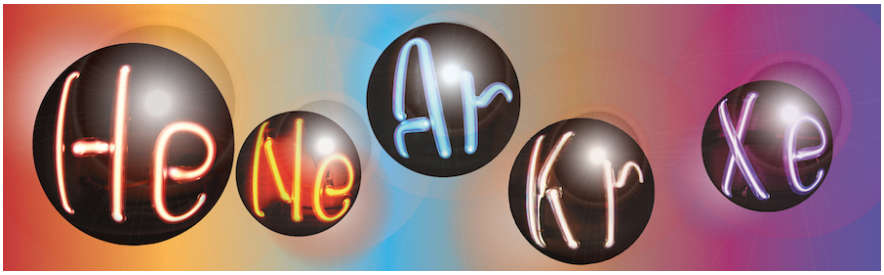

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Mass test setup for the DUNE FD1 SiPMs characterization and first results

Tuesday 27 August 2024 12:10 (20 minutes)

The Deep Underground Neutrino Experiment (DUNE) is an upcoming neutrino physics experiment that will answer some of the most compelling questions in particle physics and cosmology. The DUNE Far Detector (FD) exploits silicon photomultipliers (SiPMs) to detect scintillation photons produced by the interaction of charged particles in the liquid Argon time projection chamber (LarTPC). Light signals are indeed extremely important to determine one of the spatial coordinates of the interaction and also allow to trigger non-beam events.
The SiPMs are photosensors consisting of a matrix of single-photon avalanche diodes operating in the Geiger-Mueller region. Their high sensitivity and dynamic range, as well as the possibility to fill large surfaces with high-granularity sensors, makes them an ideal choice for the DUNE FD photodetection system.
An international consortium of research groups is currently engaged in systematic quality assurance tests of all the sensors that will be installed in the FD to control their specifications. A custom set-up, CACTUS (Cryogenic Apparatus for Continuous Tests Upon SiPMs), has been developed at Ferrara and Bologna Universities-INFN sites to automatically perform the tests for a large number of sensors in parallel. This system can characterize up to 120 SiPMs simultaneously both testing their mechanical and thermal resistance, and measuring the complete current-voltage curve for each sensor at room and cryogenic temperatures. These data allow to extrapolate the quenching resistor and the breakdown voltage, the key operating parameters of the SiPMs.
Furthermore, the CACTUS test facility allows for dark noise characterization through a custom-made fixed threshold amplifier-discriminator system.
Until now, more than 13000 arrays of 6 sensors each, produced by Hamamatsu Photonics K.K., have been fully tested by the laboratories involved in the measurements, showing a failure rate of 0.3%.

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