

Review of LBNE Far Detector Scientific Capabilities

9 September, 2011

Purpose: The Long Baseline Neutrino Experiment (LBNE) is considering two options for an initial far detector configuration at the Homestake site in South Dakota. These are:

- A liquid argon detector located at either the 800 or 4850 level
- A water Cherenkov detector located at the 4850 level

Cost considerations allow only one of these options to be built in the first stage, which will utilize a 700 kW beam from Fermilab and the large underground space at Homestake to conduct a broad scientific program in neutrino physics, grand unification, and astrophysics¹.

The LBNE Science Collaboration and Project Management have decided to make the choice of which configuration to use before the end of 2011, as this will facilitate concentrating on a single major option, thus advancing the schedule significantly and lowering project costs in this early stage. The principles and procedures to be followed in making this decision are covered in the documents “Far Detector Technology Choice General Principles²” and “Procedures for LBNE Far Detector Configuration Decision³”. A key element in the decision process is a review by an external independent committee of the scientific capabilities of the two far detector options. The review will be charged by and report to the LBNE Collaboration Co-Spokespersons. This is the charge to that review committee.

The LBNE Collaboration has prepared Case Study⁴ proposals that describe the scientific potential and program that would be followed for both scenarios and a Conceptual Design Report⁵ (CDR) that describe the technical design of the LBNE Project, including the designs of the proposed liquid argon and water detectors. These documents will form the basis for the far detector configuration choice, and are key input to the Scientific Capabilities Review.

Charge: The Scientific Capabilities Review Committee is asked to evaluate and compare each of the two approaches to building LBNE with respect to its capabilities to achieve the science goals of the experiment¹. The Committee’s review should consider, but not necessarily be limited to, the following questions:

- 1) What are the crucial assumptions made by proponents in deriving the sensitivity for fulfillment of the science goals?
- 2) How well are these assumptions justified by the proponents based on extrapolation from existing experiments, test beam measurements, and/or validated simulations?
- 3) How well have the proponents considered consequences of detector performance being degraded from the assumptions by “reasonable”

variations, where “reasonable” is determined from experience with similar detectors?

- 4) Are there major scientific risks and opportunities that are not covered sufficiently in the Case Studies?

Procedure and Timescale for the Review: The committee is asked to review the documentation provided by the Science Collaboration and then to meet with proponents of the two scenarios in order to hear presentations and discuss in depth with collaboration members issues relevant to the charge. Tentatively, this in person review will be scheduled in the time frame of early November at Fermilab, starting at 9am the first day and ending at 1:30pm the last day. The first two days would consist mostly of public presentations plus question and answer sessions, while the last half-day would consist of a closed executive session.

Final Report: A final report to the Spokespersons is requested by the November 18. The report should be a public one, and an oral presentation to the LBNE Executive Committee (possibly via phone) is requested upon completion.

¹ Physics Research Goals of the LBNE Project, LBNE-doc-3056, 18 Nov 2010, http://lbne2-docdb.fnal.gov/0030/003056/003/KeyAssumptions-PhysicsGoals_V1.0.pdf.

² Far Detector Technology Decision General Principles. LBNE-doc-4099, 28 July 2011, <http://lbne2-docdb.fnal.gov/0040/004099/002/Far%20Detector%20Technology%20Decision%20General%20Principles%20-%20Approved.pdf>.

³ Procedures for LBNE Far Detector Configuration Decision. LBNE-doc-4099, 28 July 2011, <http://lbne2-docdb.fnal.gov/0040/004099/002/Far%20Detector%20Technology%20Decision%20General%20Principles%20-%20Approved.pdf>.

⁴ LBNE Case Study Report: 200 kt Water Cherenkov Far Detector, LBNE-doc-3495, http://lbne2-docdb.fnal.gov:8080/0034/003495/007/case_study_v3.1.pdf; LBNE Case Study Report: Liquid Argon TPC Far Detector, LBNE-doc-3600, http://lbne2-docdb.fnal.gov:8080/0036/003600/002/lar_casestudy_v1.1.pdf.

⁵ LBNE Conceptual Design Report, LBNE-doc-2339, <http://lbne2-docdb.fnal.gov:8080/cgi-bin/ShowDocument?docid=2339>.