The ASACUSA-Cusp Experiment - Progress Towards an Antihydrogen Beam

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The ASACUSA Cusp experiment aims to perform spectroscopy of the hyperfine structure of ground state antihydrogen in a field-free region. This will allow comparisons with hydrogen which would provide a test of CPT symmetry. To achieve this, spectroscopy apparatus has been developed to use a Rabi type beam method. This apparatus has been successfully tested with hydrogen [1]. Therefore, the present goal of the experiment is to produce a cold spin polarised beam of ground state antihydrogen.

The beam is produced by mixing antiprotons and positrons contained within a multi-ringed electrode trap. The trap is housed within the cold bore of a superconducting magnet which has a cusped field configuration. If the antihydrogen is produced with a low enough velocity, low field seeking states will be preferentially focused on the beam axis by the magnetic field.

In 2012, antihydrogen atoms were observed 2.7 m from the production region [2] however the rate was too low to perform spectroscopy. Subsequent measurements of the distribution of the principle quantum number (n) showed that the bulk of antihydrogen atoms emerging from the trap were in high $n>14$ states. Hence, the requirements for performing spectroscopy are clear, a beam must be produced with higher intensity and lower n.

In this presentation, I will briefly review the previous results from the experiment and give an overview of methods. I will then discuss changes taking place during the period 2019-2020 when there is no proton physics at CERN. Work is underway to both increase the beam intensity and the number of ground state antihydrogen atoms, theoretical and experimental results will be shown and discussed where available.

References

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