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Simulations for the measurement of the groundstate hyperfinestructure of antihydogen

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Charge, Parity and Time (CPT) symmetry is the most fundamental theoretical concepts in particle physics. The ASACUSA-Hbar collaboration aims to test this property by measuring the hyperfine structure in ground state antihydrogen [1].

Due to the big challenge in producing a beam of antihydrogen [2] sophisticated simulations are needed. Especially tracking of antihydrogen atoms through magnetic fields, atomic processes like Stark effect and Zeemann splitting, microwave transitions in a cavity and antiproton annihilations are required. To achieve this the particle physics toolkit Geant 4 [3] is used as a basis for developing a modular easily usable framework for simulating the ASACUSA antihydrogen beamline, the detectors and the hyperfine transitions within the microwave cavity.

The presented work describes the current status of this simulation framework and gives an overview on the challenges that arise when introducing low energy processes and testing the antiproton annihilation codes within Geant 4.

References

[1] C. Malbrunot et. al., Hyperfine Interactions, February 2014, 1-6 (2014).

[2] N. Kuroda et. al., Nature Communications 5, 3089 (2014).

[3] J. Allison et. al., IEEE Transactions on Nuclear Science, 53 No. 1, 270-278 (2006)

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