XXIX International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC2015) IOP Publishing
Journal of Physics: Conference Series **635** (2015) 052091 doi:10.1088/1742-6596/635/5/052091

Linear polarization of x rays due to dielectronic recombination into highly charged ions

Chintan Shah*[1], Holger Jörg*, Zhimin Hu*, Sven Bernitt†, Hendrik Bekker†, Michael A. Blessenohl†, Daniel Hollain†, Sebastian Weber*, Stepan Dobrodey†, Stephan Fritzsche‡, Andrey Surzhykov♮, José R. Crespo López-Urrutia† and Stanislav Tashenov*[2]

* Physikalisches Institut der Universität Heidelberg, 69120 Heidelberg, Germany
† Max–Planck–Institut für Kernphysik, 69117 Heidelberg, Germany
‡ Friedrich-Schiller-Universität Jena, 07743 Jena, Germany
♮ Helmholtz-Institut, 07743 Jena, Germany

Synopsis The linear polarization of x rays produced by dielectronic recombination into highly charged ions was for the first time measured at an electron beam ion trap using a newly developed Compton polarimeter. The experimental results open a possibility for diagnostics of anisotropies of hot plasmas. We also demonstrate a high sensitivity of the x-ray polarization to the Breit interaction.

We report the first measurement of linear polarization of x rays emitted in the process of dielectronic recombination (DR) into highly charged ions. The krypton and xenon ions in the He- though O-like charge states were produced in an electron beam ion trap (EBIT) and the electron-ion collision energy was tuned into various KLL DR resonances. In these resonances an electron recombines into the L- shell of the ion and a bound electron is simultaneously excited from the K- to the L-shell. The polarization of the x rays emitted perpendicular to the electron beam propagation direction was analysed using the Compton polarimetry technique. For this the x rays were Compton-scattered in a block of beryllium or boron carbide. The scattered x rays were detected by an array of SiPIN diodes which sampled their azimuthal angular distribution, see Fig. 1. By fitting the Klein-Nishina formula to the measured scattering distributions we extracted the degrees of polarization of several DR transitions with a typical accuracy below 10%. The measured degrees of polarization range from -0.84 to 0.48 for krypton ions and from -0.43 to 0.53 for xenon ions. This measurement opens possibilities for polarization diagnostics of hot plasmas. Such diagnostics will be sensitive to the directionality of the electron-ion collisions revealing plasma anisotropies. Moreover, we have demonstrated that the polarization of the x rays emitted in the dielectronic recombination exciting the intermediate state $[1s2s^2 2p_{1/2}]_1$ is highly sensitive to the Breit interaction. The latter accounts for retardation and magnetic contributions to the Coulomb repulsion between the electrons. For both krypton and xenon ions, the experimental results for this resonance agree with the predictions that include the Breit interaction and they rule out by 2σ and 5σ, respectively, the calculations that treat the electron–electron interaction purely by the Coulomb force.

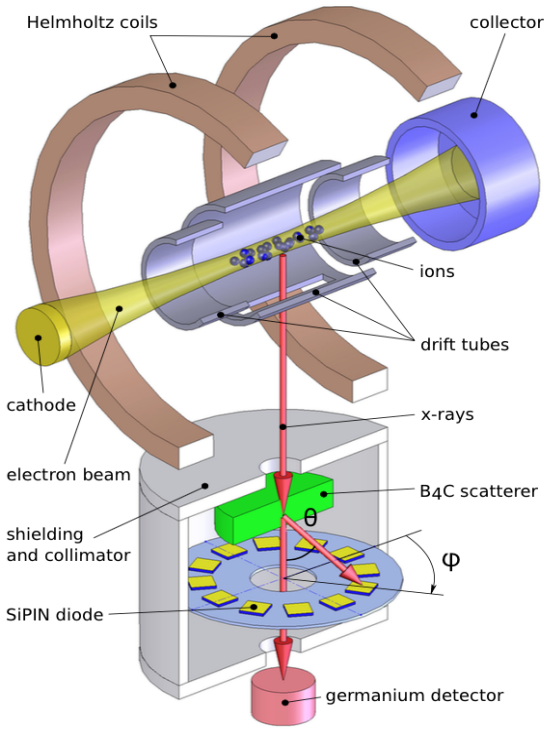

Figure 1. Scheme of the experiment: the ions are produced and trapped in an EBIT. The polarization of the x rays emitted in the electron-ion collisions is analysed using the Compton polarimetry technique.

[1]E-mail: chintan@physi.uni-heidelberg.de
[2]E-mail: tashenov@physi.uni-heidelberg.de