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Precision Measurement of Hyperfine Splitting in Antihydrogen

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Antimatter remains one of the most vital, yet mysterious areas of particle physics. The deficiency of antimatter in nature, despite its theoretically predicted abundance, leaves questions regarding our understanding of fundamental symmetries. Antihydrogen is the antimatter counterpart of the hydrogen atom, and it provides a simple antimatter system to test these symmetries, such as simultaneous charge, parity and time symmetry as well as uncovering potential deviations from the Standard Model.

The ALPHA (Antihydrogen Laser PHysics Apparatus) Collaboration based at CERN, is at the forefront of exploring fundamental properties of antihydrogen with its unique antihydrogen trapping apparatus and novel experimental techniques. The aim of my research is to measure the ground state hyperfine splitting of antihydrogen; a characteristic that arises from the interaction of the antiproton and orbiting positron and a physical property that is sensitive to QED effects. In order to precisely measure these features, the experimental procedure, magnetic field, and systematics of the experiment must be carefully considered. Presently, we look to improve upon our previous measurement's precision of 4 parts per 10^4, and to compare the resulting value with that of the well-known hydrogen atom.

In this presentation I will report on the advancements and recent results achieved by the ALPHA Collaboration towards high precision measurements of the hyperfine structure of antihydrogen, and prospects for further improvements.

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