

# Staging LBNE



Department of Energy  
Office of Science  
Washington, DC 20585

Office of the Director

A report outlining options and alternatives is needed as soon as practical to provide input to our strategic plan for the Intensity Frontier program. OHEP will provide additional details on realistic cost and schedule profiles and on the due date for the report.

We have considered both the science opportunities and the cost and schedule estimates for LBNE that you have presented to us. We have done so in the context of planning for the overall Office of Science program as well as current budget projections.

Based on our considerations, we cannot support the LBNE project as it is currently configured. This decision is not a negative judgment about the importance of the science, but rather it is a recognition that the peak cost of the project cannot be accommodated in the current budget climate or that projected for the next decade.

In order to advance this activity on a sustainable path, I would like Fermilab to lead the development of an affordable and phased approach that will enable important science results at each phase. Alternative configurations to LBNE should also be considered. Options that allow us to independently develop the Homestake Mine as a future facility for dark matter experiments should be included in your considerations.

A report outlining options and alternatives is needed as soon as practical to provide input to our strategic plan for the Intensity Frontier program. OHEP will provide additional details on realistic cost and schedule profiles and on the due date for the report.

## LBNE Reconfiguration

[About](#)

[Organization](#)

[Steering Committee](#)

[Physics Working Group](#)

[Engineering/Cost Working Group](#)

[Brinkman Letter to Oddone](#)

## Workshop April 25-26

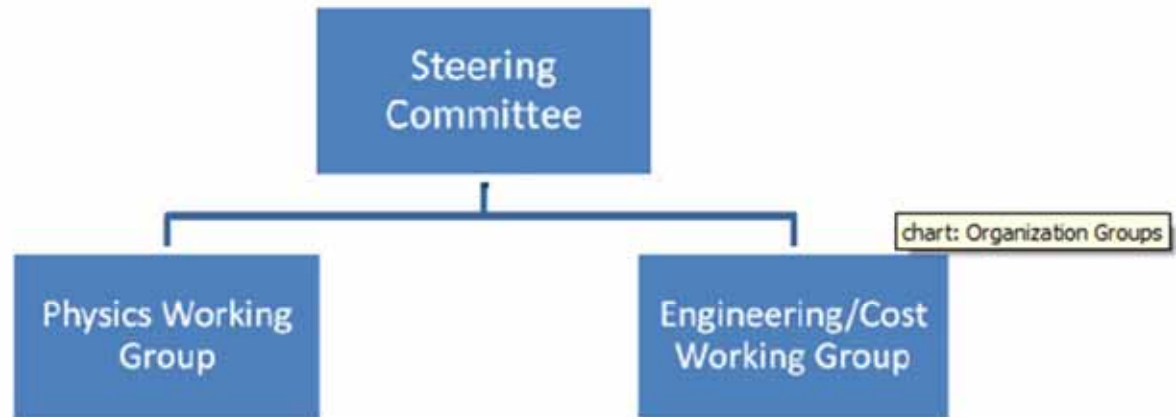
[Registration](#)

[Registrants List](#)

[Travel and Lodging](#)

## Organization

We are forming the following groups to deliver on the charge:



We will have two groups, one to study the physics reach of the possible configurations in a consistent way and a second group to study and understand the costs of the various options in a uniform way. The study requested by Bill Brinkman for the independent development of the Homestake site will be undertaken by subcommittees in both the physics and cost groups.

*Last modified: 04/06/2012*

[http://www.fnal.gov/directorate/lbne\\_reconfiguration/index.shtml](http://www.fnal.gov/directorate/lbne_reconfiguration/index.shtml)

# Steering Committee

Provides guidance to working groups, oversees the working groups, and writes the report. The times for meetings and conference calls will be worked around the availability of the members. The ex-officio members participate as observers and provide information.

## Membership

- Young-Kee Kim, FNAL, Chair
- Bob Svoboda, UC Davis
- Gary Feldman, Harvard
- Kevin Lesko, LBNL
- Ann Nelson, Washington, Seattle
- Charlie Baltay, Yale
- Jon Bagger, JHU
- James Symons, LBNL
- Steve Vigdor, BNL
- Mel Shochet, U.Chicago (chair of physics group)
- Mark Reichanadter, SLAC (chair of cost group)

## Ex-officio members

- HEPAP chair, NRC study chair: Andy Lankford, UC Irvine
- PASAG chair: Steve Ritz, UC Santa Cruz
- DOE's DUSEL review committee co-chairs: Jay Marx, Caltech and Mark Reichanadter, SLAC
- DPF chair: Pierre Ramond, U. Florida
- DOE Intensity Frontier Workshop co-chairs: Harry Weerts, ANL and JoAnne Hewett, SLAC
- LBNE Project Manager: Jim Strait
- Fermilab Director: Pier Oddone
- LBNE Lab Oversight Group member: Susan Seestrom, LANL

## Scientific Secretary

- Jeffrey Appel serves as the scientific secretary for the Steering Committee and the two working groups.

## Working Group members:

Physics Working Group	Engineering/Cost Working Group
1) Mel Shochet, U.Chicago (chair) 2) Kate Scholberg, Duke 3) Milind Diwan, BNL 4) Mark Messier, Indiana 5) Mary Bishai, BNL 6) Jenny Thomas, UCL 7) Gina Rameika, FNAL 8) Sam Zeller, FNAL 9) Bonnie Fleming, Yale 10) Gil Gilchriese, LBNL 11) Bill Marciano, BNL 12) Stephen Parke, FNAL 13) Ed Blucher, UChicago 14) Steve Brice, FNAL 15) Charlie Young, SLAC	1) Mark Reichanadter, SLAC (chair) 2) Jeff Sims, ANL 3) Jim Strait, FNAL 4) Vaia Papadimitriou, FNAL 5) Bruce Baller, FNAL 6) Chris Mauger, LANL 7) Elaine McCluskey, FNAL 8) Mike Headley, SURF 9) Marvin Marshak, U. Minnesota 10) Bob O'Sullivan, FNAL

# LBNE Reconfiguration Workshop

25-26 April 2012 *Fermi National Accelerator Laboratory*

US/Central timezone

## Overview

Scientific Programme

Timetable

Contribution List

Author index

My conference

Registration

↳ Registration Form

List of Registrants

Travel and Lodging

We have started a vigorous effort to answer Office of Science Director Bill Brinkman's charge to Fermilab to find a path forward to reach the goals of the Long-Baseline Neutrino Experiment in a phased approach.

A steering committee led by Deputy Director Young-Kee Kim, with many of the LBNE stakeholders as members, will guide the study. The steering committee will have two working groups: the physics working group, led by Mel Shochet of the University of Chicago, and the engineering/cost working group, led by Mark Reichanadter of SLAC. The steering committee will provide guidance to the working groups and will ultimately write the report for DOE. The physics working group will analyze the physics reach of the various phases and alternatives on a common basis. Similarly, the engineering/cost working group will provide cost estimates and analyze the feasibility of the proposed approaches with the same methodology. These two groups will provide to the steering committee factual input that covers as many aspects of the various options as possible. Detailed information can be found at [http://www.fnal.gov/directorate/lbne\\_reconfiguration/](http://www.fnal.gov/directorate/lbne_reconfiguration/)

To inform the community, discuss the status of the work in progress and seek input, we will

To inform the community, discuss the status of the work in progress and seek input, we will hold a workshop on April 25 and 26 that is open to all interested parties.

The time scale for concluding these studies is very short because the results will influence the Congressional budget process for FY13 and the Office of Science planning process for FY14. We plan to have a preliminary report by June 1, which will be vetted by our Physics Advisory Committee and the FRA Board of Directors. A final report will be available on July 1.

**Location:** *Fermi National Accelerator Laboratory*  
Batavia, Illinois  
Room: One West, Wilson Hall

**Chairs:** *Kim, Young-Kee*

<https://indico.fnal.gov/event/LBNERN12>  
Last modified: 10 April 2012 18:50

**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  $\delta$  vs. significance of measuring  $\delta_{CP}$ ” and “precision of  $\delta_{CP}$  vs.  $\delta_{CP}$ ” (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



# Phasing Options Under Consideration by LBNE Collaboration

- Beam and Near Detector Now;  
Far Detector Later.
- Far Detector Now;  
Beam and Near Detector Later.
- Beam (pared down?), mini-Near Detector, small Far Detector Now;  
Larger Far Detector and Full Near Detector Later.

# Alternatives to LBNE Using NuMI Beam Under Consideration by LBNE Collaboration

- On-Axis Detector at Soudan (735 km)
  - Underground
    - => Could preserve non-beam-based physics
  - Can we lower the neutrino beam energy?
  - Proton beam power limited to  $\lesssim 1$  MW.
- Off-Axis Detector at Ash River (810 km)
  - Surface only => no non-beam-based physics.
  - Narrow-band beam => no spectral information.
  - Larger detector possible on surface.