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Laser cooling of antihydrogen atoms in the ALPHA trap

Monday 27 October 2025 13:30 (30 minutes)

Antihydrogen - the bound state of an antiproton and a positron - is of great interest for tests of fundamental symmetries which compare antimatter to ordinary matter. In the ALPHA experiment these exotic atoms are confined in a magnetic minimum with a lifetime of many hours, limited only by annihilations on background gas in the vacuum chamber. This enables high precision measurements which require long interrogation times and where the lowest achievable sample temperature is desired.
Doppler cooling of the trapped antihydrogen atoms has been demonstrated with a single laser beam resulting in 3D cooling*. This is possible due to partial coupling of motional degrees of freedom in the confining potential. Complexity in the dynamics of the cooling process arise due to potentially disparate timescales of cooling along the laser axis and energy mixing in the trap.
In this talk I will present recent progress on laser cooling in ALPHA as well as its combination with adiabatic expansion cooling, which has produced the coldest antihydrogen samples to date.

Footnotes

- Baker, C.J., Bertsche, W., Capra, A. et al. Laser cooling of antihydrogen atoms. Nature 592, 35–42 (2021)

Funding Agency

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