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Testing the CPT symmetry using slow antiprotons¹

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In this “antimatter” overview talk, I will cover the following topics: (1) Why antimatter experiments are important? (2) CERN’s antiproton decelerator (AD), and the goals of the major experiments in the AD hall. (3) Antiprotonic helium laser spectroscopy pursued by the ASACUSA collaboration. In a series of measurements, the antiproton- to-electron mass ratio was determined to the level of 2×10^{-9} . In addition to being one of the most stringent CPT-symmetry tests, the antiprotonic-helium results now contribute to the CODATA recommended values of the fundamental physical constants. (4) Production and detection of antihydrogen by ATHENA, ATRAP and ALPHA collaborations. For example, in ATHENA (in 2002), some 100 antihydrogen atoms per second were produced by mixing 10^8 positrons with 10^4 antiprotons in a “nested” Penning trap. The next step is to confine them in a magnetic trap, but despite more than 5 years of hard work, antihydrogen trapping has not yet been successful. I will discuss why this is difficult, based on a recent re-analysis of the ATHENA data. (5) Production of ultra low energy antiprotons in ASACUSA, and future possibilities with the ELENA (extremely low energy antiproton ring).

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