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Observation of Hyperfine Transitions in Trapped Ground-State Antihydrogen

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Cold antihydrogen promises a unique opportunity to study the properties of atomic antimatter, and via comparisons with its well-studied matter-counterpart, the possibility to test fundamental symmetries such as CPT invariance. We report the first observation of positron spin flip transitions between hyperfine levels of ground state antihydrogen () and the first experimental constraint on the zero-field hyperfine splitting of these atoms. The experiments involved atoms confined in a 0.5 Kelvin deep magnetic potential well, and provides compelling evidence that ground-state are held in the trap for long periods of time. Transitions between hyperfine levels are induced by injecting microwave radiation at appropriate frequencies. The resulting spin flip causes the to be expelled from the trap and the resulting antiproton annihilation is then observed. Remarkably, this experiment was performed with trapping rate of approximately 1 anti-atom/attempt.
The observed results will be compared with expectations from simulations of trapped dynamics and independent in-situ electron cyclotron resonance measurements of magnetic and microwave field amplitudes. Prospects for experiments that will constrain the zero-field hyperfine splitting of the atom at the 10-6 level in our newly constructed apparatus will also be discussed.
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