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On the spectrum of antihydrogen: characterization of the 1S-2S transition

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The study of the spectrum of atomic hydrogen has played a central role in the history of quantum mechanics. The comparison between theory and experiment has found in the hydrogen atom your best companion. As the simplest atomic system, it allowed the comparisons to reach an unprecedented accuracy. Examples of the power of comparison between theory and experiments is the capability of quantum electrodynamics to precisely predict transition frequencies, and modern measurements of the 1S-2S transition (in atomic hydrogen) to a precision of a few parts in 1015.
Over the past few years has been possible to study the antimatter equivalent of the hydrogen –the antihydrogen. The motivation behind the study of the antimatter is try to understand the unbalanced amount of matter and antimatter in our Universe. The Standard Model predicts that should have been equal amounts of matter and antimatter in the primordial Universe, but today ours Universe is observed to be made almost entirely of ordinary matter. This difference motivates the search of a small asymmetry in the laws of physics that govern the two types of matter. In this case, the CPT theorem requires that hydrogen and the antihydrogen spectrum should be exactly the same.
In this work the ALPHA collaboration reports the more precise measurement performed on anti-atom. Here we characterize one of the hyperfine components of this transition using magnetically trapped atoms of antihydrogen and compare it to model calculations for hydrogen in our apparatus. This measurement is consistent with charge–parity–time invariance at a relative precision of the first observation of 2×10−12 —two orders of magnitude more precise than the previous determination—corresponding to an absolute energy sensitivity of 2 × 10−20 GeV.

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