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The Engineering of the Mu2e Calorimeter

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The Mu2e experiment at Fermi National Accelerator Laboratory (Batavia, Illinois, USA) searches for the charged-lepton flavor violating neutrino-less conversion of a negative muon into an electron in the field of an aluminum nucleus. The dynamics of such a process is well modelled by a two-body decay, resulting in a mono-energetic electron with energy slightly below the muon rest mass (104.967 MeV). Mu2e will reach a single event sensitivity of about 3x10−17 that corresponds to four orders of magnitude improvement with respect to the current best limit.
The calorimeter plays an important role to provide excellent particle identification capabilities and an online trigger filter while aiding the track reconstruction capabilities, asking for 10% energy resolution and 500 ps timing resolution for 100 Mev electrons. It consists of two disks, each one made by 674 un-doped CsI crystals, read out by two large area UV-extended SiPMs. In order to match the requirements of reliability, a fast and stable response, high resolution and radiation hardness (100 krad, 10^12 n/cm^2) that are needed to operate inside the evacuated bore of a long solenoid (providing 1 T magnetic field) and in the presence of a really harsh radiation environment, fast and radiation hard analog and digital electronics has been developed. To support these crystals, cool down the SiPMs and support and dissipate the electronics heat power, a sophisticated mechanical and cooling system has been also designed and realized.
We describe the mechanical details, design and performances along with the assembly status of all the calorimeter components and its integration in the Mu2e Experiment.

Collaboration

Mu2e

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