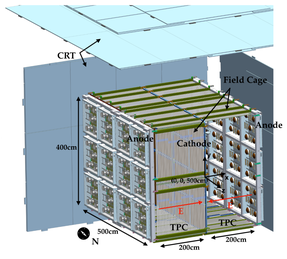
Inclusive Charged-Current Electron Neutrino Interactions in SBND

Lynn Tung (University of Chicago) on behalf of the SBND Collaboration

FERMILAB-POSTER-26-0093-V

Short-Baseline Near Detector (SBND)

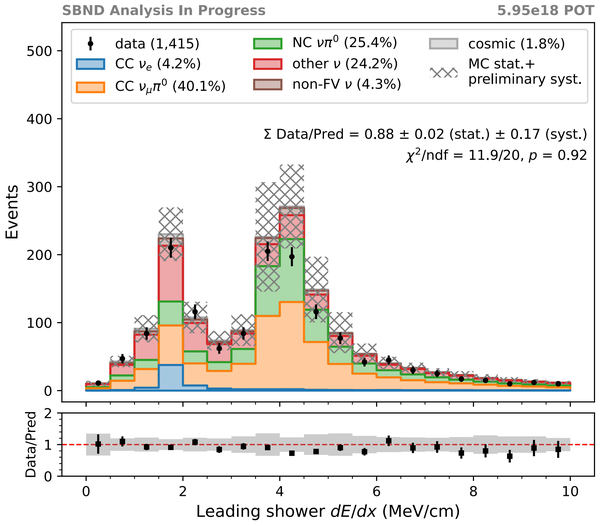
- 112-ton Liquid Argon Time Projection Chamber (LArTPC)
- Near detector for the Short-Baseline Neutrino Program at Fermilab, located just 110m from the Booster Neutrino Beam (BNB) target
- Already recorded over 4 million ν-argon interactions with 7.0x10^{20} POT
- Rich single detector physics program of neutrino-argon cross-section measurements and beyond the standard model searches



ν_eCC Selection

	Stage	Efficiency (%)	Purity (%)
Neutrino Candidate Selection	No cuts	97.5	<0.5
	Cosmic Rejection	89.0	0.7
	TPC Containment	62.2	1.0
	High-Energy Shower	55.5	13.7
Muon Rejection	Leading Track Length	54.7	15.4
Electron Selection	Conversion Gap	41.1	27.3
	Shower dE/dx	28.2	57.8
	Shower Opening Angle	25.6	79.4
	Shower Length	**25.6**	**80.9**

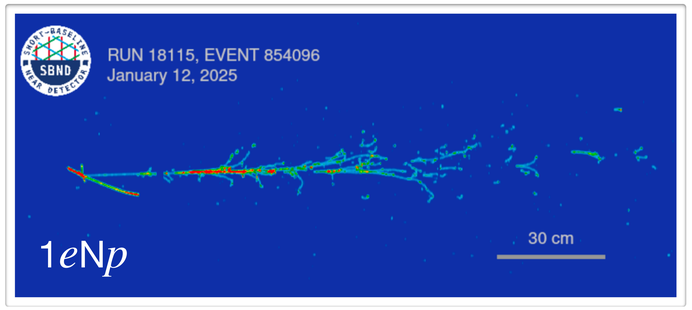
Neutrino Candidates: EM Shower dE/dx

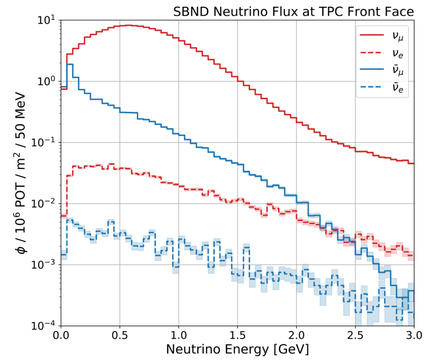


energy density per unit length (dE/dx) of the start of all electromagnetic showers with reconstructed energy > 200 MeV

- detailed calorimetry information
  - **signal vs. background**: photon pair production peak ~4 MeV/cm vs. electron peak around ~1.8 MeV/cm
- excellent agreement between the data and prediction in both normalization and shape
- significant statistics of charged-current and neutral current interactions with EM activity, such as neutral pions π^0

ν_eCC Interactions





CCν_e's make up only 0.5% of all interactions!

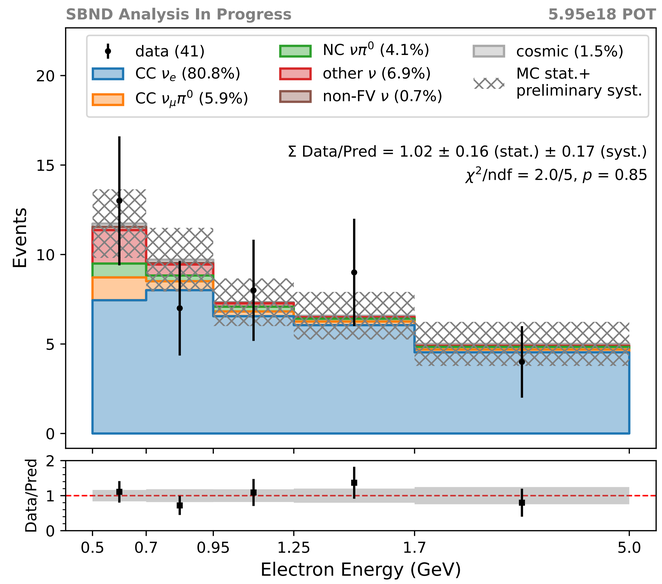
a challenge to reject all cosmic and neutrino backgrounds

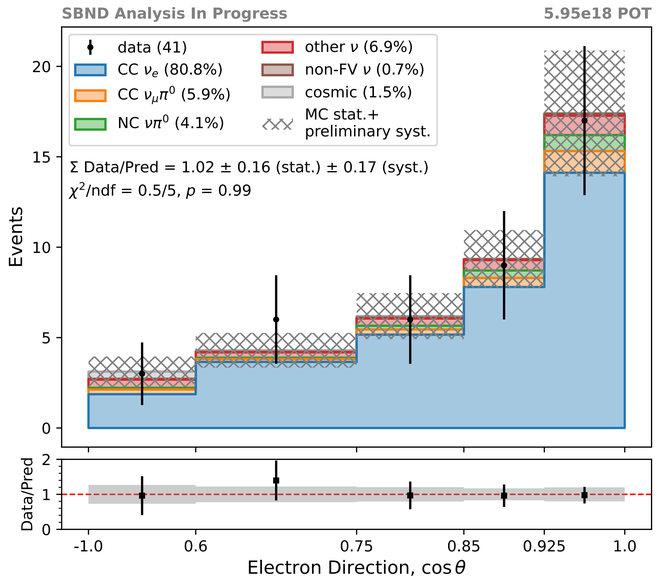
ν_eCC Inclusive Signal Definition

- incoming neutrino is an electron neutrino
- charged current (CC) interaction
- outgoing lepton is an electron with energy > 500 MeV
  - avoid unblinding low energy excess (LEE) region

- precision cross-section measurements of ν_e are critical for next-generation neutrino experiments [1]
- selected ν_eCC events in SBND have significant overlap with the DUNE 2nd oscillation maximum [2]

Selected ν_eCC Candidates





41 ν_eCC candidates with 80.9% purity and 25.6% efficiency with <2 days of data!

- for the first result (1x10^{20} POT), expect >700 candidates: a x3 improvement in statistics over existing results [3]
- with SBND's full dataset and continued improvements to the analysis, expect >10k events

This document was prepared by SBND using the resources of the Fermi National Accelerator Laboratory (Fermilab), a U.S. Department of Energy, Office of Science, Office of High Energy Physics HEP User Facility. Fermilab is managed by FermiForward Discovery Group, LLC, acting under Contract No. 89243024CSC000002.

References

[1] DUNE Collaboration, JINST 15, T08010 (2020)
[2] SBND Collaboration, arXiv:2504.00245 (2025)
[3] MicroBooNE Collaboration, PRD 105, L051102 (2022)