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A Laser-Cooled Ion Source to Sympathetically Cool Positrons in the ALPHA Experiment[1] MUHAMMED SAMEED, DANIEL MAXWELL, NIELS MADSEN, College of Science, Swansea University, Swansea SA2 8PP, Wales, UK — The ALPHA experiment at CERN studies the properties of antimatter by making precision measurements on antihydrogen. Antihydrogen atoms are produced by mixing a cloud of cold antiprotons with a dense positron plasma inside a magnetic trap. The formation of antihydrogen, of which only the coldest atoms remain trapped, depends principally on the kinetic energy of the constituent plasmas. Presently, the trapping rate is approximately two atoms in a seven minute cycle. During mixing, the antiprotons thermalize in the positron plasma prior to antihydrogen production. Colder positron temperatures would therefore result in an increased fraction of trapped antihydrogen atoms in the ALPHA mixing trap. At present, the positrons used for antihydrogen production in ALPHA reach energies of about 50 K. Much colder positron plasmas may be achieved by sympathetically cooling the positrons using laser-cooled beryllium ions. Preliminary results in the development of a low flux and low energy beryllium ion source using a pulsed ablation laser are presented. Precision ablation techniques coupled with laser-cooling can subsequently be used to effectively cool positrons. A provisional design of an ablation source is also presented for installation in the ALPHA apparatus in 2017.

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