SBN Progress – October 2019

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I. Altered Dispersion Relations Fit to LSND & MiniBooNE

We have fit the LSND and MiniBooNE neutrino oscillation data with a model of altered dispersion relations, as discussed in arXiv:1808.07460 by theorists Dominik Doering, Heinrich Paes, Philipp Sicking, & Thomas J. Weiler. As shown in Figure 1, this model fits the data well with a best fit at approximately 1.75 eV2, which agrees with the best fit from the NEOS reactor neutrino experiment (PRL 118, 121802). Furthermore, the probability of the best fit is ~67%, and the model naturally explains well the world neutrino data and why short-baseline neutrino oscillations have not been observed above 1 GeV. MiniBooNE completed data taking in July with a total of ~3E21 protons on target (POT), and will plan to present final results at the Neutrino 2020 conference in June.

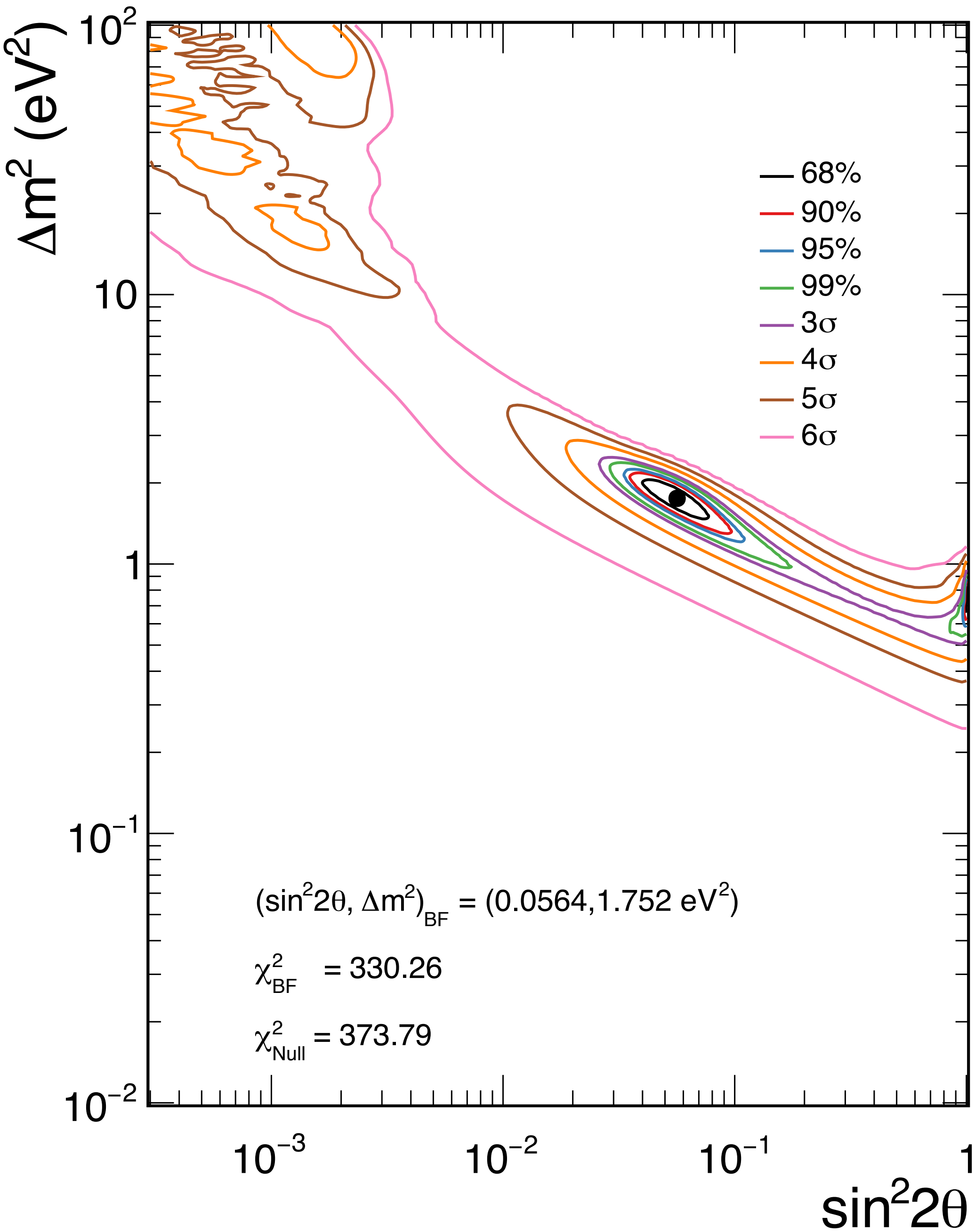

Figure 1: The best fit to the LSND and MiniBooNE neutrino oscillation data with the altered dispersion relations model.

2. Measurement of the Neutron Flux at Lujan & PDS Test

The CAPTAIN cryostat is filled with 10-tons of LAr and is making more tests of the SBND Photon Detection System (PDS) in the Lujan neutron beam at LANL. Figure 2 shows a photograph of the detector with concrete shielding added to the front and sides of the detector. In addition, sheets of borated-poly have been mounted on the outside of the concrete shielding to absorb thermal neutrons. Figure 3 shows the number of photoelectrons observed by CAPTAIN as a function of time around the Lujan 295 ns beam spill. By adding shielding, the beam neutrons have been both reduced and delayed by ~150 ns relative to the start of the beam spill. With this reduction of neutron deposited energy, there is an opportunity to search for neutrino coherent scattering off argon before the PDS is shipped to Fermilab.

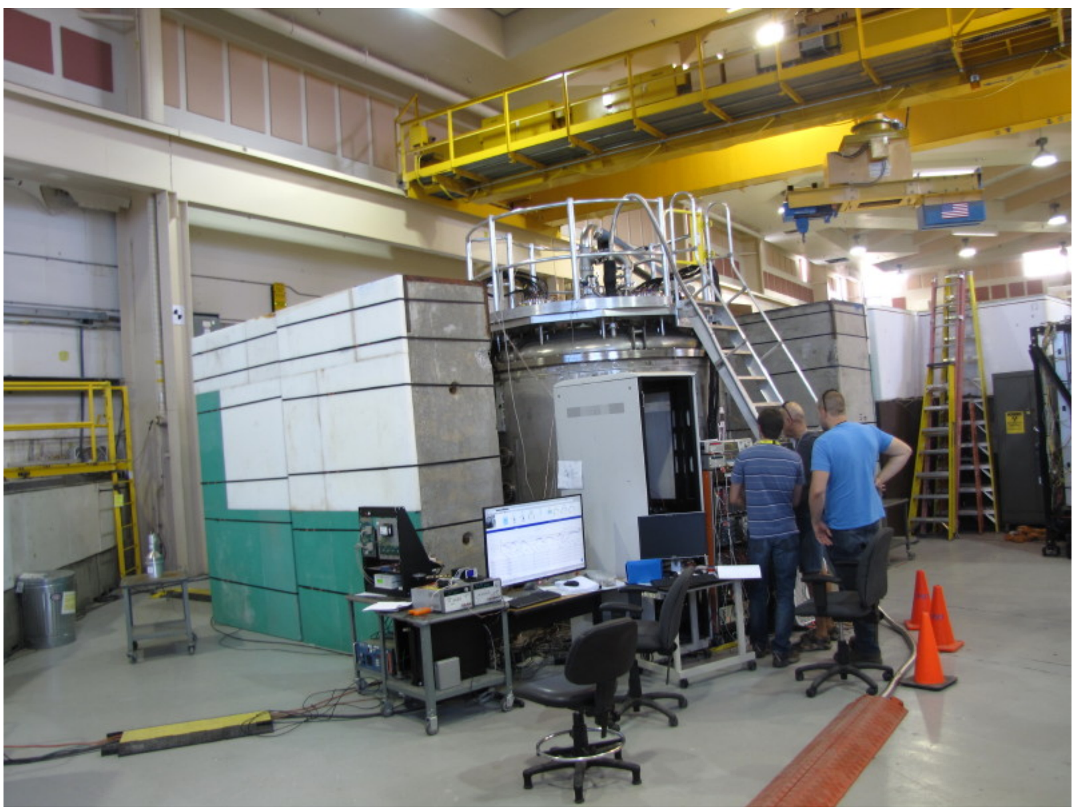

Figure 2: A photograph of the CAPTAIN cryostat with concrete shielding added to the front and sides of the detector.

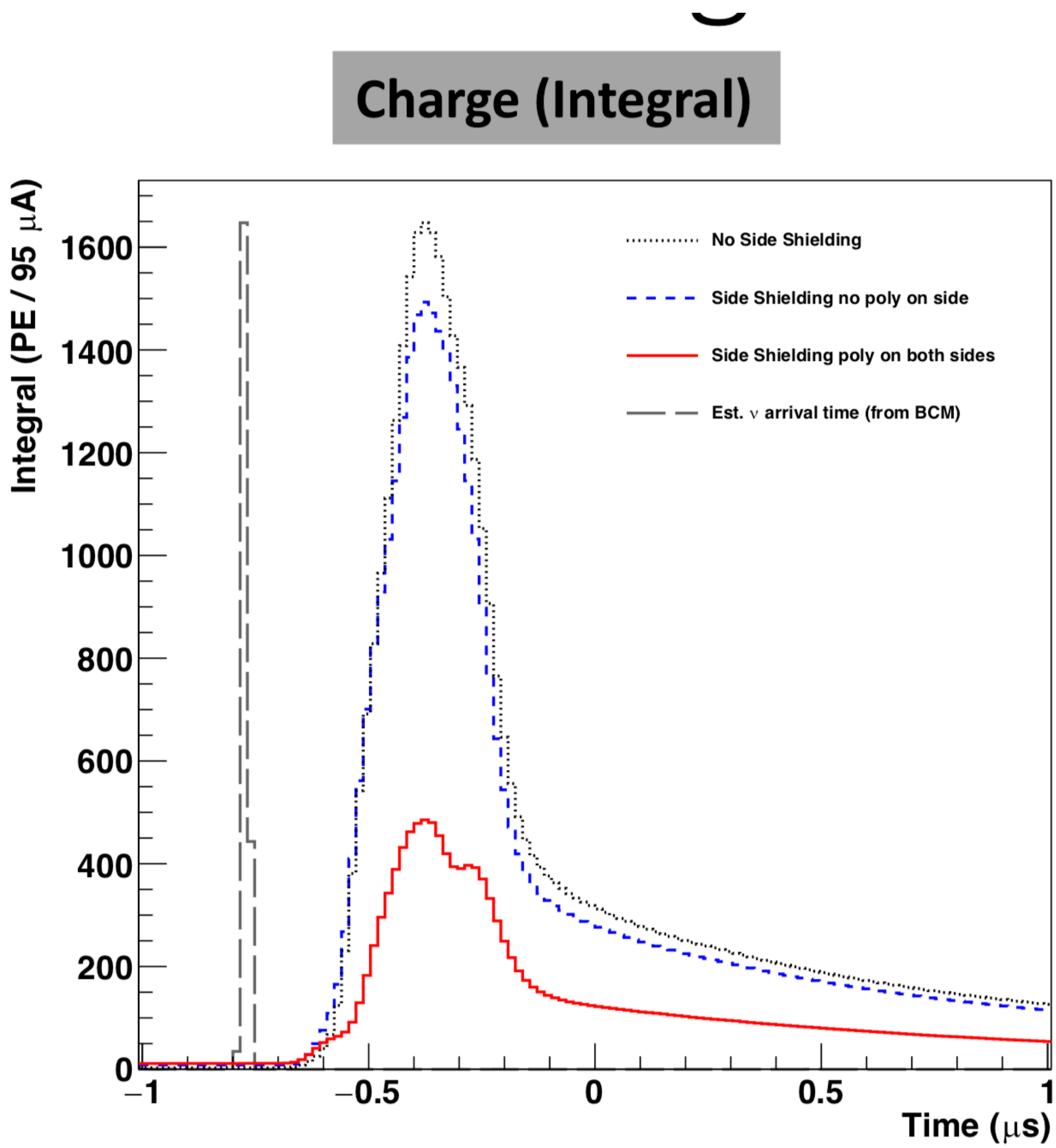

Figure 3: The number of photoelectrons observed by CAPTAIN as a function of time around the Lujan 295 ns beam spill. By adding shielding, the beam neutrons have been both reduced and delayed relative to the start of the beam spill.

4. Single-photon Low Energy Excess and Detector Physics analyses in MicroBooNE

Gollapinni and her team are co-leading the effort to produce first results for the single-photon interpretation of the

MiniBooNE Low Energy Excess Analysis in MicroBooNE. Most recent results from the analysis were presented at the NuFact 2019 conference. The primary effort from the LANL team involves selecting neutral current neutral pion background (which forms the biggest background to single photon selection) and using that to develop a data-driven constraint for the analysis. In addition, the LANL team is also leading the systematics evaluation for the analysis. Figure 4 below shows the reconstructed mass of neutral pions using a two-photon selection for both data and Monte Carlo. An event display from MicroBooNE data that passes the two-shower selection is also shown. The goal for the team is to produce the first results for Neutrino 2020.

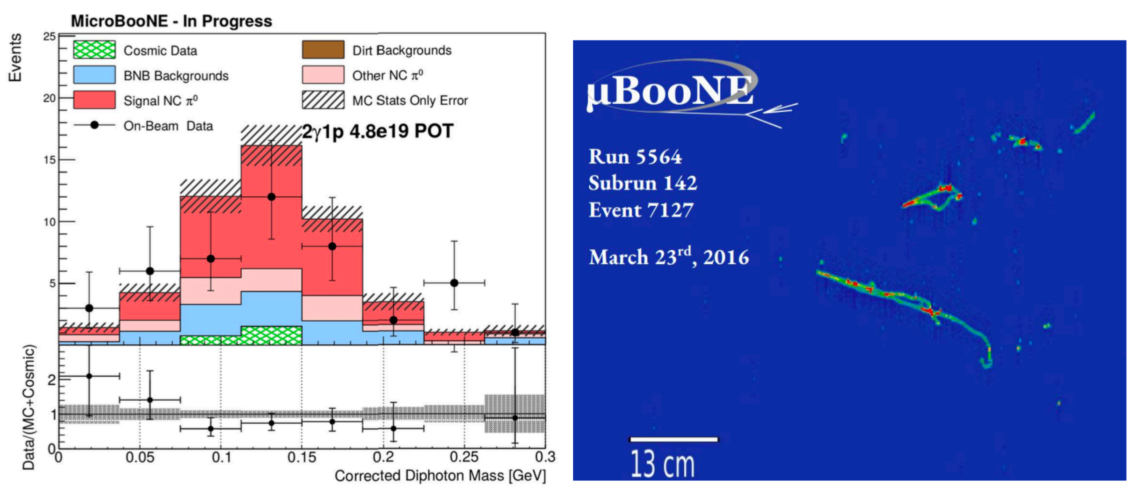

Figure 4: *(left) Reconstructed neutral pion mass peak after energy dependent correction. (right) A data event that passes the neutral pion selection through two photon showers*

5. Slow Controls System at SBND (and ICARUS)

LANL team is leading the design and development of the Slow Controls system for the SBND experiment. The team has already developed controls and monitoring for various sub-systems. Figure 5 shows an example of the display developed for ground monitoring for SBND that was implemented in ICARUS.

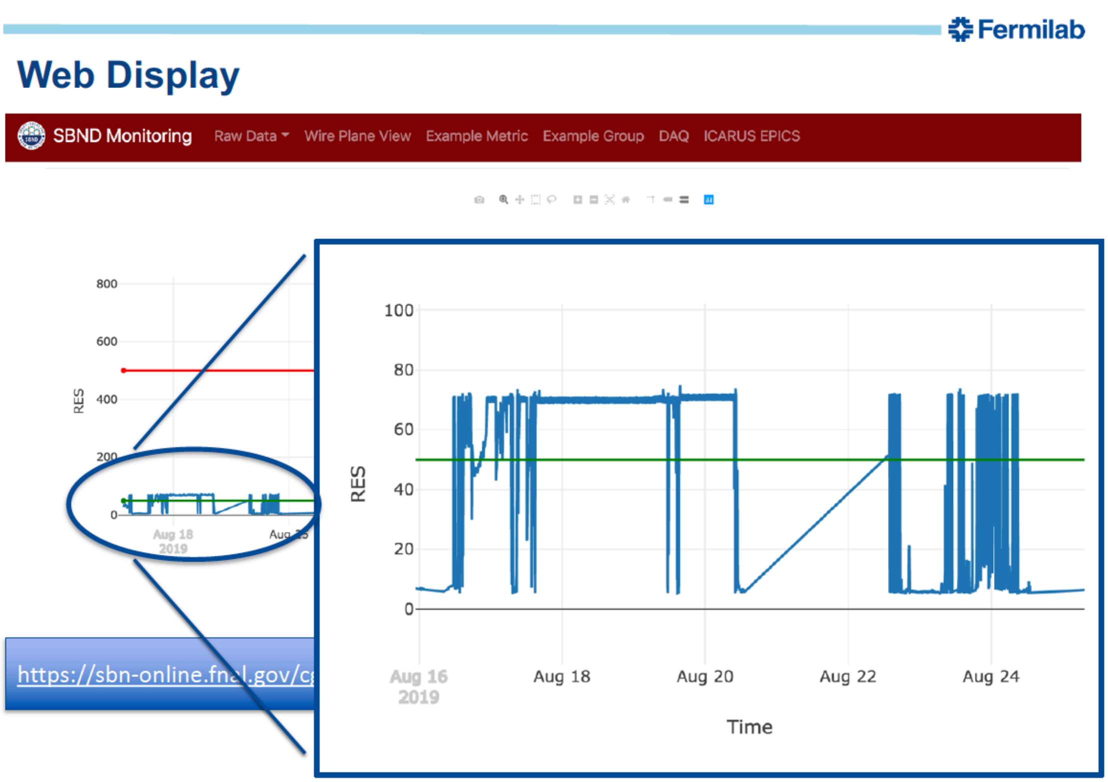

Figure 5: *Slow Controls web display of the ICARUS ground monitoring, initially developed for SBND by the LANL team.*

6. Calibration, Cryogenic Instrumentation, & Slow Controls at DUNE

The LANL team has leadership in cryogenic instrumentation, slow controls and calibration. The primary effort over the past few weeks is to finalize the DUNE technical design report (TDR) for chapters on the above three topics. A penultimate draft of the TDR has been submitted to Long Baseline Neutrino Committee (LBNC) on July 26th. We have also been working on developing an engineering design for the laser calibration system for the DUNE far detector. Plans for cryogenic instrumentation, calibration and slow controls for the ProtoDUNE Run 2 has also been actively underway.