**Stochastic Acceleration of Antihydrogen for Precision Charge Neutrality Measurements**

**Abstract:**

Recently stochastic acceleration has been proposed as a technique for a precision measurement of any putative charge of antihydrogen. Simulations indicate that the precision achievable with stochastic acceleration exceeds that of the current ALPHA Collaboration experimental result by several orders of magnitude

**Summary:**

Experiments on normal matter atoms and molecules have found them to be charge neutral to 10^-21 e, where e is the magnitude of the electron change. The CPT theorem requires that antihydrogen be neutral if hydrogen is neutral. Quantum anomaly cancellation also demands charge neutrality of antihydrogen. Recently the ALPHA collaboration found an experimental bound on the charge of antihydrogen to be (-1.3 +/- 1.1+/- 0.4) e (where the errors are statistical and systematic, respectively). This measurement made use of the influence of applied electric fields during on the antihydrogen dynamics under the assumption of a putative charge to the anti-atom. Simulations predict variation in the location of annihilations on the ALPHA detector with putative antihydrogen charge.

Stochastic acceleration has been proposed [2] as a precision method for measuring a putative charge of antihydrogen. Applications of stochastic fields give random kicks to an antihydrogen with a nonzero charge. These random kicks lead to the anti-atom escaping from the trap and annihilating. The stochastic acceleration method should improve precision to 3x10^-11 e with existing trapping rates and temperatures. Laser and adiabatic cooling should permit improvements to 3x10^-12. Here we examine how stochastic acceleration results in orders-of-magnitude improvement in experimentally achievable performance.

[1] C. Amole, M. D. Ashkezari, M. Baquero-Ruiz, W. Bertsche, E. Butler, A. Capra, C. L. Cesar, M. Charlton, S. Eriksson, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, A. Gutierrez, J. S. Hangst, W. N. Hardy, M. E. Hayden, C. A. Isaac, S. Jonsell, L. Kurchaninov, A. Little, N. Madsen, J. T. K. McKenna, S. Menary, S. C. Napoli, K. Olchanski, A. Olin, A. Povilus, P. Pusa, C. Ø. Rasmussen, F. Robicheaux, E. Sarid, D. M. Silveira, C. So, T. Tharp, R. I. Thompson, D. P. van der Werf, Z. Vendeiro, J. S. Wurtele, A. Zhmoginov, (ALPHA collaboration), and A. Charman. Nature Communications http://dx.doi.org/10.1038/ncomms4955 (2014)

[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.