Long-Baseline Neutrino Experiment

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Collaboration status
Organization and reviews
Comments on risks for far detector scale up.

FNAL PAC meeting
23 January, 2014
Long-Baseline Neutrino Experiment in US

Final LBNE configuration is:

- A horn-produced broad-band beam with 60-120 GeV protons at 700 kW (upgradable to 2.3 MW) from FNAL.
- Planning change: 700 kW → 1.2 MW at LBNE start.
- A baseline of 1300 km towards the Sanford Underground Research Facility in Lead, South Dakota.
- A 35 kt fiducial volume liquid argon time projection chamber located at the 4850 ft level.
- A high resolution near detector at FNAL.
- This configuration will be achieved in a phased manner according to financial constraints.
LBNE Science Collaboration

- 452 members, 82 institutions, 6 countries (Sept. 2013)
- The collaboration has well-organized scientific and technical working groups.
- There is frequent communication with the funding agencies.
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- **357 US + 95 non-US**
  - 21% non-US; 26% of faculty/scientists
  - Significant growth since CD-1
  - We anticipate the collaboration to grow to 600-700 members.

Fort Collins, September 2013
## LBNE Collaboration - Detail

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<tr>
<th>Country</th>
<th>Faculty</th>
<th>Postdocs</th>
<th>Students</th>
<th>Engineers</th>
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<td><strong>80</strong></td>
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<td><strong>48</strong></td>
<td><strong>6</strong></td>
<td><strong>452</strong></td>
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<td>Non-US</td>
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<tr>
<td>Fraction non-US</td>
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<td>20%</td>
<td>10%</td>
<td>8%</td>
<td>0%</td>
<td>21%</td>
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Our intention is to create an international collaboration at FNAL with these and additional partners. The collaboration will be appointing an International Advisory Group soon.

We expect considerable growth as further discussions take place.
International Partnerships Essential
(Extremely brief summary)

• UK (9 inst.) Interactions with STFC CEO, SOI on long-baseline physics approved, a 3-yr proposal to be developed by May with large emphasis on LBNE.

• Italy (8 inst.) Discussion with INFN president, and C. Rubbia. Interim INFN support for LBNE participation. Additional Italian collaborators anticipated. Broad US-Italy agreement on ICARUS and LBNE under discussion.

• Europe/LBNO (multiple institutions): Joint task force for developing a common science strategy and R&D planning.

• CERN: Discussions for partnership on both infrastructure and detectors for LBNE. Cooperation on R&D projects WA104 and WA105 being planned.

• Brazil (5 inst.): Discussions with FAPESP with encouragement for proposal, R&D proposal to FAPESP and to Federal agencies in the works with emphasis on FD photon subsystem.

• India (5 inst): Regular interactions with collaborators ongoing. Current scope is mainly for the near detector. DOE and DAE are in the process of creating agreements.

• Discussions also on-going with Russia, China, and Japan for joint R&D or scientific cooperation.

• More details in Bob Wilson’s talk to P5.
We are preparing a request for resources to 1) conduct reviews, 2) engage partners, 3) produce time-critical technical work.
DOE review of R&D and Software/computing

- DOE review of LBNE of all project and off-project R&D and software/computing, May 12-16, 2014.
- Review will include R&D coordination with international partners.
- DOE Charge will be provided soon. The elements are
  - Physics software tools: progress on simulations, reconstruction, analysis of 35t prototype data.
  - R&D priorities: mechanism for coordination with other projects, and schedules.
- Collaboration will hold mini-workshops to prepare for this review in March, 2014.
Scientific Review of Systematics
(update on systematic error)

• Long-baseline experiments aiming for CP violation with high statistics will require significantly better systematic control on backgrounds and signal.

• This will require 1) multiple analysis models, 2) carefully designed near detector, 3) external input on cross sections.

• LBNE has a task force on systematics. And the collaboration intends to have reviews with external participation focused on:
  – Analysis Strategies and projections using current tools
  – Near detector scientific requirements
  – Near detector design and simulations

• Charge will be developed in consultation with FNAL. A 2 stage process anticipated:
  – 6 months: analysis strategies and projections, requirements
  – 1-2 yrs: a complete simulated data analysis for LBL oscillations.
Risk Analysis for extrapolating to > 10 kt

- LBNE has a risk register after a high level risk analysis. For the far detector the elements of risk are:
  - 1) Cryostat and cryogenics
    • For a very large detector the membrane technology appears appropriate and is being tested.
  - 2) Purity
    • For necessary scale purity must be achieved without evacuation.
  - 3) Scale up of TPC
    • Modularity using wrapped planes to simplify construction.
    • Low cost, cold electronics needed to improve performance.
  - 4) Electronics Noise
  - 5) High voltage for long drifts.
  - 6) Civil construction of a large appropriate cavern and utilities
Mitigation of risks

• 1) and 2) 35 ton cryostat test is a success
  – contracting and business model has been tested, Purity in bare vessel achieved without evacuation.
• 3) TPC scale up and integration is being tested by prototyping a full frame (PSL), and by 35 ton Phase II.
• 4) Electronics will be tested in 35 ton. Also under test in Bern. Microboone has the same front end. Rigorous grounding and shielding designs are included in plan.
• 5) High Voltage: LBNE TPC and cryostat design allow better insulation than previous designs. Experience from Microboone and ICARUS. HV prototype built and tested at 200 kV at UCLA.

Membrane cryostat risk has largely been mitigated, we are working on the rest.
Pictures

35 ton cryostat

Cryogenic services under Plate B

Purity Monitors (Drift Chambers)

Membrane tank convolutions for shrinkage

lifetime achieved 2.5 ms (required ~1.5ms)

David Montanari, Barry Norris, Michelle Stancari, Alan Hahn, Russ Rucinski, Terry Tope, Bruce Baller.
(Risk 6) CF Far Site Geotech Program

- General area where detector(s) could be placed is being explored.
- Planning to do drilling in early 2014.
- The scope of this drilling program was recently decided.

Examples of possible detectors