Contribution ID: **23** Type: **Oral**

Measurement of the ground-state hyperfine splitting of antihydrogen

Wednesday, 13 October 2010 12:00 (20 minutes)

The hydrogen atom is one of the most extensively studied atomic systems, and its ground state hyperfine splitting (GS-HFS) at 1.42 GHz has been measured with an extremely high precision of 10^-12. Therefore the antimatter counterpart of hydrogen, the antihydrogen atom, consisting of an antiproton and a positron, is an ideal laboratory for studying the CPT symmetry.

Kostelecky and his colleagues created an extension to the standard model by introducing parameters into its Lagrangian which violate either the CPT symmetry or the Lorentz invariance [1]. These parameters have a dimension of energy (or frequency), therefore their model claim that it is not the relative but the absolute precision of a measurement which matters when doing a CPT test. Thus by measuring a relatively small quantity on the energy scale (like the 1.42 GHz GS-HFS), a smaller relative accuracy is needed to reach the same absolute precision. This makes a determination of the GS-HFS frequency with a relative accuracy of 10^-4 competitive to the measured relative mass difference of 10^-18 between the neutral kaon and antikaon, which is often quoted as the most precise CPT test so far.

The ASACUSA collaboration at CERN's Antiproton Decelerator (AD) plans to measure the antihydrogen GS-HFS in an atomic beam apparatus [2,3] similar to the ones which were used in the early days of hydrogen HFS spectroscopy. The apparatus will use antihydrogen atoms produced in a superconducting cusp trap (i.e. anti-Helmholtz coils). The inhomogeneous magnetic field of such a trap will create a partially polarized beam, which will then pass through a radiofrequency resonator to flip the spin of the antihydrogen atoms. Finally a sextupole magnet analyses the spin orientation of the atoms. Simulations showed that such an experiment is feasible if appr. 100 antihydrogen atoms per second can be produced in the ground state, and that an accuracy of appr. 10^-7 can be reached within reasonable measuring times [3].

[1] R. Bluhm, V.A. Kostelecky, N. Russell, Phys. Rev. Lett. 82 (1999) 2254.

[2] ASACUSA collaboration, Proposal CERN-SPSC 2005-002, SPSC P-307 Add. 1, 2005.

[3] B. Juhasz, E. Widmann, Hyp. Int. 193 (2009) 305.

Primary author: Dr JUHASZ, Bertalan (Stefan Meyer Institute for Subatomic Physics, Vienna, Austria)

Co-author: Dr WIDMANN, Eberhard (Stefan Meyer Institute for Subatomic Physics, Vienna, Austria)

Presenter: Dr JUHASZ, Bertalan (Stefan Meyer Institute for Subatomic Physics, Vienna, Austria)

Session Classification: Session We - 2

Track Classification: Low energy precision tests of the Standard Model