



Contribution ID: 28

Type: Talk

Validation of the Measurement System for Mass Characterization of SiPMs in the Photon Detection System of the DUNE Far Detector VD

Currently under construction in the United States, the Deep Underground Neutrino Experiment (DUNE) is a next-generation international experiment focused on neutrino oscillation studies. The DUNE Far Detector will consist of four 17-kton Liquid Argon Time Projection Chamber (LArTPC) modules, two with established geometries and technologies in Phase I, while the remaining two are under discussion for Phase II. Phase I will consist of one Vertical Drift (VD) detector and one Horizontal Drift (HD) detector. Both LArTPCs will employ a Photon Detection System based on X-ARAPUCA devices instrumented with Silicon Photomultipliers (SiPMs).

This contribution presents the validation of a custom measurement system developed for the characterization of SiPMs for the VD module. The experimental setup is designed to ensure accurate and reliable I-V measurements at both room and cryogenic temperatures, supporting the large-scale automated testing required for more than 100,000 light sensors.

It presents a comprehensive analysis of the measurement chain (including biasing and current-readout stages) to evaluate metrological performance, stability, repeatability, and breakdown voltage extraction through normalized-derivative methods coupled with second-order polynomial fitting.

Experimental results demonstrate the suitability of the system to serve as the baseline for the CACTUS-VD (Cryogenic Apparatus for Continuous Tests Upon SiPMs for Vertical Drift) facility, enabling robust qualification of SiPMs in large batches for long-term neutrino experiments.

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