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Development, construction and tests of the Mu2e electromagnetic calorimeter mechanical structures

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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 □-N(A,Z) □ e-N(A,Z) of a negative muon into an electron in the field of an aluminum nucleus. The observation of this process would be the unambiguous evidence of physics beyond the Standard Model. Mu2e detectors comprise a straw-tracker, an electromagnetic calorimeter and an external veto for cosmic rays. The electromagnetic calorimeter provides excellent electron identification, complementary information to aid pattern recognition and track reconstruction, and a fast online trigger. The detector has been designed as a state-of-the-art crystal calorimeter and employs 1340 pure Cesium Iodide (CsI) crystals readout by UV-extended silicon photosensors and fast front-end and digitisation electronics. A design consisting of two annular disks positioned at the relative distance of 70 cm downstream of the aluminum target along the muon beamline satisfies Mu2e physics requirements.
The hostile Mu2e operational conditions, in terms of radiation levels, 1 tesla magnetic field and 10ˆ-4 Torr vacuum have posed tight constraints on the design of the detector mechanical structures and materials choice. The support structure of the two 670 crystals matrices employs two aluminum hollow rings and parts made of open-cell vacuum-compatible carbon fibre. The photosensors and front-end electronics associated to each crystal are assembled in a unique mechanical unit inserted in a machined copper holder. The 670 units are supported by a machined plate made of vacuum-compatible plastic material. The plate also integrates the cooling system made of a network of copper lines flowing a low temperature radiation-hard fluid and placed in thermal contact with the copper holders to constitute a low resistance thermal bridge. The digitisation electronics is hosted in aluminum crates positioned on the external surfaces of the two disks. The crates also integrate the digitisation electronics cooling system as lines running in parallel to the front-end system.
In this talk we will review the constraints on the calorimeter mechanical structures, the mechanical and thermal simulations that have determined the design technological choices, and the status of mechanical components production, tests and assembly.

Author: Dr PASCIUTO, Daniele (INFN Pisa)

Co-author: DONATI, Simone (University of Pisa and Istituto Nazionale di Fisica Nucleare)

Presenter: Dr PASCIUTO, Daniele (INFN Pisa)

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