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High-precision measurements of the antiproton's fundamental properties

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The quantum-field theories, which are used in the Standard Model of particle physics to describe particles and their fundamental interactions, are invariant under the combined charge, parity, and time reversal (CPT) transformation. This fundamental symmetry requires conjugate particle/antiparticle pairs to have identical properties, such as charge-to-mass ratios, magnetic moments, or lifetimes. In return, the Standard Model can be challenged by performing high-precision comparisons of fundamental properties of conjugate particle-antiparticle pairs.

Inspired by this principle, the BASE collaboration targets to increase the sensitivity of CPT invariance tests by comparing the fundamental properties of single protons and antiprotons in an advanced multi Penning trap system. Our recent experiments constitute the most precise measurements of the proton's magnetic moment with a relative uncertainty of 3.3 ppb, the proton-to-antiproton charge-to-mass ratios with a fractional precision of 69 ppt and the antiproton's magnetic moment with a resolution of 0.8 ppm. These measurements set the most stringent constraints on CPT-violating interactions using antiprotons, and test the standard model at an absolute energy scale of < 10-25 GeV and < 10-22 GeV, respectively.

I will present an overview of our most recent results, and discuss prospects of BASE for the near future.

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