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How does antimatter fall? : focus on the GBAR experiment (CERN)

One of the main questions of fundamental physics is the problem of the asymmetry matter/antimatter in the universe and the action of gravity on antimatter. Tests on antimatter gravity have currently a limited precision, with the sign of gravity acceleration not yet known experimentally. Ambitious projects are developed at CERN facilities to produce low energy antihydrogen with the aim of measuring the free fall of antihydrogen atoms. Among them, the GBAR experiment (Gravitational Behaviour of Antihydrogen at Rest) aims at measuring the gravity acceleration of antihydrogen atoms during a free fall in Earth's gravitational field. The simulation of the free-fall chamber includes the Monte-Carlo generation of trajectories and the statistical analysis. A precision of the measurement beyond the % level is confirmed by taking into account the experimental design. We also propose a new method using quantum reflection of antiatoms above a reflecting mirror followed by a classical free fall; the quantum interference pattern obtained at detection improves the accuracy of the experiment by approximately 3 orders of magnitude.

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