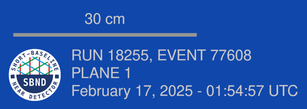
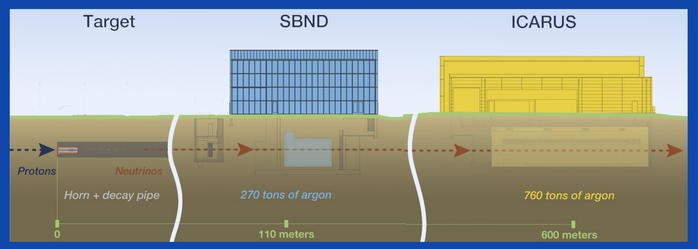
Search for ν_μ Disappearance in the Short-Baseline Neutrino Program Utilizing an Exclusive 1μ1p QE-Like Final State

Nathaniel Rowe (University of Chicago) and Gray Putnam (Fermi National Accelerator Laboratory), for the SBN Collaboration



The SBN Program at Fermilab

- Several short-baseline experiments reported results which deviate from the 3-neutrino oscillation model. One possible explanation is the existence of a sterile neutrino which would most easily be investigated via oscillations.
- The two-detector configuration of Fermilab's Short-Baseline Neutrino (SBN) Program [1] enables an exploration of short-baseline oscillations through muon neutrino disappearance.



An Event Selection Oriented Around Energy Resolution

TPC Containment Cut
Remove interactions not contained in a single TPC

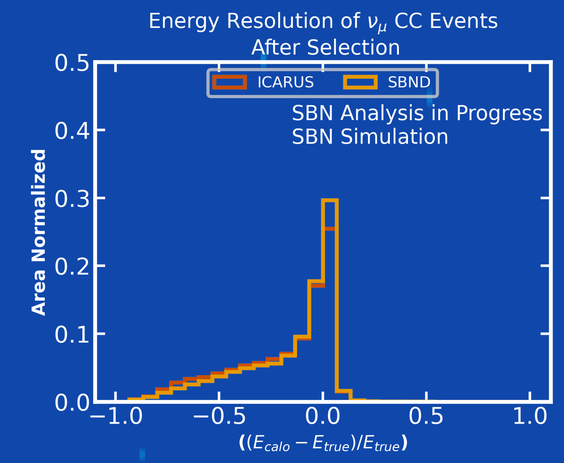
→ **Flash Cut**
Mimic the trigger with PE threshold

→ **Cosmic Cut**
Remove the cosmic backgrounds

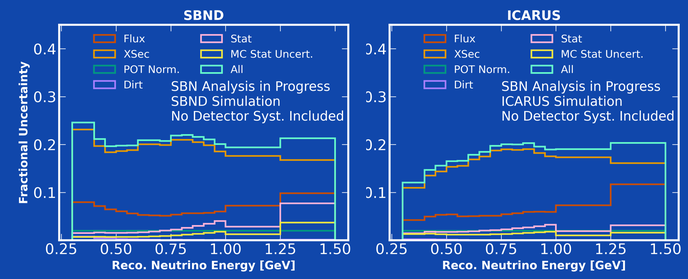
→ **Two Prong Cut**
Only select events with two tracks

→ **PID Cut**
Make sure those tracks are 1μ1p

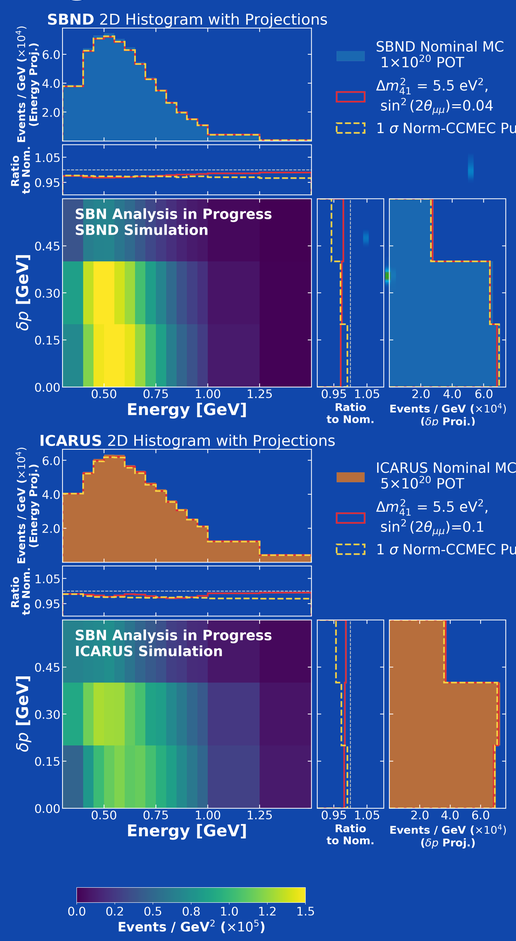
The 1μ1p final state offers simple and identifiable interactions which are robust against detector effects. This choice allows us to trade statistics for reductions in systematic uncertainties.



Reducing Correlated Uncertainties

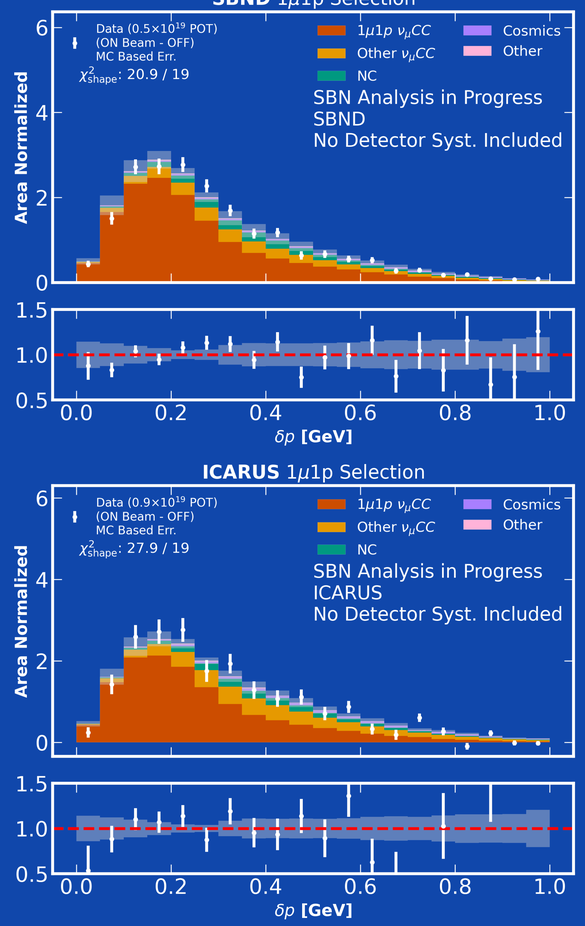


Increased Resilience Against Systematics Using 2D Fits



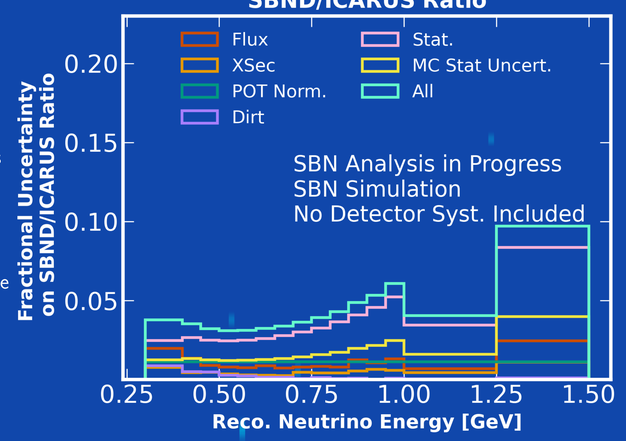
2D fits in E_{reco} and δp further reduce degeneracies between oscillations and cross-section systematics. δp offers strong separation between quasi-elastic and non-quasi-elastic interaction modes [2], forcing more distinct shapes relative to E_{reco} distributions.

Data/Simulation Comparisons



The two detector design of the SBN Program allows for reduction of cross-section and flux uncertainties in the final result due to their highly correlated behavior between the two detectors.

SBND/ICARUS Ratio



References

[1] Machado, Palamara, and Schmitz. The Short-Baseline Neutrino Program at Fermilab (2019)

[2] The MicroBooNE Collaboration. Measurement of nuclear effects in neutrino-argon interactions using generalized kinematic imbalance variables with the MicroBooNE detector (2024)

uchicago Fermilab

FERMILAB-POSTER-26-0071-PPD

This document was prepared by the SBN Program 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 Fermi Forward Discovery Group, LLC, acting under Contract No. 89243024CSC000002.