Particle Physics Colloquium , Univ. Heidelberg, Germany, 24.07.2018

High-precision comparisons of the fundamental properties of protons and antiprotons

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The Baryon Antibaryon Symmetry Experiment (BASE-CERN) at CERN's antiproton decelerator facility is aiming at high-precision comparisons of the fundamental properties of protons and antiprotons, such as charge-to-mass ratios, magnetic moments, and lifetimes. Our single-particle multi-Penning-trap experiments provide sensitive tests of the fundamental charge-parity-time invariance in the baryon sector.

We measured the antiproton-to-proton charge-to-mass ratio with a fractional precision of 69 p.p.t. [1], as well as the antiproton magnetic moment with fractional precisions of 0.8 p.p.m. [2] and 1.5 p.p.b. [3], respectively. At our matter companion experiment BASE-Mainz, we have performed proton magnetic moment measurements with fractional uncertainties of 3.3 p.p.b. [4] and 0.3 p.p.b. [5]. By combining the data of both experiments we provide a baryon-magnetic-moment based CPT test

$$\frac{g_{\bar{p}}/2}{g_p/2} = 1.000\ 000\ 000\ 2\ (15),$$

which improves the uncertainty of previous experiments [6] by more than a factor of 3000. A unique antiproton reservoir trap used in BASE furthermore allows us to set constraints on directly measured antiproton lifetime [7]. Our current value $\tau_{\bar{p}} > 10.2\,a$ improves previous best limits by a factor of 30.

This talk will summarize the recent achievements of BASE and give an outlook on future perspectives.

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