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Asacusa's Ramsey spectrometer for high precision hyperfine sprectroscopy

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The ASACUSA (Atomic Spectroscopy And Collisions Using Slow Antiprotons) collaboration, based at the Antiproton Decelerator facility of CERN aims to measure the ground state hyperfine structure of antihydrogen at a ppm level relative precision with a Rabi-type beam experiment [1,2]. ASACUSA produces antihydrogen atoms by the mixing of antiprotons with positrons in a double cusp trap with strong magnetic field gradients for the formation of a polarised beam [3].

For the Rabi-type experiment, a spectrometer line with a strip-line microwave cavity has been fully commissioned with studies on hydrogen. With the use of this spectroscopy apparatus a relative precision of 10-9 has been achieved, which is so far the most precise measurement of the hyperfine splitting of hydrogen in a beam method [4]. A Ramsey type beam spectroscopy method [5] has the potential to improve this precision by a factor of 10. However, the existing strip line cavity, is not well suited for the Ramsey scheme as the decisive Ramsey fringes near the transition frequency can't be observed. This demanded the design of new microwave devices.

I shall discuss the finite element simulations and design aspects of various options for cavity and transmission lines, which will be used as the source of the perturbing field for driving transitions in the hyperfine levels. The flexibility of the device which can allow us to better study the systematics shall also be addressed.

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Author: Mr NANDA, Amit (Stefan Meyer Institute, Austrian Academy of Sciences)

Presenter: Mr NANDA, Amit (Stefan Meyer Institute, Austrian Academy of Sciences)

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