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The Mu2e Straw Tube Tracker and Crystal Calorimeter of the Mu2e Experiment

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The Mu2e experiment will search for neutrinoless conversion of muons into electrons in the field of an aluminum nucleus. The signature of this process is a 105 MeV electron. Precise and robust measurement of the outgoing electron momentum, along with powerful background rejection, are essential elements of the experiment. We describe the unique features of the low-mass straw tube tracker and the crystal calorimeter that meet these stringent requirements. The tracking and calorimeter systems must operate in a vacuum and a 1 Tesla magnetic field. The tracker consists of about 20,000 thin-wall Mylar straws held under tension to avoid the need for supports within the active volume. In addition to measuring distance from the wire by drift time, subnanosecond measurement of signal propagation time is used to measure position along the wire. Charge will be measured using ADCs to provide particle identification capability. The calorimeter confirms the identity of conversion electrons found in the tracker, aids in track reconstruction by providing a seed cluster, and, using timing and E/p information, rejects cosmic ray muons that evade the cosmic ray veto system. The calorimeter consists of two disks, each containing 930 crystals of barium fluoride (BaF₂). The readout of the fast scintillation component of BaF₂ at 220 nm will be done with high efficiency by a large area UV-sensitive APD that incorporates an interference filter to discriminate against the more intense slow scintillation component at 300nm.

Summary

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