The efficiency of a Cosmic Ray Tagger veto on selection of contained neutrino interactions in SBND

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Midterm presentation

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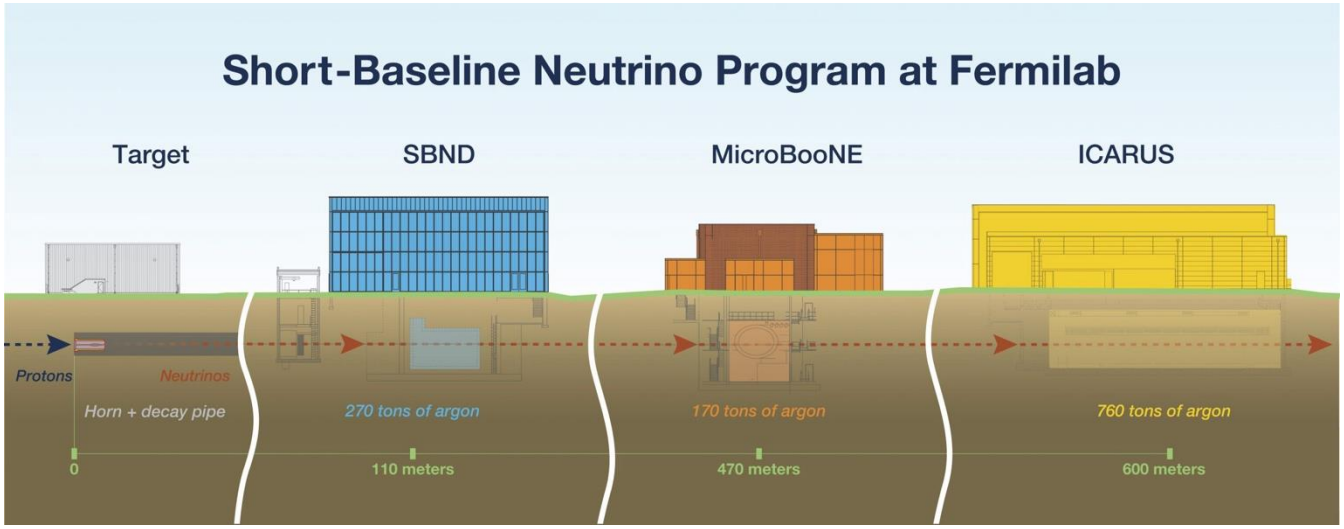
Short-Baseline Near Detector

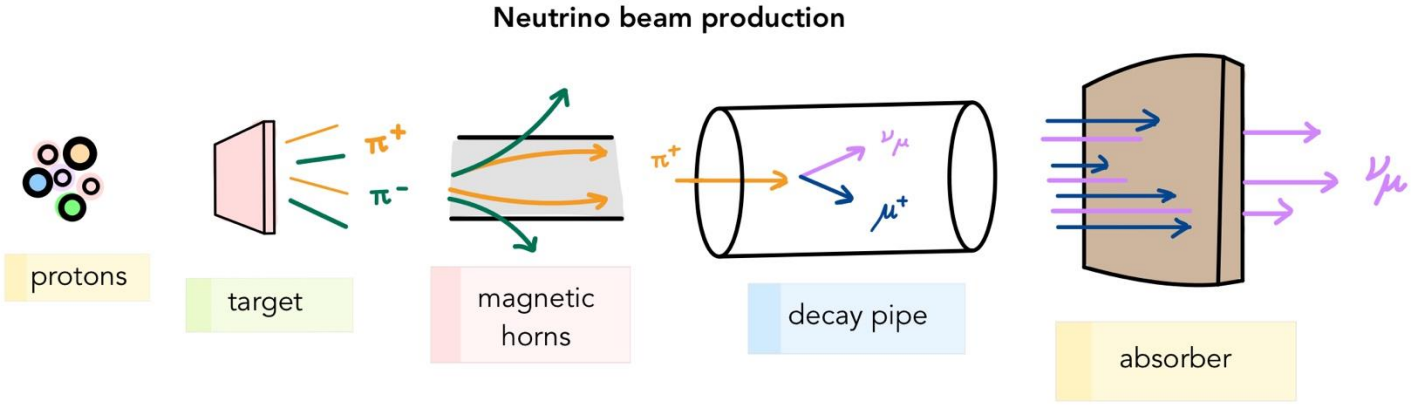
- The Short-Baseline Near Detector (SBND) will be one of three liquid Argon neutrino detectors sitting in the Booster Neutrino Beam (BNB) at Fermilab, as part of the Short-Baseline Neutrino Program.
- MicroBooNE and ICARUS are the intermediate and far detectors in the program, respectively.



Physical Motivations

The SBND experiment has three main goals:

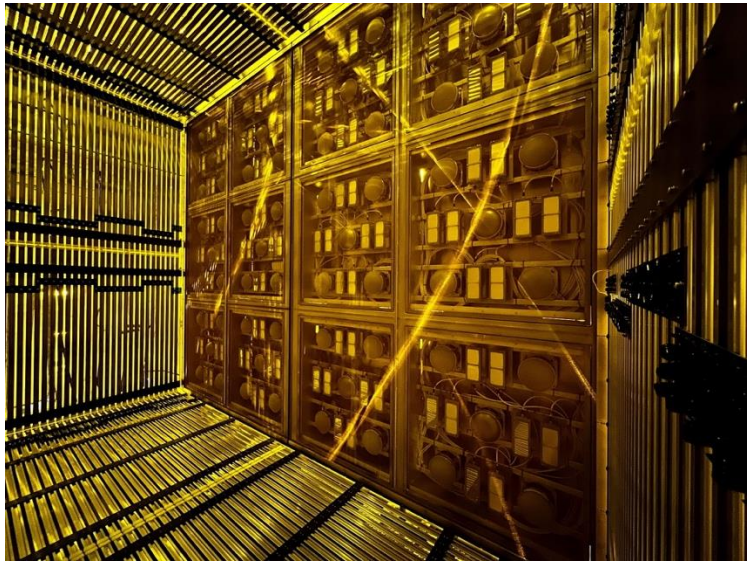
- resolving the question of the existence of the sterile neutrino
- performing the most precise neutrino-Argon cross-section measurements
- searching for new physics beyond the Standard Model

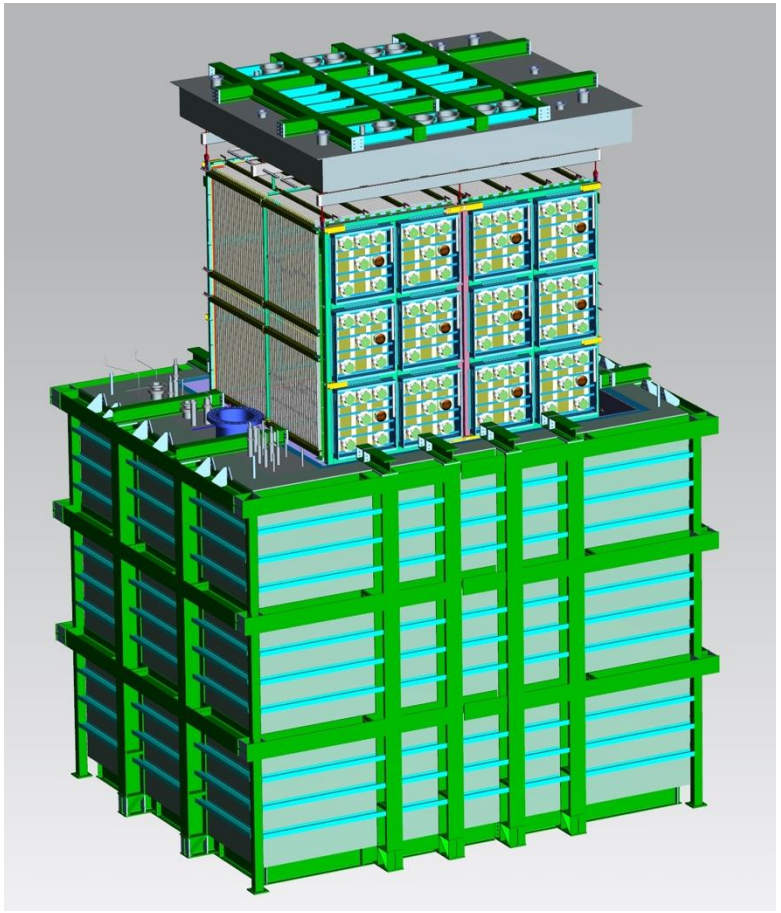


SBND descriptions

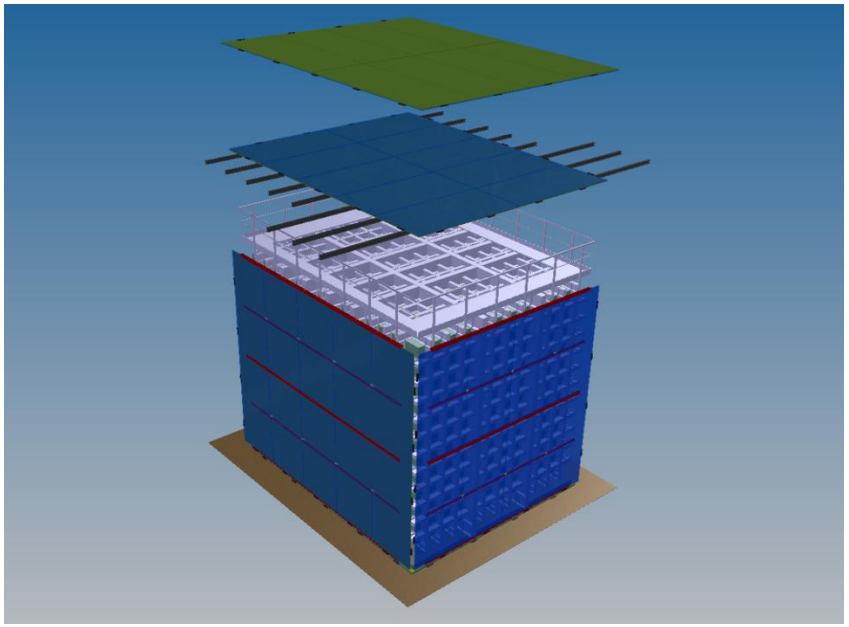
SBND is a multi-component system with three different detectors:

- Time Projection Chamber (TPC)
- Photon detection system (PDS)
- Cosmic Ray Tagger (CRT)





Cosmic Ray Tagger (CRT)



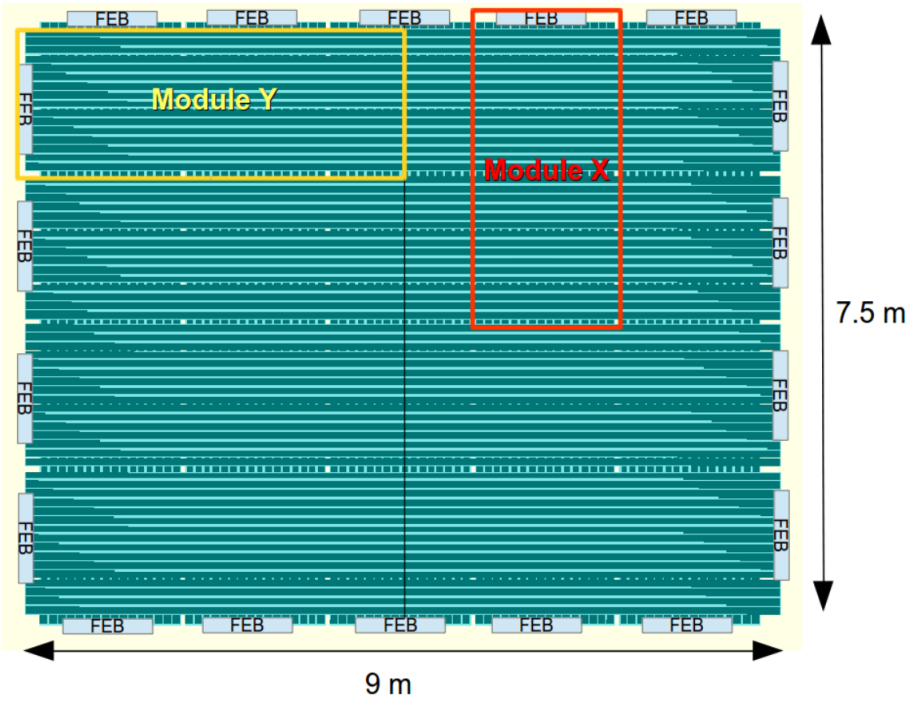
The CRT helps to distinguish between cosmic ray events and other types of interactions, by providing precise timing and spatial information.

This allows to filter out unwanted cosmic ray signals from the data, ensuring that only the relevant particle interactions are analyzed.

Scintillating Tracker Design

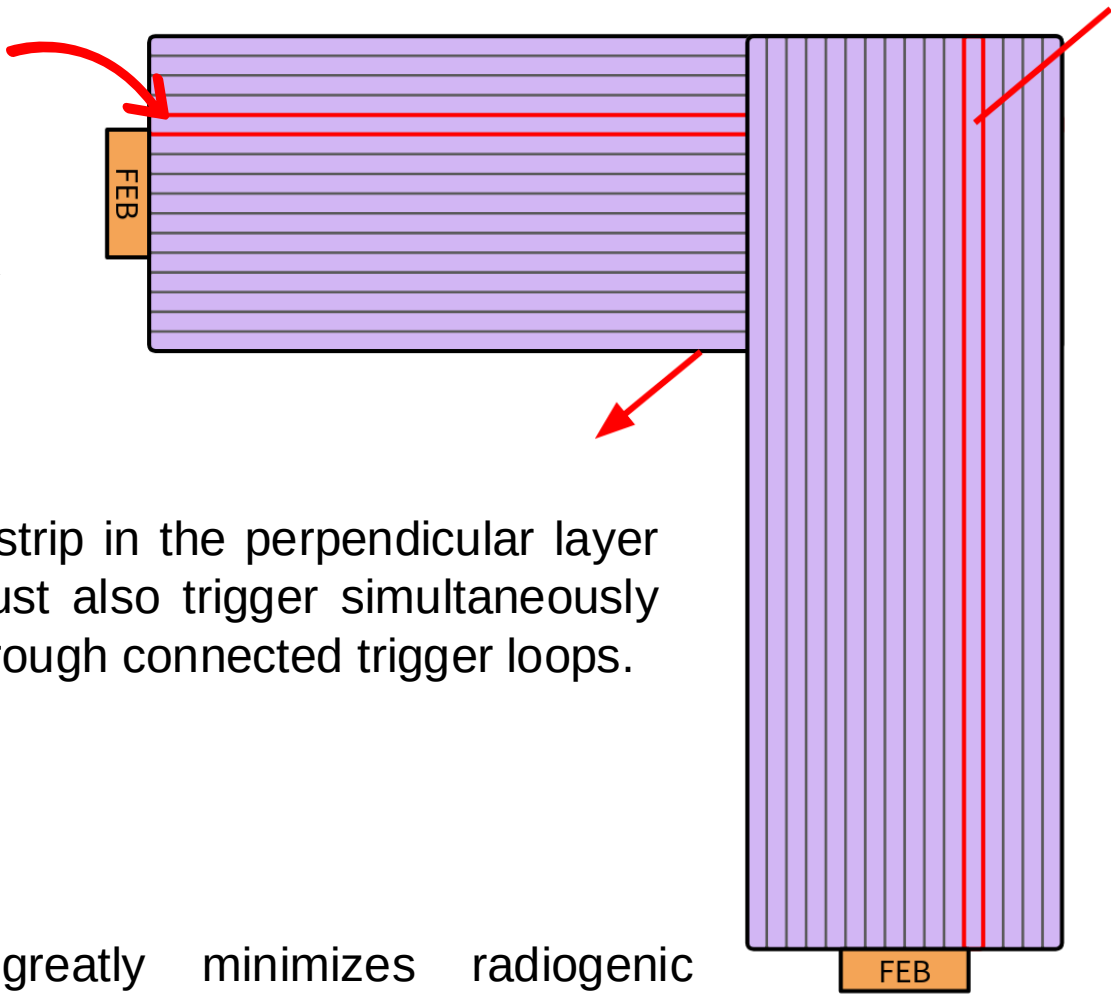
The SBND Cosmic Ray Tracker consists of seven planes made up of several scintillating modules.

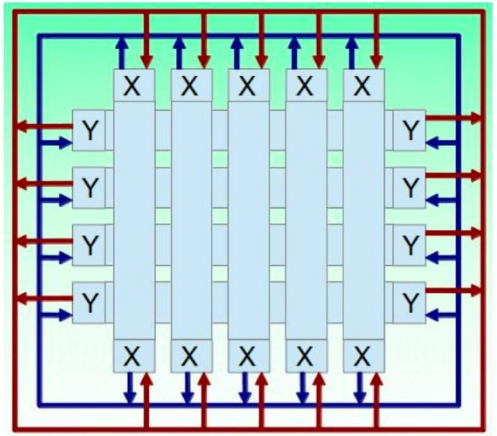
Each of these planes is composed of modules arranged in two perpendicular layers, with each module read out at its outer edge by a Front-End Electronics Board (FEB).



Electronic readout system

Each FEB needs a coincident signal above the threshold from the two channels of a scintillating strip to avoid dark noise fake hits.





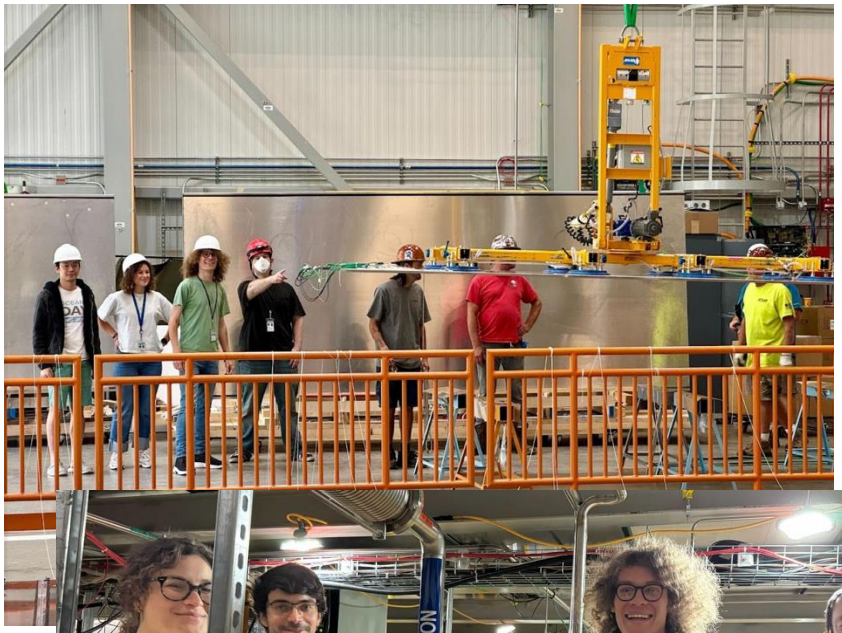
A strip in the perpendicular layer must also trigger simultaneously through connected trigger loops.

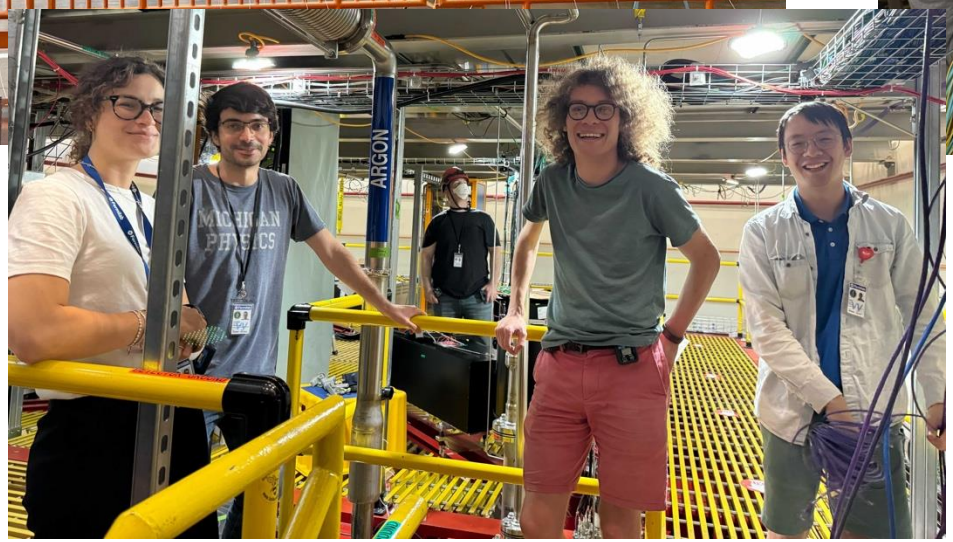
This 4-fold coincidence greatly minimizes radiogenic backgrounds that don't pass through both scintillator layers.

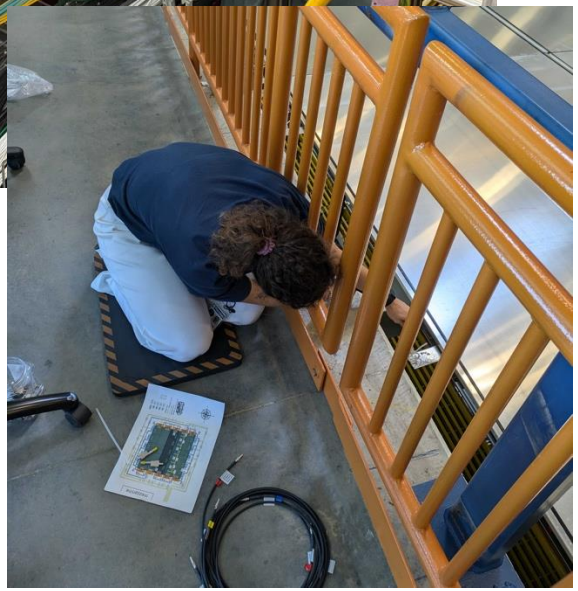
MORE : https://sbn-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=37601

CRT Top Low commissioning

So, what have I done so far?



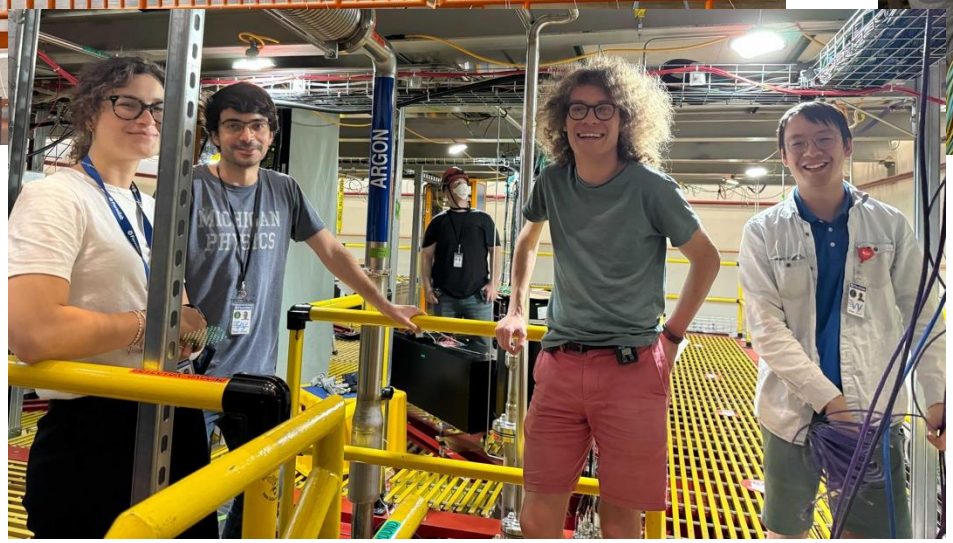


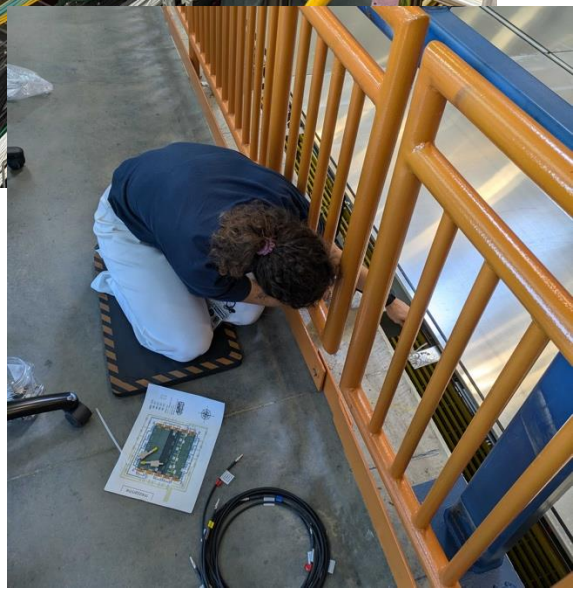


CRT Top Low commissioning

So, what have I done so far?

A LOT OF CABLES!

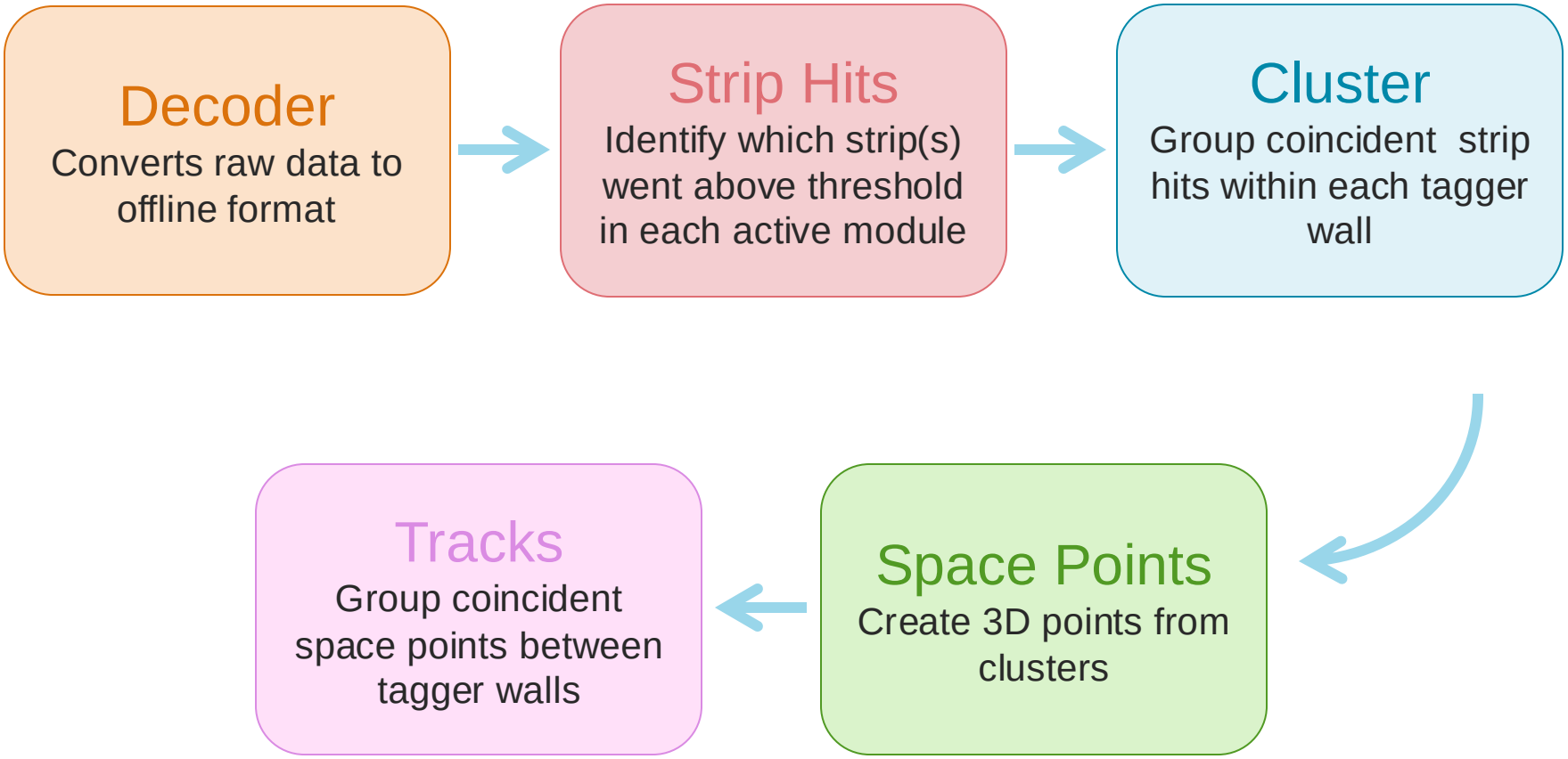




CRT Top Low commissioning

On August 13, the final 8 modules of the CRT Top Low were successfully installed!

CRT Data Reconstruction

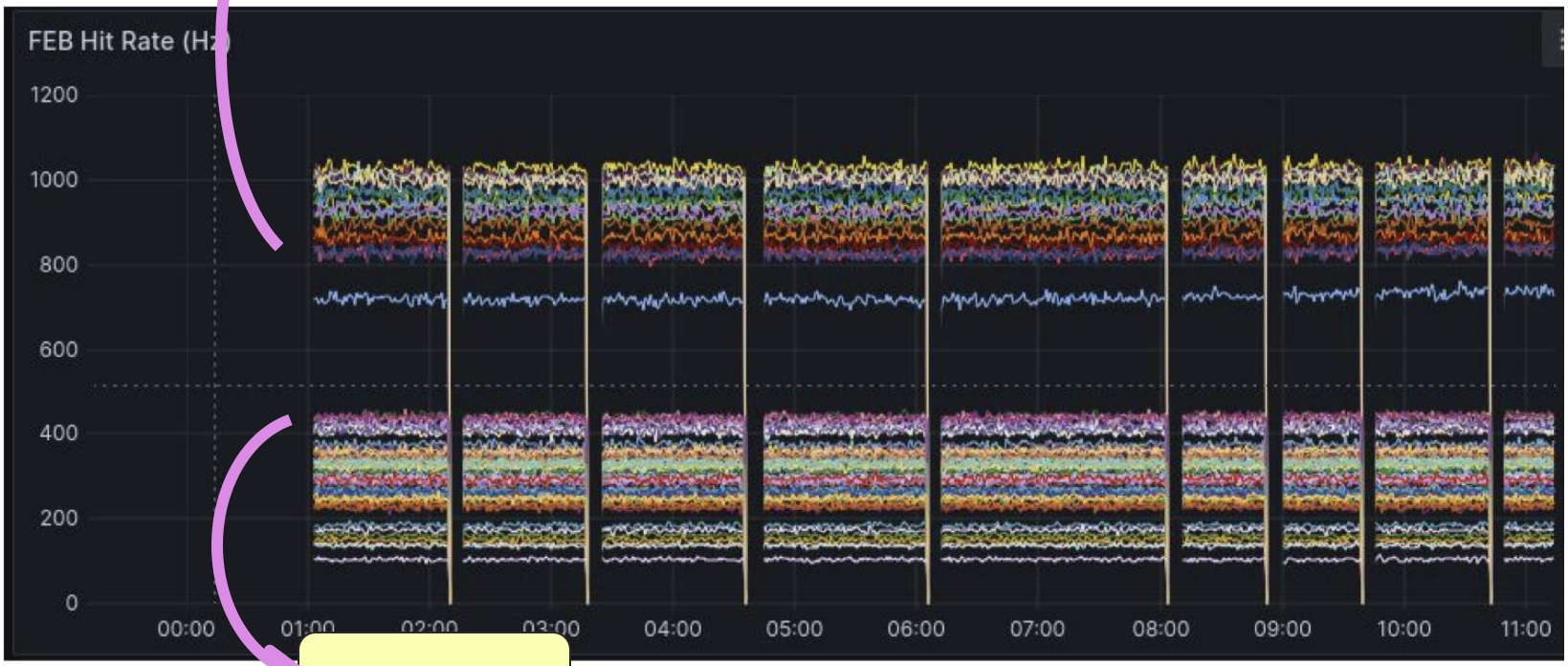


MORE: https://sbn-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=36812

East Wall events rate

East wall shows a very high strip hits rate even if the 3D points rate has a similar level to the other walls!

East Wall FEBs

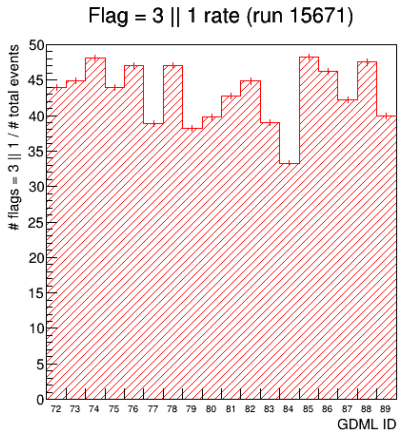


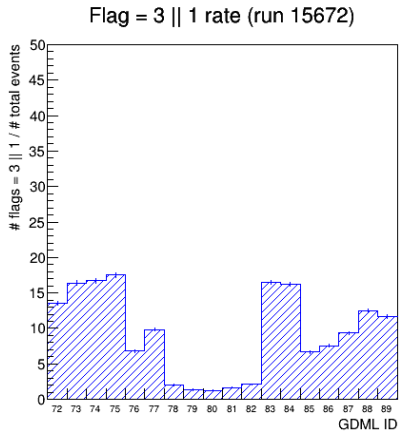
Others FEBs

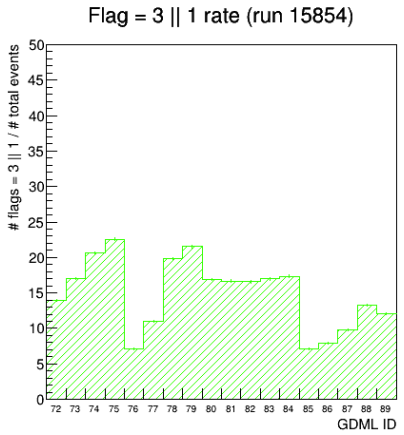
MORE: https://sbn-docdb.fnal.gov/cgi-bin/sso/ShowDocument?docid=37478

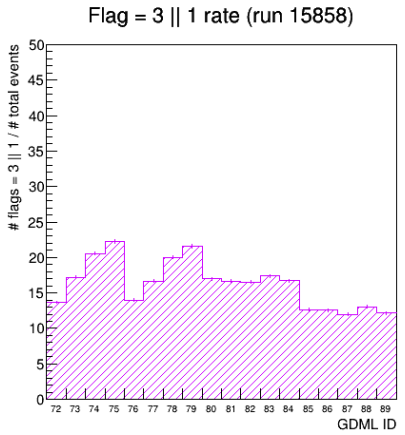
East Wall events rate

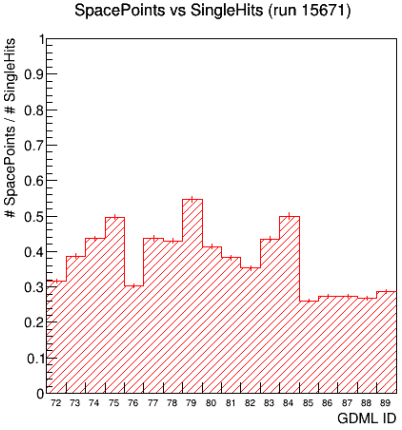
Due to an incorrect connection, the T_{IN} and T_{OUT} loops were actually a single loop.

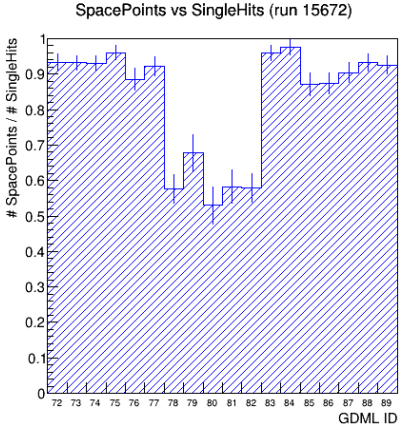


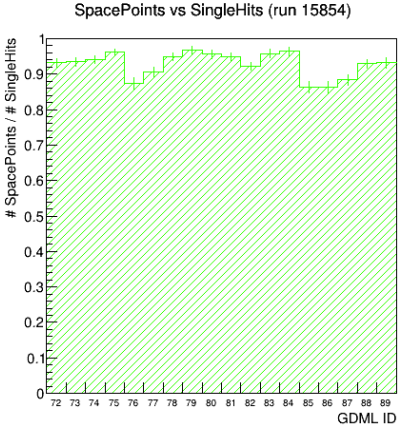


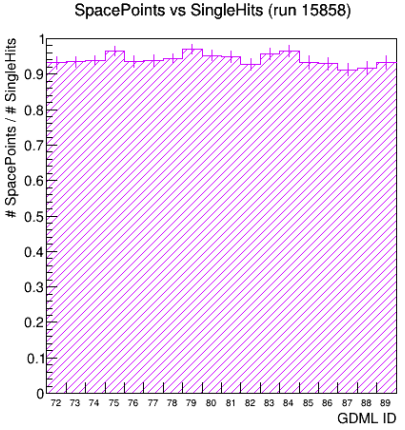












What's next?

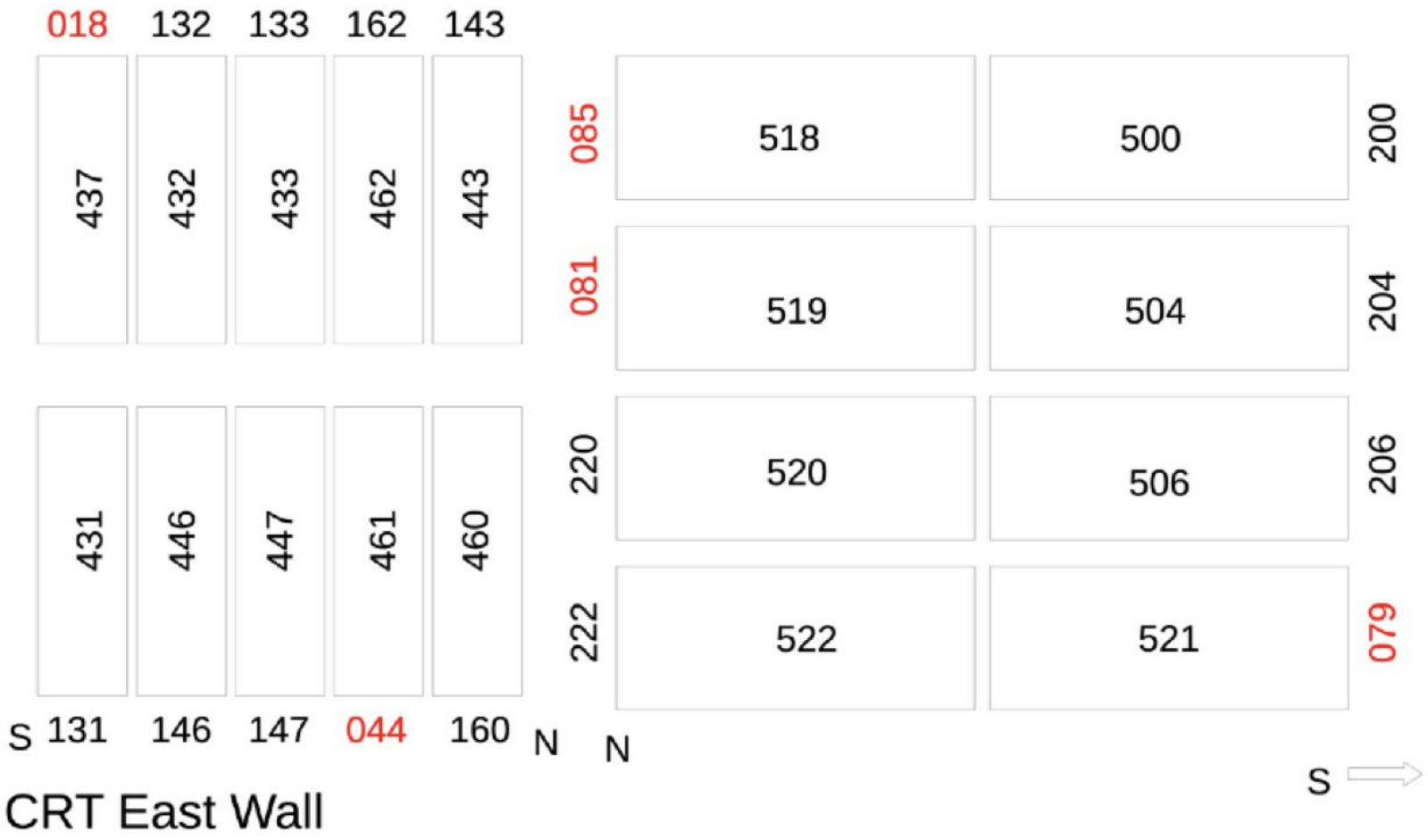
1. Calculate the efficiency of using a CRT veto in a contained neutrino trigger

2. Study the distribution of the time difference between the PMT signal and the CRT signal

Thank you for the attention!

Backup slides

East wall FEB placement



Channel map