

Alpha - Laser cooling of antihydrogen atoms

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I review some of the developments that allowed the ALPHA Collaboration to perform laser spectroscopy on the 1S-2S transition in trapped antihydrogen with 12 significant figures [1] - the most accurate measurement on antimatter - and the achievement of laser cooling in our trapped sample [2]. The implications of these steps towards testing CPT Invariance and the Weak Equivalence Principle in a ballistic gravity experiment [3-6] are enormous. Future prospects and developments, such as the need to address a direct comparison of hydrogen and antihydrogen in the same electromagnetic and gravitational environment, towards a comparison at the level of 15 significant figures via laser spectroscopy and high-precision measurement of Earth's gravitation acceleration on antihydrogen are briefly discussed.

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- [5] A. I. Zhmoginov, A. E. Charman, R. Shaloo, J. Fajans and J. S. Wurtele, Nonlinear dynamics of anti-hydrogen in magnetostatic traps: implications for gravitational measurements, *Class. Quantum Grav.* 30, 205014 (2013).
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