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Precision Spectroscopy of Trapped Antihydrogen in the ALPHA Experiment

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Precision measurements of magnetically trapped antihydrogen provides a unique and powerful way to test fundamental symmetries. A cornerstone of the standard model, CPT symmetry demands that the spectrum of antihydrogen be identical to that of its ordinary matter counterpart. Of particular interest is the 1S-2S transition which has been measured in hydrogen[1] with the remarkable relative precision of a few parts in 10^{15} , and promises a particularly elegant and high precision test of CPT symmetry by comparison to antihydrogen.

In 2016, the ALPHA collaboration made the first observation[2] of the 1S-2S transition in antihydrogen, and very recently this measurement was drastically improved[3] to reach a fractional precision of 2×10^{-12} . The observed frequency in antihydrogen is consistent with CPT symmetry at the current level of precision.

In this talk, I will present this latest measurement of the 1S-2S transition and introduce the methods of anti-atom spectroscopy developed by ALPHA. Finally, I will touch on future improvements needed to take this milestone measurement to the same precision as its hydrogen counterpart.

[1] Parthey, C.G. et al, Phys. rev. lett. 107, 203001 (2011).

[2] Ahmadi, M. et al, Nature 541, 506-510 (2017).

[3] Ahmadi, M et al, Nature (2018)

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