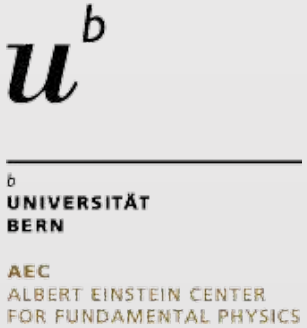

INTENSE MidTerm Review Secondment Report

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University of Bern

Past UNIBE Secondments

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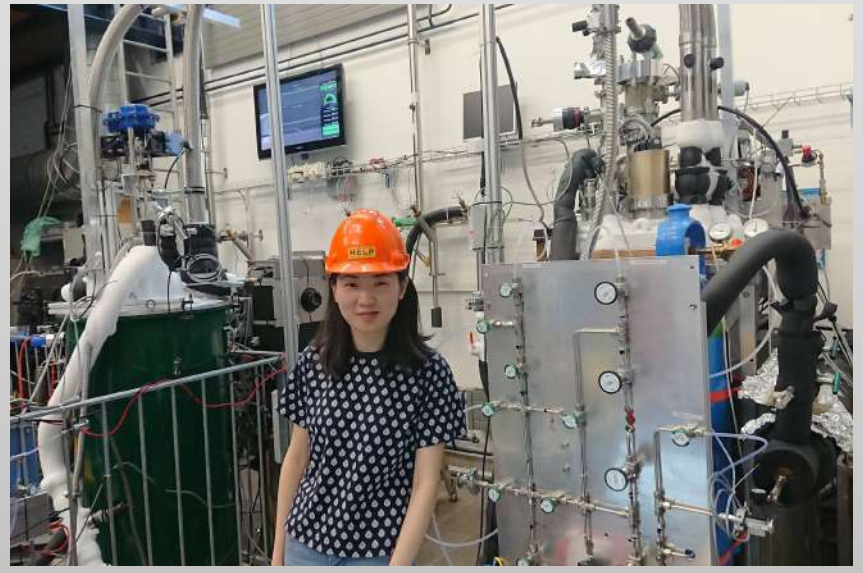
Yifan Chen

- Fermilab
- MicroBoone
- LArTPC electric field calibration using a UV laser system (doi.org/10.1088/1748-0221/15/07/P07010)



Thomas Mettler

- Fermilab
- SBND and MicroBoone
- Cosmic Ray Tagging (CRT) system (https://doi.org/10.1088/1748-0221/14/04/P0400)

My INTENSE Secondment

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- 6 Months
- Fermilab
- WP1 – Neutrino Detectors
- *"O1.5: Transfer knowledge from experience with the SBN detectors to the next generation of LAr-TPCs (DUNE)."*

Deep Undergound Neuntrino Experiment

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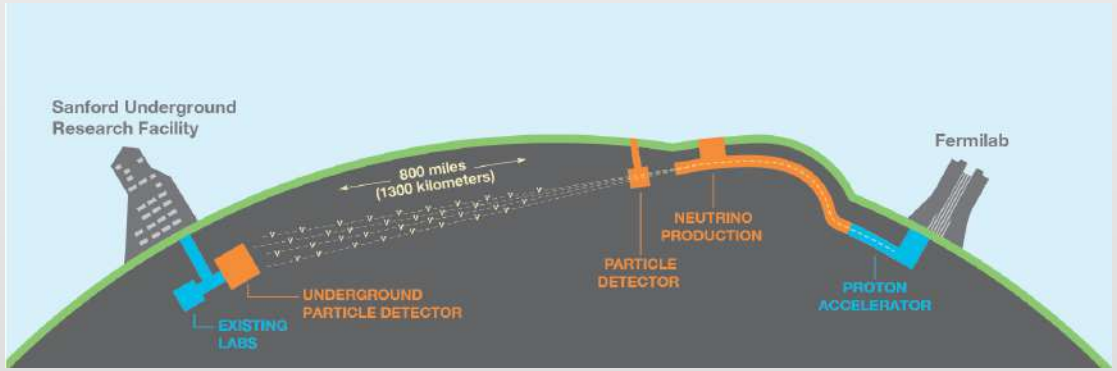
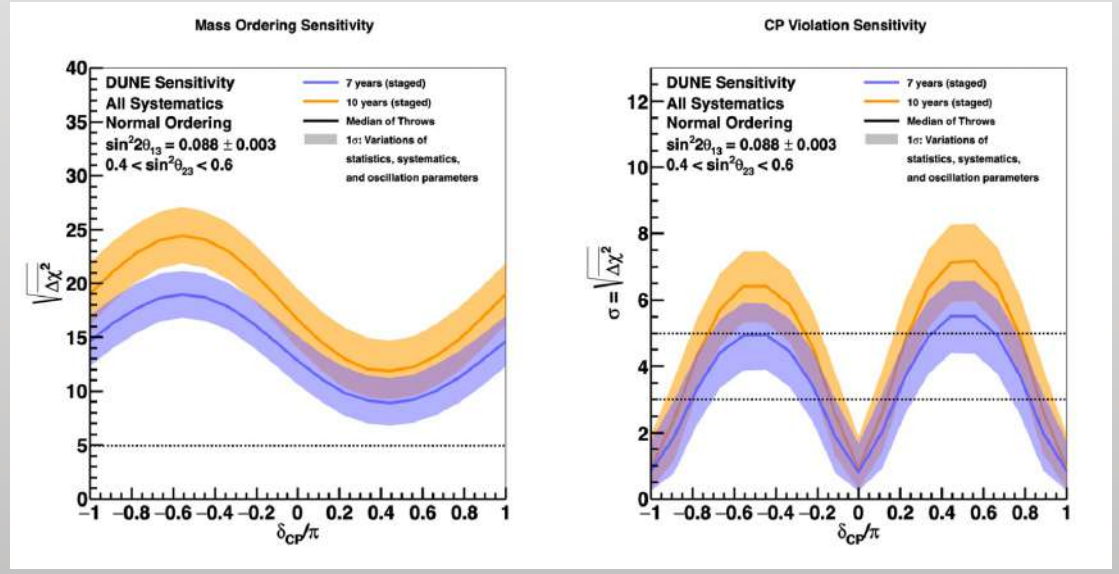
- Long baseline neutrino oscillation experiment (1300 km)
- Major goals:
  - δ_{CP}
  - Mass ordering
  - Non-beam physics (e.g. super nova ν)
- Overcome low ν cross section?
  - High intensity ν_μ ($\bar{\nu}_\mu$) beam (1.2 / 2.4 MW)
  - High detector mass (70kt FD / 50t ND)





DUNE ND-LAr

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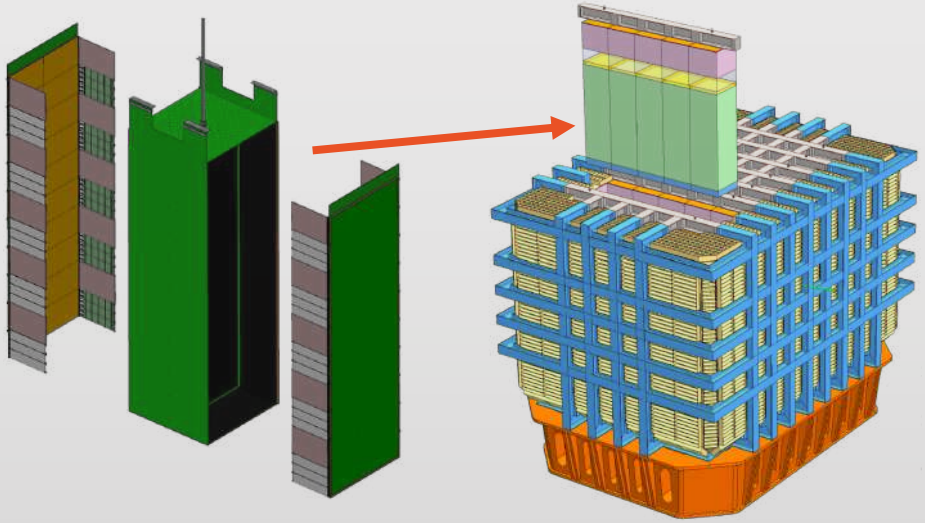
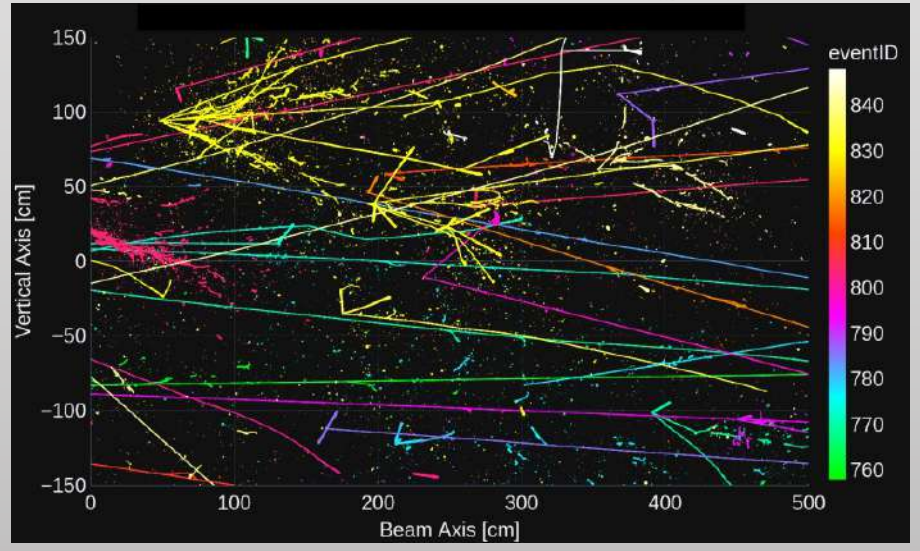
- 7 x 5 x 3 m^3 LAr TPC
- ~50 ν interactions per Spill (Phase I)
- Drift time at 0.5 kV/cm: >4 ms
- For Monolithic Design: **PILEUP**

  ⇒ **Segmentation!**





SBND Light Readout

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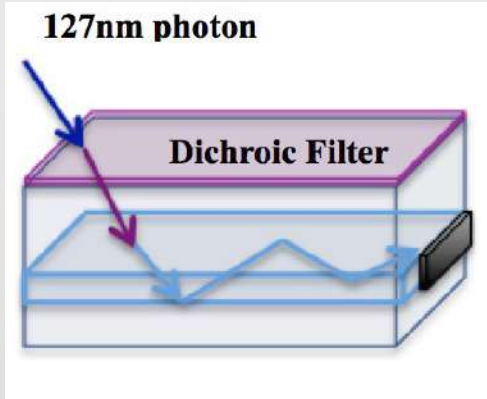
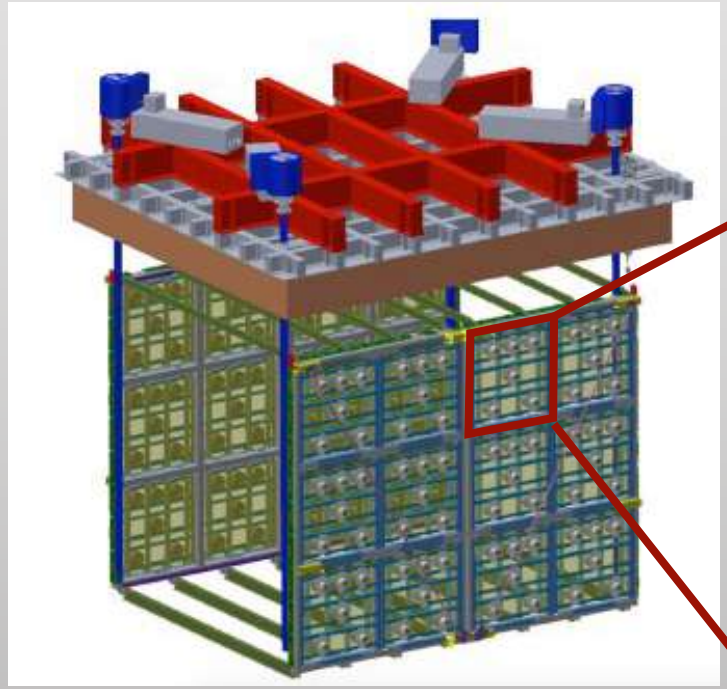
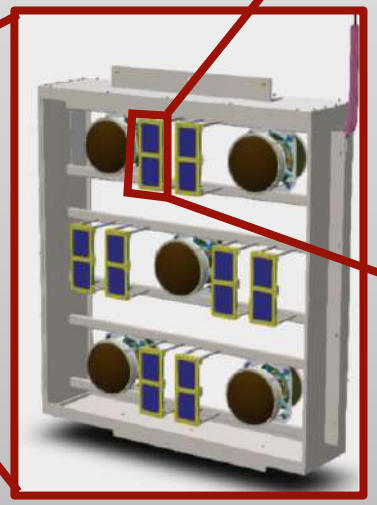
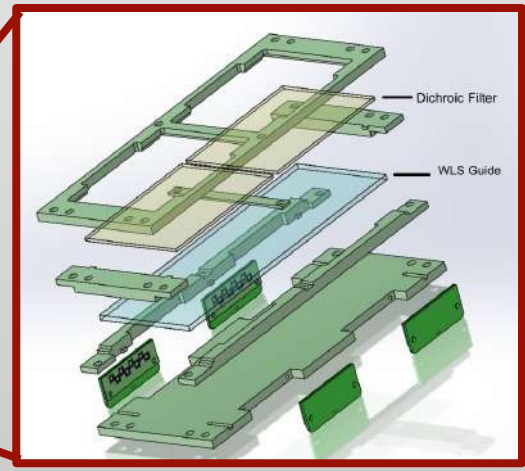
- 192 X-ARAPUCA light traps
- Silicon PhotoMultiplier (SiPM) based readout
- Sensitive for 128nm LAr scintillation light
- Proposed for DUNE far detector









ND-LAr Light Readout

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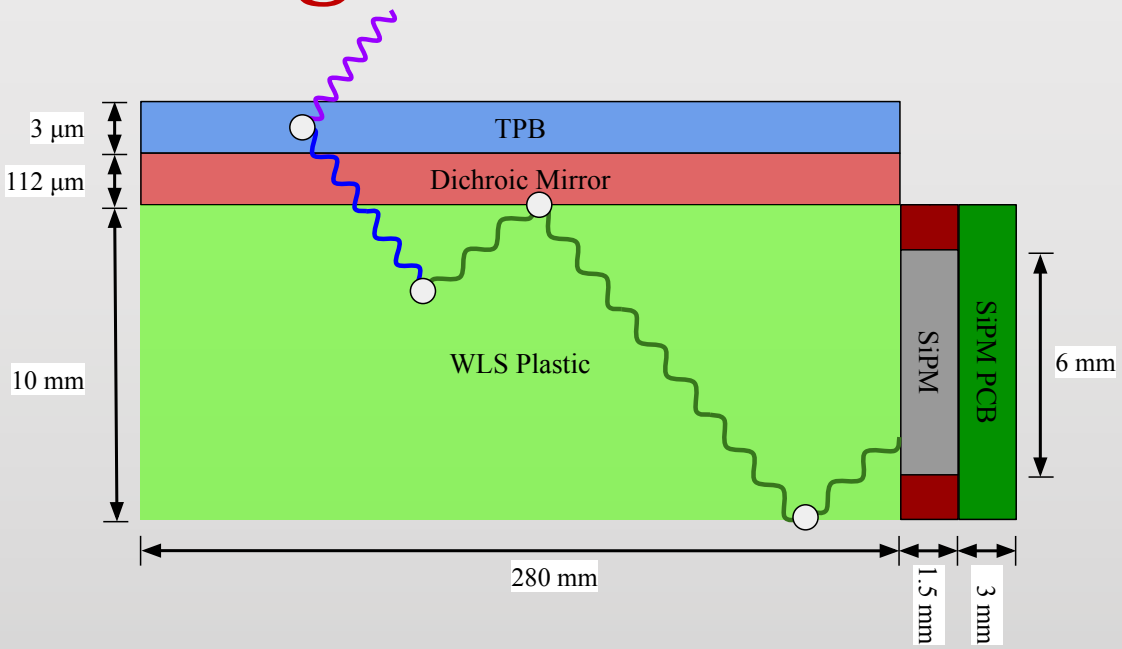
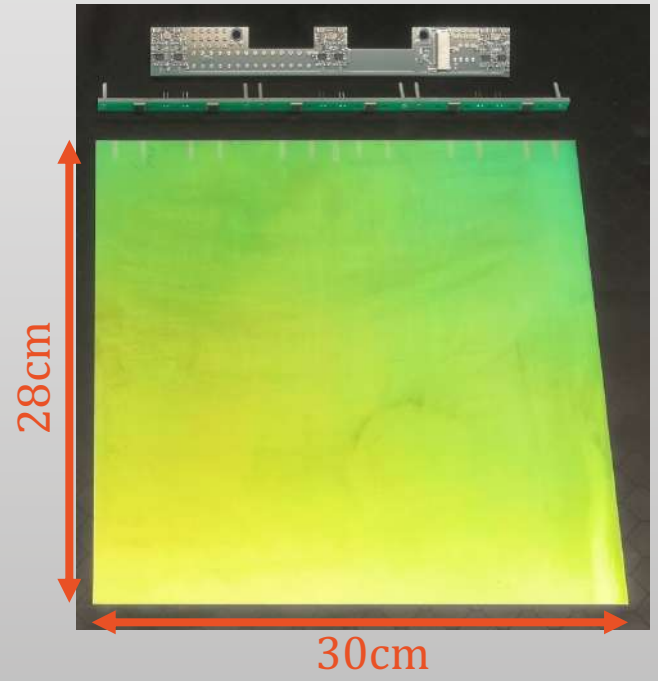
- New Requirements:
  - More compact light readout
  - Anode plane occupied by pixelated charge readout
    -> Light readout in HV drift field
- Approach large active area to increase efficiency and spatial resolution

ArCLight



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



https://doi.org/10.3390/instruments2010003

ND-LAr Prototyping

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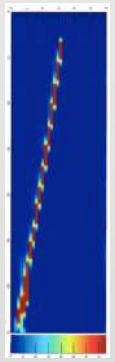
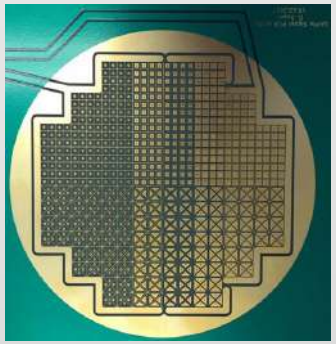
Isolated tests of novel technologies (2018-2020)

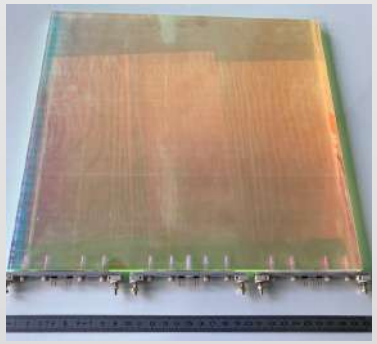
Resistive Shell



Charge readout

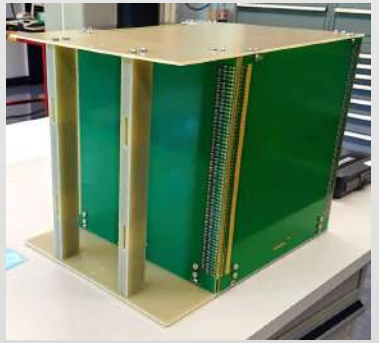


Light readout



SingleCube (2020)

First combined charge and light test

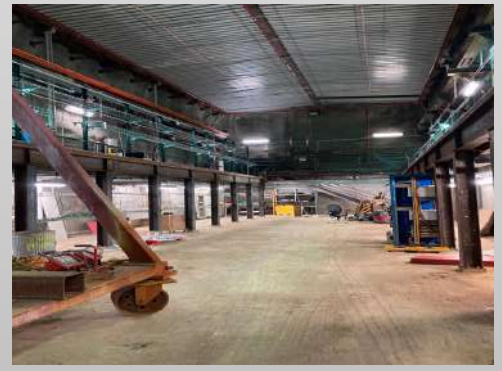


SingleModule (2021-2022)

First test of integration of all subsystems

2x2 Demonstrator (2023-…)

First combined test of multiple modules in a neutrino beam



Single Modules @ FNAL

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- Prepare readout electronics and data acquisition system for prototype testing
- Using existing infrastructure from MicroBoone
- Exchange knowledge with collaborators to allow future protoyping integration

Single Modules @ FNAL

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