Contribution ID: **170** Type: **oral**

Design, status and perspectives for the Mu2e crystal calorimeter

Monday, May 22, 2017 2:00 PM (18 minutes)

The Mu2e experiment at Fermilab searches for the charged-lepton flavor violating neutrino-less conversion of a negative muon into an electron in the field of a aluminum nucleus. The dynamics of such a process is well modelled by a two-body decay, resulting in a mono-energetic electron with an energy slightly below the muon rest mass (104.967 MeV). If no events are observed in three years of running, Mu2e will set a limit on the ratio between the conversion rate and the capture rate Rμe of ≤ 6 × 10^{-17} (@ 90% C.L.). This will improve the current limit by four orders of magnitude [1].

A very intense pulsed muon beam (~ 10^{10}μ/ sec) is stopped on a target inside a very long solenoid where the detector is located. The Mu2e detector is composed of a tracker and an electromagnetic calorimeter and an external veto for cosmic rays surrounding the solenoid. The calorimeter plays an important role in providing excellent particle identification capabilities, a fast online trigger filter while aiding the track reconstruction capabilities. It should be able to keep functionality in an environment where the n, p and photon background from muon capture processes and beam flash events deliver a dose of 120 Gy/year in the hottest area. It will also need to work in 1 T axial magnetic field and a 10−4 torr vacuum. The calorimeter requirements are to provide a large acceptance for 100 MeV electrons and reach
• a time resolution better than 0.5 ns @ 100 MeV; • an energy resolution O(10%) @ 100 MeV;
• a position resolution of 1 cm.
The calorimeter consists of two disks, each one made of 674 pure CsI crystals read out by two large area array 2×3 of UV-extended SiPM 6×6 mm2. A dedicated beam test has been performed at the Beam Test Facility (BTF) in Frascati (Italy) where a small calorimeter prototype, based on a 3×3 matrix of undoped CsI crystals 3×3×20 cm3 coupled with large area UV-extended MPPC from Hamamatsu, has been exposed to an electron beam in the energy range between 80 and 130 MeV. The analog signals have been acquired with a CAEN waveform digitization at 250 Ms/s. Time and energy resolution measurements have been performed using a low energy electron beam, in the range [80,120] MeV, and cosmic rays.

We present result of the beam test analyses for the timing and energy resolution. For normal incidence, a time resolu- tion of ~ 110 ps (250 ps) has been measured in the energy range around 100 MeV (20 MeV). The energy response has also been studied achieving an energy resolution of the order of about 7% @ 100 MeV as limited by energy leakage (due to the small calorimeter dimension) and by beam energy spread. Reasonable data and MC agreement is observed. Dependence of response a resolution as a function of the impinging angle are also presented.

References

[1] Mu2e Collaboration, Mu2e Technical Design Report, http://arxiv.org/abs/1501.05241, 2015

Summary

We present the design and status of the electromagnetic calorimeter of the Mu2e experiment @ Fermilab. Mu2e will lead the Charged-Lepton-Flavor violation search in the next future and we show the role of the calorimeter in the Mu2e experiment together with the state of the art of the calorimeter project and the R&D results.

Primary authors: PEZZULLO, Gianantonio (I); Dr MISCETTI, Stefano (Laboratori Nazionali di Frascati)

Presenter: PEZZULLO, Gianantonio (I)

Session Classification: R1-Calorimeters(1)

Track Classification: Calorimeters