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The Mu2e electromagnetic calorimeter

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The Mu2e experiment at Fermilab aims to measure the charged-lepton flavor violating neutrinoless conversion of a negative muon into an electron, producing a monochromatic electron with an energy slightly below the rest mass of the muon (104.97 MeV). We expect to set a limit on the ratio between the muon conversion and capture rate of 6.7 × 10ˆ−17 at 90% CL in three years of running using a pulsed μ- beam that should provide ˜10ˆ18 stopped muons on an aluminum target.

The calorimeter is designed to confirm that electron candidates reconstructed by the extremely precise tracker system are indeed conversion electrons, to provide stringent m/e particle identification and to provide a standalone, tracking independent, software trigger filter. It must also function in an environment in which the n, p and photon background from muon capture processes and beam flash events deliver a dose of as much as 120 Gy/year. It must also function in 1 T axial magnetic field and in a 10ˆ−4 torr vacuum enclosure inside the Detector Solenoid.

We therefore look for a calorimeter with a large acceptance for signal events, a reasonable energy O(5%) and time O(500 ps) resolution and a position resolution better than 1 cm to compare the impact point of the extrapolated tracks on the calorimeter surface. The Mu2e calorimeter design is two disks each with 900 BaF2 crystals. Each crystal is read out by two large area avalanche photodiodes (APD's). These crystals match the requirements for stability of response, high resolution and radiation hardness. APD signals are amplified and shaped and then readout through 200 MSPS waveform digitizers optically connected to the DAQ system. We present the calorimeter design, the results obtained at 100 MeV with a LYSO prototype to test a first version of calorimeter system integration, and the R&D and simulation carried out to verify the design.

Oral or Poster Presentation

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