Bremsstrahlung polarization correlations and their application for polarimetry of electron beams

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Synopsis The correlation between electron spin and photon linear polarization in atomic-field bremsstrahlung was measured with a polarized electron beam. The angle of photon polarization and the photon emission intensity were found to be correlated with the spin orientation. These effects are interpreted in terms of spin-orbit interaction. They lead to a new technique of electron beam polarimetry.

Linear polarization of hard x-rays emitted in the process of the atomic field electron bremsstrahlung has been measured with a polarized electron beam [1]. The correlation between the initial orientation of the electron spin and the angle of photon polarization has been systematically studied by means of Compton and Rayleigh polarimetry techniques applied to a segmented germanium detector, see Figure 1. The results are in a good agreement with the fully-relativistic calculations. They are also explained classically and in a unique way manifest that due to the spin-orbital interaction the electron scattering trajectory is not confined to a single scattering plane.

The developed photon polarimetry technique with a passive scatterer is very efficient and accurate and thus allows for novel applications. Bremsstrahlung polarization correlations lead to a new method of polarimetry of electron beams [2]. Such a method is sensitive to all three components of the electron spin. It can be applied in a broad range of the electron beam energies from 100 keV up to a few 10 MeV. The results of the test measurement at 100 keV will be shown. The optimum scheme for electron polarimetry will be analyzed and the relevant theoretical predictions will be presented. A closely related polarimetry technique for heavy ion beams can be developed based on Radiative Recombination.

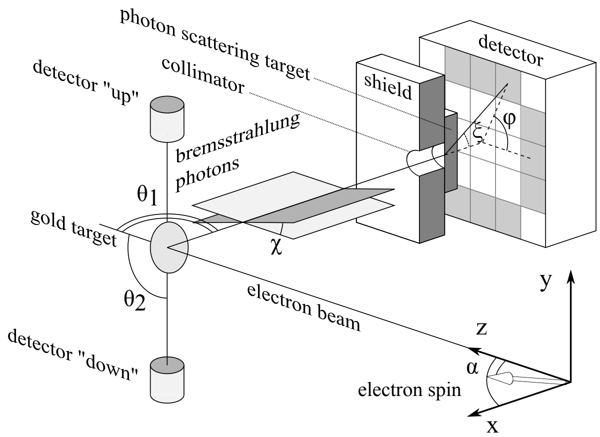

Figure 1. Scheme of the experiment.

References

[1] S. Tashenov *at al* 2011 *Phys. Rev. Lett.* **107** 173201

[2] S. Tashenov *at al* 2013 *Phys. Rev. A* **87** 022707

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