

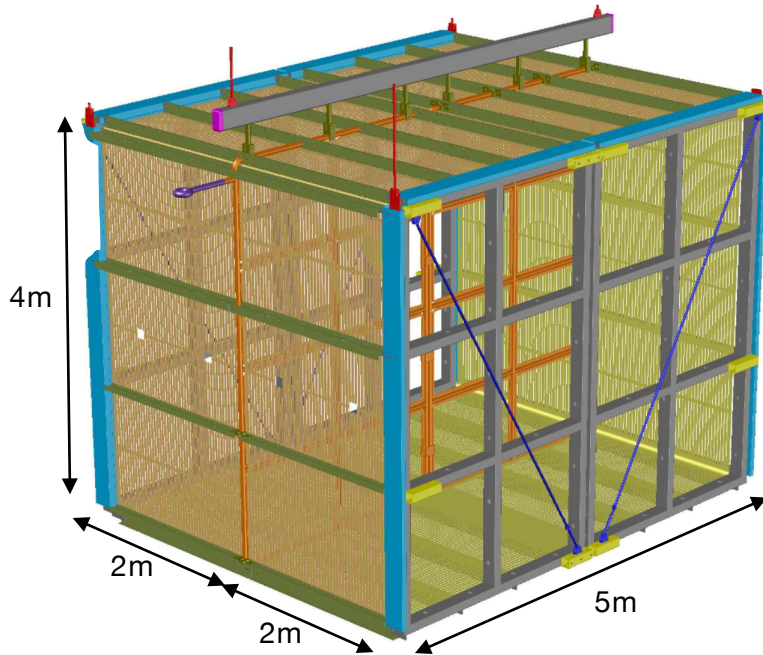
Status of SBND

Thomas Wester, University of Chicago
On behalf of the SBND collaboration

ICARUS Collaboration Meeting
2024 October 14



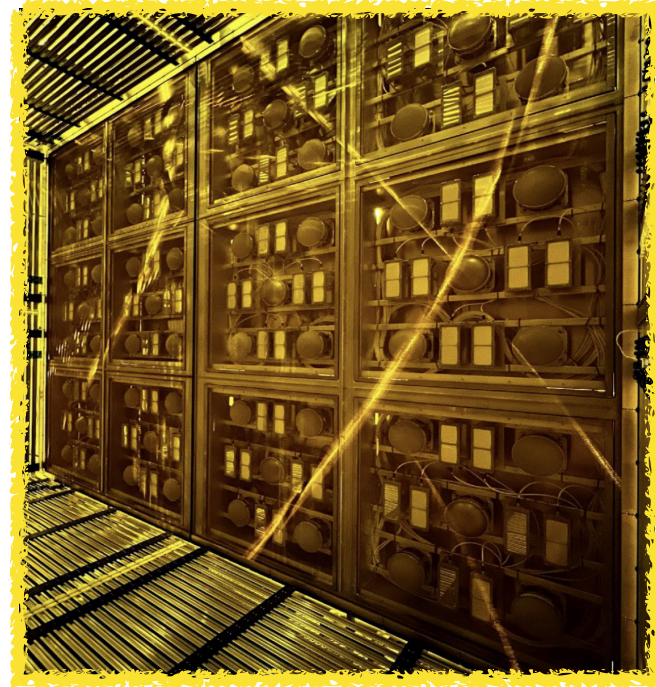
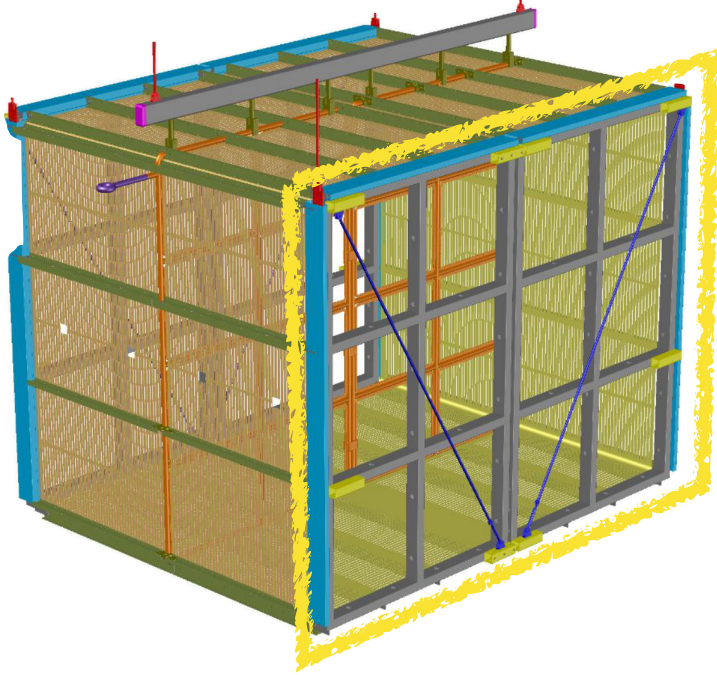
SBND Overview



SBND

- Active mass: 112t
- Cathode HV: -100kV
- Baseline: 110m
~2 million ν_μ CC/year
~15,000 ν_e CC/year

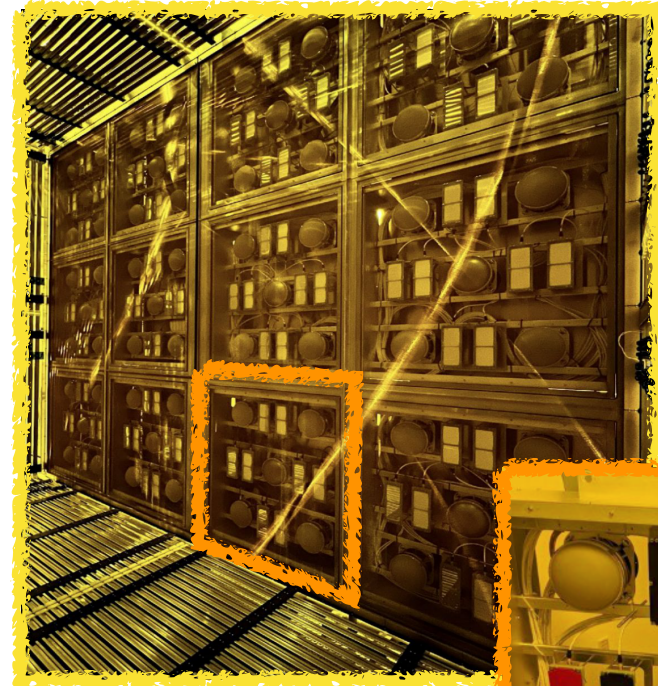
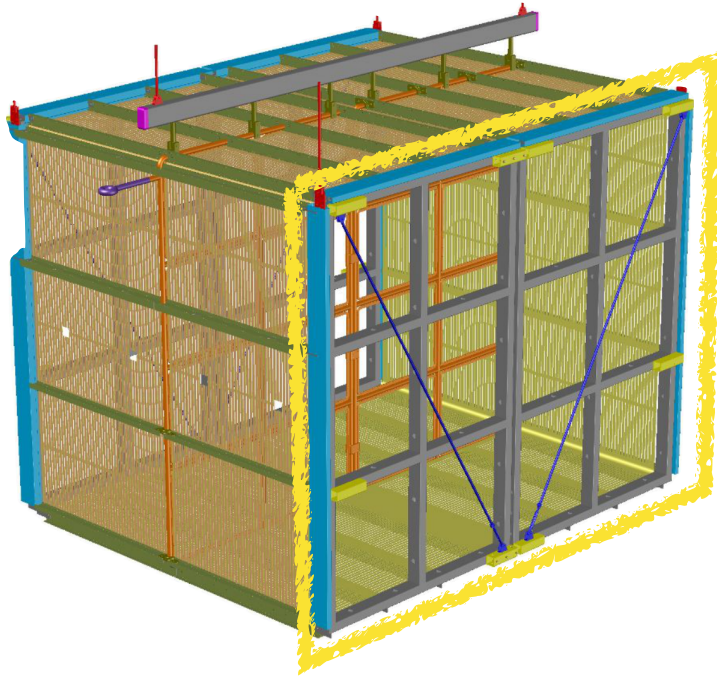
SBND Overview



TPC readout

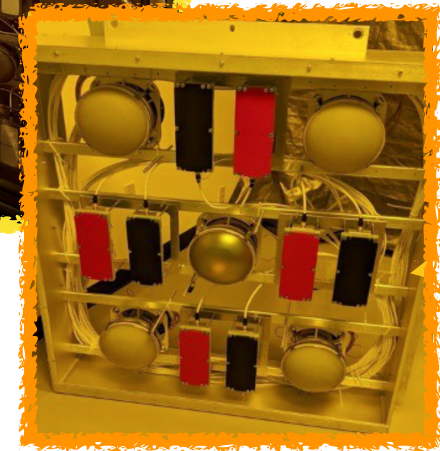
- ~11,000 total wires
- 3 planes/TPC: 0° , $\pm 60^\circ$ to vertical
- Pre-amplification and digitization in LAr

SBND Overview



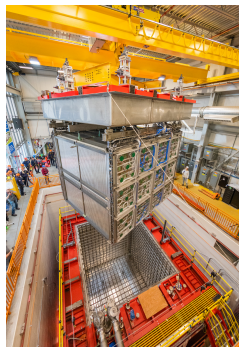
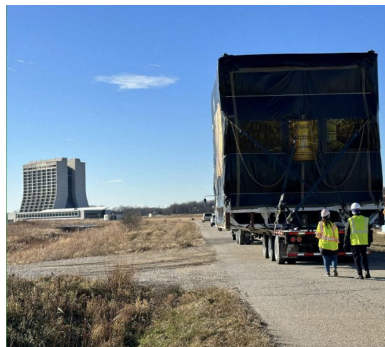
Photon detection system (PDS)

- TPB-coated foils on cathode
- 120 PMTs
96 TPB-coated, 24 uncoated
- 192 X-ARAPUCAs
96 PTP-coated, 96 uncoated



24 PDS boxes

SBND Timeline

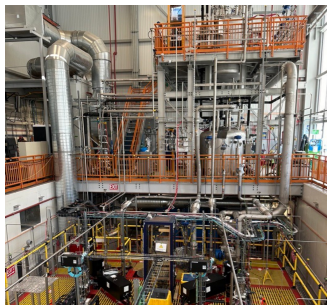


September— 2022	December— 2022	March— 2023	June— 2023	September— 2023	December— 2023	March— 2024	June— 2024	September— 2024
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TPC assembly completed

TPC move to ND building

TPC installed in cryostat



Cryo. installation complete

LAr filling

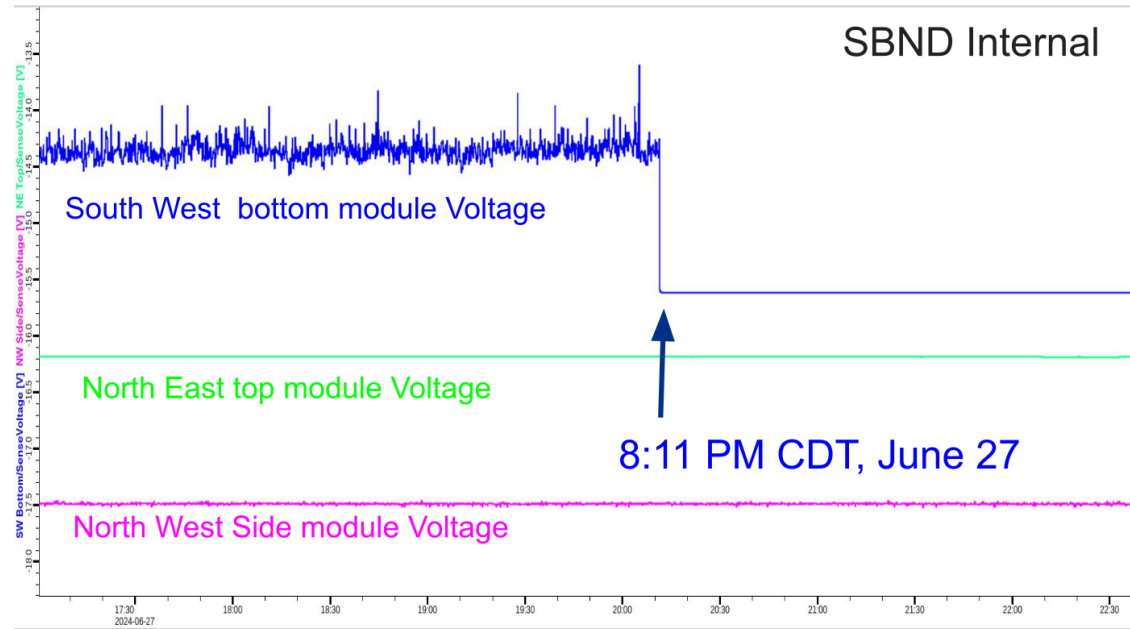
Vertical CRT wall installation

BNB summer shutdown
Ramp to -100 kV

Top CRT installation

SBND HV Issues

- Unstable current observed in the south-west bottom field cage module observed during SBND's first ramp
- At SBND collaboration meeting in June, decided to ramp in steps to study the instability
- During the ramp, at -35 kV, instabilities went away → Proceeded to ramp slowly to -100 kV over the next several days

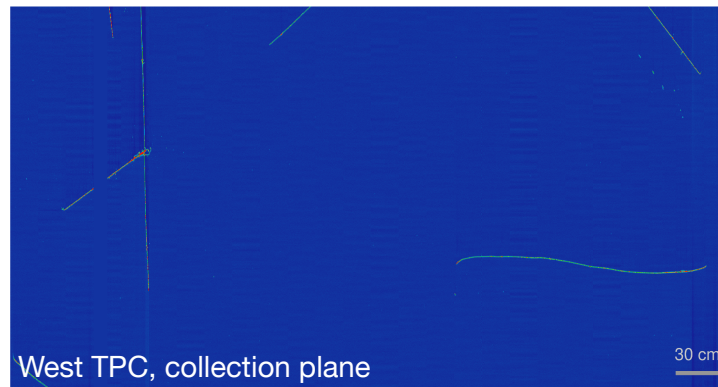
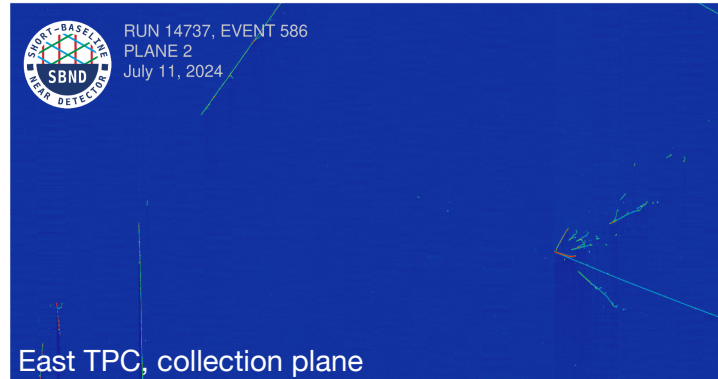


First Neutrino Data

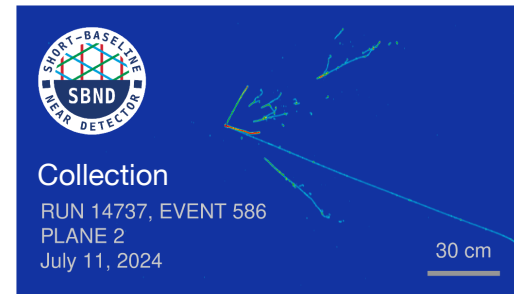
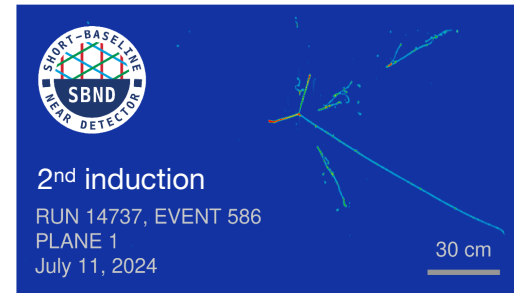
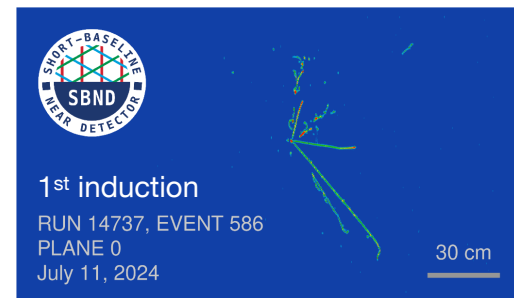
Neutrino data collected July 3-12!

- Nominal cathode HV
- PMTs on
- Zero-bias trigger

Now analyzing:
Confirmed good signal-to-noise readout, enables reconstruction development & data quality checks before beam resumes.



Raw data



Noise filtering applied

Summer Commissioning



Characterizing SBND performance:

- TPC: Noise studies, first reconstruction
- PDS: PMT-TPC timing checks, preparing X-ARAPUCAs
- CRT: Installation of remaining panels & data quality checks

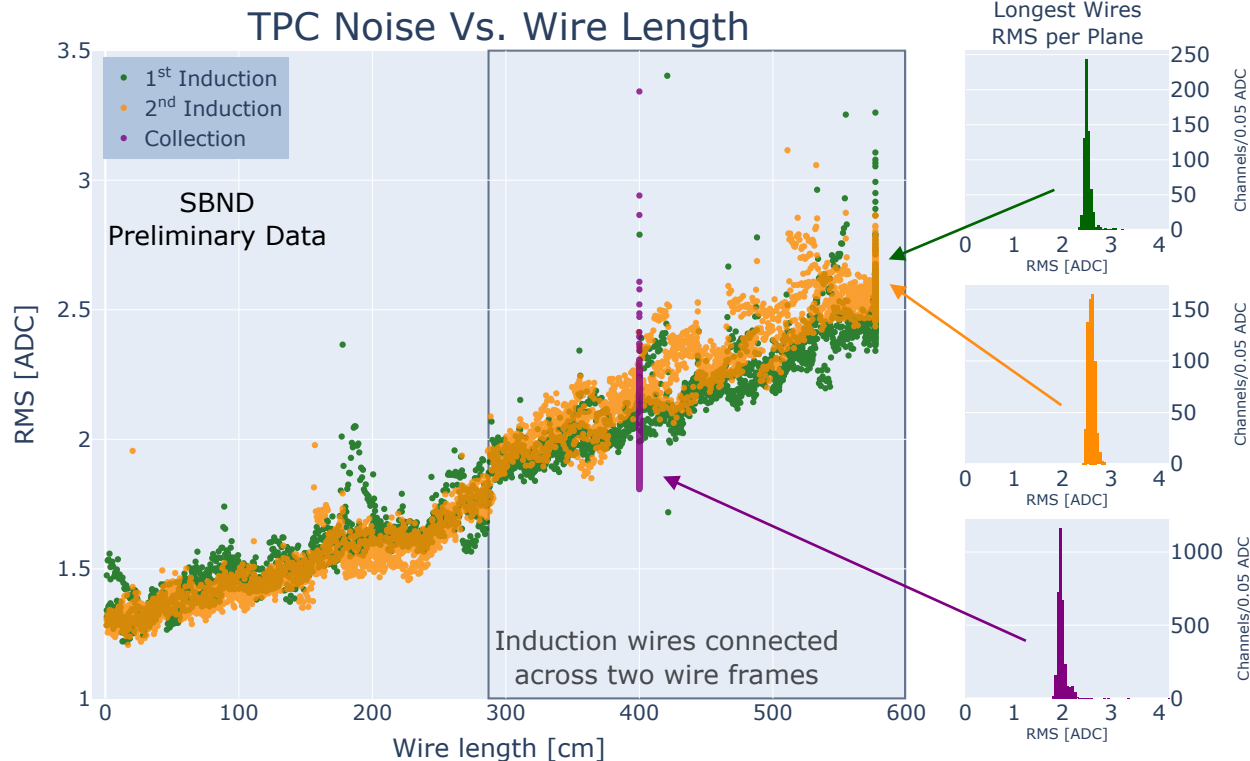
Beam readiness

- DAQ & trigger testing
- Data management
- Operations improvements

TPC Performance



- Observe expected wire length vs. noise dependence
- Narrow noise distributions on all three wire planes

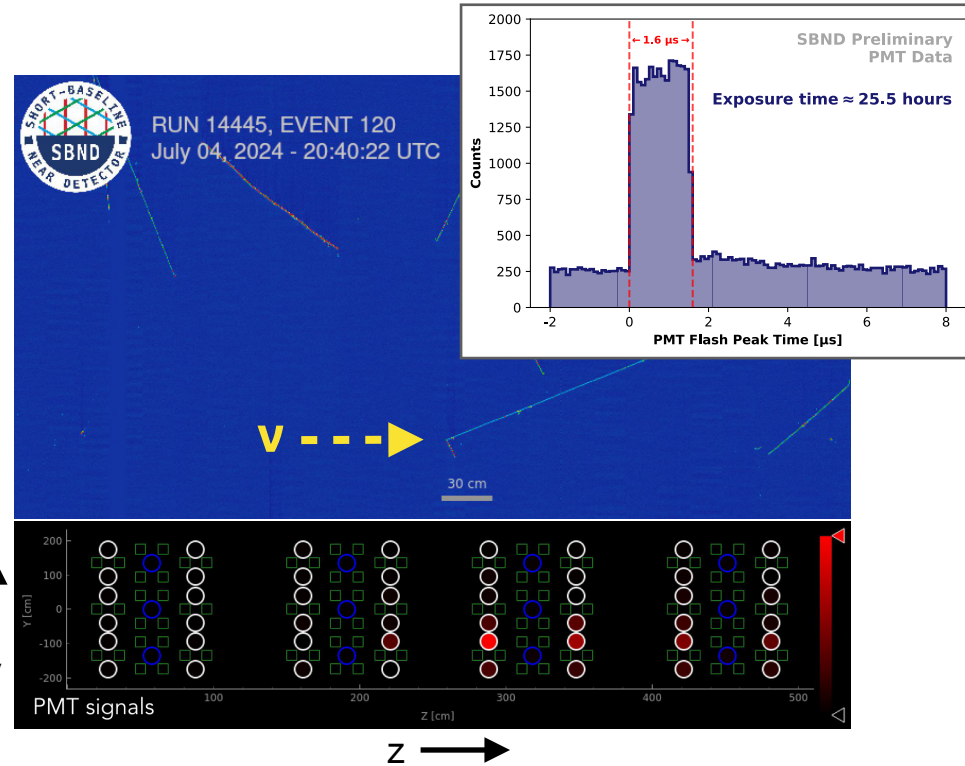
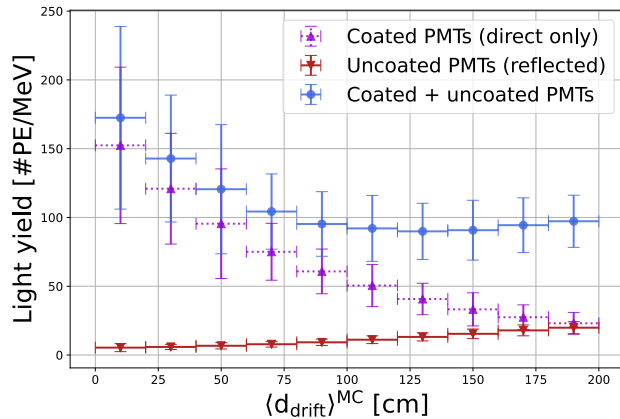


PDS Commissioning



PMTs have been powered up and collecting data this summer

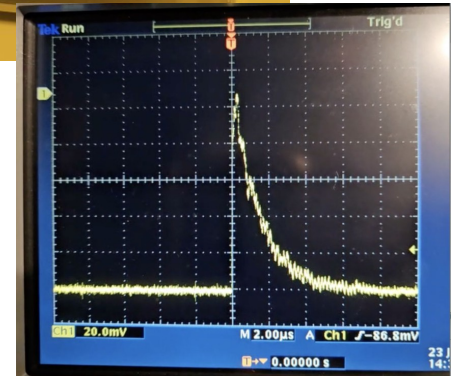
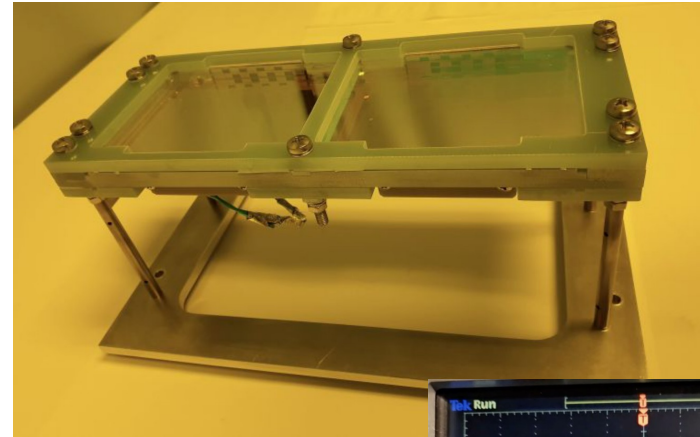
- “Top hat” plot: PMTs see beam!
- TPC/PDS synchronization observed in data
- PDS simulation paper published
Eur. Phys. J. C **84** 1046 (2024)



X-ARAPUCAs

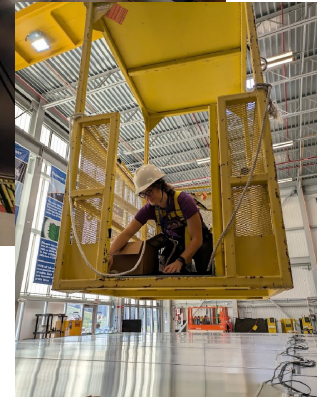
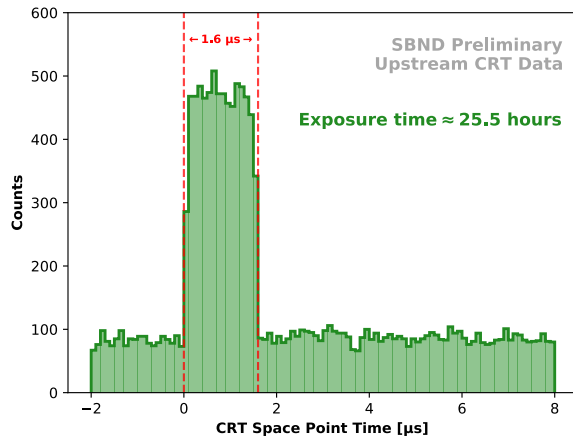
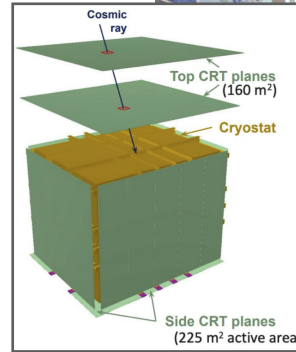


- X-ARAPUCAs connected to APSAIA readout (1/4 of total) are on, visible signals on scope
- Tests of remaining X-ARAPUCAs with ARARA readout are ongoing
- Working now to integrate X-ARAPUCAs into slow controls and DAQ



CRT: Installation Complete

- Observation of BNB with CRTs
- Final two top CRT modules installed this summer
- All walls powered on and collecting good data



DAQ & Trigger



Extensive DAQ testing this summer

- SBND runs last several hours
Causes of run crashes are varied and being investigated one-by-one
- Trigger readout demonstrated at 5 Hz
- Different trigger types tested:
 - Beam signals
 - PMTs
 - CRTs (North-South, East-West)

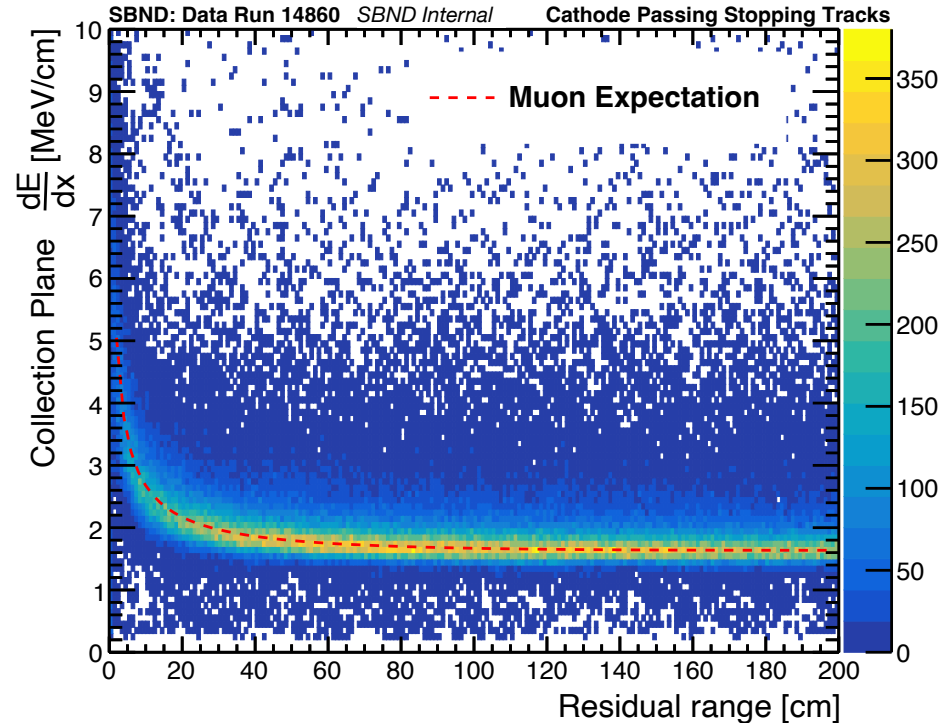


Penn Trigger Board (PTB)

First Calibrations



- **Electron lifetime:** Preliminary measurement shows >10 ms
SBND design requirement: 3 ms
- **TPC gain calibration:** Good data/MC agreement across range of dE/dx

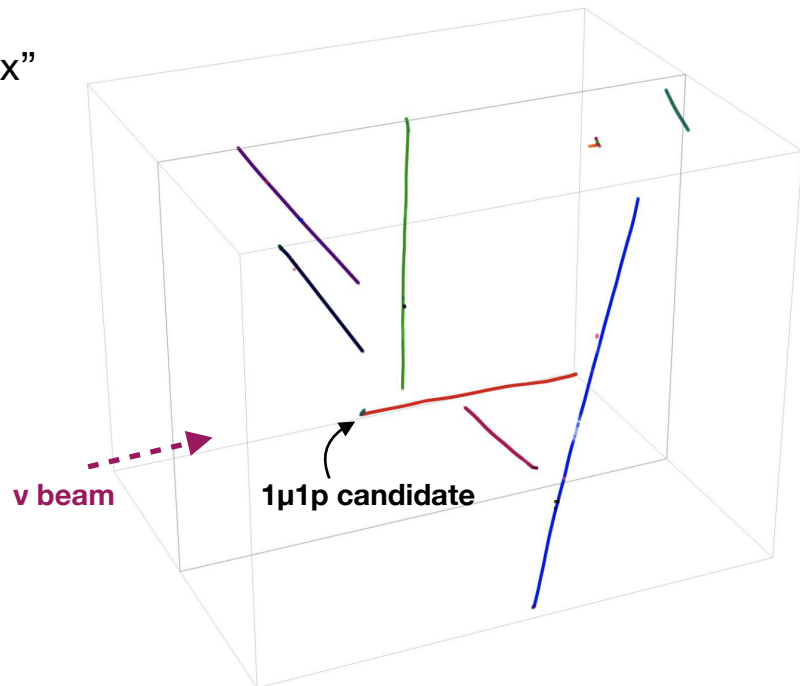


SBND Reconstruction



TPC reconstruction with Pandora working “out-of-the-box”

Actively developing machine-learning signal processing and reconstruction methods for SBND



Raw data



Noise filtering,
2D signal deconvolution



3D Pandora reconstruction

SBND Computing



- SBND production:
 - 300k central value events generated over the past few weeks incorporating recent sbndcode developments, now analyzing
 - Preparing for SBND keep-up processing
~100 MB/s data rate for decoded files → ~0.25 PB/month
- **Polaris supercomputer** at Argonne National Lab
 - Copy of SBND data available on Polaris.
First neutrino data transferred
 - Production workflows implemented: ~1 million MC events generated for calibration studies this summer
 - AI group discussions on how to best incorporate Polaris into SBN production ongoing



SBND Operations

Erin Yandel is the current SBND run coordinator through December 2024

Gray Putnam is the current SBND deputy run coordinator.

Summer operation highlights:

- Protocols for power outages
Detector has been brought down & back up successfully three times since August
- Shift improvements
New slow controls metrics, automation of routine shifter tasks, subsystem expert trainings



Erin Yandel
SBND RunCo



Gray Putnam
SBND Deputy RunCo



Mônica Nunes
SBND Operations

Summary

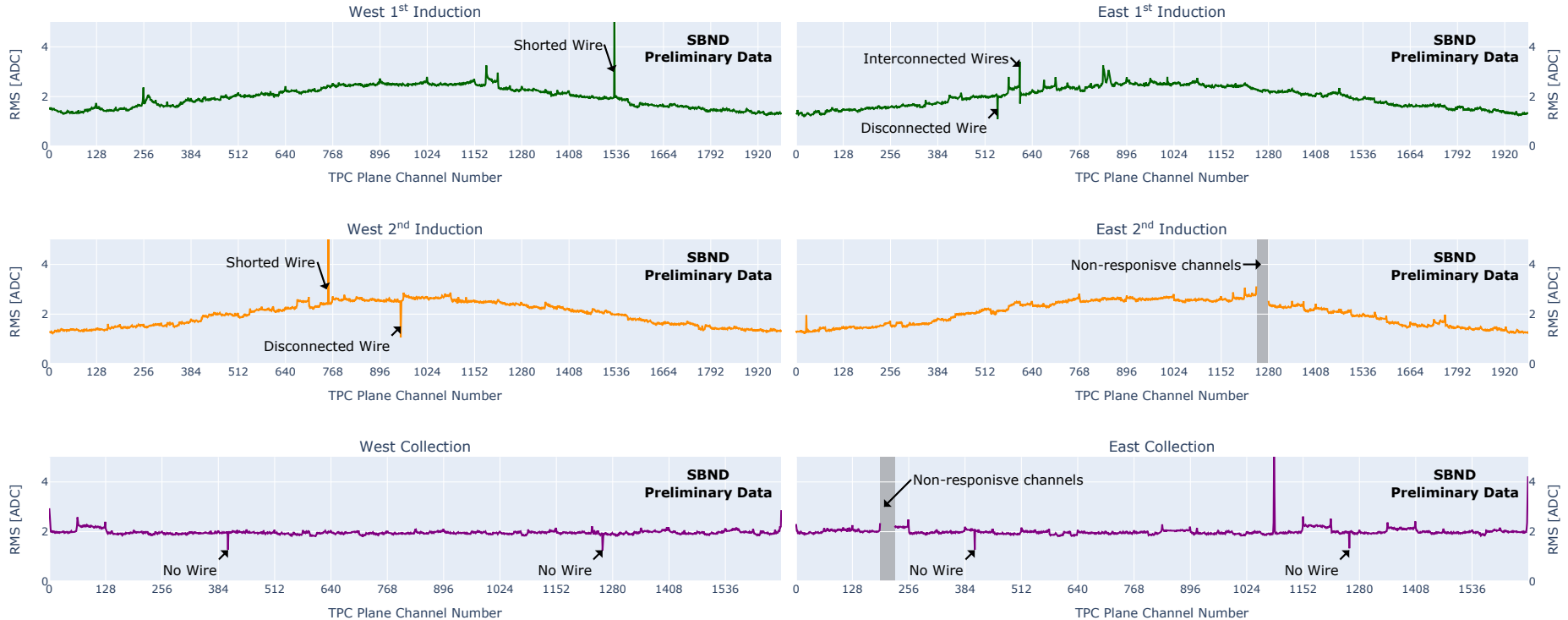


- SBND commissioning is concluding; transitioning to operations
- SBND installation is now 100% complete
- Studying our commissioning data:
 - Calibrations underway
 - Neutrino reconstruction working

Extra

TPC Noise: All Channels

TPC Noise per Channel



Induction Plane Calibration

