

LBNE Reconfiguration Steering Committee Kickoff Meeting

April 9, 2012

Present:

Steering Committee: Appel, Bagger, Baltay, Feldman, Kim, Nelson, Reichanadter, Shochet, Symons, Vigdor

Ex-Officio Members: Hewett, Lankford (last 10 minutes), Marx, Oddone, Ramond, Ritz

Please dial in early for future meetings so that we can begin at the start of the reserved time.

There was a discussion of the timing needed and work level possible. This is summarized in the materials sent out before the meeting. The starting point for studies or physics and costs will be the Homestake studies already done, with perturbations and extrapolations from there.

The two options to be considered for a phased program are basically (1) building a beam to SURF and a small LAr detector for that site and (2) using the existing NuMI beam to a new LAr detector at either Ash River or the SOUDAN mine. Any suggestion of a third site was viewed as very likely to be too expensive, and not worth considering with what is known now.

For a big detector, don't give up on proton-decay and supernova-neutrino physics goals.

A first phase LBNE project seems to be limited to about \$650M, with up to \$200M per year at peak annual funding. This will not give the full range of physics proposed for DUSEL. Nevertheless, there must be a defensible physics reach at the end of the Phase I project. The conversation focused on searching for CP violation as the most attractive goal to try to reach. Any project will be vulnerable if the physics reach is not competitive, and future projects will be vulnerable depending on the first phase.

It is possible that the mass hierarchy will be known by the time that an LBNE project can be doing physics.

Whatever is done for LBNE may define the US underground physics for twenty years. Reaching a full, timely program at Homestake may only be doable if you assume that there will be a funding "boost" in about five years.

Two study options are proposed: (1) building a new beamline toward Homestake and adding some detector and (2) using the existing NuMI beamline and focusing resources on a detector at either the SOUDAN or Ash River site (along with relatively minor improvements to the NuMI target and horn as needed).

Options listed as 1(a) and 1(c) on the agenda material were deleted from further consideration, and three new options have been added to the initial list (NuMI: combination, on-axis with the MINOS beam, and on-axis surface detector on the NuMI beam line). Deleted option 1(a) was beam to SURF and only a

near detector. Option 1(c) was SURF far detector only (either at half size or full size); i.e., no beam to the detector.

As distributed by Young-Kee Kim on the day after the meeting, here are the instruction and options to be considered by the working groups:

Initial set of options for working groups to consider

The physics group will provide physics reach for each option. Physics reach includes

- Mass hierarchy reach
- CP reach including “fraction of CP phase δ vs. significance of measuring δ_{CP} ” and “precision of δ_{CP} vs. δ_{CP} ” (For NuMI options, assume that the mass hierarchy is resolved by NOvA/T2K by 2020)
- Proton decay
- Supernovae neutrinos

The engineering/cost group will provide the cost estimate for each option. There is no time for original work, only gathering numbers, aiming for uniform criteria, commenting on reliability and risks, etc. They could start with the (rather detailed/carefully-done) Homestake numbers and make perturbations around these.

Assumptions for both SURF/LBNE Phase-1 options and NuMI options

- $\sin^2 2\theta_{13} = 0.095$
- Beam power – 700 kW = NOvA beam power (Note that for neutrino mass hierarchy and CP violation, detector mass and beam power are interchangeable. For example, physics sensitivity with 700 kW and 15kT detector is equal to that of 1.1 MW and 10kt detector)
- Far detector technology – LAr TPC (LBNE baseline technology)
- Exposure – 10 years (2021 – 2030)
- NOvA runs for 6 years through 2020 at a beam power of 700 kW
- T2K runs through 2020 at a beam power of 300 kW on average (T2K is running at 120 kW right now. The phase-1 upgrade will get to ~400 kW and the phase-2 upgrade will get to ~750 kW.)

Assumptions for all of SURF / LBNE Phase-1 options

- Beam and near detector – LBNE baseline design
- Far detector mass – 2kT and 5kT LAr (also provide information with 10kT and 34kT LAr – both physics reach and cost estimate)

Assumptions for all of NUMI options

- Far detector mass – 5kT, 10kT, 15kT, and 20kT LAr (also provide information with 34kT LAr – both physics reach and cost estimate)
- NOvA continues to run between 2021 and 2030

Initial set of options

1. Option 1
 - LBNE Phase-1: surface (not 800L)
2. Option 2
 - LBNE Phase-1: depth (4850L)
3. Option 3: NuMI On-Axis
 - Detector in the Soudan Underground Mine (2300L)
 - Low Energy Beam = current MINOS beam energy spectrum
4. Option 4: NuMI On-Axis
 - Detector on the Soudan surface
 - Low Energy Beam = current MINOS beam energy spectrum (At the Soudan site, the spectra between surface and underground are very similar)
5. Option 4: NuMI Off-Axis
 - Detector at Ash River (surface)
 - Medium Energy Beam = NOvA beam energy spectrum
6. Option 5: NuMI On-Axis and Off-Axis combination
 - Combination of a detector in the Soudan Mine and a detector at Ash River
 - Low Energy Beam = current MINOS beam energy spectrum

Continuing with the summary of the meeting, ...

The problem would be over-constrained if we give the options, cost envelope, and required physics reach. So, the first step is to take the options and cost limits above, and determine the physics reach of each option.

The cost of independent development of Homestake for neutrinoless double beta decay and/or a generation 3 direct dark matter experiment (also requested by Brinkman letter to Oddone) will be done in parallel. It should start with the previous study (Marx and Reichenadter panel study) and ask how much the identified costs there could be reduced if these experiments are the only users. An independent charge will be generated for this.

If deemed useful, the WG's can schedule one or more joint meetings. Also, the chairs will stay in direct contact, as well as meeting with the full Steering Committee regularly.

Young-Kee will write explicit draft charges for each of the Physics and Engineering/Cost WGs and the underground facility for neutrinoless double beta decay and/or a generation 3 direct dark matter experiment. The charges will be sent to the Steering Committee too, of course.