

Laser spectroscopy of cooled antiprotonic helium atoms

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on behalf of the ASACUSA collaboration

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The Atomic Spectroscopy and Collisions Using Slow Antiprotons (ASACUSA) collaboration at the Antiproton Decelerator facility of CERN is carrying out precise laser spectroscopy experiments on antiprotonic helium ($\bar{p}\text{He}^+ \equiv \bar{p} + \text{He}^{2+} + e^-$) atoms [1, 2, 3]. Employing buffer-gas cooling techniques in a cryogenic gas target, samples of atoms were cooled to temperature $T = 1.5\text{--}1.7$ K, thereby reducing the Doppler width in the single-photon resonance lines [3]. By comparing the results with three-body quantum electrodynamics calculations, the antiproton-to-electron mass ratio was determined as $M_{\bar{p}}/m_e = 1836.1526734(15)$. Besides providing a consistency test of CPT symmetry, the results have recently been used to set constraints on any exotic fifth force that may exist at the $\sim 1 \text{ \AA}$ length scale [4, 5, 6, 7]. Further improvements in the experimental precision are currently being attempted.

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- [1] V.I. Korobov, L. Hilico, J.-P. Karr, Phys. Rev. Lett. 112 (2014) 103003.
 - [2] V.I. Korobov, L. Hilico, J.-P. Karr, Phys. Rev. A 89 (2014) 032511.
 - [3] M. Hori et al., Science 371 (2016) 610.
 - [4] E.J. Salumbides, W. Ubachs, V.I. Korobov, J. Mol. Spect. **300** (2014) 65.
 - [5] J. Murata, S. Tanaka, Class. Quantum Grav. **32** (2015) 033001.
 - [6] P. Brax, S. Fichet, G. Pignol, arXiv:1710.00850 (2017)
 - [7] F. Ficek *et al.*, arXiv:1801.00491 (2018)