

PROBES MidTerm Review Secondment Report

Livio Calivers, livio.calivers@lhep.unibe.ch

University of Bern

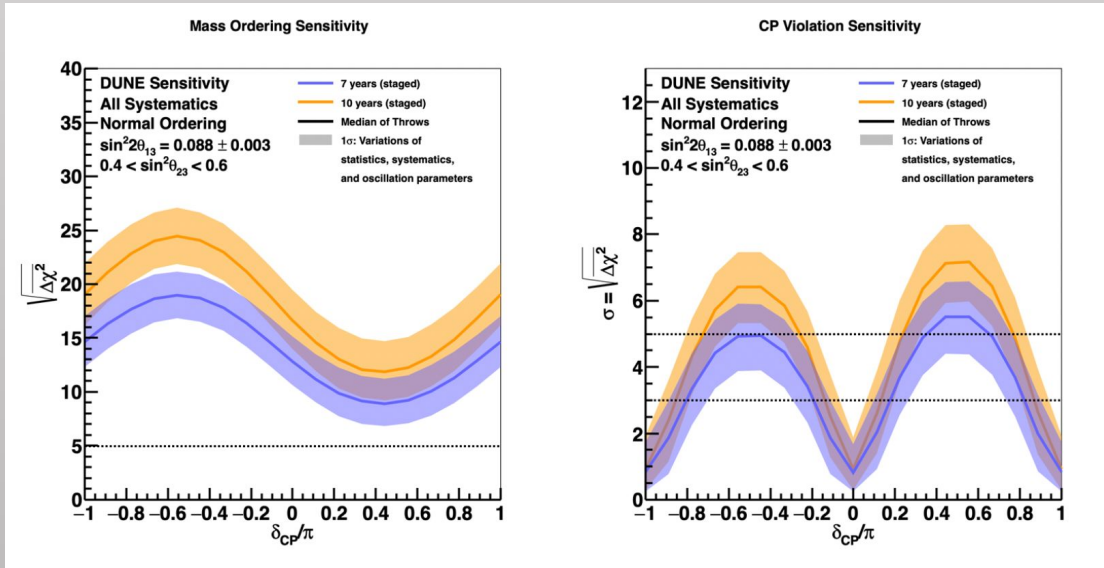
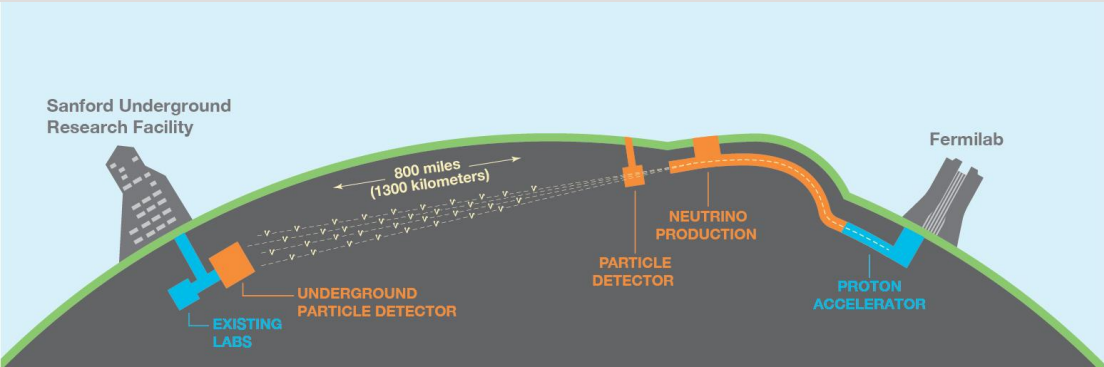
My PROBES Secondment

- 1 Month in Oct 2023
- 1 Month Now (Feb 2024)
- Fermilab
- *“Transfer knowledge from experience with the SBN detectors to the next generation of LAr-TPCs (DUNE).”*



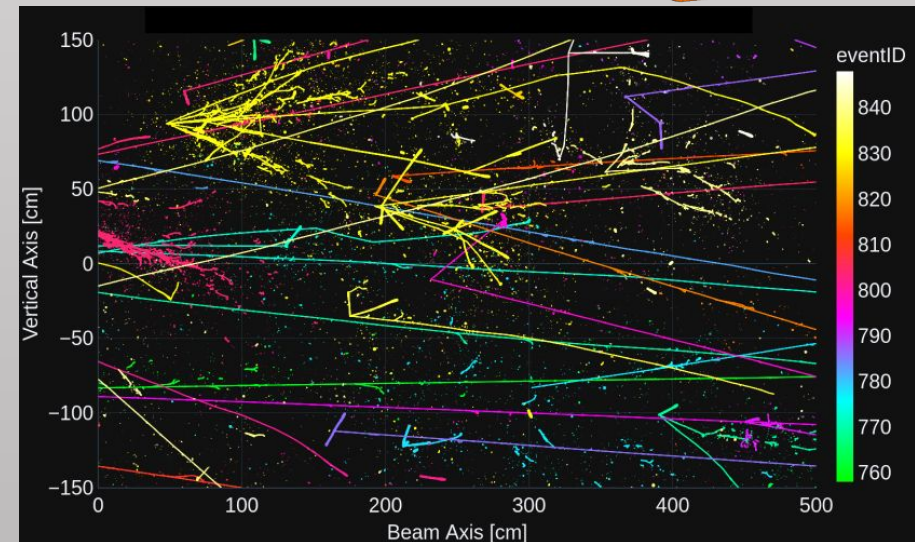
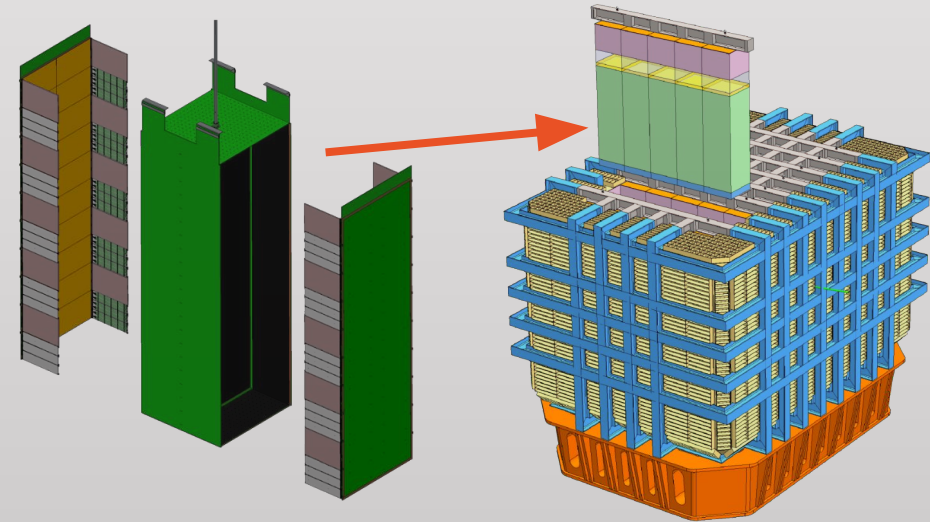
Deep Underground Neutrino Experiment

- Long baseline neutrino oscillation experiment (1300 km)
- Major goals:
 - δ_{CP}
 - Mass ordering
 - Non-beam physics (e.g. super nova ν)
- Overcome low ν cross section?
 - High intensity ν_{μ} ($\bar{\nu}_{\mu}$) beam (1.2 / 2.4 MW)
 - High detector mass (70kt FD / 50t ND)



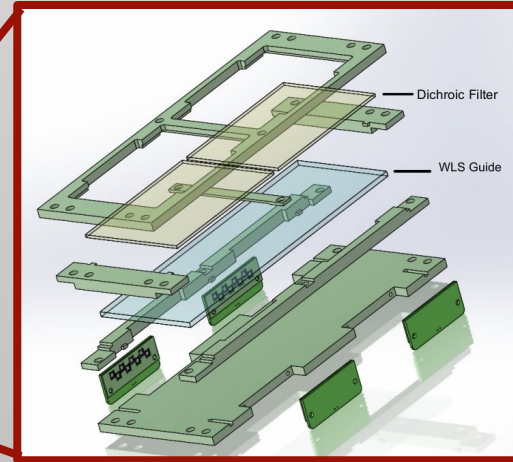
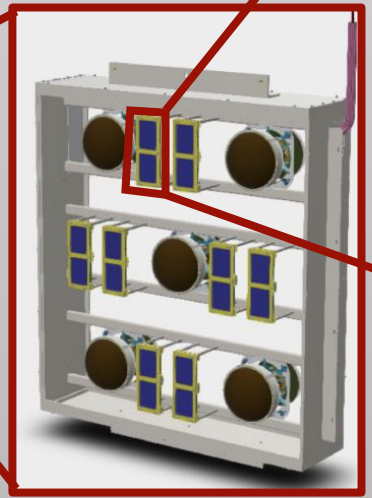
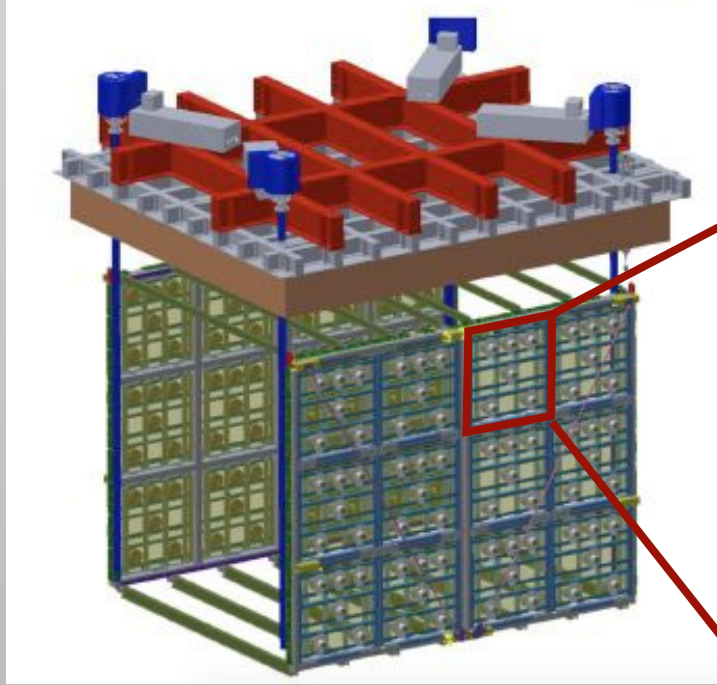
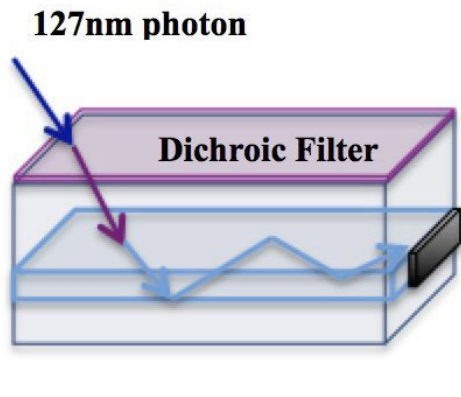
DUNE ND-LAr

- 7 x 5 x 3 m³ LAr TPC
- ~50 ν interactions per Spill (Phase I)
- Drift time at 0.5 kV/cm: >4 ms
- For Monolithic Design: **PILEUP**
⇒ **Optical Segmentation!**

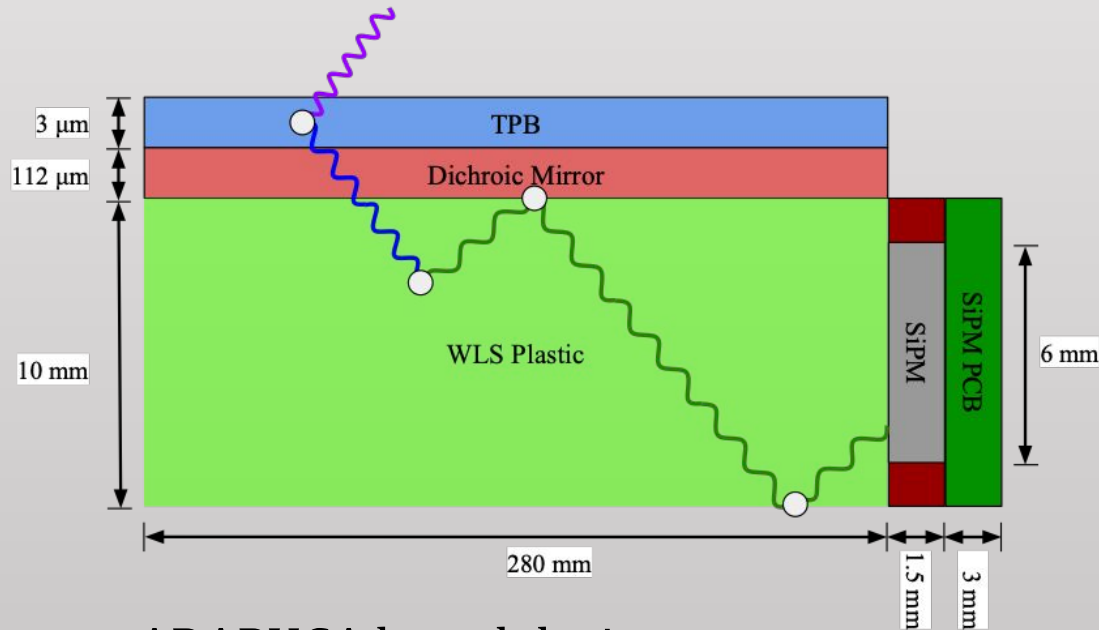


SBND Light Readout

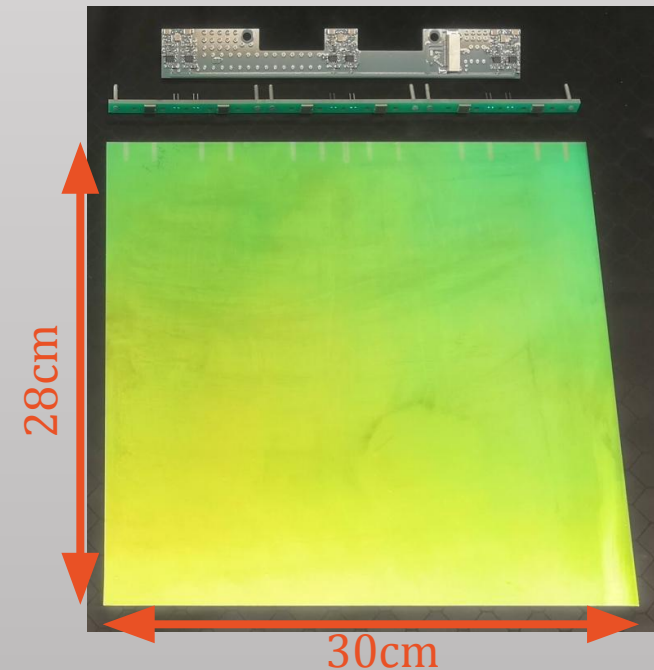
- 192 X-ARAPUCA light traps
- Silicon PhotoMultiplier (SiPM) based readout
- Sensitive for 128nm LAr scintillation light
- Proposed for DUNE far detector



ArCLight for DUNE-ND LAr



- ARAPUCA based design
- Dichroic mirror directly placed on wave length shifter
- Improved dead volume – active area ratio
- Fully dielectric ->Placed in drift field



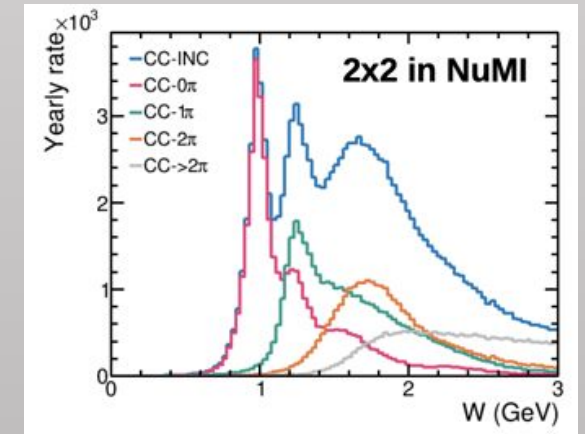
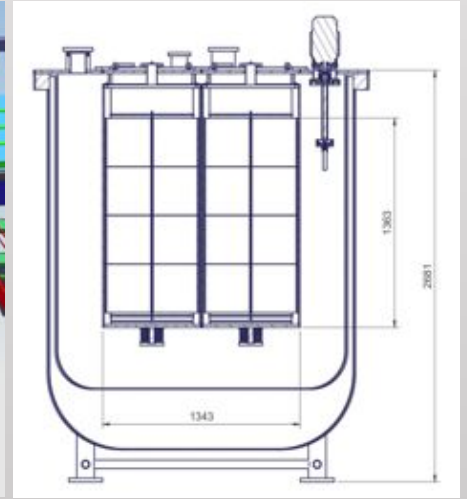
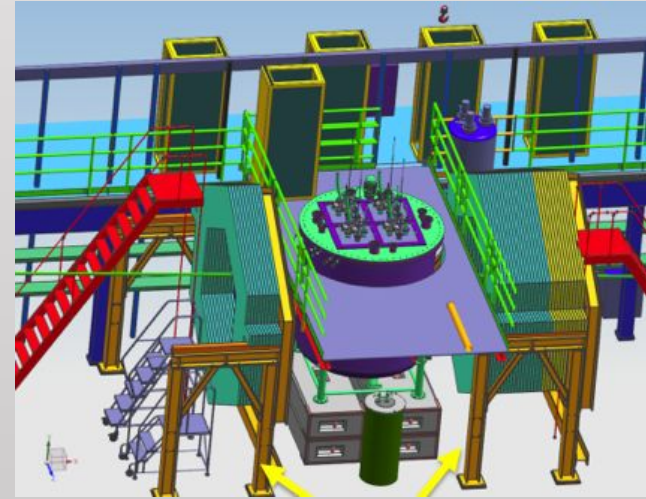
ND-LAr 2x2 @ Fermilab

Operation in NuMI Neutrino Beam

- **Demonstration of multi module operation in a 2x2 arrangement**
- Installed four TPC modules in former location of MINOS-ND at Fermilab
- Includes upstream/downstream trackers, repurposed from Minerva
- **First neutrino beam data for DUNE ND-LAr in 2024**

Goals:

- **Demonstration of maturity for physics publications in a GeV neutrino beam!**
- Develop neutrino signal analysis and reconstruction techniques
 - Reconstruction of native 3D neutrino signals
 - Charge-light signal correlations, tolerance to beam pileup
 - Track matching with external trackers



Current status of 2x2

- Detector insertion during October secondment
- Just started warm commissioning phase now
- I am onsite as the responsible expert for the light readout system



Next steps

- Finalise cabling and configuration of detector systems
- Finish warm commissioning in the upcoming weeks
- After detector filling start with cold commissioning and calibration
- Goal: Get first month(s) of NuMI beam data until shutdown in July!

