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Hyperfine Structure Measurements on Hydrogen and Deuterium for CPT and Lorentz Invariance tests

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The ASACUSA collaboration proposed a hyperfine structure (HFS) measurement on a beam of antihydrogen at the antiproton decelerator of CERN to test CPT invariance. Supporting matter experiments are of high relevance in antihydrogen research. They have been performed for the sigma transition ($F, M_F: 1,0 \rightarrow 0,0$) of the hydrogen HFS at 1.42 GHz with the noteworthy precision of 2.7 ppb using ASACUSAs antihydrogen HFS spectrometer. Subsequently the setup has been improved to access the more sensitive pi transition ($F, M_F: 1,1 \rightarrow 0,0$) and campaigns have been carried out to address so far unconstrained coefficients of the standard model extension (SME) framework. This is possible even without comparison to antimatter through alternating measurements with static magnetic guiding fields of opposing directions. In parallel a device has been designed to enable similar HFS measurements around 320 MHz on deuterium, where the proton possesses a significantly larger momentum resulting in orders of magnitude higher sensitivity to certain SME coefficients. The status of the analysis of the latest hydrogen campaign will be presented and a progress report on the deuterium experiment will be given.

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