the He- though O-like charge states were produced in an electron beam ion trap
(EBIT). The electron-ion collision energy was tuned into the KLL DR resonance, where an electron
recombines into the L- shell and an electron from the ion is excited from the K- to the L-shell. The
polarization of x rays which were emitted perpendicular to the electron beam propagation direction was
analyzed using Compton polarimetry. For this the x rays were Compton scattered in a block of boron
carbide. The scattered x rays were detected by an array of SiPIN diodes which sampled the azimuthal
angular scattering distribution. The Klein-Nishina formula was fitted to the measured distribution having
the degree of linear polarization as a free parameter. The degree of polarization was extracted with the
typical accuracy of below 10%, ranging between -43% to 53%. This first measurement of the degree
of polarization of DR transitions opens possibilities for polarization diagnostics of hot plasmas. Such
diagnostics will be sensitive to the directionality of the electron-ion collisions and thus revealing the
plasma anisotropies.

Figure 1: Scheme of the experiment:
x rays emitted by the xenon ions, that
are produced and trapped in the EBIT,
are scattered by a block of boron carbide.
The azimuthal distribution of the scat-
tered x rays is measured by an array of
SiPIN diodes. A germanium detector
registered unscattered x rays.

References