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Letter of Intent

High Resolution Spectroscopy of p-Atoms with a Focussing Crystal Spectrometer at LEAR

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The study of simple atomic systems with an antiproton captured in an atomic orbital offers the possibility to gain essential information about such exotic atoms. For this purpose an instrument with a resolution better than the natural line width of the X-ray transitions and very high overall precision is needed. An instrument that meets ideally these specifications is a focussing crystal spectrometer.

At the Institut für Kernphysik of the Kernforschungsanlage Jülich a focussing crystal spectrometer of the Johann type is being constructed. Equipped with suitable crystals it is designed to cover an energy range from 1.5 to 20 keV. Using a special bending technique for the crystal to reach a spherical shape with a radius of curvature of ~ 3 m and with a position-sensitive detector with a spatial resolution of about 30 μm we aim at an overall resolution of the instrument of $\Delta E/E \sim 10^{-4}$. Absolute internal calibration, essentially free of systematic errors, is foreseen by means of adding a suitable gas to the source chamber. Due to the special design of the spectrometer the geometrical efficiency is planned to be $\sim 10^{-4}$, while the crystal reflectivity will be close to 1. Source and detector size are optimized for stopping a low-momentum p-beam in a gas target.

The very intense p-beam of LEAR offers the unique possibility to study the atomic p-system with such a high-resolution diffractometer.

After a check of performance of our instrument we plan to submit a proposal for high-resolution studies of the p-atom with our focussing spectrometer at the LEAR facility.