Precision measurement of the hydrogen hyperfine splitting in a beam for tests of Lorentz invariance

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The ASACUSA-CUSP experiment located at CERN's antiproton decelerator aims at measuring the ground state hyperfine splitting of antihydrogen $\overline{H}$) using a beam technique to test CPT symmetry. For this purpose, a beam of cold (50K) hydrogen was developed to characterize the antihydrogen spectroscopy apparatus [1]. Beyond serving as a testbench for the $\overline{H}$ experiment, the hydrogen beamline offers on its own a variety of possible measurements especially in the context of the Standard Model Extension (SME). The SME is an effective field theory that allows CPT and Lorentz symmetries to be broken [2]. A precise measurement of the hydrogen ground state hyperfine splitting was realized already in 2017 using the extrapolation of a single hyperne transition (1) reaching a relative precision of 2.7 ppb [3]. Since then several additions to the setup were made allowing the precise measurement of the $\pi 1$ transition which provides sensitivities to some SME coefficients [4, 5]. A new measurement campaign on hydrogen started in 2021 and focuses on $\pi 1$ precision measurements with swapping external magnetic field orientations using the $\sigma 1$ transition as a reference to constrain SME coefficients. The status and results of these measurements will be presented and an overview on the underlying theory and the experimental setup will be given.

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