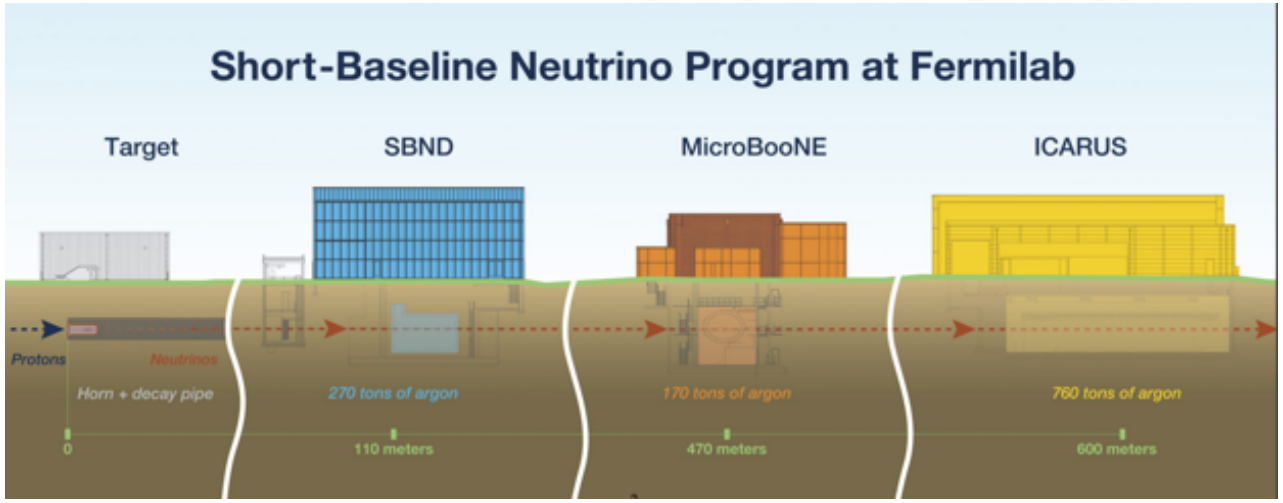
WP1:
NEUTRINO DETECTORS

INTERIM REPORT
DECEMBER 2, 2022



MicroBooNE operation

- Longest time operated LArTPC to date
- 24/7/365 operation
- 1-2 people on shift on-site,
  later also remote-only shifts,
  10-15 on-call experts on-site and off-site
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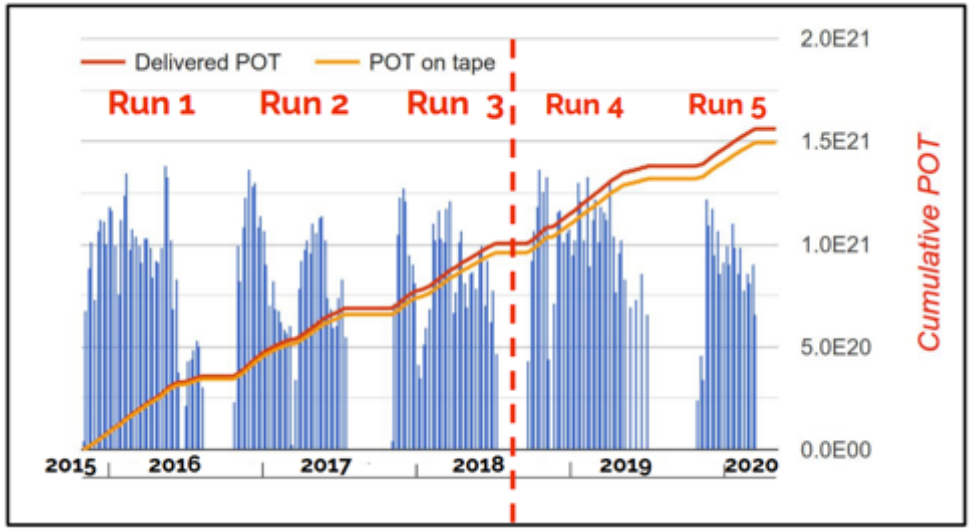
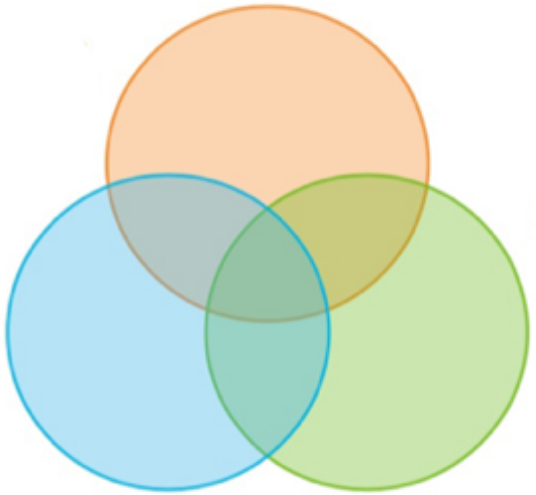


- "Intense" post-data taking phase with detector studies
  - Taking advantage of a well understood detector from operation since 2015
  - Noise and Light studies by varying HV, grounding studies
  - Reverse HV, rise HV —> 70 kV (stable) to 128 kV (small instabilities)
  - Purification study to understand impurities
  - Radon doping —> interesting results on Rn being filtered
  - Triggering

Understand MiniBooNE LEE & other New Physics Searches

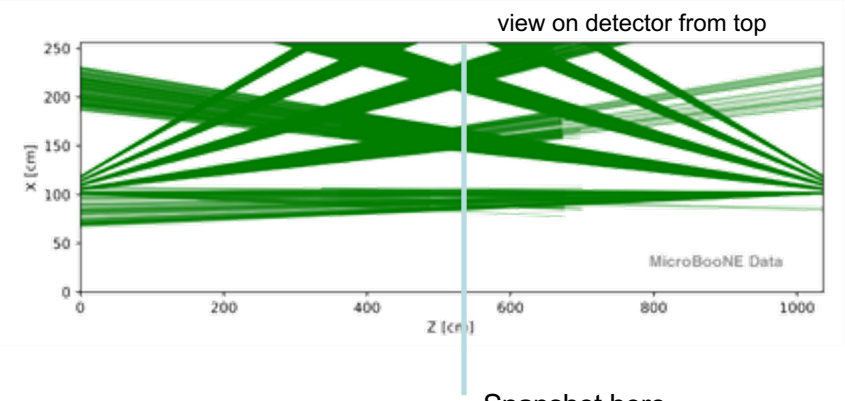


Precision measurements of ν – Ar cross-sections

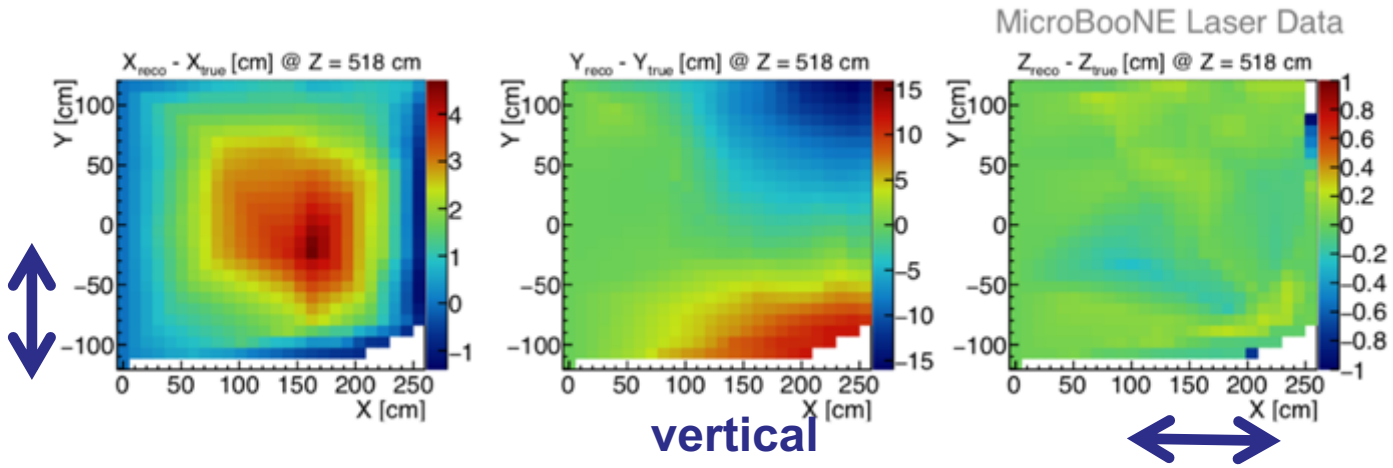
Pioneering R&D of LArTPC detector technology

- More than 45 publications in the past 5 years https://microboone.fnal.gov/documents-publications/
- More than 75 public notes sharing progress with community as we go https://microboone.fnal.gov/public-notes/

UV-laser analysis

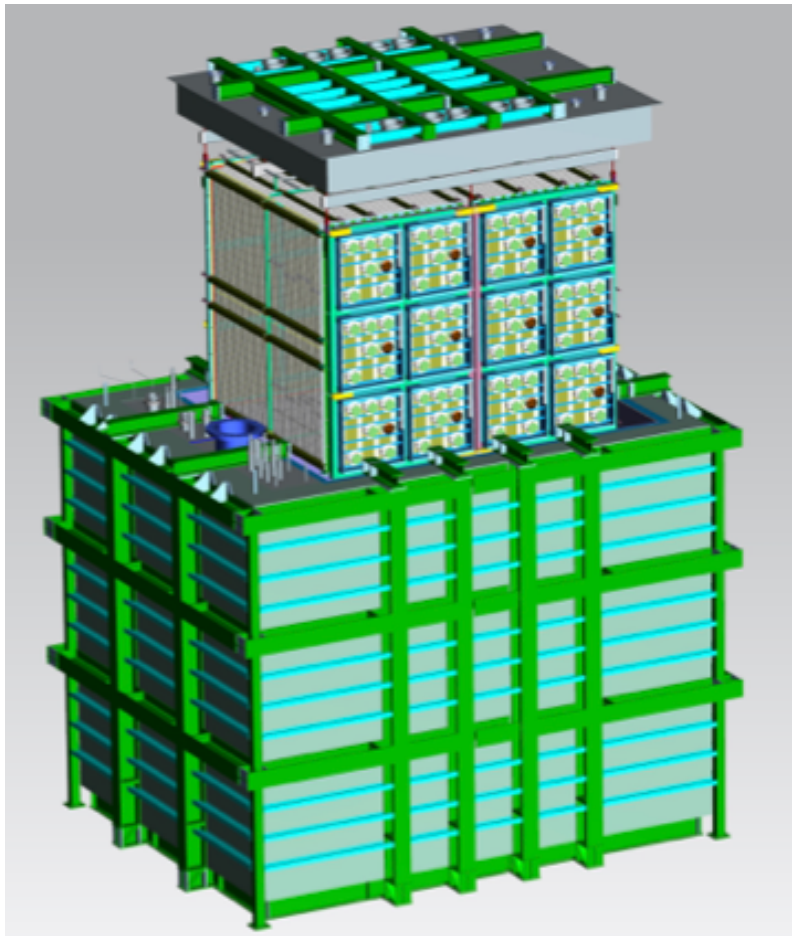


Laser tracks shot into MicroBooNE
Laser light induces straight tracks

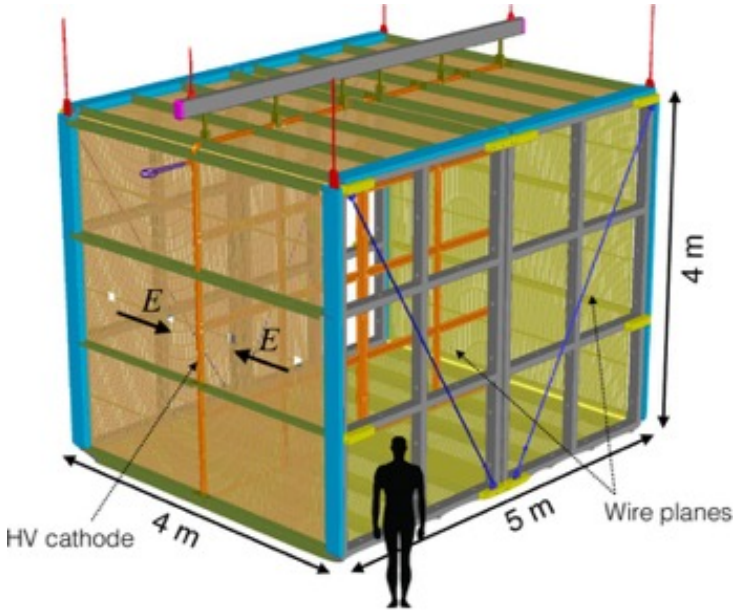


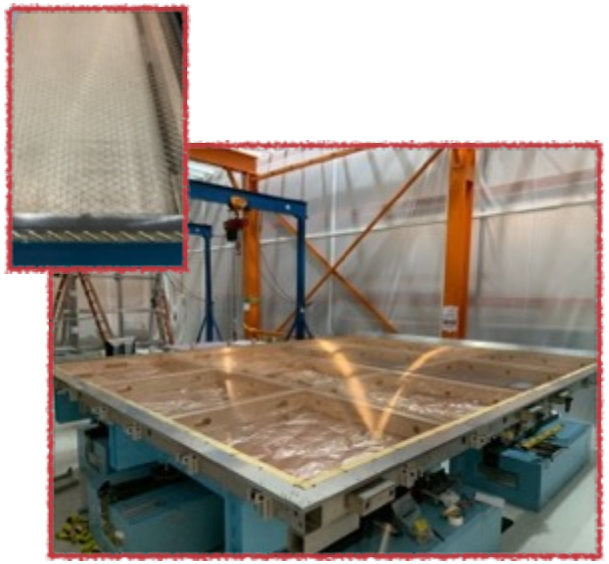
Measured Electric field

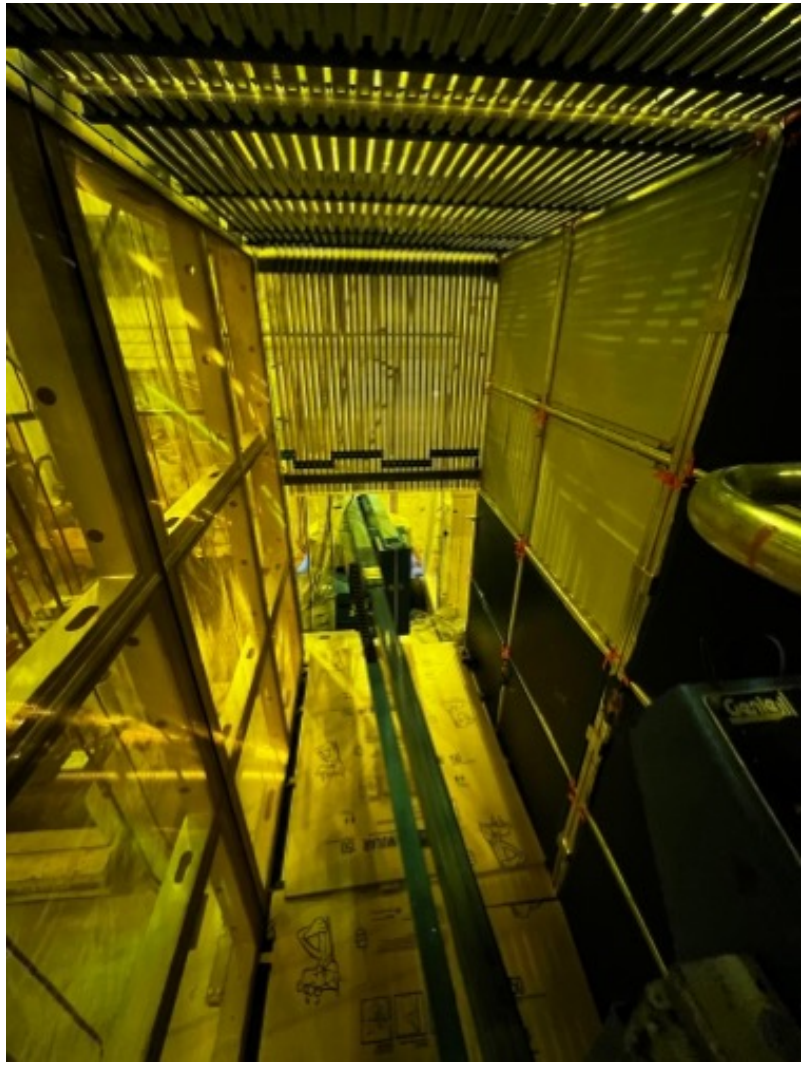
SBND

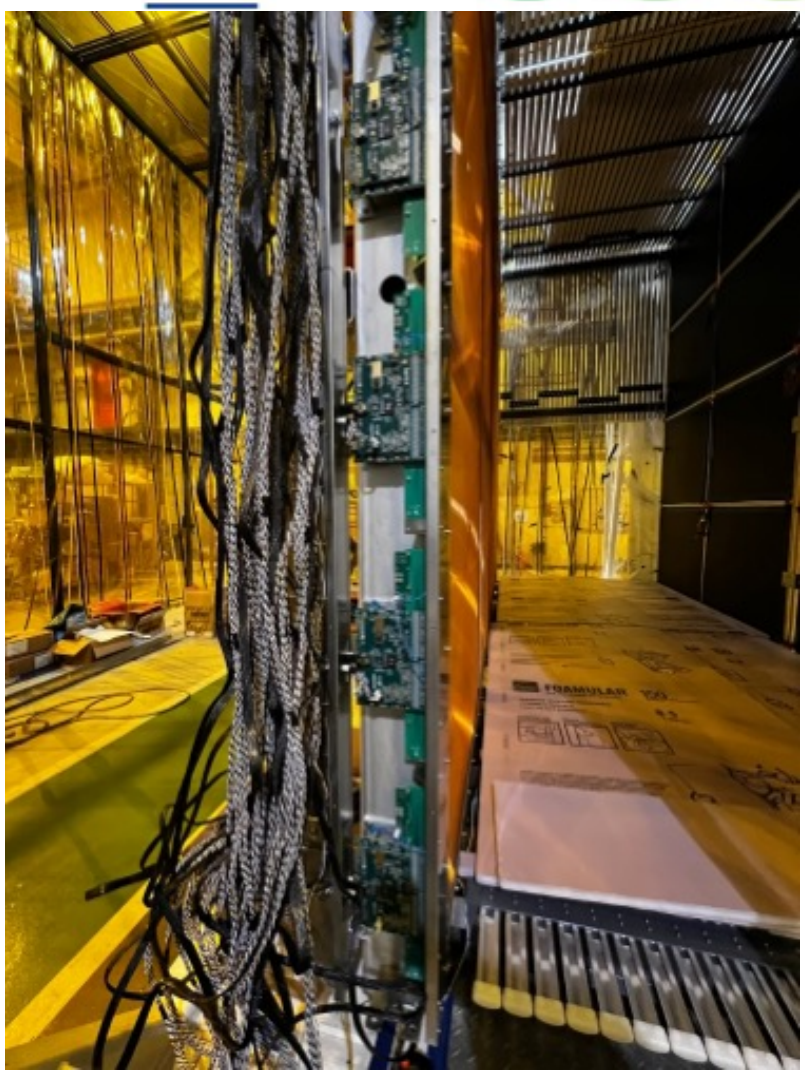


Short-Baseline Near Detector (SBND) is located 110 meters from the Booster Neutrino Beam target, and has 112 tons of liquid argon within the active







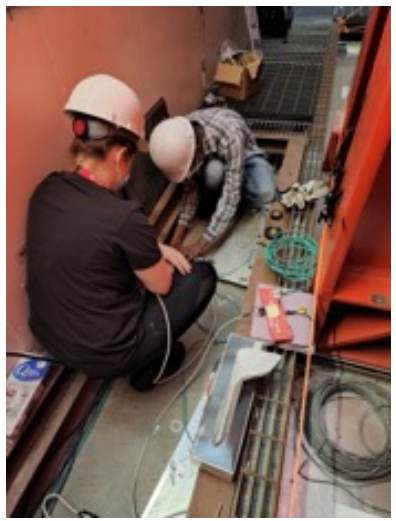


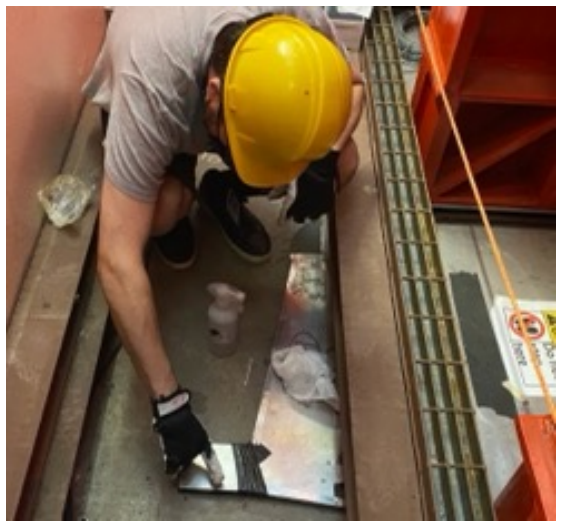
Field cage assembly

Cold electronics installation

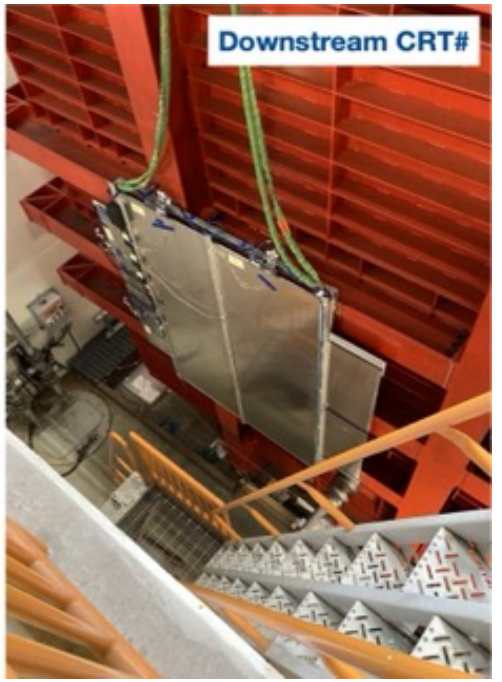
SBND Cosmic Ray Tagger

- System delivered from UBERN
- Temporary beam muon telescope installed on the upstream and downstream walls of the SBND cryostat.
- This CRT enabled pre-LAr commissioning of the DAQ, CRT, Beam, Trigger and PMT electronics.
- Bottom modules installed before cryostat placed on top

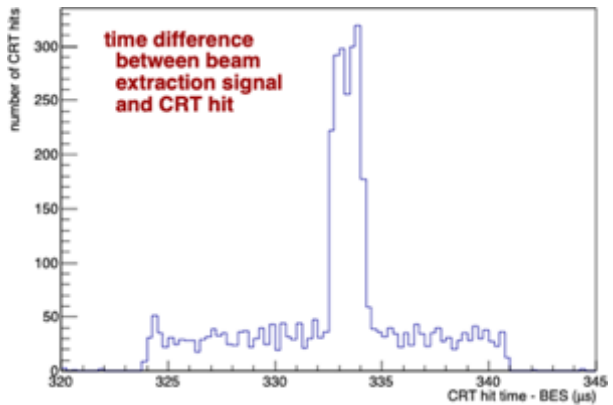




Bottom CRT installation

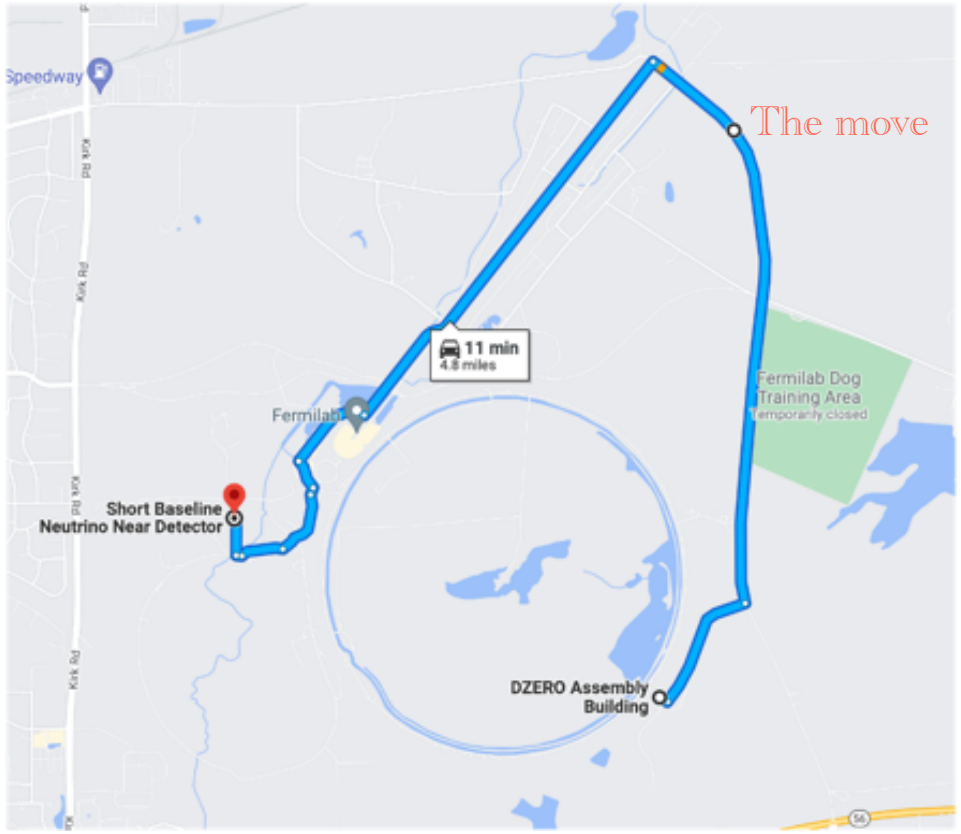


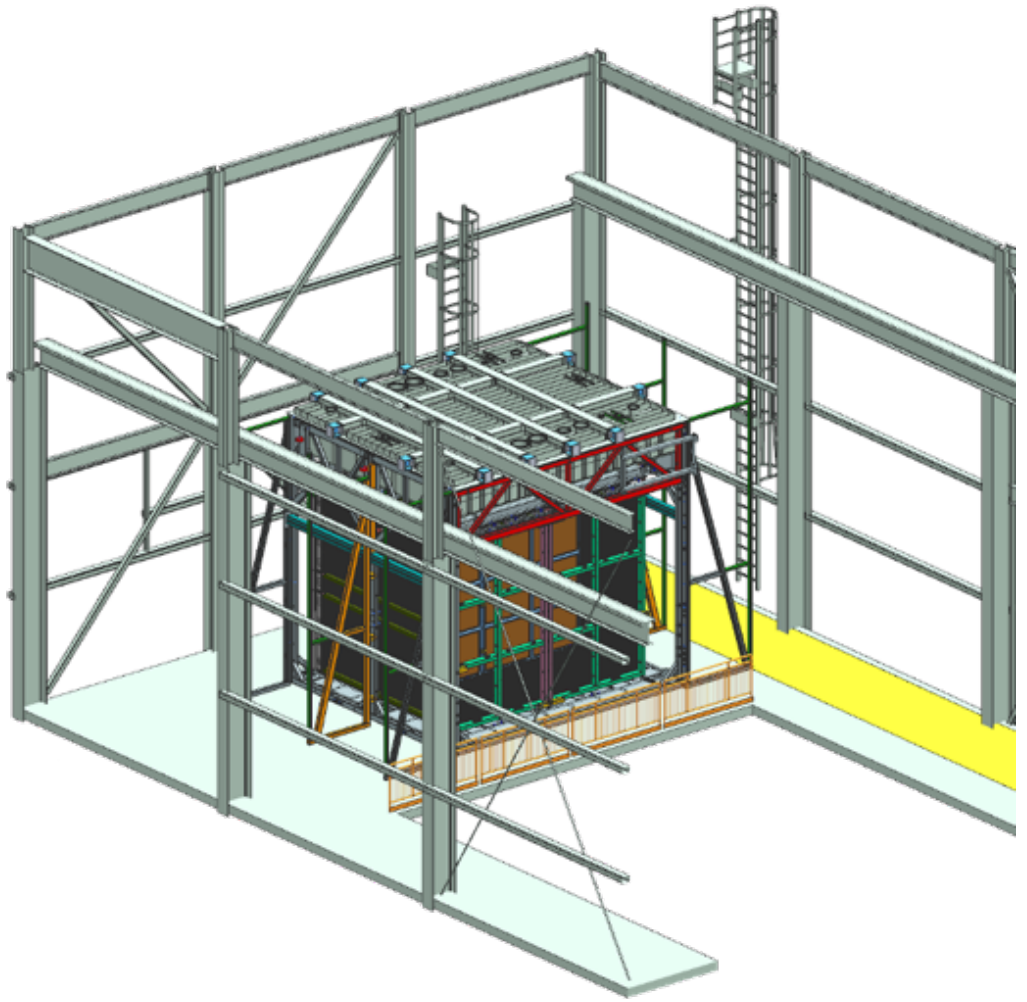
First “SBND data” before full detector installation



Beam spill duration is 1.6 us CRT timing resolution is 1-2 ns

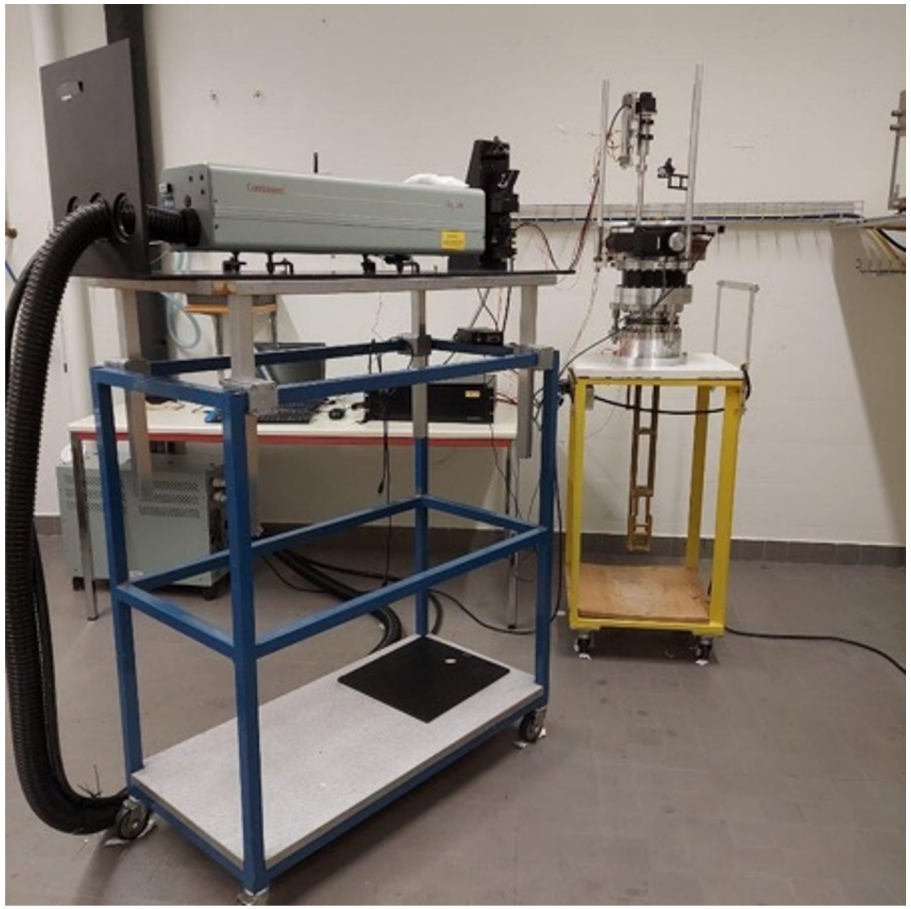
Putting the detector into the cryostat

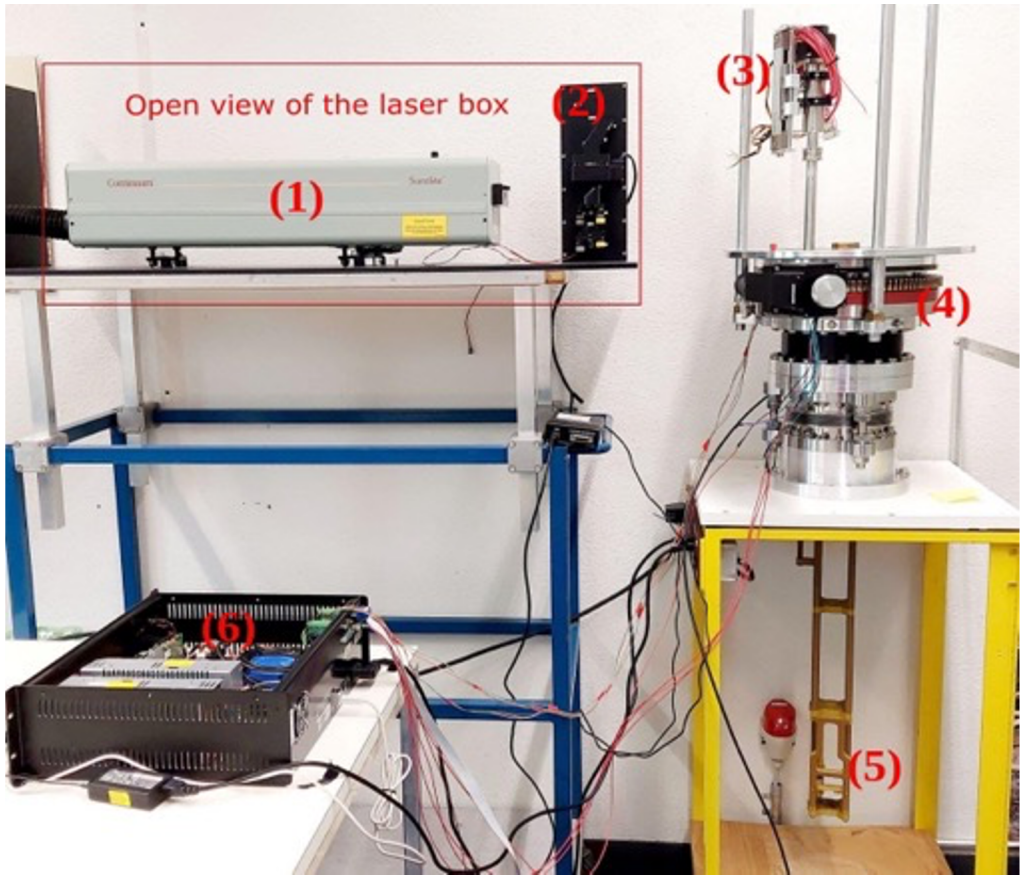




- Assembled Detector moved to the ND building YESTERDAY
- Detector insertion inside the cryostat is expected to take place in spring
- Expected to be ready for cryogenic operations at the beginning of next summer

SBND UV Laser





Unit built at the University of Bern, see ESR report

ICARUS construction and commissioning

Aug. 28th 2020: start of TPC/PMT operation

Dec. 2021: completion of CRT installation

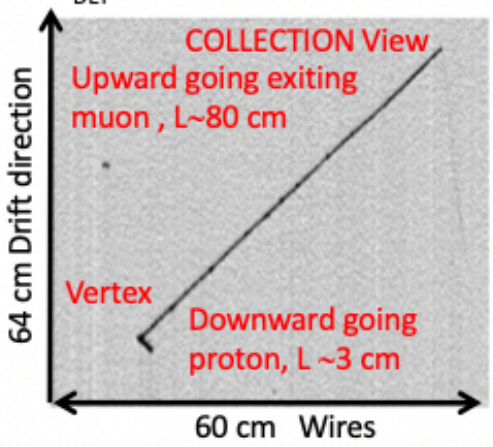
June 7th 2022: completion of overburden installation

Steady data taking with BNB, NuMI beams since March 2021, in parallel with commissioning activities.

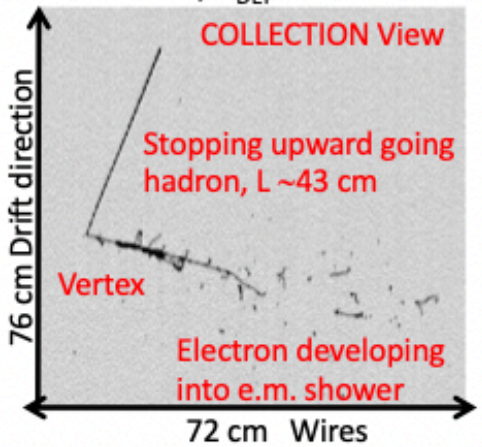
Cosmics, ν_μ, and ν_e samples collected for trigger/calibration/event reconstruction studies.

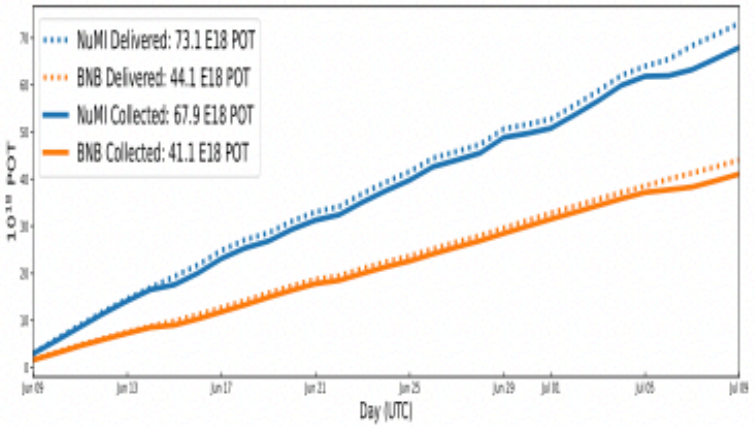
Started data taking for physics with BNB, NuMI: June 9th 2022

BNB CC QE νμ candidate, E_{DEP} ~ 200 MeV



Contained NuMI CC QE νe candidate, E_{DEP} ~ 800 MeV

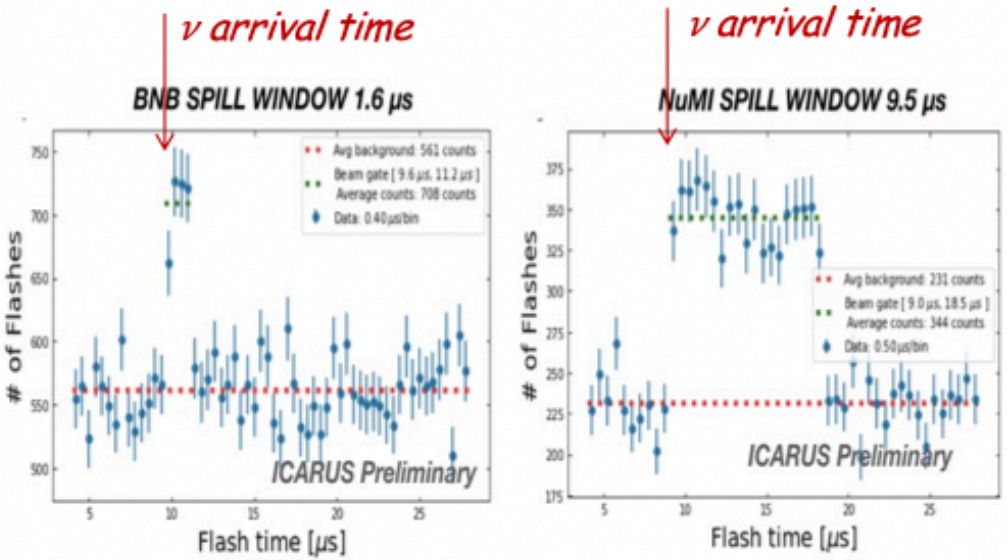




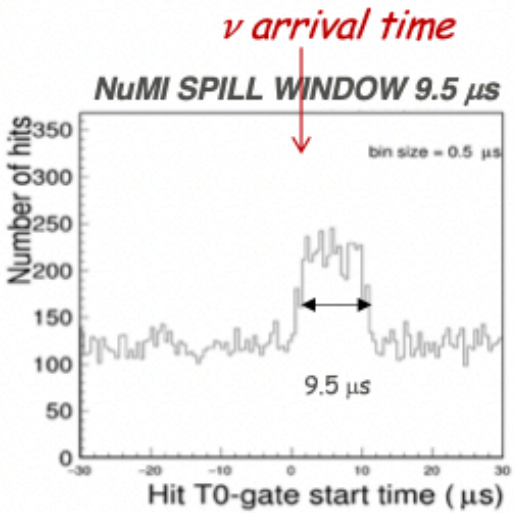
Collected event statistics (93% efficiency): 4.1×10^{19} pot (BNB), 6.7×10^{19} pot (NuMI)

ICARUS trigger system

- Trigger signal: scint. light from >5 fired PMT pairs in a 6 m longitudinal detector slice (30 left + 30 right PMTs per cryostat) in coincidence with the beam spill identified by an Early Warning signal of proton beam extraction.
- PMT and CRT signals are recorded 2 ms around the trigger to recognize/tag cosmics crossing the LAr-TPCs during the 1 ms e- drift time.
- The detector timing has been set by looking for excess of PMT light signals and of side CRT hit signals over the cosmic background in correspondence of the beam arrival.



Light signals excess in PMT system



Hit signals excess in Side CRT

- Trigger efficiency initially evaluated on cosmic muons: > 97 % for E_{DEP} >250 MeV

Conclusions

- Excellent progress
- Recovering from COVID-time, travels and hardware activities resumed
- WP goal of publishing detector papers from MicroBooNE achieved
- WP goal of constructing ICARUS and commissioning achieved, first detector studies and publications underway
- WP goal of constructing SBND made good progress, underway