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Positron Detection System of Muonium-to-Antimuonium Conversion Experiment

The Muonium-to-Antimuonium Conversion Experiment (MACE) aims to investigate charged lepton flavor violation (cLFV) through investigating spontaneous muonium-to-antimuonium conversion. This process is detected using a positron detection system (PDS), which consists of a lead-free microchannel plate (MCP) and a BGO electromagnetic calorimeter (ECal). In this study, we conducted preliminary prototype experiments to evaluate the performance of the PDS. Using photomultiplier tubes (PMTs) coupled with BGO scintillation crystals, we measured the detector's time resolution, achieving a value of approximately 2.6 ns. Additionally, utilizing a positron beam at the Institute of High Energy Physics (IHEP), we determined the detection efficiency of the lead-free MCP for positrons in the energy range of 300 eV to 1200 eV, obtaining an efficiency about 30%. These results demonstrate the feasibility of the PDS for the MACE and provide critical insights into its operational performance.

Primary author: 彭华兴, UNKNOWN

Presenter: 彭华兴, UNKNOWN

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