

# Neutrino Working Group Report

Bonnie Fleming – Yale  
Ed Kearns – Boston

# Agenda

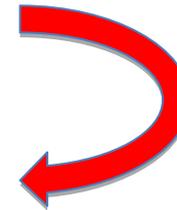
AM session 10:30 -12:30

- 1) Introduction 10+2 Fleming/Kearns
- 2) Report from DUSEL 10+3 Lesko (remote)
- 3) Beamline review 10+5 Hylan
- 4) Water Cherenkov 15+10 Diwan
- 5) Liquid Argon 15+10 Rameika
- 6) Sensitivity studies 15+10 Saoulidou

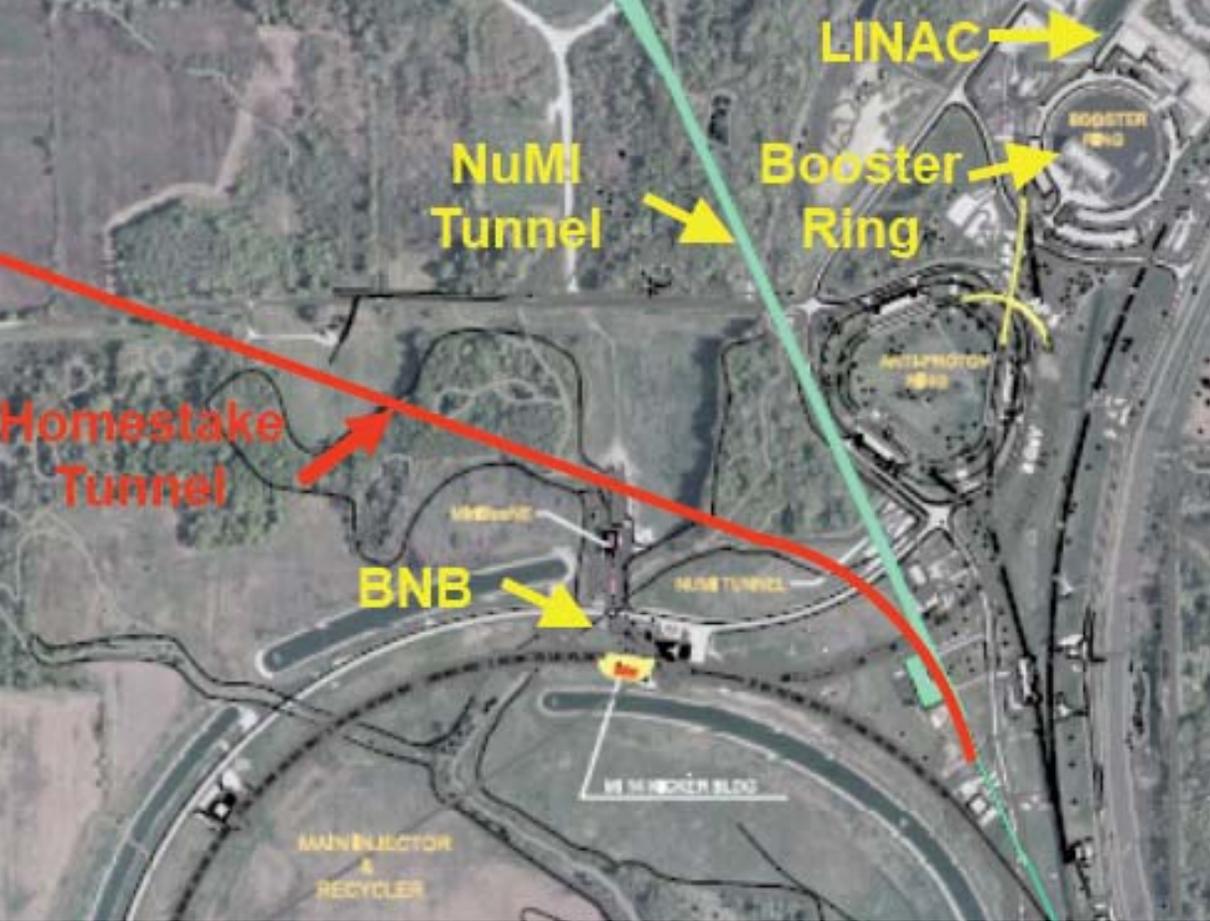
12:30-1:30: Lunch

PM session: 1:30-3:30

- 1) Nu Factory 15+5 Geer
- 2) HiResMnu 15+10 Mishra
- 3) NuSONG 15+10 Conrad
- 4) Very short presentations 15+10 group
- ~~5) Final discussion 25 min Fleming/Kearns  
(point-by-point review of golden book nu section)~~

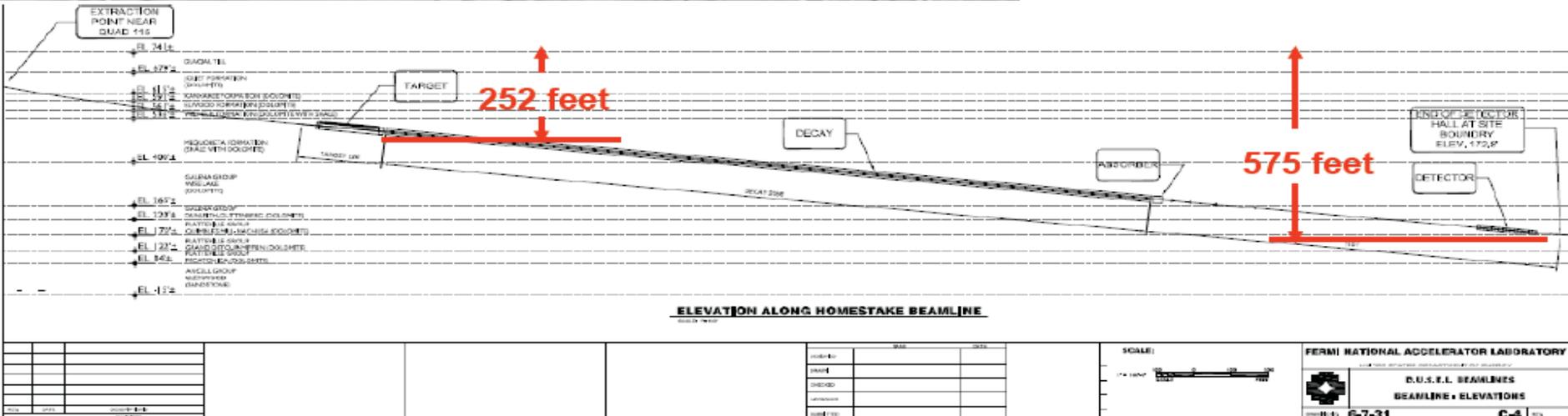


B. Louis – 8 GeV  
D. Harris – Scattering



Upgraded NuMI  
beamline  
or  
New beamline to  
DUSEL

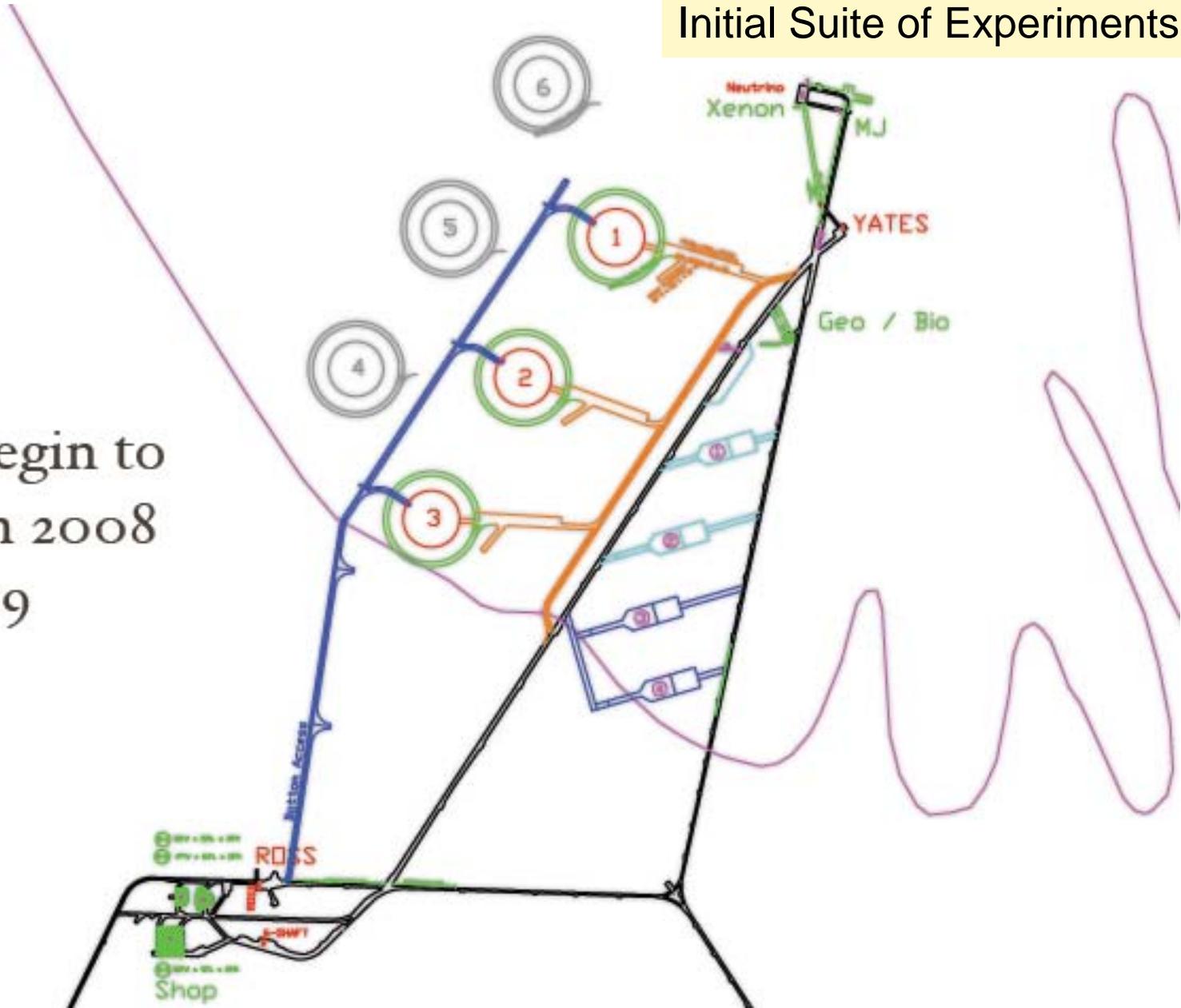
- 60 GeV
- $1.7 \times 10^{14}$  pot/spill @ 1.4 Hz
- 2.3 MW
- DUSEL beamline:
  - 400-627 m decay pipe
  - 500-575 ft deep near detector
  - Cost/schedule similar to NuMI
- R&D for high beam power



# DUSEL

4850-ft level “engineering” cavity under consideration for Initial Suite of Experiments

Can begin to  
core in 2008  
& 2009

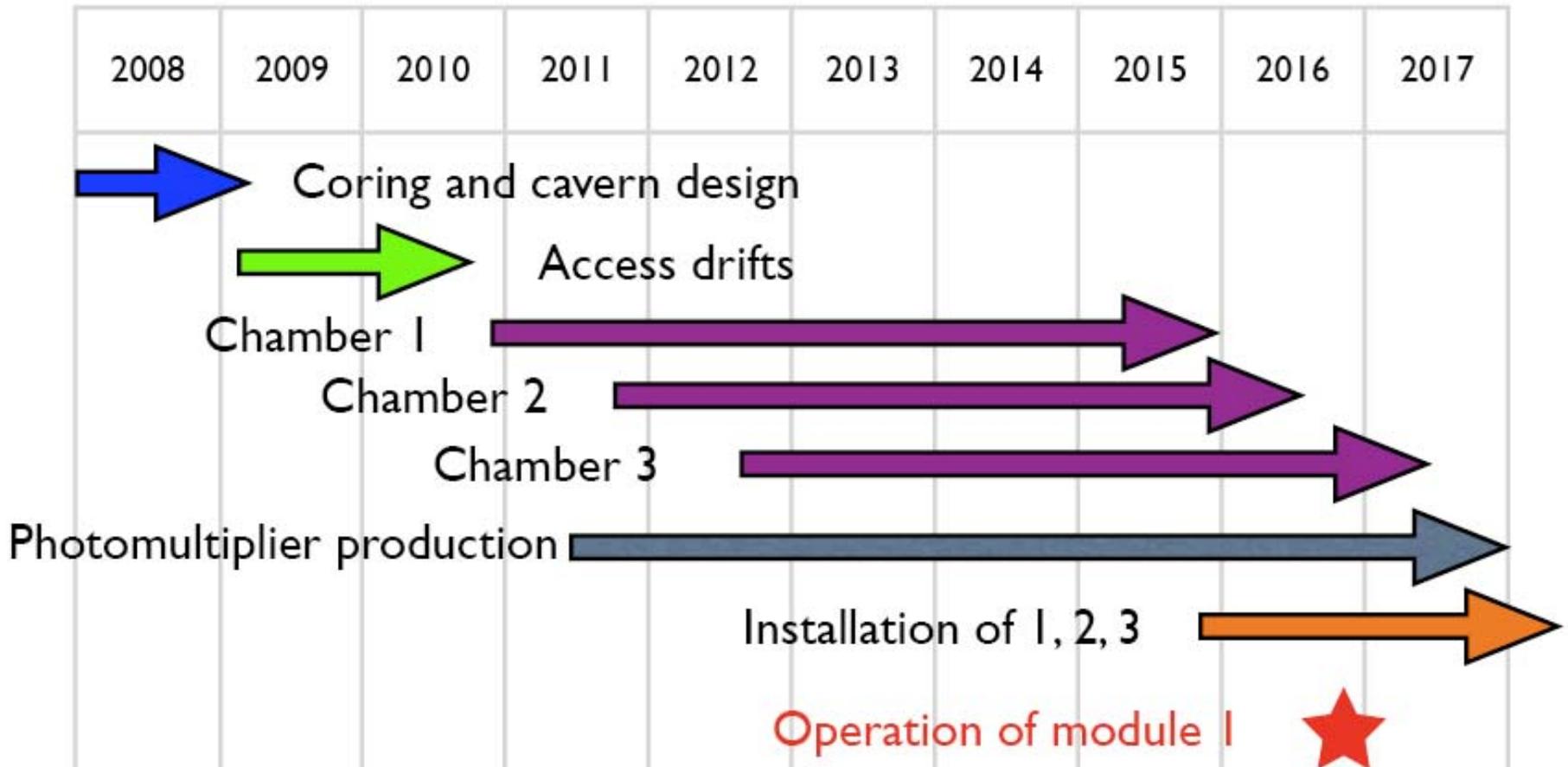


# N × (100 kton fiducial volume) Water

Mature, proven experimental technique

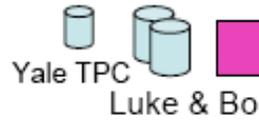
Detailed design, cost, schedule needs work

Main R&D item: minimize cost per photon collected  
(essentially per PMT costs)



# Liquid Argon TPC

Promising but unproven experimental technique.  
Needed: demonstrate feasibility at large mass.  
Numerous R&D items.  
Multi-detector staged program being developed.



R&D

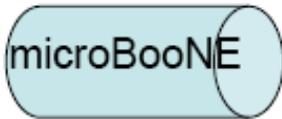
Purity, electronics development



ArgoNeuT

R&D Physics

Underground safety, cryo operation, Beam  $\nu_e$ ,  $\gamma/\pi^0$  separation  
TPC performance, reconstruction



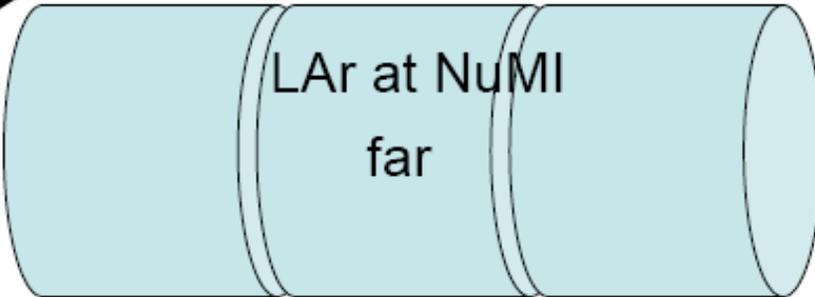
microBooNE

R&D Physics

Cold electronics, evacuation  
requirement, tank construction,  
insulation Low E excess, cross sections



near

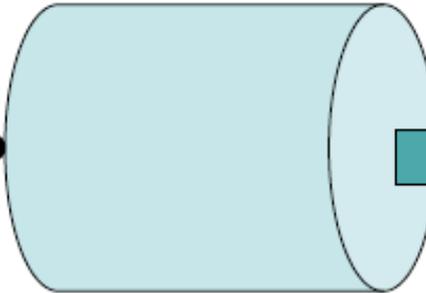


R&D Physics

R&D Physics

Underground operation,  
Technical & cost scaling  
 $\theta_{13}$ , mass hierarchy

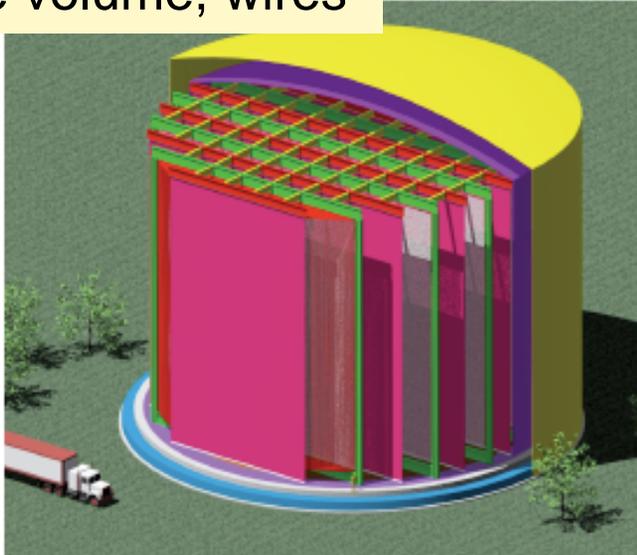
M x N = 100 kT



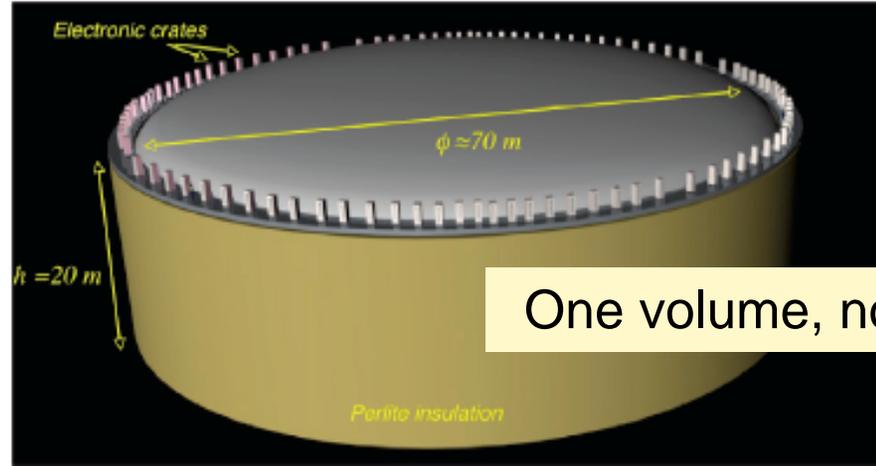
Physics !!!

# Major Configuration Options – Need Assessment

One volume, wires



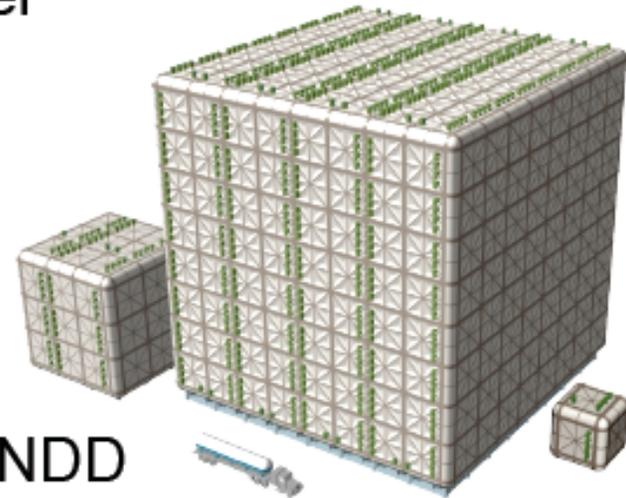
FLARE



One volume, no wires

Glacier

50 - 100kT  
concepts

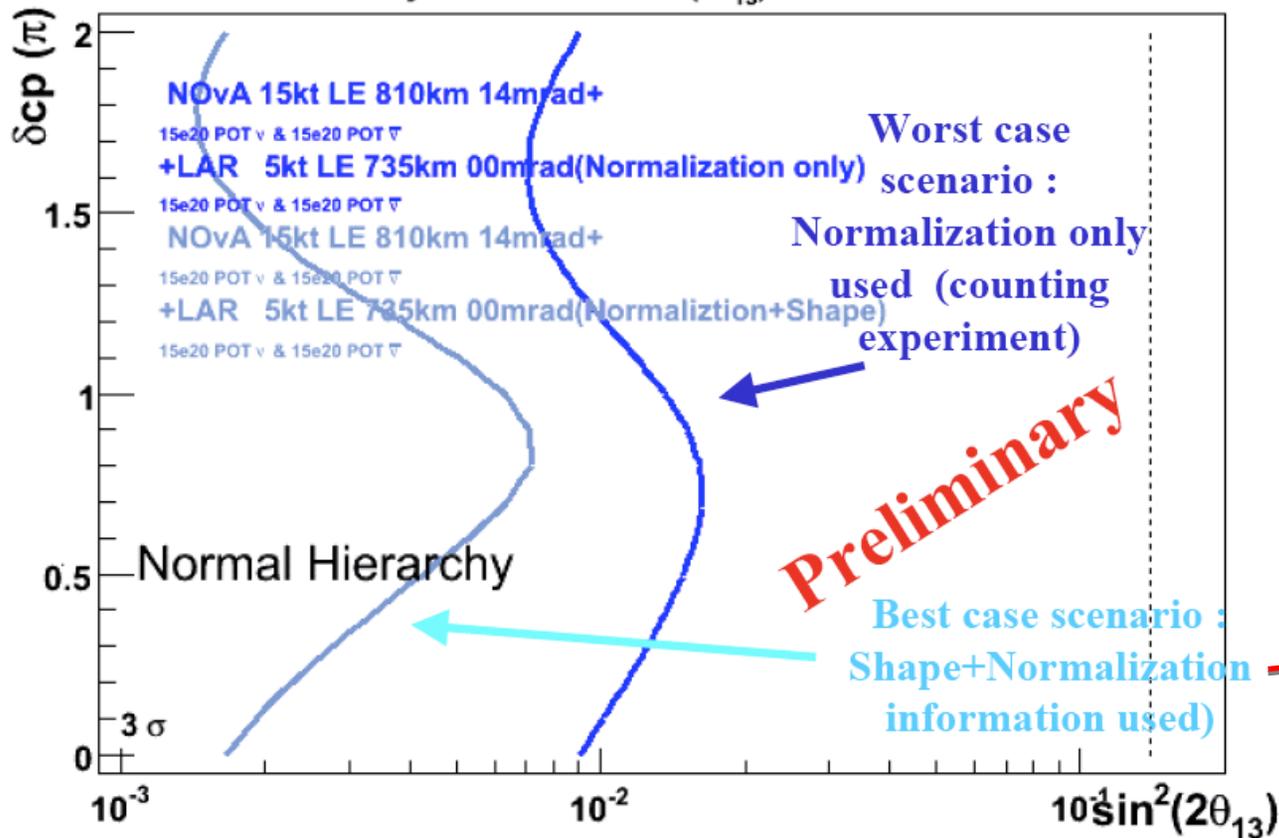


LANNDD

Modular, wires

# 5kton LAr TPC in MINOS Hall

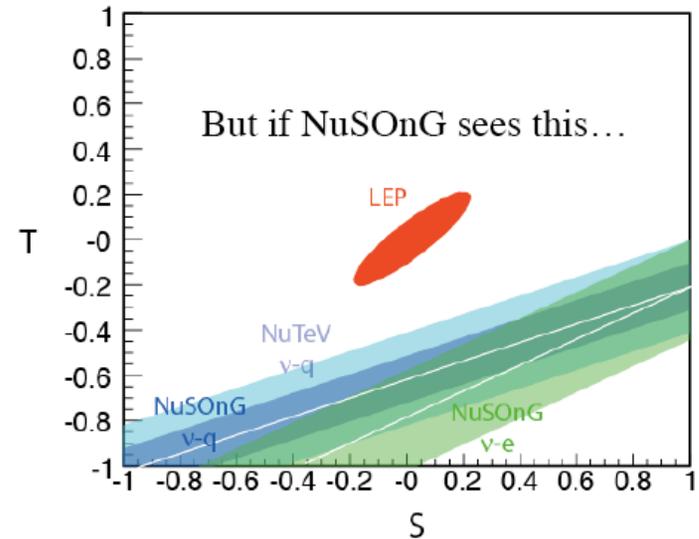
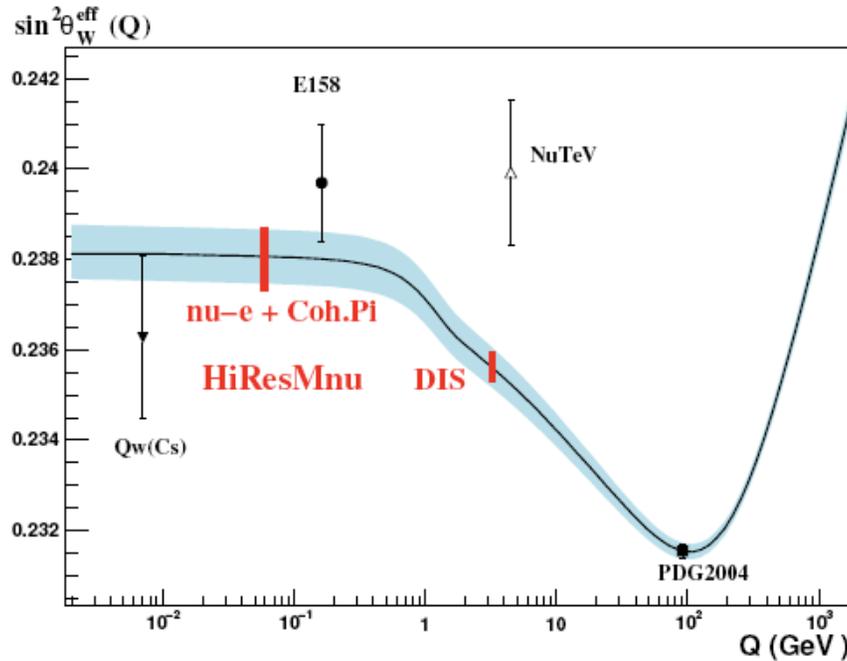
3  $\sigma$  Discovery Potential for  $\sin^2(2\theta_{13}) \neq 0$



× But no neutrino energy response or resolution smearing.

N.B.: If 5-kton FV achieves 97% efficiency for  $p - \nu K^+$  this detector would be competitive with Super-K for this mode (22.5 kton, 14% efficiency).

# Precision Electroweak Neutrino Measurements



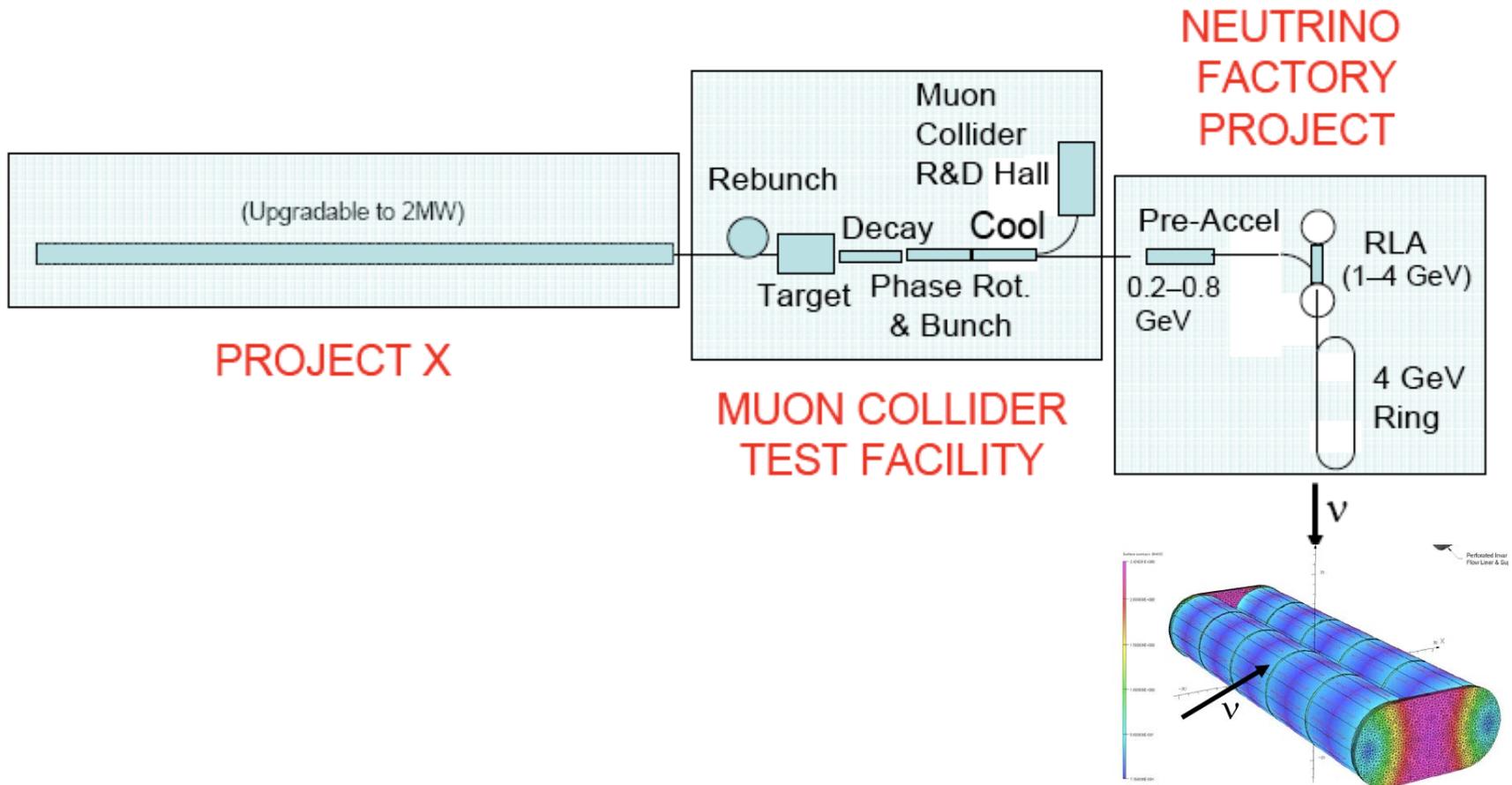
There is new physics in the neutrino sector!

Plots for illustration purpose. Sensitivity (i.e. error bars) need to be carefully established.

- New  $x_W$  measurement would be unique on world stage
- Value of theoretical impact should be reviewed
- NuSONG: high energy protons from Tevatron, CHARM II-like detector
- Tevatron-based beam could lead to additional neutrino experiments
- HiResMv: "parasitic" use of superbeam to DUSEL, NOMAD-like detector
- Both offer long list of measurements, thesis topics
- **Needs review: beyond the scope of this (FNAL/P5) exercise**

# Neutrino Factory

- Low energy neutrino factory option presented
- Totally active scintillator detector (sci-bar)
- Magnetized hall (0.5 T) with superconducting transmission lines
- Test facilities could exploit Project X
- Neutrino factory could be a future option



# Summary

- ❖ Neutrino physics is a compelling motivation for a high intensity proton source.
- ❖ New ideas regarding neutrino scattering physics has revived interest. Needs development. Maybe unique contributions.
- ❖ Experimental strategy for FNAL-DUSEL could be based on:
  - Staged R&D program of LAr Detectors/Experiments
  - Construction of modular water Cherenkov detectors jumpstarted by DUSEL
  - Eventual implementation of 100 kton LAr detector underground
  - Physics case is very strong for proton decay, supernova, other particle astrophysics – do not neglect!
- ❖ Oscillation physics well-established in recent reports – we are trying to restate in the Golden Book. But an experimental strategy for a Fermilab program is new. Critical reading needed. Still rough. Working lunch at a big round table about how to improve the draft. Please attend!