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Antimatter Advances Include Trapped Antihydrogen in Its Ground State[1]

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Three recent advances in antimatter physics show significant progress towards precision tests of fundamental symmetries. The first and primary focus of this talk is ATRAP's observation of five simultaneously trapped antihydrogen atoms per trial, confined for long enough to ensure that they are in their ground state.[2] Large numbers of simultaneously trapped atoms are crucial if laser cooling and spectroscopy of antihydrogen at high levels of precision are to be achieved. Fundamental to this result is the careful control and characterization of the geometry and temperature of the large-number antiproton and positron plasmas from which antihydrogen is formed, along with enhanced event detection and cosmic ray background rejection techniques. A second advance, by the ALPHA collaboration, is a demonstration that smaller numbers of simultaneously trapped antihydrogen atoms can be ejected from a magnetic trap when microwaves flip the spin of the atoms.[3] A third advance is a direct measurement of the proton magnetic moment to 2.5 parts per million using a technique that can be directly applied to an antiproton[4] to improve the precision with which the antiproton magnetic moment is measured by a factor of 1000.

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[2]G. Gabrielse et al. (ATRAP Collaboration). Phys. Rev. Lett. **108**, 113002 (2012).
[3]C. Amole et al. (ALPHA Collaboration). Nature **483**, 439 (2012).
[4]J. DiSciacca and G. Gabrielse. Phys. Rev. Lett. **108**, 153001 (2012).