Precision Measurements in Pionic Hydrogen

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The strong interaction in the pion nucleon system leads to a shift and a broadening of the ground state in pionic hydrogen. These two quantities are measured in an experiment at the Paul Scherrer Institute with unprecedented precision and allow an experimental test of recent calculations in the framework of Chiral Perturbation Theory. Meanwhile the theory has reached an accuracy of a few percent [1,2].
Experimental advances in precision spectroscopy developed for X-rays from antiprotonic hydrogen and others [3] are employed in this experiment [4]. The expected accuracy is about 1% for the broadening and 0.2% for the shift. Compared to previous experiments this will be an improvement by an order of magnitude for the broadening.
Pions are stopped in a cryogenic target cell, situated at the axis of a cyclotron trap (see figure 1). The pions are captured by hydrogen and a fraction of them eventually cascades down to the ground level. The resulting X-rays are Bragg-reflected by a spherically bent crystal and detected in an array consisting of 6 CCDs.
Recent results of this experiment are presented at this conference.

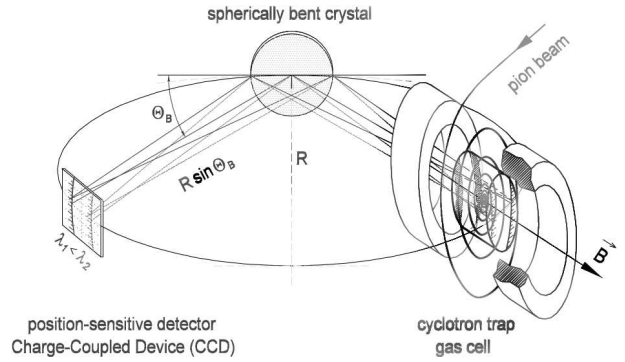

Figure 1: Scheme of the Experimental Set-up.

References

[1] N. Fettes, U.-G. Meissner, Nucl. Phys. **A676** (2000) 311.
[2] V.E. Lyubovitskij, A. Rusetsky, Phys. Lett. **B494** (2000) 9.
[3] D. Gotta et al., Nucl. Phys. **A660** (1999) 283.
[4] PSI Experiment R-98.01.