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DUNE Far Detector Photon Detection System Validation with ProtoDUNES

The Deep Underground Neutrino Experiment (DUNE) is a next-generation long-baseline experiment for neutrino physics currently under construction in the US, aiming to measure neutrino oscillation parameters, search for beyond standard model physics, and detect supernova neutrinos. DUNE will include a Near Detector and a Far Detector (FD), located 1300 km away from the ND and 1.5 km underground. The FD will consist of four 17-kton active Liquid Argon Time Projection Chambers (LArTPCs). In Phase I, two modules implementing horizontal (HD) and vertical (VD) drift technologies will be used. To test these technologies, two 750-ton LArTPCs (ProtoDUNES) were built at CERN and operated over the past two years.

The topology of a neutrino interaction in the LArTPC is reconstructed from the tracks of secondary charged particles, which produce scintillation light and ionization charge carriers during their propagation in LAr. The reference time of the event is provided by the scintillation light, detected by X-ARAPUCA modules. These are photon traps consisting of a box with highly reflective internal walls instrumented with Silicon PhotoMultipliers (SiPMs). Therefore, the FD Photon Detection System (PDS) is critical for the DUNE physics program.

In this talk, the designs of the DUNE PDS for the first two modules are presented, along with first results from ProtoDUNE-HD and ProtoDUNE-VD PDS operations.

The preliminary results demonstrate the successful operation of the PDS, marking a crucial step toward validating the HD and VD designs for the first FD modules.

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