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The Mu2e Electromagnetic Calorimeter

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The "muon-to-electron conversion"(Mu2e) experiment at Fermilab will search for the Charged Lepton Flavour Violating neutrino-less coherent conversion /muˆ-N(A,Z) -> e-N(A,Z) of a negative muon into an electron in the field of an aluminum nucleus. The observation of such physics process would be the unambiguous evidence of the existence of physics beyond the Standard Model. The Mu2e detector is composed of a tracker and an electromagnetic calorimeter and an external veto for cosmic rays. The calorimeter plays an important role in providing excellent particle identification capabilities, a fast online trigger filter and aiding track reconstruction. The calorimeter requirements are to provide a large acceptance for ˜100 MeV electrons and reach: 1) a time resolution better than 0.5 ns; 2) an energy resolution O(10%); 3) a position resolution of 1 cm. The detector has been designed as a state-of-the-art crystal calorimeter and employs pure Cesium Iodide (CsI) crystals and UV-extended Silicon PhotoMultipliers (SiPMs) readout by fast analog electronics with a digitization at 200 Msps. A design consisting of two disks, each one made of 674 crystals readout by two large area 2x3 arrays of SiPMs of 6x6 mmˆ2 area can largely satisfy Mu2e requirements. The detector has to satisfy many other demanding requests, such as keeping the required performance in an extremely hostile environment with 1 tesla axial magnetic field, high radiation level and 10ˆ-4 Torr vacuum. We have verified with a campaign of test beams that the CsI crystals will withstand the expected dose and fluence with a small light yield loss and the SiPMs will function under the expected neutron irradiation when cooled to 0 C. This requires a good engineering design of the calorimeter mechanics and its cooling system, in terms of performance as well as reliability.
A large scale detector prototype has been constructed and tested at the beam test facility in Frascati. It consists of 51 pre-production crystals readout by a 102 SiPMs. All the tests and progresses done so far to define the calorimeter design, the satisfying results obtained with the test beam of the prototypes as well as the current production phase will be reported in this presentation. At the moment, all the components for the first disk have been tested and characterized. According to the Mu2e Collaboration plans, calorimeter construction will begin in spring 2020.

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