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Conceptual design of a robotic arm for the maintenance of the ReadOut Units of the Mu2e electromagnetic calorimeter

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The Mu2e experiment at Fermilab will search for the Standard Model forbidden coherent conversion of a negative muon into an electron in the field of an aluminum nucleus.

The calorimeter complements the tracking information, providing track-seeding and particle identification to help reconstruct the mono-energetic electron candidates. The calorimeter is based on 1348 undoped CsI crystals displaced in two donut-shaped staggered matrix disks.

Each crystal is read by two custom made arrays of UV-extended Silicon Photomultipliers (SiPMs).

The system is completed by a radioactive calibration source, a fast laser calibration system and the digitizing electronics\

The two SiPMs glued on a copper holder, two independent Front-End Electronics (FEE) boards, coupled to each SiPM, and the guide for the calibration fiber needle form a Readout Unit (ROU).

The ROU holder has a size of approximately $34 \times 34 \times 70 \text{ mm}^3$ and consists of a copper bulk structure where 2 SiPM and readout boards are mounted, a fiber needle centering tube and a copper Faraday cage fastened with 4 custom stainless steel screws to a brazed cooling copper line.

There are 674 ROU packed next to each other, vertically staggered, per calorimeter disk.

From each ROU, 2 SiPM multiple cables and a fiberglass fiber depart towards different locations.

The very compact matrix of SiPM modules,

the multiplicity of services they need and the narrow space of accessing after installation, complicates the manipulation of such modules in the experimental hall which could be necessary for maintenance.

This poster shows the conceptual mechanical design of a robotic arm composed by a gantry structure for xyz positioning on the desired ROU and equipped with custom-designed grippers to unscrew fasteners, un-clip connectors, unscrew the fiber needle and pick up the module, in a dedicated sequence.

Collaboration

Mu2e

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