

LBNE Reconfiguration Physics Working Group 2nd Meeting

April 16, 2012

Present:

- Mel Shochet, U.Chicago (chair)
- Mary Bishai, BNL
- Ed Blucher, UChicago
- Steve Brice, FNAL
- Milind Diwan, BNL
- Bonnie Fleming, Yale
- Gil Gilchriese, LBNL
- Mark Messier, Indiana
- Gina Rameika, FNAL
- Kate Scholberg, Duke
- Jenny Thomas, UCL
- Charlie Young, SLAC
- Jeffrey Appel, FNAL (Scientific Secretary)

In e-mail to the Working Group, Mel Shochet summarized the meeting this way:

Today's meeting was very informative; most of the information on the [mass] hierarchy and CP violation that the Steering Committee requested is already there. It was agreed in response to points raised during the presentations [by Mary Bishai and Gina Rameika] that some updates, checks, and text clarifications would be made in the next few days. It was also agreed that an updated list of assumptions would be distributed to the group on that timescale. Kate [Scholberg] said she would put together material on proton decay and cosmic neutrinos by next Monday.

We agreed that our next meeting would be early next week. However that leaves very little time to put everything together into the needed talks for the workshop. The agenda would be Kate's presentation and updates on Mary and Gina's work.

At the Steering Committee meeting on Friday, Jim Strait gave the answer to the question that Bonnie Fleming asked at our last meeting. If no near

detector is built, there could be approximately 10kT more of far detector. The near detector and its hall are just over \$100M together. The cost per additional ton of LAr detector is about \$10M. If instead, a simple hole-in-the-ground detector were built to just measure the electron neutrino flux, then about 8kT could be added to the far site.

Jim Strait asked, for the Soudan options, whether the MINOS near detector would be sufficient for Phase 1 at least to do the physics.

A more detailed summary of the meeting on the 16th follow below.

The summary of the previous meeting was approved for posting on the web.

Mary Bishai presented single-experiment physics-reach plots for mass hierarchy and CP violation. The plots should be considered preliminary since they have not been vetted by the LBNE Collaboration.

Mary began with a background set of slides, but then went to the sensitivities of individual experiments. The physics reach was calculated using GLOBES software. She used TDR numbers for NOvA, though better efficiencies are now expected. She plans to redo plots with updated efficiencies. Results were said to be fairly insensitive to uncertainties in backgrounds.

Milind Diwan noted that the focus on mass hierarchy and CP violation significance assumes the standard three-generation framework and does not allow for non-standard possibilities. It was noted that MINOS+ will constrain some extensions of the three-generation framework.

Mary also quickly showed sensitivities to neutrino oscillation parameters other than the mass hierarchy and CP violation.

The summary and conclusions slide of Mary's presentation said:

The Ash River site (or other NuMI off-axis sites) was optimized for θ_{13} appearance at small values, but the lack of spectral information and smaller event rate are not well matched to measurements of mass hierarchy and a broader program.

LBNE-Homestake early stages outperform similar stages (=similar exposure) of the NuMI options. For the LBNE-Homestake option, no external constraints are needed for ν_e appearance measurements with exposures greater than or equal to 60 kT-yrs.

The ν_τ appearance measurements are better at NuMI-Soudan on-axis than in LBNE - but these measurements are already being done at CNGS with essentially the same baseline.

The ultimate performance for CP-violation measurements with greater than or equal to 300 kT yrs of exposure of LBNE-Homestake is significantly better than the NuMI options.

Longer baselines are better at ANY stage of the experiment

Gina Rameika presented sensitivities when combining results from multiple experiments; in particular, LBNE options, NuMI options, and T2K. Gina also used GLOBEs software. Where results were relevant, she got the same results as Mary's independent work with the same software system.

The summary slide of Gina's presentation said

NuMI option looks promising if viewed as a program, combining data from a new detector and NOvA.

NuMI option leverages real value by continued use of our investments in NuMI and NOvA.

Further study needed to optimize configuration: detector mass, location and beam configuration

– Ash River option is significantly improved using the LE beam; this appears to be because of the shape information in the LE beam; this needs to be checked independently.

LBNE masses below 10 kT do not seem competitive with a NuMI program.

A 15 kT detector at LBNE running for 10 years is sensitive to CP violation at the 3 sigma level for 50% of δ_{cp} values. This option does not require any external constraints (no previous knowledge of mass hierarchy or θ_{13}). A combination of experiments, NOvA running for 16 years + Soudan 15 kT for 10 yrs + T2K running for 7 years can reach the same sensitivity.