Observation of the 1*S*-2*S* transition in trapped antihydrogen

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Antihydrogen, the bound state of an antiproton and a positron and the antimatter counterpart of hydrogen, holds the promise of some of the most precise tests imaginable on the fundamental symmetry of matter and antimatter. We report the first observation of the 1*S*-2*S* transition in trapped antihydrogen[1], a milestone in the quest to use antihydrogen to do a precision test of the CPT Theorem, a cornerstone of the Standard Model. The 1*S*-2*S* transition is known to $\sim$15 decimal places in hydrogen[2]. We discuss how this first observation was made possible through a number of key advances in the ability to magnetically trap antihydrogen, that must be made from its constituents. We further discuss the crucial enhancement of the 243 nm laser light that excites the two-photon transition and the unique detection capabilities of the ALPHA apparatus necessary to probe the ultimately few anti-atoms available for these experiments. This first observation was consistent with the equivalent transition in hydrogen to $\sim 2\times 10^{-10}$, and paves the way for measurements of the line shape in order to establish tight experimental bounds on the CPT symmetry of hydrogen and antihydrogen.

References

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[2] G. Parthey et al., Phys. Rev. Letts. **107**, 203001 (2011)

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