Positron accumulation for use in matter-antimatter pair plasmas

E. V. Stenson¹, H. Niemann¹, U. Hergenhahn¹, H. Saitoh¹, N. Paschkowski¹, T. Sunn Pedersen¹, G. H. Marx², L. Schweikhard², C. Hugenschmidt³, J. R. Danielson⁴, C. M. Surko⁴

¹ Max Planck Institute for Plasma Physics, Greifswald & Garching, Germany
² Ernst-Moritz-Arndt University, Greifswald, Germany
³ Technical University of Munich, Garching, Germany
⁴ UCSD, San Diego, California

Positrons have exposed new phenomena in atomic physics, been used as components for the creation of anti-atoms, and proved to be valuable tools for material diagnostics; they also represent the limiting ingredient in the formation of an electron-positron pair plasma. These plasmas have been an object of theoretical inquiry for decades, and APEX (A Positron-Electron Experiment) aims to finally create them in the laboratory. To do this, an intermediary will be needed between NEPOMUC (Neutron-Induced Positron Source Munich, the source of APEX’s positrons) and the magnetic confinement device that will be used for the pair plasma. The purpose of the Positron Accumulation Experiment (PAX) is to provide this bridge.

PAX will cool and store incoming positrons over a period of approximately 10-15 minutes. This will be accomplished by means of a series of non-neutral plasma traps: a differentially pumped buffer gas trap; a lower-pressure, longer-time accumulator; and ultimately a high-field, high-capacity, multi-cell trap. Preliminary experiments using positrons from a Na-22 source have been conducted in the buffer gas trap and accumulator. Electron experiments are being conducted in a linear trap in the high-field magnet, in preparation for the construction of the multi-cell trap. The results of these investigations will be presented.

![Diagram showing the role of PAX](image_url)

Figure 1: Illustration showing the role of PAX, which will bridge the parameters of the NEPOMUC positron beam with the requirements of the APEX pair plasma confinement device.