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CPT tests with antihydrogen and antiprotonic helium atoms

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Recent progress of the CPT tests with antihydrogen and antiprotonic helium atoms by the ASACUSA collaboration at CERN's antiproton decelerator will be presented. The antiprotonic helium atom (antiproton+electron+helium nucleus) is a serendipitously discovered metastable three-body system, whose energy levels can now be studied by laser spectroscopy techniques to a relative precision of $\sim 10^{-9}$ [1]. By comparing these precise experimental results with the result of three-body QED calculation [2], the antiproton-to-electron mass ratio was determined to a relative precision of 1.2×10^{-9}. While this can be used as a precise test of the CPT symmetry [3], CODATA instead assumed the CPT, and combined our results with the proton-to-electron mass ratio measured by the Penning trap method in their adjustment of the fundamental physical constants [4]. In addition to the laser spectroscopy of antiprotonic helium, ASACUSA collaboration also aims at measuring the ground-state hyperfine splitting of antihydrogen using the (anti)-atomic beam method. Extraction of antihydrogen atoms from a "cusp" trap has so far been demonstrated [5]. Both of these experiments will benefit from the completing of a new antiproton decelerator-cooler ring called ELENA, which is under construction at CERN.

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