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

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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 $[1s2s^22p_{1/2}]_1$, 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.

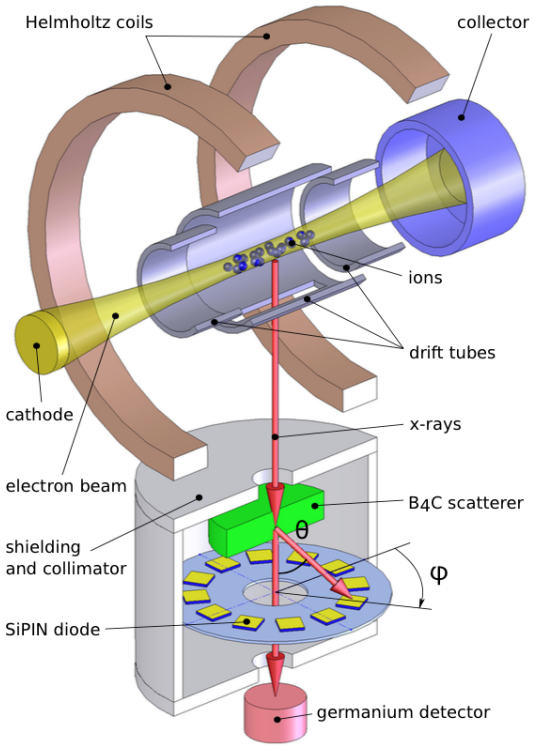

Figure 1: *Scheme of the experiment: x rays emitted by the xenon ions, that are produced and trapped in the EBIT, are scattered by a block of boron carbide. The azimuthal distribution of the scattered x rays is measured by an array of SiPIN diodes. A germanium detector registered unscattered x rays.*

References

[1] H. Joerg *et al.* Phys. Rev. A. **91** 042705 (2015)