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Laser Cooling of Antihydrogen

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Antihydrogen, the simplest atomic antimatter system, is an excellent platform to search for matter-antimatter asymmetries. The kinetic energy (and thus velocity) of synthesized antihydrogen trapped in the laboratory setting is very large relative to the energy well depth of the trap providing the confining force. Accuracy of any measurements performed on trapped antihydrogen, and the complexity of future experiments, is sensitive to the kinetic energy of the sample. There are a variety of techniques used in atomic physics experiments to decrease a sample's temperature, but the additional constraints of working with trapped antimatter made laser cooling the most promising choice.

I demonstrate the ability to modify the kinetic energy distribution of a trapped sample of antihydrogen using the 1S-2Pf transition in antihydrogen using a vacuum ultraviolet (VUV) laser system (i.e. laser cooling). The change in kinetic energy is observed using a time-of-flight analysis from a pulsed laser spectroscopy run as well as a narrowing of the 1S-2S line shape. This development is greatly important to the future studies of the antihydogen system, as well as the search for physics beyond the standard model.

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Please select: Experiment or Theory

Experiment

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