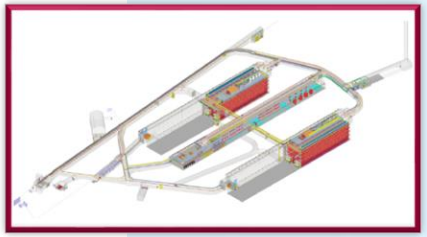
The front-end electronics of the DUNE Photon Detection System

Esteban Cristaldo for the DUNE Collaboration

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA
INFN Istituto Nazionale di Fisica Nucleare
DUNE

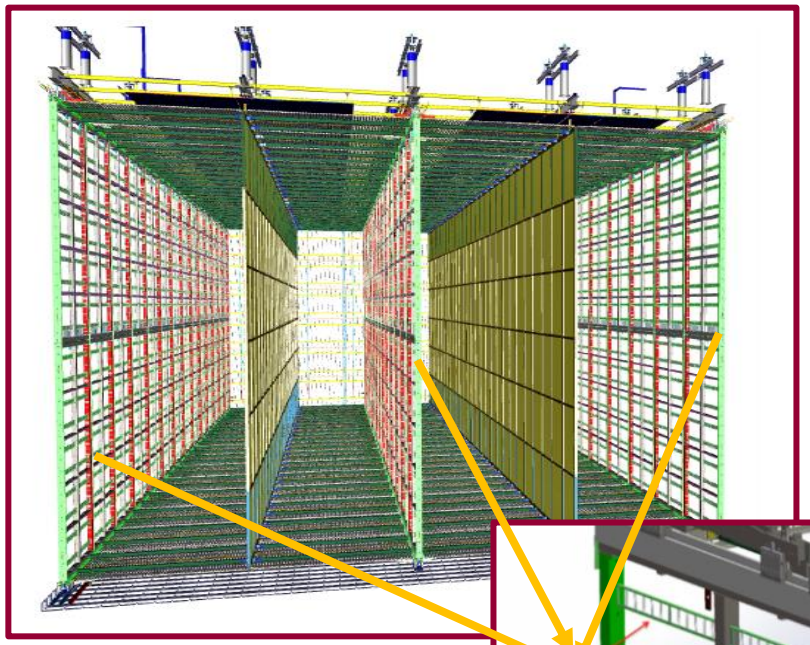
Deep Underground Neutrino Experiment

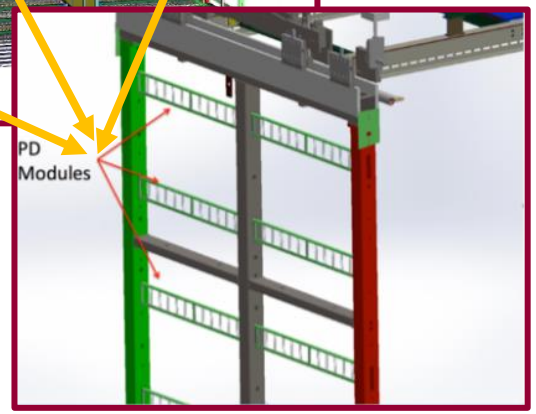


The DUNE (Deep Underground Neutrino Experiment) will consist of two detectors exposed to a high intensity neutrino beam and separated by a distance of 1300 km: the far detector, with a projected total mass of 70 kt of liquid argon and located 1.5 km underground at the Sanford Underground Research Facility (SURF) in South Dakota, U.S.A; and the near detector, located near the beam source at FERMILAB, in Illinois, U.S.A.

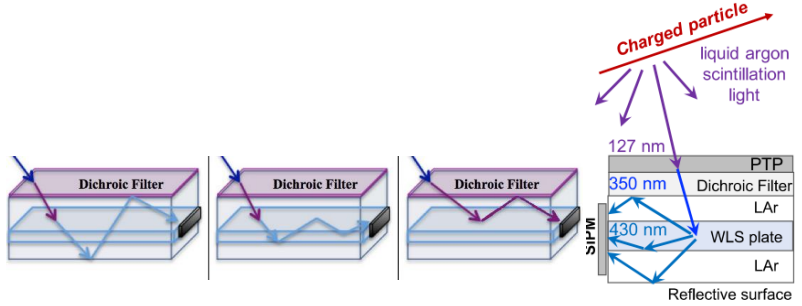
DUNE Far Detector - Horizontal and Vertical Drift

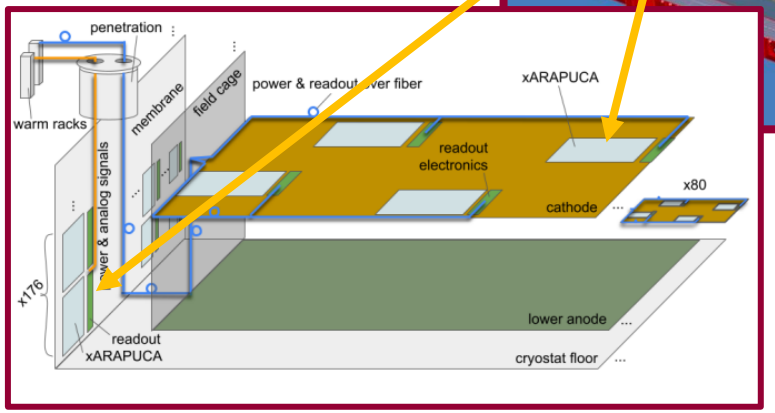
DUNE Far Detector 1 Horizontal Drift



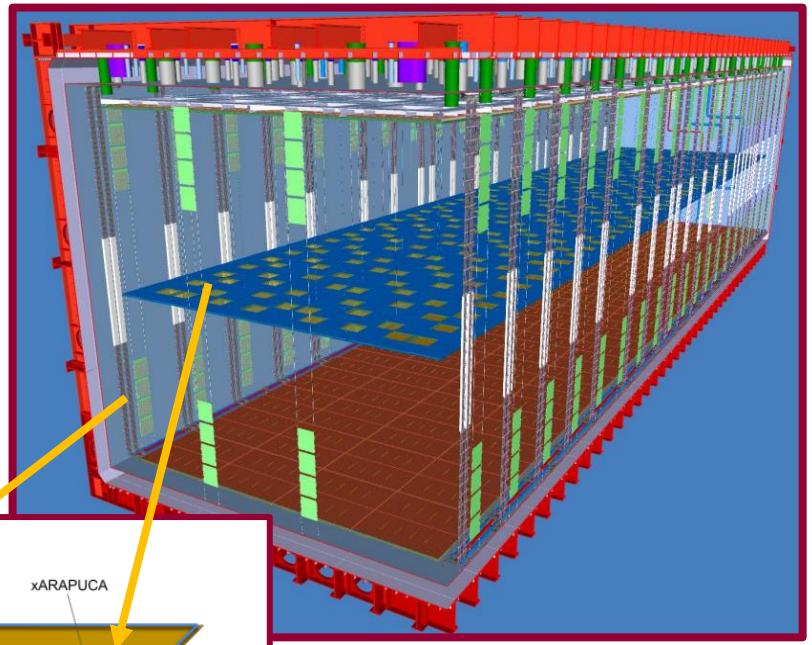


Photon Detection Technology: X-ARAPUCA



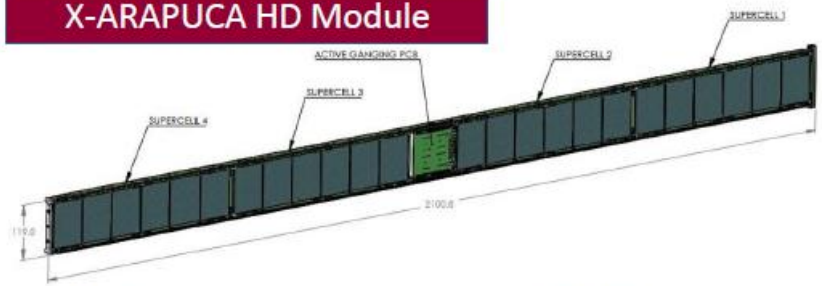


DUNE Far Detector 2 Vertical Drift



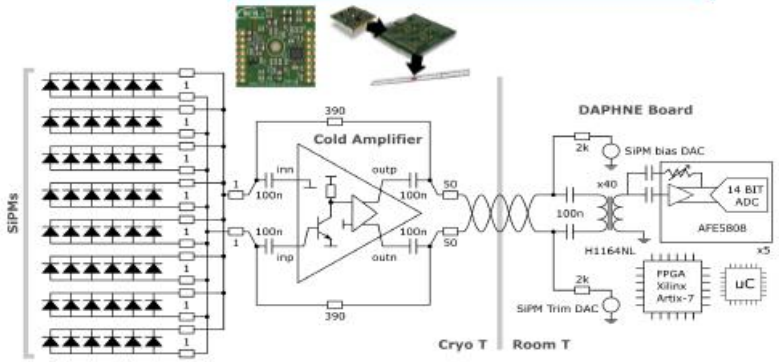
Photon Detection System and Cold Electronics

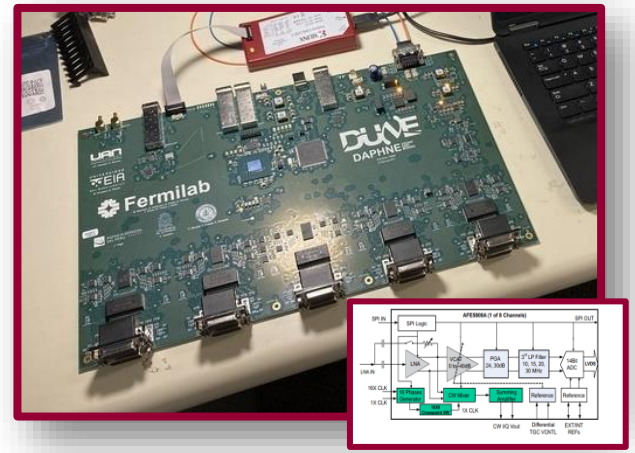
X-ARAPUCA HD Module



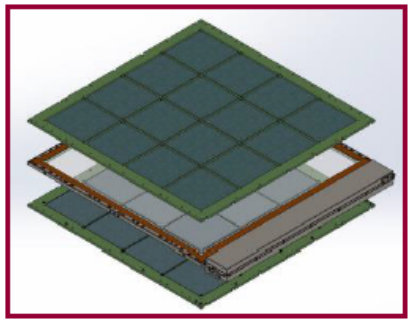
- Light collector: 10 modules per APA (Anode Plane Assembly). 1000 single-sided and 500 doubled-sided.. 462 cm² per side collection área.
- Photosensor: Hamamatsu and FBK 6x6mm SiPM. 192 per module. 288,000 in total.
- Channels: 4 per module. 6000 in total..

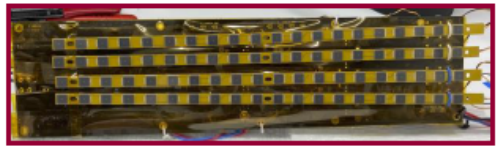
DUNE FD1-HD PDS Cold Electronics

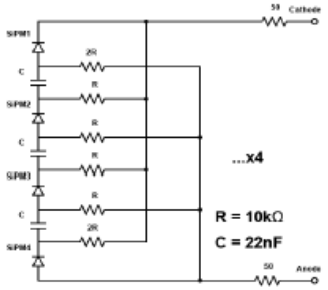




X-ARAPUCA VD Module



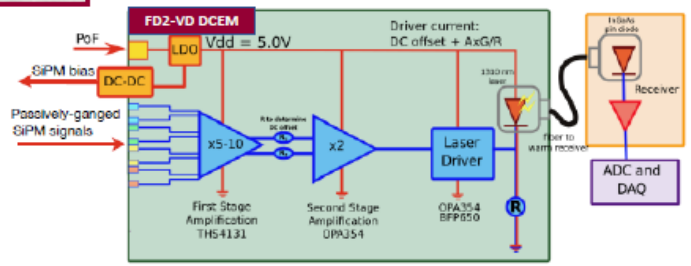




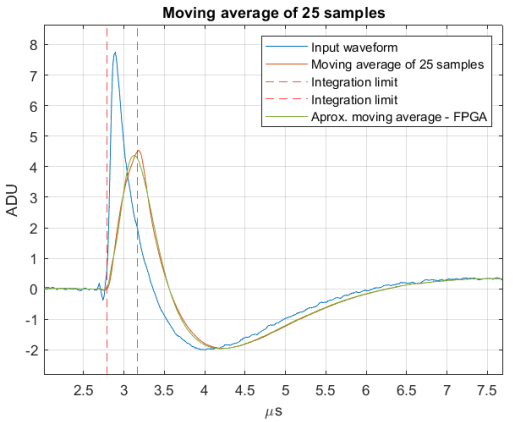
Hybrid ganging flex circuit

- Light collector: 352 single-sided wall modules and 320 double-sided modules in the cathode plane. 3600 cm² per module per side collection area.
- Photosensor: Hamamatsu and FBK 6x6mm SiPM. 160 per module. 107,520 in total.
- Channels: 2 per module. 1344 in total.

DUNE FD2-VD PDS Cathode and Wall Modules Cold Electronics

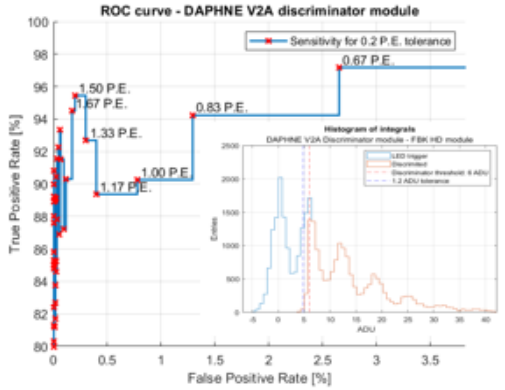


Due to the high voltaje environment in the cathode, PD modules implement Power-Over-Fiber and Signal-Over-Fiber technologies to power the amplifiers and SiPMs and to produce the output signals. PDS Modules in the wall will have a copper readout, hence a similar amplification system as the FD1-HD system.

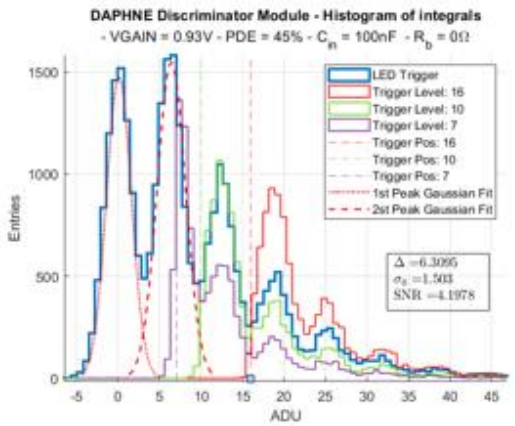


Photon Detection System Validation

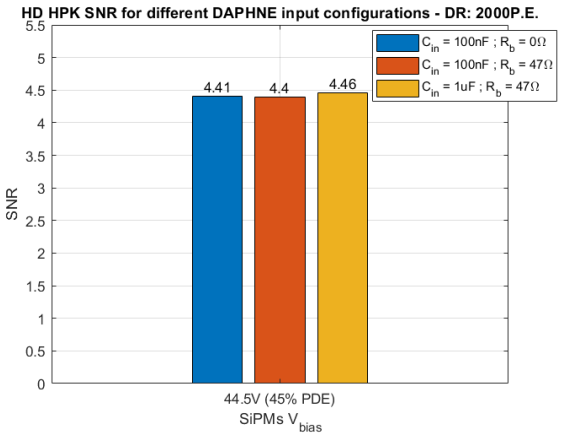
Sensitivity

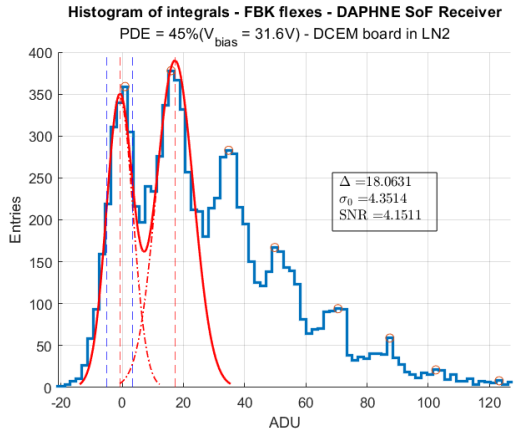


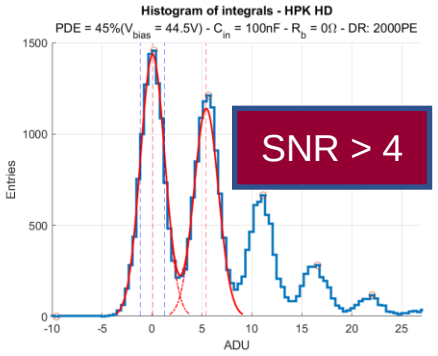
~0.19% False Positive Rate for 1.5 P.E. threshold



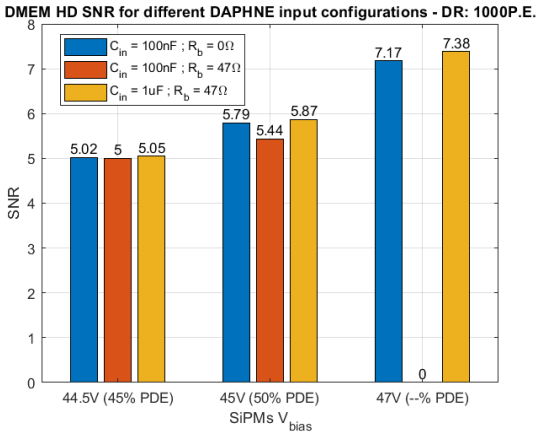
Test at the University of Milano Bicocca



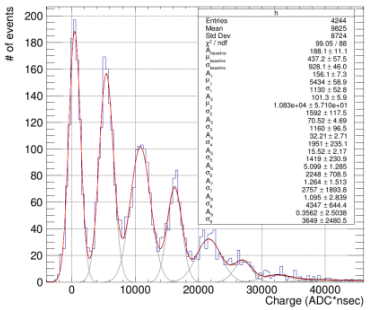


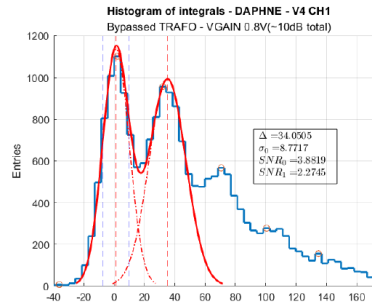


SNR > 4



CERN Vertical Drift Coldbox





SNR: 5.9

Thank you very much!!