DAMOP11-2011-020010

Abstract for an Invited Paper
for the DAMOP11 Meeting of
the American Physical Society

Antihydrogen Trapped

PAUL D. BOWE[1], Department of Physics and Astronomy, Aarhus University, DK-8000 Aarhus C, Denmark

In 2010 the ALPHA collaboration succeeded in trapping antihydrogen atoms for the first time.[2] Stored antihydrogen promises to be a unique tool for making high precision measurements of the structure of this first anti-atom. Achieving this milestone presented several substantial experimental challenges and this talk will describe how they were overcome. The unique design features of the ALPHA apparatus will be explained.[3] These allow a high intensity positron source and an antiproton imaging detector similar to the one used in the ATHENA[4] experiment to be combined with an innovative magnet design of the anti-atom trap. This seeks to minimise the perturbations to trapped charged particles which may cause particle loss and heating.[5] The diagnostic techniques used to measure the diameter, number, density, and temperatures of both plasmas will be presented as will the methods developed to actively compress and cool of both plasma species to sizes and temperatures[6,7,8] where trapping attempts with a reasonable chance of success can be tried. The results of the successful trapping experiments will be outlined as well as some subsequent experiments to improve the trapping rate and storage time.

[1]For the ALPHA Collaboration

[2] "Trapped antihydrogen," G.B. Andresen *et al.*, *Nature* 468, 673 (2010)

[3] "A Magnetic Trap for Antihydrogen Confinement," W. Bertsche *et al.*, *Nucl. Instr. Meth. Phys. Res. A* 566, 746 (2006)

[4] "Production and detection of cold antihydrogen atoms," M.Amoretti *et al.*, *Nature* 419, 456 (2002).

[5] "Antihydrogen formation dynamics in a multipolar neutral anti-atom trap." G.B. Andresen *et al., Phys. Lett. B* 685, 141 (2010)

[6] "Evaporative Cooling of Antiprotons to Cryogenic Temperatures," G.B. Andresen *et al. Phys. Rev. Lett* 105, 013003 (2010)

[7] "Compression of Antiproton Clouds for Antihydrogen Trapping," G. B. Andresen *et al. Phys. Rev. Lett* 100, 203401 (2008)

[8] "Autoresonant Excitation of Antiproton Plasmas," G.B. Andresen *et al.*, *Phys. Rev. Lett.* 106, 025002 (2011)