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A Novel Low-Energy Ion Source: Production and Trapping of H⁻ Ions for H/Hbar Comparison

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The ALPHA experiment (CERN) performs precise tests of fundamental Physics using spatially confined samples of antihydrogen atoms ($\bar{\text{H}}$). For a direct H – $\bar{\text{H}}$ spectroscopic comparison, methods for loading atomic hydrogen into the apparatus are being considered. In this direction, we have demonstrated a novel source for low energy ions, capable of producing electrons, anions and cations. The source is based on the Matrix Isolation Sublimation technique, where the plume resulting from the laser ablation of a solid precursor is directed towards a sublimating inert gas matrix. Using a solid LiH target and a Ne matrix, we were able to produce samples consisting of electrons, H[±] and Li[±]. Axial energy distributions peaked at values between 0 and 25 meV were observed following the capture of these particles in a Penning trap. A new version of the apparatus is being built to demonstrate the scalability of the technique. Such a source can be integrated into the ALPHA apparatus, where low energy H⁻ ions can be guided to the $\bar{\text{H}}$ trapping region using the existing charged-particle magnetic transport system.

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