Trigger efficiency Icarus-t600 trigger system

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Meeting Title

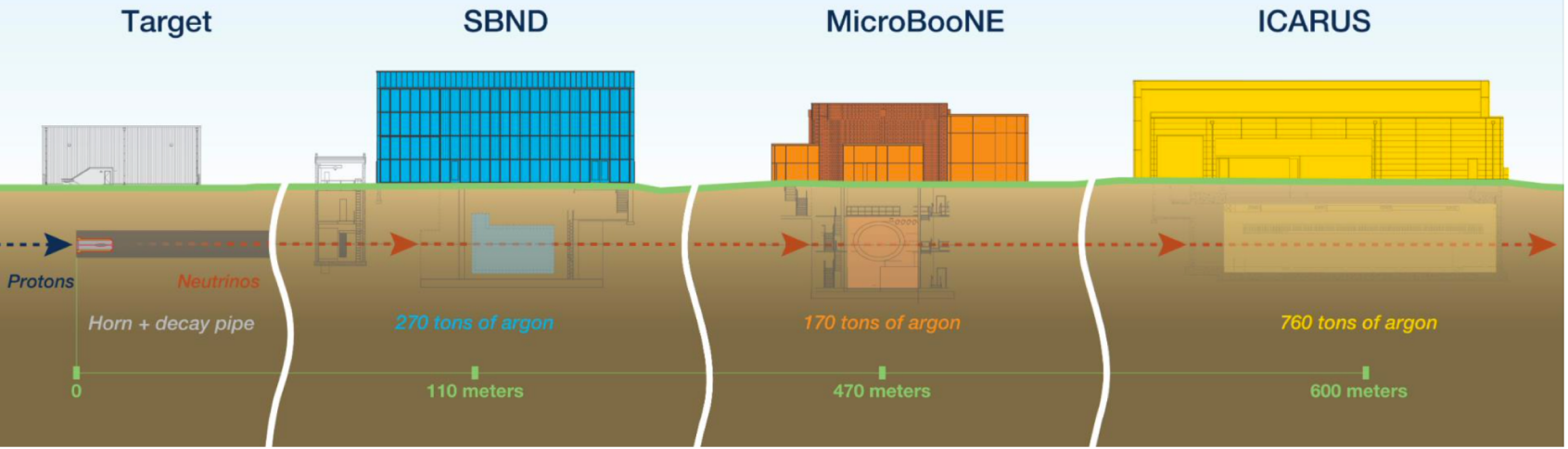
Day Month Year

The SBN Project

- Three Liquid Argon TPC (**LAr-TPC**) detectors at increasing baselines on the Booster Neutrino Beam (**BNB**)
- **ICARUS**, at 600 m from target, on short baseline is the far detector and will collect neutrinos also from the **NuMI** beam (off-axis)

Goals:

- Test the allowed parameter space of past anomalies at >5σ with BNB
- Test the Neutrino-4 oscillation hypotesis with disappearance of ν_μ from BNB and ν_e from NuMI
- Study ν(~3 GeV)-LAr with NuMI for DUNE



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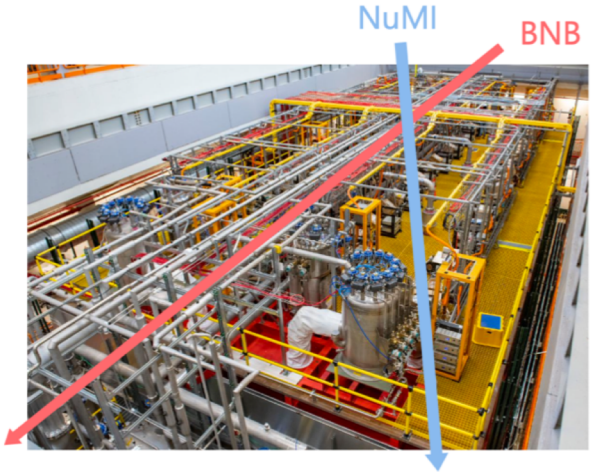
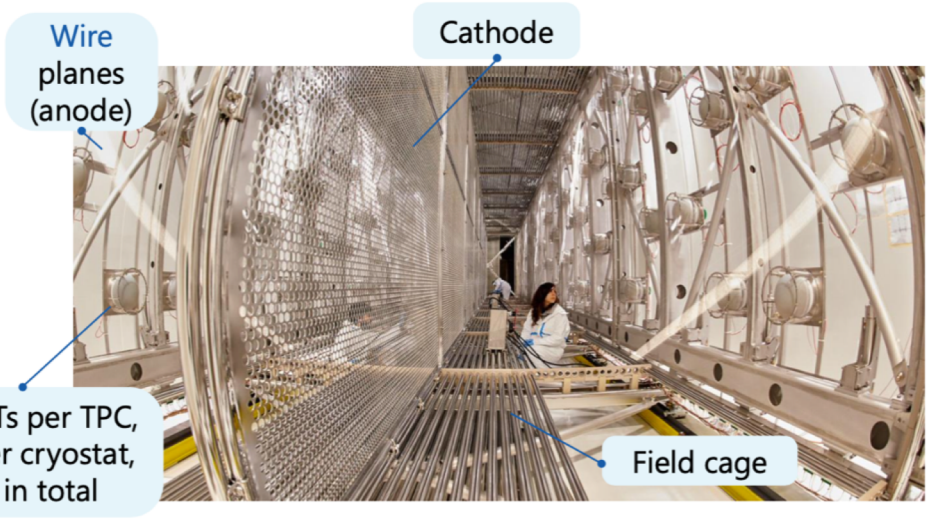
The ICARUS T600 Detector

- LAr-TPC high granularity self-triggering detector with 3D **imaging** and calorimetric capabilities, ideal for ν physics
- Two **cryostats**, each with 2 **TPC**s with a common central cathode (nominal configuration: HV = 75 kV, E = 0.5 kV/cm and 1.5 m drift length)
- Ionization charge continuously read *non-destructively* by 3 wire planes
- Scintillation light read by a system of 360 8" **PMT**s (180 per cryostat) for timing and triggering





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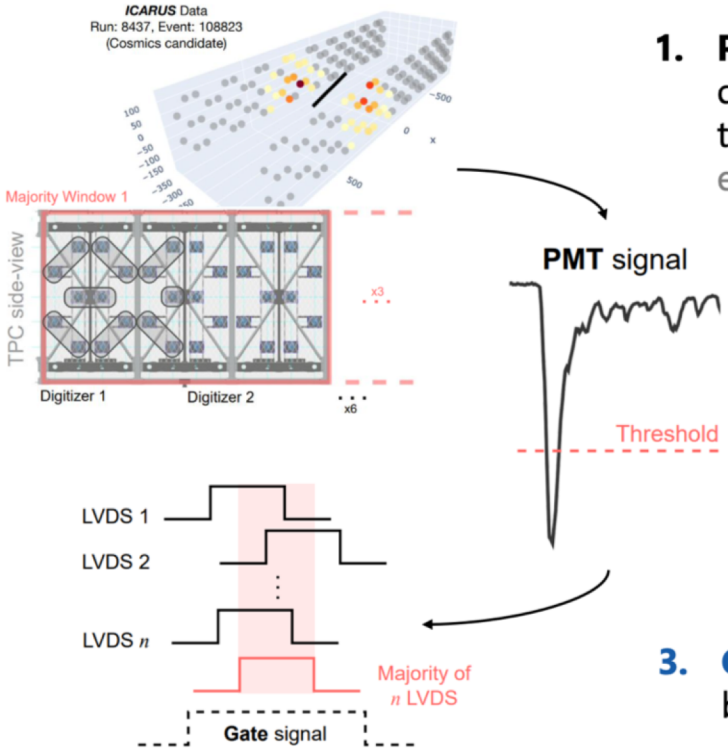
The ICARUS T600 Detector: trigger working principle



1. **PMT signals** are digitized at 500 MHz and discriminated with a 400 ADC (i.e., 8 photoelectrons) threshold, generating **LVDS** logical outputs (one every pair of adjacent PMT, combined in OR)

2. FPGA processing based on a **majority logic**: at least 5 LVDS signals in front facing 6 m-sections along the longitudinal direction (30 PMTs x 2 sides) to produce a majority trigger primitve

3. **Global trigger**: trigger primitive coincident with the beam gate (e.g., 1.6 μs for BNB)

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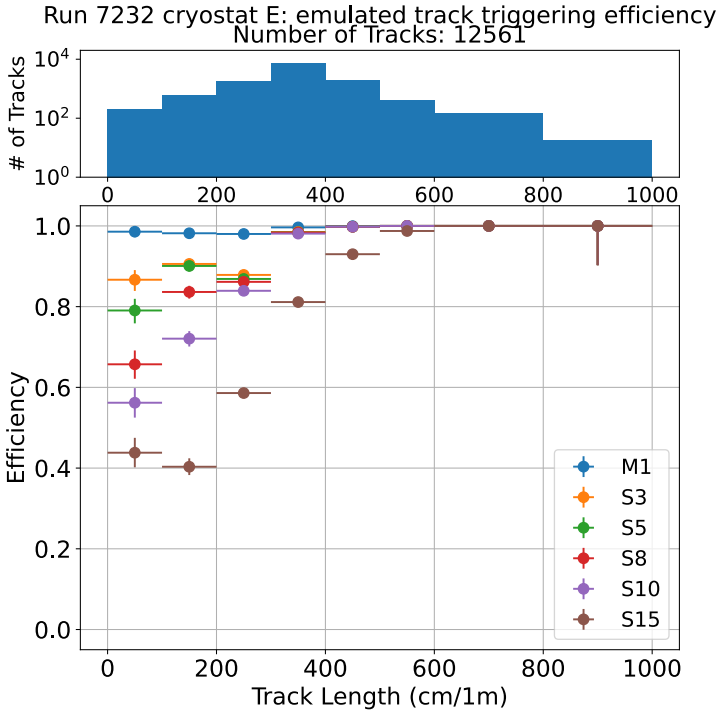
2-2.5m Anomaly

- The detector has a noticeable drop in efficiency with tracks ~2m – 2.5m
- Presumed not be due to split tracks during track reconstruction (not statistically significant to draw conclusion)
- Possible geometric bias
- Possible loss if photons hit field cage at higher y values
- Possible boarder distortions of the electric field



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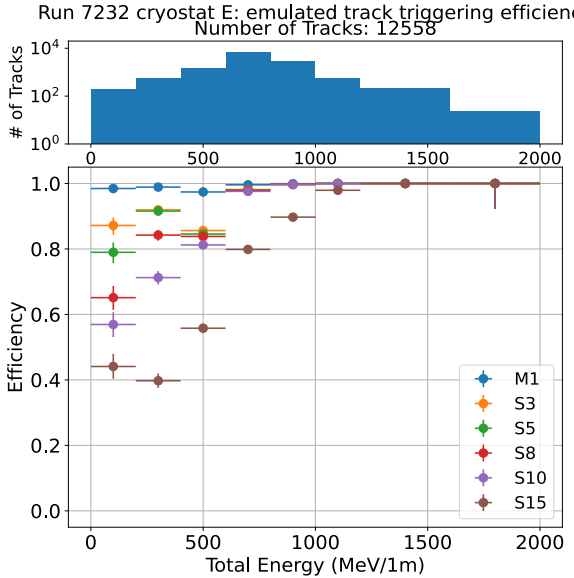
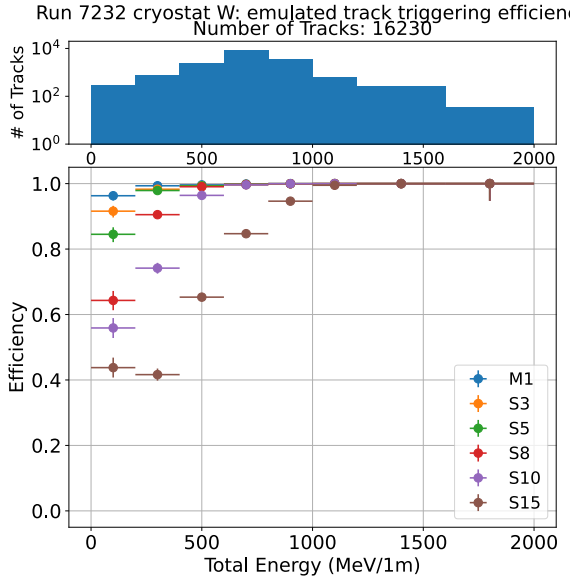
Efficiency measurements by energy





- Notice there is a noticeable drop in efficiency
- Translated distance into energy
- Uses Minimum Specific energy loss (MIP) 2.12

- Noticed that the 2m anomaly persist
- Noticed that the dip is not cryostat dependent

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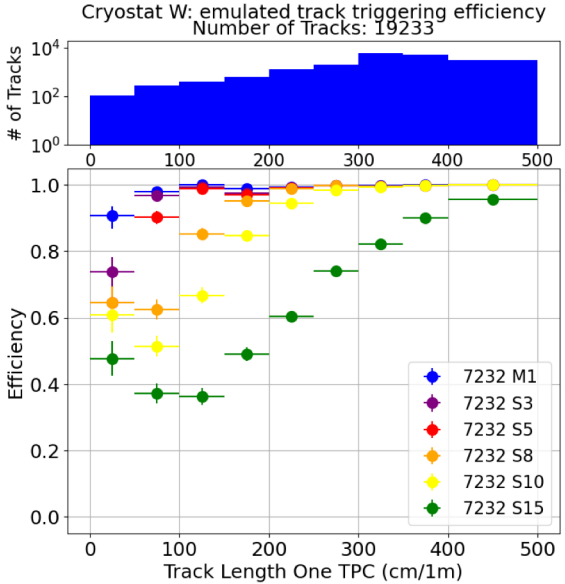
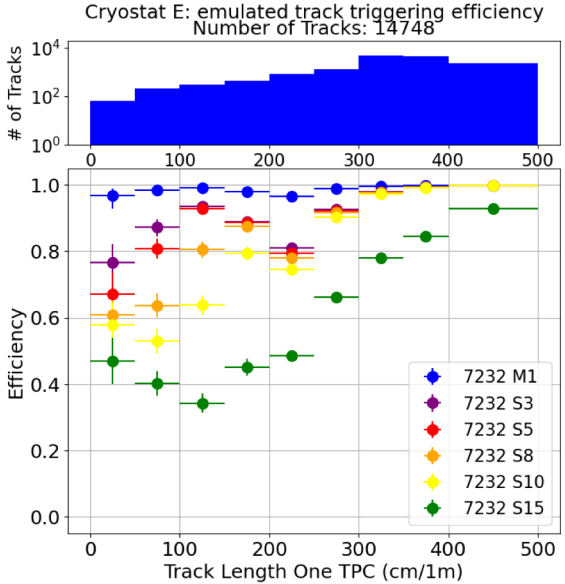
Check for single TPC efficiency





- Cheeked for efficiency ranging a single TPC
- Intended to see more clearly the anomaly
- Limits the scope of questions to the first half of detector
- No significant change was noticed

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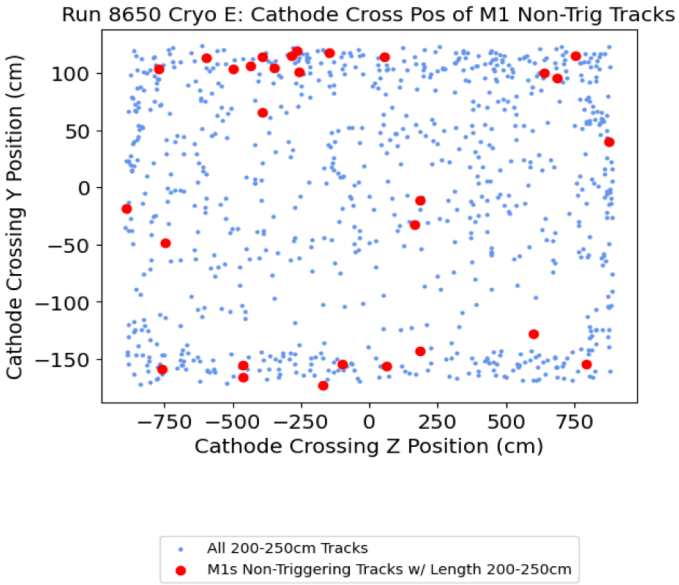
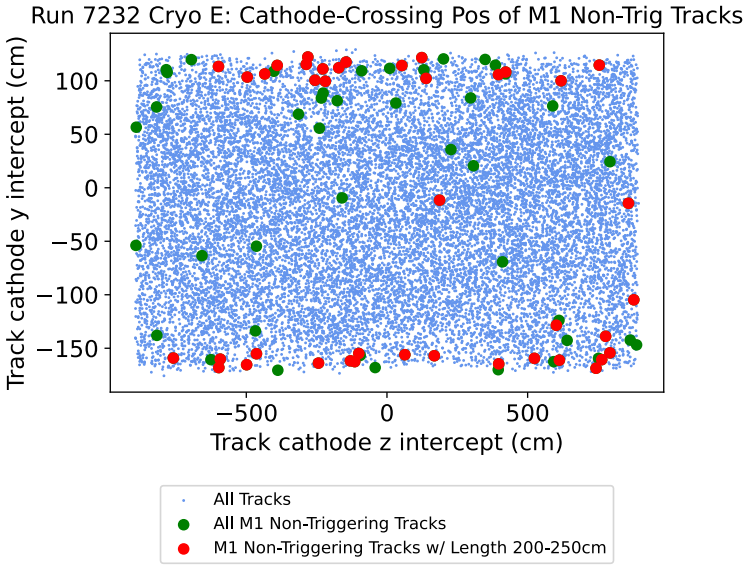
Check for geometric bias



Courtesy of Tanvi Krishnan

- Census was made for the non triggering tracks
- Noticed that from the non triggering tracks the 2m – 2.5 m tracks are at the extreme Y values



Courtesy of Tanvi Krishnan

- The field cage is nearby potentially blocking photons from triggering PMTs
- Plans Intend to perform a TITUS display analysis on data

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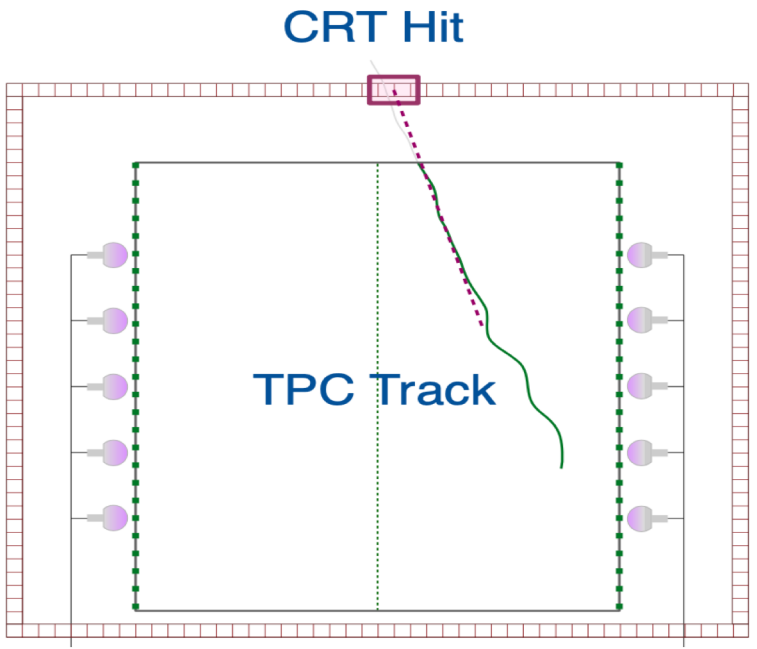
Future study directions

- We still need to ad CRT information
- Adding information from the CRT, we can extract a T0 value for all tracks
- No need to select only cathode-crossing tracks
- Still need to do TITUS reconstructions of 2m – 2.5m tracks
  - May provide further lines of study if statistically significant anomalies are found such as overall small or interrupted tracks



G. Petrillo

Courtesy of J. Zettlemoyer

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Special Thanks.

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