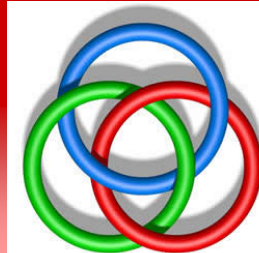




国立研究開発法人理化学研究所 仁科加速器研究センター
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Casting Light on Antimatter: Fundamental Physics with Trapped Antihydrogen

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Antihydrogen, an atomic form of antimatter consisting of an antiproton and a positron, is a promising tool for testing some of the most fundamental symmetries in physics, such as CPT invariance and Einstein's Equivalence Principle in General Relativity. Several experiments at CERN's Antiproton Decelerator facility have been working towards the ultimate goal of precision measurements of antihydrogen properties, since the start of the AD in 1999. Among them are the ATHENA and ALPHA experiments. Important milestones have been achieved by both experiments over the past 15 years, including production of cold antihydrogen [1], stable confinement of antihydrogen for as long as 1000 seconds [2, 3], and the first proof-of-principle spectroscopic measurement on antihydrogen atoms [4].

Following these milestones, the ALPHA collaboration recently constructed an entirely new apparatus, ALPHA-2. It allows laser access to the trapped anti-atoms, enabling laser cooling and precision spectroscopy. The first physics results with the new apparatus has been recently reported: a precision measurement of charge neutrality of antihydrogen [5], which in turn provides an improved measurement of the electric charge of the positron, as a test of CPT. In the meantime, the collaboration is developing an ambitious new project, ALPHA-g, to study the gravitational properties of antimatter to address, for the first time, the question of whether antimatter falls in the same way as matter does.

In this talk, I will start with some discussions of the motivations [6], followed by recent achievements and the future prospects of the fundamental physics studies with ALPHA.

References:

[1] M. Amoretti et al. (ATHENA Coll.), Nature 419, 456 (2002). [2] G.B. Andresen et al. (ALPHA Coll.), Nature 468, 673 (2010). [3] G.B. Andresen et al. (ALPHA Coll.), Nature Physics 7, 558 (2011). [4] C. Amole et al. (ALPHA Coll.), Nature 483, 439 (2012). [5] M. Ahmadi et al. (ALPHA Coll.), Nature 529, 373 (2016). [6] M.C. Fujiwara, Antihydrogen, CPT, and Naturalness, arXiv:1309.7468.

* The talk will be given in English language.

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