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Challenging the Standard Model: High-Precision Comparisons of the Fundamental Properties of Protons and Antiprotons[1]

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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. Such experiments provide sensitive tests of the fundamental charge-parity-time invariance in the baryon sector. BASE was approved in 2013 and has measured since then, utilizing single-particle multi-Penning-trap techniques, the antiproton-to-proton charge-to-mass ratio with a fractional precision of 69 p.p.t., as well as the antiproton magnetic moment with fractional precisions of 0.8 p.p.m. and 1.5 p.p.b., respectively. At our matter companion experiment BASE-Mainz, we have performed proton magnetic moment measurements with fractional uncertainties of 3.3 p.p.b. and 0.3 p.p.b. By combining the data of both experiments we provide a baryon-magnetic-moment based CPT test $g_{pbar}/g_p = 1.000\ 000\ 000\ 2(15)$, which improves the uncertainty of previous experiments 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. Our current value t_p>10.2a improves previous best limits by a factor of 30. In this talk I will review the achievements of BASE and focus on recent developments which will allow us to further reduce our measurement uncertainties.

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