MATTER AND TECHNOLOGIES

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A Compton polarimeter telescope for the high keV-low MeV X-ray regime

The linear polarization of hard x-ray photons is an important observable for precision tests of QED on the dynamics of high-Z atomic systems at particle accelerators like GSI/FAIR as well as synchrotron facilities like DESY/PETRA3.
For the design of a Compton Polarimeter covering a wide energy range of x-ray energies, we followed the concept of a telescope configuration with thick planar semiconductor detectors (Si(Li)- and HPGe-material). In the first project phase at FZ-Jülich we manufactured a 9mm thick Si(Li)-DSSD to cover the low energy range (below 200keV) and equipped it with preamps whose input stage is moved close to the detector crystal to benefit from its low operation temperature (approx. 90K). This system was characterized in the lab, outperforming previous systems with respect to energy resolution by a factor of two, and was employed successfully in a beamtime at DESY/PETRA3. The scope of the second project phase is the extension of the energy range of the phase 1 polarimeter system. For the high energy upgrade of the system, we produced a 15mm thick HPGe-DSSD which serves as the second layer of the telescope (stopper for high energy photons). Results of phase 1 showed the need to redesign the analogue frontend electronics.
The test results of the system running in the lab environment confirmed a longtime stable operation of the whole system combined with state-of-the-art energy resolution as well as a 3D position resolution of approx. 1mm in the crystal depth, necessary for a high-quality polarization measurement and high event reconstruction efficiency. We measured with a conventional DAQ schema (shaper, CFDs, VME ADCs) as well as with DPP electronics (GSI Febex4a) for higher event rates. The system is ready for data production under experiment conditions.

Speed talk:

I am unwilling/unable to present a speed talk

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