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Experimental Determination of a Bound on Antihydrogen Charge

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An unusual test of CPT and quantum anomaly cancellation has been performed [1] by the ALPHA Collaboration. A bound on the charge neutrality of antihydrogen has been determined [1] through a retrospective analysis of the dynamics of antihydrogen atoms as they are released from the ALPHA trap. The analysis studies the influence of electric fields on antihydrogen dynamics under different assumptions of putative charge. Extensive numerical modeling and knowledge of the position of actual antihydrogen annihilations on our silicon vertex detector yield a limit on antihydrogen charge of Q=(-1.3 +- 1.1 +-.4)x 10^(-8) e where e is the magnitude of the electron charge, and the errors are from statistical and systematic effects, respectively. Future experiments using a stochastic acceleration technique [2] have the potential to significantly improve the experimental precision reported here.

[1] C. Amole et al. (ALPHA collaboration) and A. E. Charman. An Experimental Limit on the Charge of Antihydrogen, Nature Communications, June 2014. http://dx.doi.org/10.1038/ncomms4955.
[2] M. Baquero-Ruiz, A. E. Charman, J. Fajans, A. Povilus, F. Robicheaux, J. S. Wurtele and A. I. Zhmoginov, Measuring the electric charge of antihydrogen by stochastic acceleration. http://arxiv.org/abs/1405.1954

Primary author: Prof. WURTELE, Jonathan (UC Berkeley/LBNL)

Co-author: (CERN), ALPHA Collaboration (http://alpha.web.cern.ch)

Presenter: Prof. WURTELE, Jonathan (UC Berkeley/LBNL)

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