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ASACUSA antihydrogen program: current status and prospects

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The ASACUSA experiment aims at a precise measurement of the ground state hyperfine (GSHFS) splitting of antihydrogen with an initial relative precision of $\leq 10^{-6}$ to test the combined CPT symmetry. The Rabi-type measurement will be carried out in a polarized beam of antihydrogen atoms that is synthesized via three-body-recombination (3BR) of positrons and antiprotons at CERN's Antiproton Decelerator complex [1]. A measurement with ground-state hydrogen atoms using the spectroscopy apparatus envisioned for antihydrogen yielded a 3ppb-precise value of the GSHFS [2], improving the previous measurement in a beam by more than an order of magnitude.
Antimatter atoms are produced via 3BR in a wide range of highly excited Rydberg states [3,4]. Thus, compared to hydrogen, the main challenge with antihydrogen lies in the production of GS atoms. Measurements [5,6] indicate that the rate of low-lying states needs to be increased by more than an order of magnitude to make measurements possible. In this view, the ASACUSA-CUSP collaboration is investigating different techniques to increase the GS fraction in the beam relying on stimulated deexcitation. I will present here novel developments on light-stimulated deexcitation [7] employed directly at the antihydrogen formation region that allow driving the formed atoms toward ground-state and thus enable a more efficient beam formation and polarization. As a consequence the ground state fraction at the cavity would be significantly increased. I will conclude on the future ASACUSA-CUSP physics program and it's prospects for antimatter spectroscopy measurements.

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