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Fundamental tests of antimatter gravitation with antihydrogen accelerators

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The Antihydrogen Laser Physics Apparatus (ALPHA) collaboration at CERN has been successfully pushing the boundaries of high precision atomic physics with antihydrogen to characterise the peculiarities of antimatter in a universe suspiciously dominated by matter today. Starting from the blossoming expertise developed by the collaboration with antihydrogen traps and laser spectroscopy measurements, ALPHA is currently directing its efforts towards ALPHA-g, the next generation of antihydrogen traps, two Penning-Malmberg and neutral atom traps, intended to measure the gravitational acceleration g of antimatter on Earth with higher precision.

This challenging goal requires homogeneity and precise knowledge of the magnetic fields in the system with a careful analysis of the experimental protocol and diagnostic techniques, i.e. controlling the probe and background magnetic fields in the experiment. Starting from an analysis of the underlying principles and designs of the ALPHA-g machine underpinned by the recent contributions and results from the collaboration, the discussion will develop around the precision improvements in the magnet control system critical to achieve the aforementioned objective.

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