Antihydrogen synthesis with lower energy antiprotons in the ASACUSA double-cusp trap

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We, the ASACUSA collaboration, have developed a source of antihydrogen atoms at the CERN Antiproton Decelerator in order to test CPT symmetry through in-flight ground-state hyperfine spectroscopy. The production of antihydrogen beams was already demonstrated in [1]. During a long shutdown of the CERN accelerators, we upgraded the trap system with a double-cusp magnetic field. It improved the focusing power for the antiatomic beam and achieved a low leak field at the position of the spectrometer line next to the double-cusp trap, which is required for the planned high-precision spectroscopy. Antihydrogen atoms were synthesized by injecting a slow antiproton cloud from an antiproton accumulator into a positron plasma confined in the double-cusp trap. Since the production rate strongly depends on the temperature of the positron plasma, it is mandatory to inject a cold antiproton cloud at slightly above the potential energy of the plasma in order to suppress unnecessary heat up. We attempted to prepare a cold antiproton cloud in the accumulator by improving the manipulation. And then, we transported it while keeping the energy spread as small as possible by a modified magnetic transportation scheme at low kinetic energies. In 2014, we are succeeded in transporting antiprotons with a lower energy of 50 eV compared to 150 eV in 2012 and confirmed antihydrogen synthesis in the double-cusp trap. The current status will be discussed.

References

[1] N. Kuroda *et al.* Nat. Commun. **5** 3089 (2014)