



Contribution ID: 78

Type: Poster

An automated QC station for the final calibration of the Mu2e Calorimeter SiPMs

Wednesday, 25 May 2022 08:35 (1 minute)

The Mu2e experiment at Fermilab will search for the Standard Model forbidden conversion of a negative muon into an electron and the calorimeter is an important part of this experiment. It is based on undoped CsI crystals, each one read by two custom-made arrays of UV-extended Silicon Photomultipliers (SiPMs). Two SiPMs glued on a copper holder and two independent Front End Electronics (FEE) boards, coupled to each SiPM, form a Readout Unit (ROU). To ensure consistency and reliability of the ROUs, we have built an automated Quality Control (QC) station to test them.

The QC station is located at LNF (Laboratori Nazionali di Frascati) and can test two ROUs at the same time. The SiPMs are exposed to the light of a 420 nm pulsed LED attenuated by means of an automated nine-positions filter-wheel. The transmitted light is diffused on the SiPMs surface using a box with sanded glass that also provides light tightness and allows to have a controlled environment, ensuring good reproducibility of the measurements. The ROUs are held in place by an aluminum plate that serves also as a conductive medium for temperature stabilization.

The ROUs are powered by a low voltage and a high voltage supply controlled remotely. The data acquisition of the FEE signals is handled by a Mezzanine Board and a Master Board (Dirac) USB-controlled with Python and C++ programs. The data acquisition has been parallelized and 10000 events per wheel position can be acquired in around one minute.

A scan at different light intensities is performed for each of the selected supply voltages, V_i , around the SiPM operational voltage, V_{op} , thus allowing to reconstruct the response, gain, photon detection efficiency and their dependence on $V_i - V_{op}$. We will present the first results obtained on a large sample of production ROUs and the achieved reproducibility.

Collaboration

Mu2e

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Session Classification: Calorimetry - Poster Session