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# Linear Polarization of the High-Energy End of Bremsstrahlung in Electron-Atom Collisions

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**Synopsis** We report on the effects of electron spin polarization on the bremsstrahlung polarization properties occuring in collisions of polarized electrons with thin target foils.

Electron-nucleus bremsstrahlung is one of the basic photon-matter processes. Recent theoretical and experimental studies concentrate on the influence of the incident electron spin polarization on the bremsstrahlung linear polarization properties [1, 2]. These investigations are also related to the diagnostic of stored beams of polarized ions as proposed within the frame of the atomic physics collaboration at the future FAIR facility.

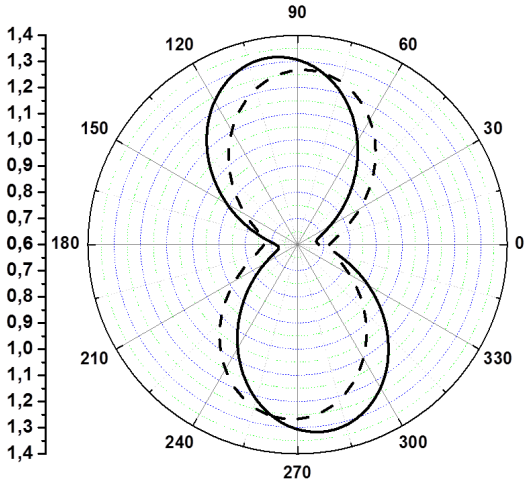


**Figure 2**. Preliminary results of the azimuthal fit of the Compton scattering distribution. The solid line shows the fit for the distribution recorded while using a transversely polarized beam. The dashed curve shows the reference curve recorded with an unpolarized electron beam.

At the polarized electron source SPIN of the TU Darmstadt [3] we studied the linear polarization of bremsstrahlung arising from the collision of unpolarized and transversely polarized electrons (100 keV) with thin gold targets. For detection of the emitted bremsstrahlung photons we employed a novel position sensitive Si(Li) detector dedicated for Compton polarimetry in the x-ray regime [4].

A non-zero electron polarization gives rise to a rotation $\chi$ of the photon polarization vector with respect to the reaction plane and to an enhanced degree of linear polarization $P_L$ in comparison to the unpolarized case. These two experimental observables are related to the Stokes parameters [5] which describe the linear polarization properties of radiation:

$$P_L = \sqrt{P_1 + P_2} \quad , \quad \tan(2\chi) = \frac{P_2}{P_1} \qquad (1)$$

The parameter $P_1$ depends on the collision energy as well as on the target material, while $P_2$ is sensitive to the electron spin polarization and vanishes for an unpolarized beam.

Fig. 1 shows the azimuthal distribution of Compton scattered bremsstrahlung photons of the measurements with an unpolarized and transversely polarized eletron beam. The degree of linear polarization $P_L$ and the orientation of the polarization vector $\chi$ can be obtained from this scattering distribution. A clear rotation of the polarization axis is visible and the preliminary results are in good agreement with theoretical calculations.

## References

[1] A. Surzhykov, 2005 *Phys. Rev. Lett.* **94** 203202

[2] V. A. Yerokhin and A. Surzhykov, 2010 *Phys. Rev. A* **82** 062702

[3] C. Heßler *at al* 2008 *Conf. Proc. EPAC08* TUPD027

[4] G. Weber *at al*, 2010 *JINST* **5** C07010

[5] W. H. McMaster, 1954 *Am. J. Phys.* **22** 351

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