Contribution ID: **48** Type: **Contributed**

The Baryon Antibaryon Symmetry Experiment (BASE)

Monday, 10 June 2013 10:10 (30 minutes)

The CPT invariance of all relativistic quantum field theories involved in the Standard Model defines that particles and their corresponding antiparticles have the same fundamental properties. Masses and lifetimes are identical, as well as charges and magnetic moments, the latter two with opposite sign.

BASE is testing the CPT invariance by a high-precision comparison of the proton and antiproton magnetic moments. The determination of the magnetic moment is based on the measurement of the frequency ratio of the spin-precession (also called Larmor) frequency and the cyclotron frequency in a Penning trap. Thereby, the g-factor is obtained, which measures the magnetic moment in units of the nuclear magnetron.

The cyclotron frequency is obtained by detection of image currents induced in the Penning trap electrodes by the particle's motion. The Larmor frequency is determined by the application of the continuous Stern-Gerlach effect. In this elegant scheme for the non-destructive detection of the spin eigenstate a strong magnetic bottle is superimposed to the Penning trap, which couples the magnetic moment of the particle to its axial motion. Thus, the spin-state analysis is reduced to an axial frequency measurement. A magnetic radiofrequency field is used to drive spin-flips of the (anti)proton, and the spin-flip probability as function of the spin-flip drive frequency is recorded to obtain the Larmor frequency.

Currently, the proton and antiproton magnetic moments are compared with a relative precision of 4.4 ppm measured in a Penning trap with a strong magnetic bottle. BASE intends to perform a measurement of the antiproton magnetic moment with a three orders of magnitude higher precision by using the so-called double Penning trap technique. In this measurement scheme, the frequency measurements are carried out in a Penning trap with a homogeneous magnetic field, while the spin-state analysis is spatially separated in a second Penning trap with magnetic bottle. Thereby, the line widths of the measured frequencies are significantly reduced. Recently, the double-trap technique has been demonstrated for the first time with a single proton at the BASE companion experiment in Mainz. This paves the way for a high-precision measurement of the antiproton magnetic moment on the ppb level with BASE at the Antiproton Decelerator (AD) at CERN.

Currently, the work to integrate BASE into the AD hall is in progress. A new experimental zone as well as a new antiproton transfer beam line are under construction and will be prepared until the end of the long shutdown LS1. The design of the BASE apparatus is complete and currently highly sensitive single particle detection systems are being developed. The experiment will be commissioned in the new area in order to prepare for the first on-line operation in 2014. The current status of BASE is presented.

Primary author: Dr SMORRA, Christian (RIKEN Advanced Science Insititute)

Co-authors: Mr MOOSER, Andreas (Institut für Physik); Mr SCHNEIDER, Georg (Institut für Physik); Mr NAGAHAMA, Hiroki (University of Tokyo); Prof. WALZ, Jochen (Institut für Physik); Prof. BLAUM, Klaus (Max-Planck-Institut für Kernphysik Heidelberg); Mr FRANKE, Kurt (Max-Planck-Institut für Kernphysik); Mr BRÄUNINGER, Sascha (Max-Planck-Institut für Kernphysik); Dr ULMER, Stefan (RIKEN Advanced Science Insititute); Dr QUINT, Wolfgang (GSI - Helmholtzzentrum für Schwerionenforschung GmbH); Prof. YAMAZAKI, Yasunori (RIKEN Advanced Science Insititute); Prof. MATSUDA, Yasuyuki (University of Tokyo)

Presenter: Dr SMORRA, Christian (RIKEN Advanced Science Insititute)

Session Classification: Symmetries

Track Classification: Standard Model and Fundamental Symmetries