LBNE Project Status

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Outline

- Long-term goals and plans of the LBNE program
- A phased approach to LBNE (and Project X)
- LBNE Project status and next steps
- Conclusions

The Long-Baseline Neutrino Experiment

The LBNE Collaboration plans a comprehensive experiment to fully characterize neutrino oscillation phenomenology using

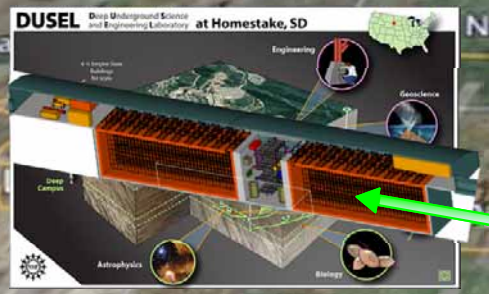
- A high-intensity, broad-band neutrino beam
- A sophisticated near detector
- A 1300 km baseline
- An advanced liquid argon TPC far detector

The goals of this program are:

- Determining leptonic CP violation and neutrino mass ordering.

  The recent measurement of non-zero θ_{13} make this a scientifically well motivated, comprehensive, and stunningly beautiful program.
- Underground physics, including the exploration of proton decay and supernova neutrinos.

Long Baseline Neutrino Experiment



New Neutrino Beam at Fermilab…

Precision Near Detector
on the Fermilab site

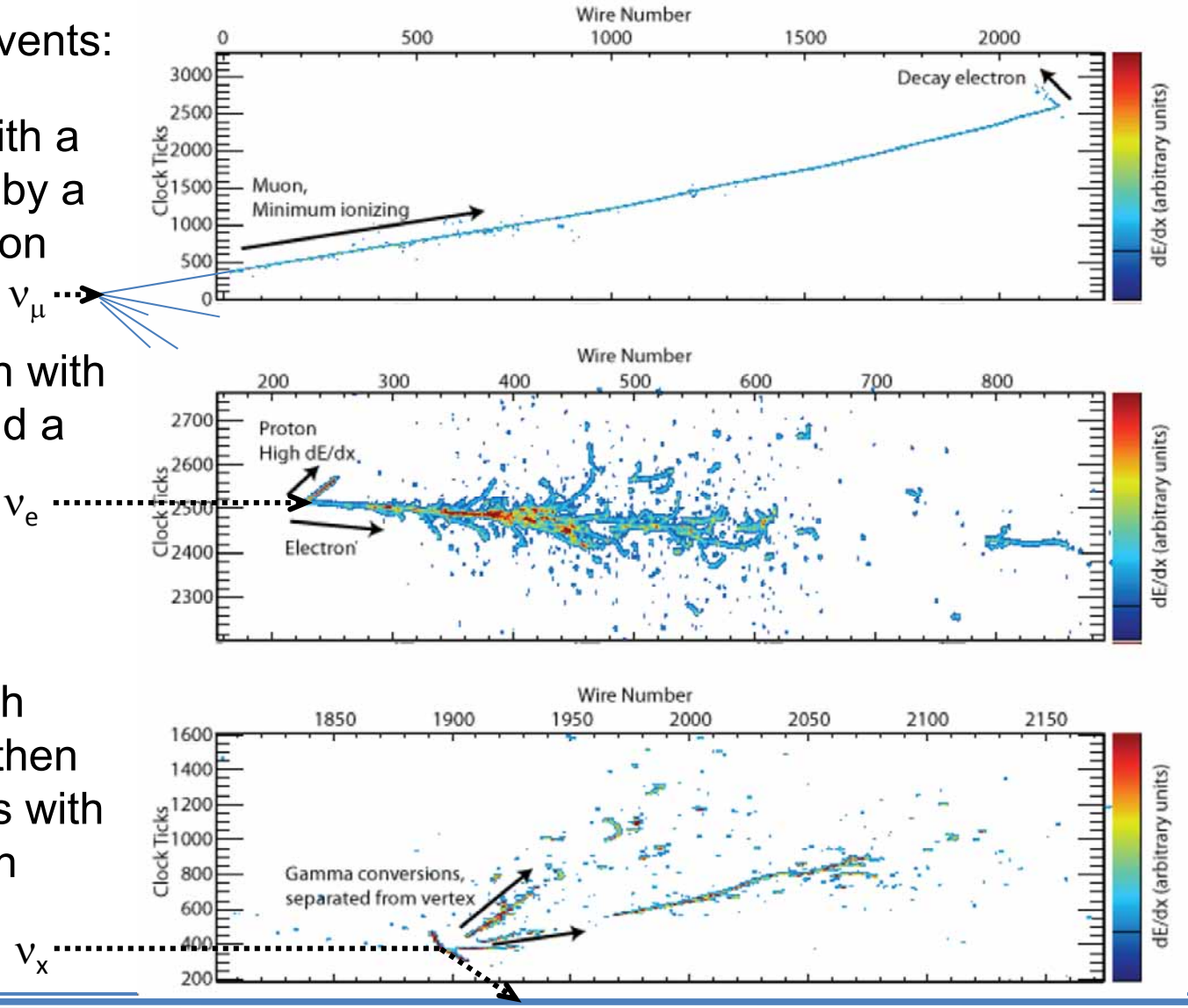
Directed towards a distant detector

34 kton Liquid Argon TPC Far Detector
at a depth of 4850 feet (4300 mwe)

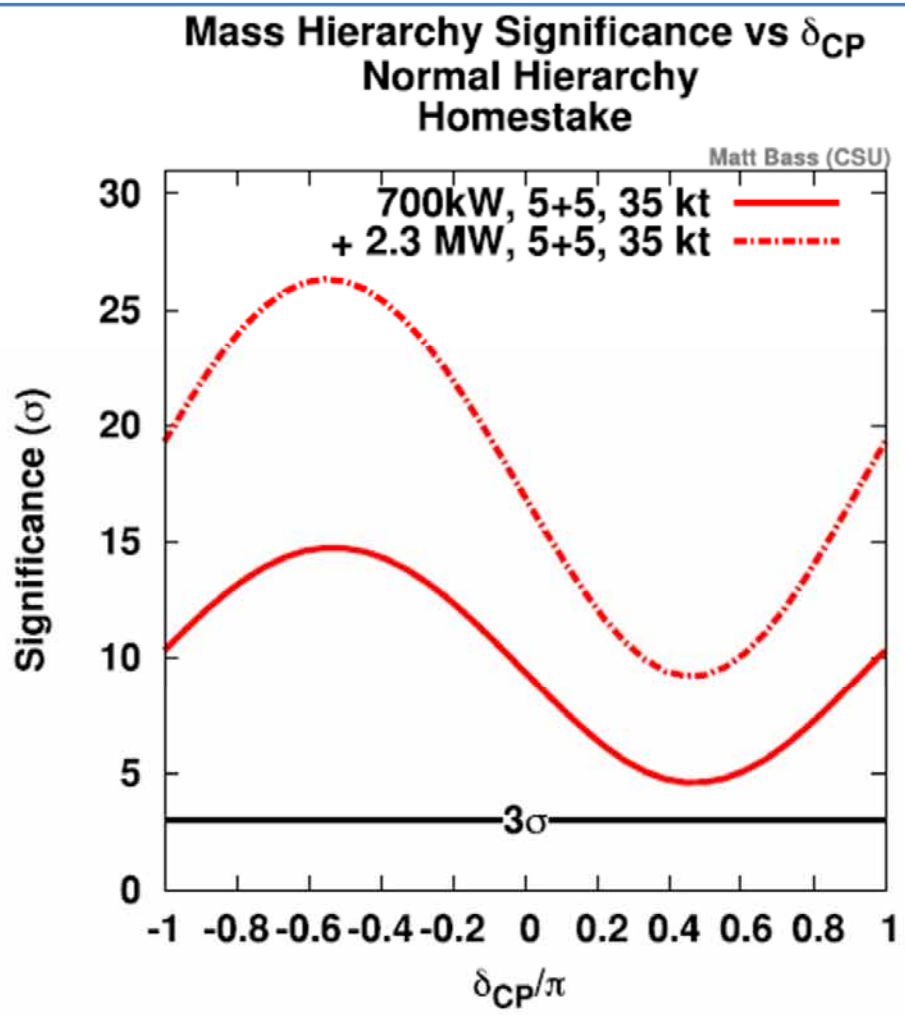
LAr TPC Capabilities

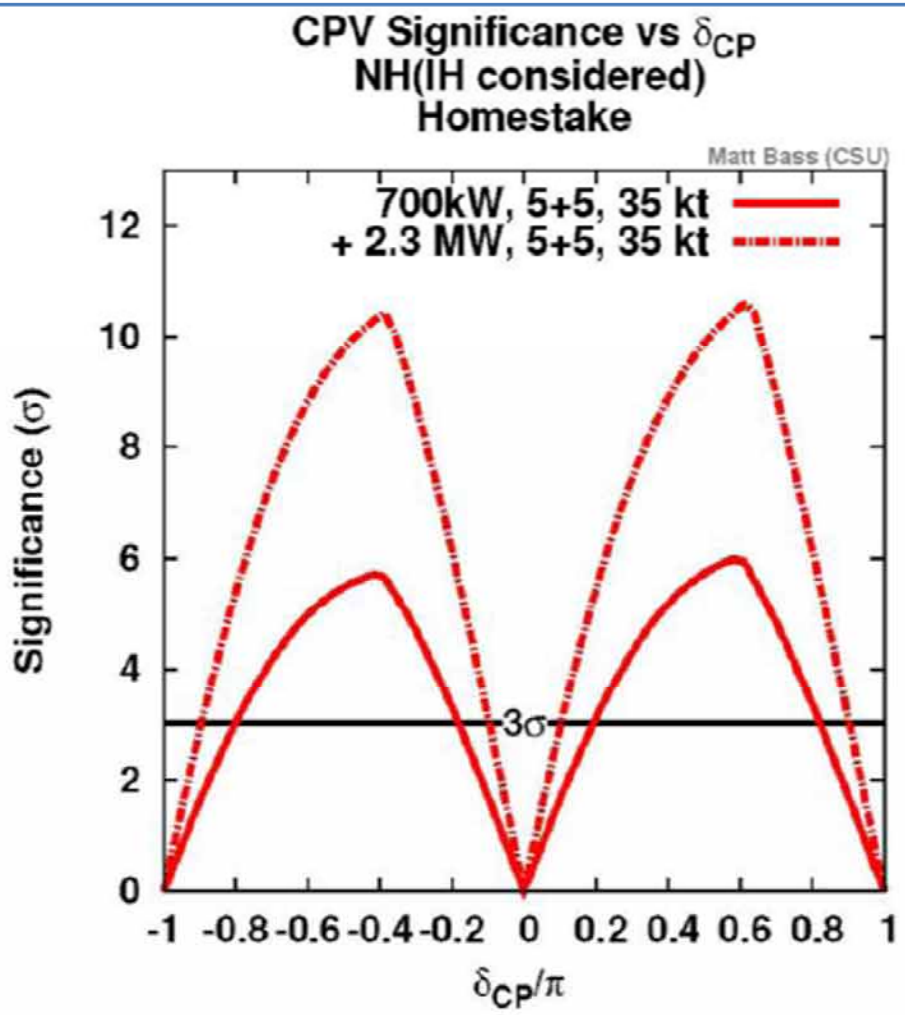
Simulated neutrino events:

- CC ν_μ interaction with a stopped μ followed by a decay Michel electron
- CCQE ν_e interaction with a single electron and a proton
- NC interaction which produced a π^0 that then decayed into two γ's with separate conversion vertices

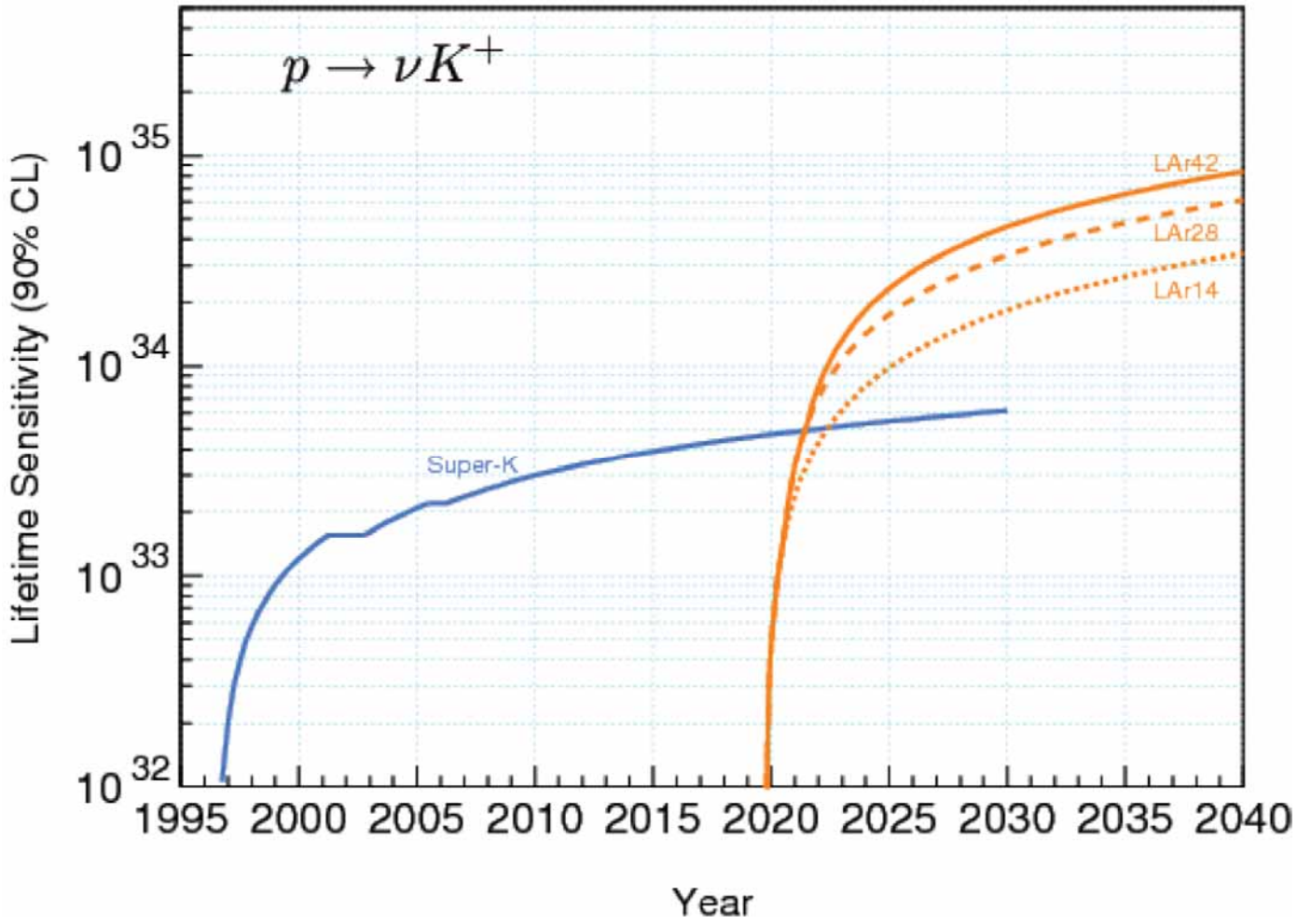


Neutrino Mass Hierarchy and CP Violation

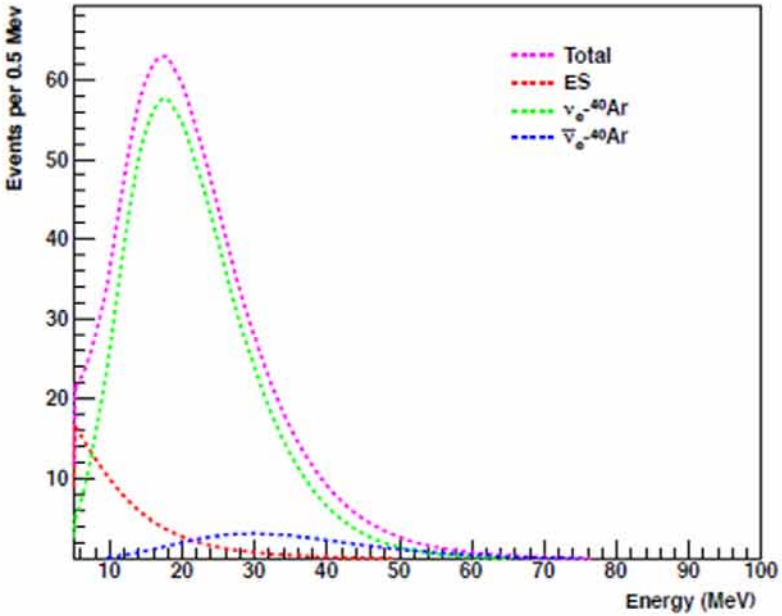


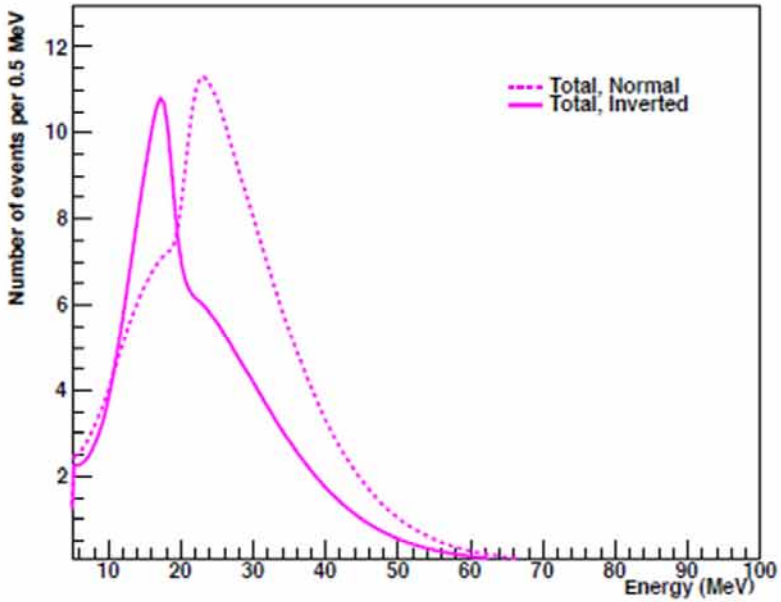


Proton Decay



Supernova Neutrinos





Channel	Events, "Livermore" model	Events, "GKVM" model
$\nu_e + {}^{40}\mathrm{Ar} \rightarrow e^- + {}^{40}\mathrm{K}^*$	2308	2848
$\bar{\nu}_e + {}^{40}\mathrm{Ar} \rightarrow e^+ + {}^{40}\mathrm{Cl}^*$	194	134
$\nu_x + e^- \rightarrow \nu_x + e^-$	296	178
Total	2794	3160

@10 kpc

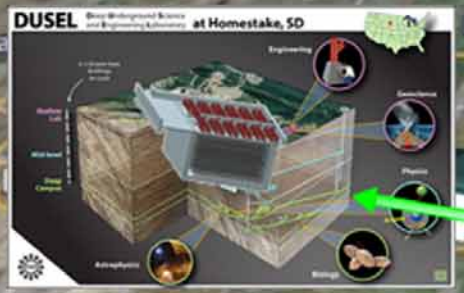
Table 6–7: Supernova burst neutrino event rates for different models in 34 kton of LAr.

LBNE as a Phased Program

The U.S. Department of Energy has stated their intention to carry out this program in a phased manner.

- The LBNE Project is the first phase
  - focuses on accelerator neutrino oscillation physics
  - includes the beam and a 10 kt fiducial mass liquid argon TPC at the surface, 1300 km from Fermilab
- The first phase will focus on long-baseline physics:
  - determine the sign(Δm^2_{32})
  - measure δ_{CP},
  - measure other oscillation parameters: θ_{13}, θ_{23}, and $|\Delta m^2_{32}|$.

Long Baseline Neutrino Experiment
Phase 1 Project



New Neutrino Beam at Fermilab…

Directed towards a distant detector

10 kton Liquid Argon TPC Far Detector just below the surface

LBNE as a Phased Program

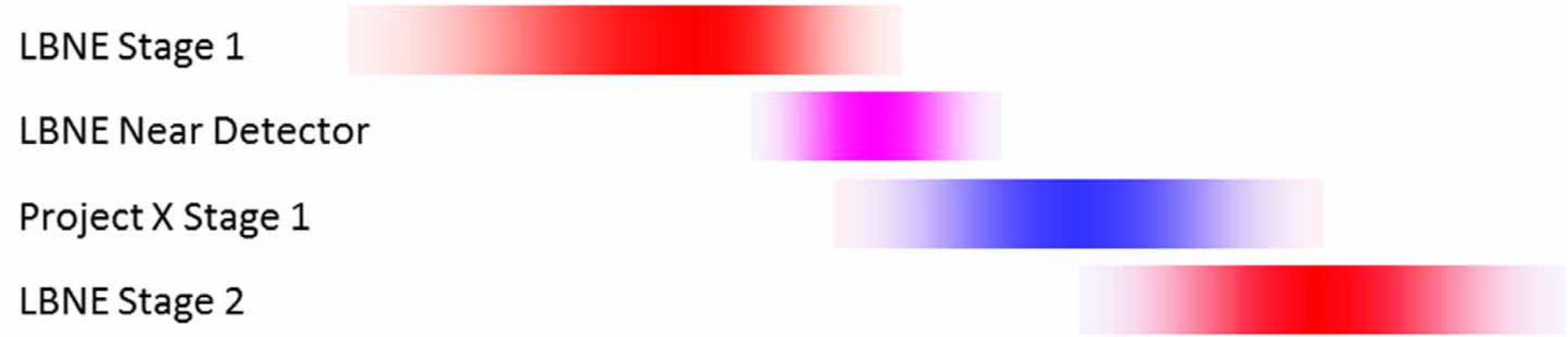
The U.S. Department of Energy has stated their intention to carry out this program in a phased manner.

- The LBNE Project is the first phase
  - focuses on accelerator neutrino oscillation physics
  - includes the beam and a 10 kt fiducial mass liquid argon TPC at the surface, 1300 km from Fermilab
- Subsequent phases are planned to include:
  - A highly capable near neutrino detector
  - A larger far detector, placed deep underground
  - Higher beam power that will be enabled by Project X

Additional national or international collaborators could increase the scope of the first phase of LBNE or accelerate the implementation of subsequent phases.

Phased Program: Possible Example

1) 10 kt LAr detector on surface at Homestake + LBNE beamline (700 kW)
2) Near Neutrino Detector at Fermilab
3) Project X stage 1 → 1.1 MW LBNE beam
4) Additional 20-30 kt detector deep underground (4300 mwe)



Additional national or international collaborators could help accelerate the implementation of the full LBNE program.

The LBNE Project Approval Status

- The next step in the DOE project approval process is "CD-1," which
  - Approves the conceptual design and overall cost and schedule.
  - Releases funds for final design and preparation for construction.
- LBNE has been through three recent reviews:
  - Fermilab Director's Review 25-27 Sep: Validated the design
  - DOE Project Review 30 Oct - 1 Nov: Validated the project plan
  - DOE Cost Review 6-8 Nov: Validated the cost estimate
- We expect CD-1 to be granted by the end of December.

Summary

- LBNE remains focused on its long-term goals:
  a) Comprehensive program to measure neutrino oscillations
     - determine the mass hierarchy and look for CP violation
     - precision measurement of other oscillation parameters
     - test the validity of the three-neutrino mixing model
  b) Search for baryon number violating processes
  c) Measure neutrinos from astrophysical sources, especially from a core-collapse supernova in our galaxy
- Fiscal constraints require us to approach our goals in a phased program
- The LBNE Project will build the first phase, and is expecting DOE approval of “CD-1” this year.
- New national or international collaborators could add scope to phase 1 or accelerate the implementation of later phases.