LBNE Reconfiguration Physics Working Group 3rd Meeting

April 20, 2012

Present:

- Mel Shochet, U.Chicago (chair)
- Mary Bishai, BNL
- Ed Blucher, UChicago
- Steve Brice, FNAL
- Gil Gilchriese, LBNL
- Gina Rameika, FNAL
- Kate Scholberg, Duke
- Charlie Young, SLAC
- Sam Zeller, FNAL
- Jeffrey Appel, FNAL (Scientific Secretary)

Assumptions Sheet and Near Detector Needs

Sam Zeller has updated the assumptions sheet and will send it out to the Working Group.

Gina Rameika is calculating the minimum sensitivity needed from T2K in order that those results not dominate errors.

Workshop Items from the Physics WG

The agenda now calls for 40 minutes on the first day, split between a 10 minute introduction from Mel Shochet (covering the charge, options, assumptions, etc.) and 30 minutes from Gina Rameika on the mass hierarchy and CP violation reach for each option. On the second day, Mary Bishai will more broadly cover accelerator neutrino physics and Kate Scholberg will cover proton decay and cosmic neutrinos.

Mel recounted three significant issues identified in Working Group discussions and the possibility of others which may have to be addressed after the workshop:

- The expected T2K exposure which will be provided by JPARC and T2K leadership.
- Near Detector requirements so they don't dominate physics reach, and what if the near detector is not LAr.
- The suggestion from Gary Feldman of looking at off-axis beam to Homestake to obtain a lower energy incident neutrino spectrum
- Other issues that may arise at the Workshop

Update from Mary Bishai

Mary briefly showed updated plots; e.g., sensitivities vs exposures out to 600 kT years. Jenny Thomas is working with Matt Bass on mass-hierarch sensitivity to the method of estimating sensitivities.

Non-Accelerator Physics Reach

Kate Scholberg reported on the non-accelerator physics reach in four areas: proton decay, atmospheric neutrinos, supernova-burst neutrinos, and supernova relic neutrinos. Not all topics were complete for this meeting, but are expected to be complete Monday.

For this physics, surface detector conclusions are site independent. Depth provides better signal to background ratios. Just how shallow one can go is still a question. A surface detector however is likely not OK.

Proton decay and atmospheric neutrinos have energies of the order of 1 GeV, supernova neutrinos are more like 20 MeV and are more sensitive to backgrounds. The "poster-child" best case for proton decay in LAr detectors is the decay to a charged kaon and neutrino. There, special sensitivity to low energy kaons and background suppression via eventual kaon decay are special advantages.

Kate commented that solar neutrino physics would not be added to by a LAr detector, given the total data anticipated for continued running of the Kamiokande water Cerenkov detector. She also noted that the upper limit on the number of events per kT year is expected to be the same for proton decay and supernova relic neutrinos.

Kate's summary was that the Homestake 4850 ft depth is fine for any of the physics topics covered, and that the Soudan depth at 2340 ft is fine as well.

Proton decay is the best understood at this time. Detectors on the surface are inadequate, and a minimum of 10 kT is needed to be competitive.

For atmospheric neutrinos, it is unclear if a surface detector can contribute.

For supernova neutrinos, a surface detector might contribute, but it will be highly degraded. There is a unique LAr sensitivity to electron neutrinos (as opposed to electron antineutrinos), even for a 5 kT detector, but more mass would be better.

Other Topics

Milind Diwan suggested that reactor neutrino experiments could also provide information on the neutrino hierarchy, although this would be extremely challenging. Ed Blucher agreed to report on this after the workshop.