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Advances in Microwave Spectroscopy of Antihydrogen

Monday 3 June 2019 12:00 (15 minutes)

The hydrogen ground state hyperfine splitting is known to seven parts in 10¹³ [1]. The Antihydrogen Laser Physics Apparatus (ALPHA) Collaboration seeks to perform precision tests of symmetries between matter and antimatter by measuring properties of antihydrogen and comparing them to its matter counterpart, hydrogen. This pursuit leads us to probe the ground state hyperfine splitting in antihydrogen; if charge parity time (CPT) symmetry holds then it should be identical to that of hydrogen.

We measure two positron spin resonance (PSR) frequencies in the same magnetic field, from which we extract the hyperfine splitting. In 2017, we reported a 200-fold improvement in the precision to which the hyperfine splitting had been measured in antihydrogen, resolving the frequency to four parts in 10⁴ [2]. I will describe methods that have enabled us to further increase the precision to which we are able to measure this quantity by a substantial margin. I will also discuss implications of these new methods for matter/antimatter comparisons in precision tests of fundamental symmetries.

[1] Petit, P., Desaintfuscien, M. & Audoin, C. Temperature dependence of the hydrogen maser wall shift in the temperature range 295–395 K. Metrologia 16, 7–14 (1980).
[2] Ahmadi, M., et al. Observation of the hyperfine spectrum of antihydrogen. Nature 548, 66 –69 (2017).

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