MEASUREMENT OF PROPERTIES OF ANTIHYDROGEN WITH THE ALPHA TRAP

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The goal of the ALPHA project at the CERN AD is to test fundamental symmetries between matter and antimatter using trapped antihydrogen atoms. Cold atoms of antihydrogen present a unique opportunity to study the properties of atomic antimatter, and via comparisons with its well-studied matter counterpart, the possibility to test CPT invariance. In order to probe matter-antimatter symmetry at the highest possible precision, it is essential that the antiatoms be suspended in vacuum to allow for detailed interrogation via laser light or microwaves.

The ALPHA experiment has trapped upward of 1000 antihydrogen atoms since 2010, mostly in the newly commissioned ALPHA2 trap. This presentation will describe the measurements that we have performed with these trapped antiatoms. These include proof-of-principle measurements of their ground state hyperfine transitions and their gravitational mass. By applying stochastic acceleration to trapped antihydrogen atoms, we have obtained an experimental bound on the antihydrogen charge, Qe, of $|Q| < 0.71$ parts per billion (one standard deviation), in which e is the elementary charge. I will also offer an outlook towards the current 1S2S, 1S2P and hyperfine transition spectroscopic studies.