

# A Detector for Measuring the Ground State Hyperfine Splitting of Antihydrogen

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The ASACUSA Collaboration at CERNs Antiproton Decelerator plans to measure the ground state hyperfine splitting of antihydrogen with high precision to test the combined fundamental symmetry of charge conjugation, parity transformation, and time reversal. The antihydrogen atoms are created in a double CUSP trap [1], where antiprotons and positrons are mixed. The antiatoms then enter a Rabi-like spectrometer line [2] where at the end the annihilation signal is recorded by a detector which will be the focus of this contribution. The challenging task of the detector is to distinguish background events such as cosmic particles and upstream annihilations from antiproton annihilations originating from antihydrogen atoms which are produced only in small amounts. The antihydrogen detector is composed of a position sensitive central detector and a surrounding hodoscope [3] for tracking charged annihilation products. The hodoscope is made up of two layers of plastic scintillators which are read out by silicon photo multipliers with pre-amplifier electronics. Its excellent time resolution allows to differentiate particles coming from inside from those traversing the detector from outside. For beamtime 2017 an upgrade has been carried out using scintillating fibres, improving the hodoscopes position resolution in beam direction and enabling tracking in three dimensions and precise vertex reconstruction. Furthermore, preliminary results of last years beamtime will be included, during which direct extractions of antiprotons to the detector have been done in order to study the antiproton annihilation signal.

[1] N. Kuroda et al. (2014). A source of antihydrogen for in-flight hyperfine spectroscopy. *Nature Communications*, 5,3089

[2] C. Malbrunot et al. (2014). Spectroscopy apparatus for the measurement of the hyperfine structure of antihydrogen. *Hyperfine Interactions*, 228, 61–66

[3] C. Sauerzopf et al. (2016). Annihilation Detector for an In-Beam Spectroscopy Apparatus to Measure the Ground State Hyperfine Splitting of Antihydrogen. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, A845, 579-582

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