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Radiative Electron Capture Studies for Bare Uranium Ions in Collisions with Spin-Polarized Target Electrons

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Radiative electron capture (REC), the time reversed photon ionization process in ion–atom collisions, has been studied in great detail for projectile nuclear charges covering virtually the whole periodic table of elements up to fully stripped uranium ions [1]. With regard to the beam energies, the available data span from the low-collision energy regime up to high relativistic energies of almost ⊠⊠200 where ⊠ denotes the relativistic Lorentz factor. Beside total electron-capture cross-sections, photon angular distributions and recently even the associated photon polarization phenomena were subject of these studies with an in general excellent agreement with rigorous relativistic calculations. Here we propose to extend these studies at the internal target of the ESR to radiative capture of spin-polarized target electrons into a high-Z ion e.g. U92+. By means of Compton polarimetry [2,3], the high sensitivity of the photon polarization to the initial electron spin polarization will be exploited to control the polarization transfer to the ion. Subsequently performing total electron-capture cross-section studies of spin polarized electrons into ions having already captured a spin-polarized electron, we should be able to study the polarization build up for the stored ion beam.

This experiment is the beginning of a series of experiments whose ultimate goal is the generation of spin-polarized particle beams in flight. To this end, the teams at IKP in Jülich (with their detailed knowledge in preparation, control and experiments with stored polarized particle beams) and the AP/SPARC group at GSI (with their experience in REC studies for high-Z projectiles as well as in photon polarization studies for hard x- and ⊠-rays) team up. We note that polarized beams of heavy ions have never been realized before and represent a new degree of freedom for heavy ion storage-ring experiments. This is in particular relevant for future studies in the realm of fundamental symmetries.

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[3] K. H. Blumenhagen et al., Polarization transfer in Rayleigh scattering of hard x-rays, New Journal of Physics 18, 9 (2016).

[4] W. Middents et al., Possible Polarization Measurements in Elastic Scattering at the Gamma Factory Utilizing a 2D Sensitive Strip Detector as Dedicated Compton Polarimeter, Annalen Der Physik, 2100285 (2021).

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