PHYSIKALISCHES KOLLOQUIUM

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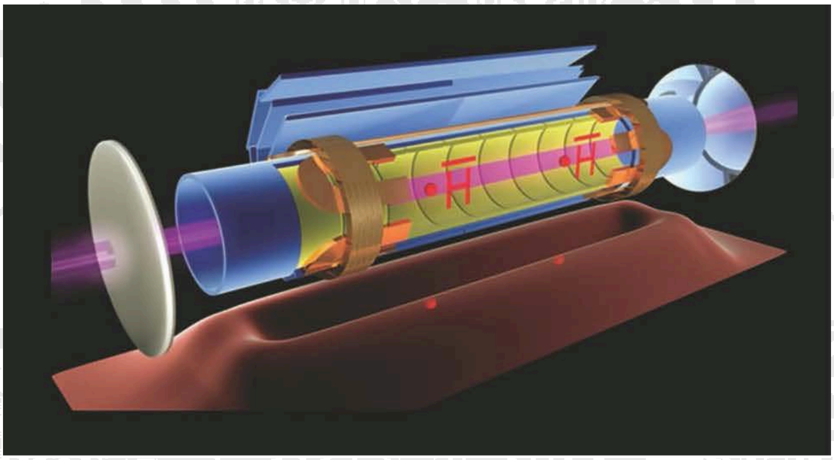

EXPERIMENTS WITH ANTIMATTER: RECENT ADVANCES FROM THE ALPHA COLLABORATION

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The ALPHA (Antihydrogen Laser PHysics Apparatus) Collaboration at CERN is engaged in precision tests of fundamental symmetries between matter and antimatter. The hydrogen atom has played a major role in the development of fundamental physics since the 1814 wavelength measurements of visible lines by Fraunhofer in the solar spectrum. Modern measurements of the hydrogen atomic spectrum have yielded some of the most precise results in physics, with the two-photon 1s-2s transition being measured to a precision of a few parts in 10^{15}. Antihydrogen, the bound state of an antiproton and positron, is the antimatter counterpart of hydrogen, and has only recently been observed spectroscopically. Measurements on antihydrogen are complicated by the need to synthesize and confine the anti-atoms prior to probing a transition of interest. Very recently, we have made great strides in our control and tuning of the plasmas involved in antihydrogen formation, resulting in an order of magnitude improvement in the trapping rate. Further development has allowed us to stack multiple trapping cycles for a measurement, resulting in hundreds of trapped anti-atoms available at a time for spectroscopy. These successes have enabled us to extend our measurement campaign, with new results for the 1s hyperfine splitting, 1s-2s forbidden transition, and 1s-2p allowed transition. The 1s-2p manifold contains a cycling transition, presenting the possibility of laser cooling of antimatter. I will provide an overview of the ALPHA experiment, present some of our recent results, and discuss future prospects for continued fundamental symmetry tests with antihydrogen.