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In Situ Magnetometry for Experiments with Antihydrogen

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The Antihydrogen Laser Physics Apparatus (ALPHA) is based at the European Organization for Nuclear Research (CERN). Using low energy antiprotons we produce, trap, and study the bound state of an antiproton and positron, antihydrogen [1]. Given the long history of atomic physics experiments with hydrogen, experiments with antihydrogen offer some of the most precise tests of quantum electrodynamics and charge-parity-time symmetry [1]. A test of the weak equivalence principle is on the horizon with a major addition to ALPHA, ALPHAg, aiming to measure the gravitational free fall of antihydrogen. All experiments in ALPHA require precise measurements of the magnetic field inside the apparatus; this is especially important for ALPHAg [2]. A technique developed in ALPHA determines the magnetic field by measuring the cyclotron frequency of an electron cloud. Microwave pulses on resonance with the cyclotron frequency, which is magnetic field dependent, heat the electrons [3]. A campaign to characterize the accuracy of this technique in a magnetic field gradient is required before a measurement of the effect of Earth's gravity on antimatter can be made. I will discuss recent progress made towards realising this goal including the application of this measurement in a field gradient.

1. Characterization of the 1S–2S transition in antihydrogen, ALPHA Collaboration, Nature, 557, 71, (2018)
2. Description And First Application Of A New Technique To Measure The Gravitational Mass Of Antihydrogen, ALPHA Collaboration, Nature Communications 4, 1785 (2013)
3. Electron Cyclotron Resonance (ECR) Magnetometry with a Plasma Reservoir, E. D. Hunter et al, Physics of Plasmas 27, 032106 (2020)

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Please select: Experiment or Theory

Experiment

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