

Antiproton and Antihydrogen Studies at ATRAP

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When compared to their matter counterparts, precision measurements of antiprotons such as the one of their charge-to-mass ratio [1] or of antihydrogen provide very stringent tests of the CPT symmetry (charge conjugation, parity and time reversal) that is fundamental to our formulation of the Standard Model of particle physics in terms of Lorentz invariant, local quantum field theories.

At ATRAP, this type of research is currently pursued along two aspects. One goal is to perform precise spectroscopy of antihydrogen in a magnetic atom trap. Here, a milestone has recently been accomplished by simultaneously trapping 5 antihydrogen atoms on average with confinement times of 15 to 1000 s- long enough to ensure that they have reached their ground state [2]. A second goal is to precisely determine the antiproton's magnetic moment μ_p . By utilizing one-particle methods in a Penning trap [3,4,5] ATRAP has performed the first direct measurement of μ_p with a precision of 4.4 parts per million [6], a 680-fold improvement over the previous values [7]. These techniques that can be applied to both, proton and antiproton, ultimately promise a gain in experimental precision of μ_p by at least a factor of 1000 in addition to the present measurement.

This talk will present recent progress in ATRAP's anti-hydrogen efforts as well as the first direct measurement of the anti-proton's magnetic moment.

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