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AEGIS upgrades and Phase 2 developments

The Antimatter Experiment: Gravity, Interferometry, Spectroscopy (AEGIS) collaboration aims at performing spectroscopic studies and direct experimental tests of the universality of free fall also known as Weak Equivalence Principle (WEP) using antimatter-containing neutral systems (antihydrogen, positronium atoms, antiprotonic atoms).

AEGIS Phase 1 was a feasibility study of a pulsed antihydrogen source. It ended in 2018 with the formation of cold antihydrogen atoms in the trap.

Since then Extra Low ENergy Antiproton ring (ELENA) has been added to AD complex and has started operation in autumn 2021. The new decelerator allows one to capture more and colder antiprotons than previously. The Phase 2 period aims to improve the antihydrogen production and conduct do a measurement of the antihydrogen free fall. To achieve these goals, significant upgrades have been implemented - a new trap, optimisation of the positron system and new electronics and control system.

The new trap allows positronium production on the trap axis which will increase the interaction time.

The positron system has been improved by adding mu-metal shielding and new coils which improves efficiency 3 times, and also the positronium conversion target can be baked during operation. The target nanochannel etching process has been improved which gives approximately 5x improvement on positronium yield.

The new ARTIQ/Sinara control system provides at nanosecond precision over extended periods of time. For the automation of the experiment, a Labview system was created enabling 24/7 data taking without supervision.

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