



NO_vA Update

MINOS Collaboration Meeting
Fermilab
20 March 2005

Gary Feldman



Overview

- **The termination of BTeV has caused a sea change for NOvA**
 - Before there was no money in the national budget for NOvA.
 - Robin Staffin, HEPAP, Feb 15, 2005:

“We believe we should be planning for a portfolio of medium scale, medium term experiments to start construction in the period 2007-10. ...Bottom line is that O(\$50-100M) per year may be available to invest in new initiatives by the end of the decade”
 - DoE is writing a CD0 for NOvA and has asked us for a FY07 construction budget.
 - NuSAG being appointed with a June 2005 report date.
 - End of Collider operations yields more than a factor of 2 increase in NOvA data rates.
- **New Proposal to be submitted tomorrow. We will push for approval at the April PAC meeting.**



NuSAG Charge

- **Three charges, one each to make recommendations on reactor experiments, double beta decay, and long-baseline experiments.**
- **“For all three charges, NuSAG should ... recommend a strategy of one (or possibly more than one) experiment in that direction, which in its opinion should be pursued as part of the U.S. program.”**
- **Options in the long-baseline category:**
 - U.S. participation in T2K
 - $\text{NO}_{\nu A}$
 - $\text{NO}_{\nu A}$ with a large liquid argon detector



Far Detector

“Totally Active”

30 kT:

24 kT liquid scintillator

6 kT PVC

32 cells/extrusion

12 extrusions/plane

1984 planes

Cell dimensions:

3.9 cm x 6 cm x 15.7m

Extrusion walls:

3 mm outer

2 mm inner

U-shaped 0.8 mm WLS

fiber into APD

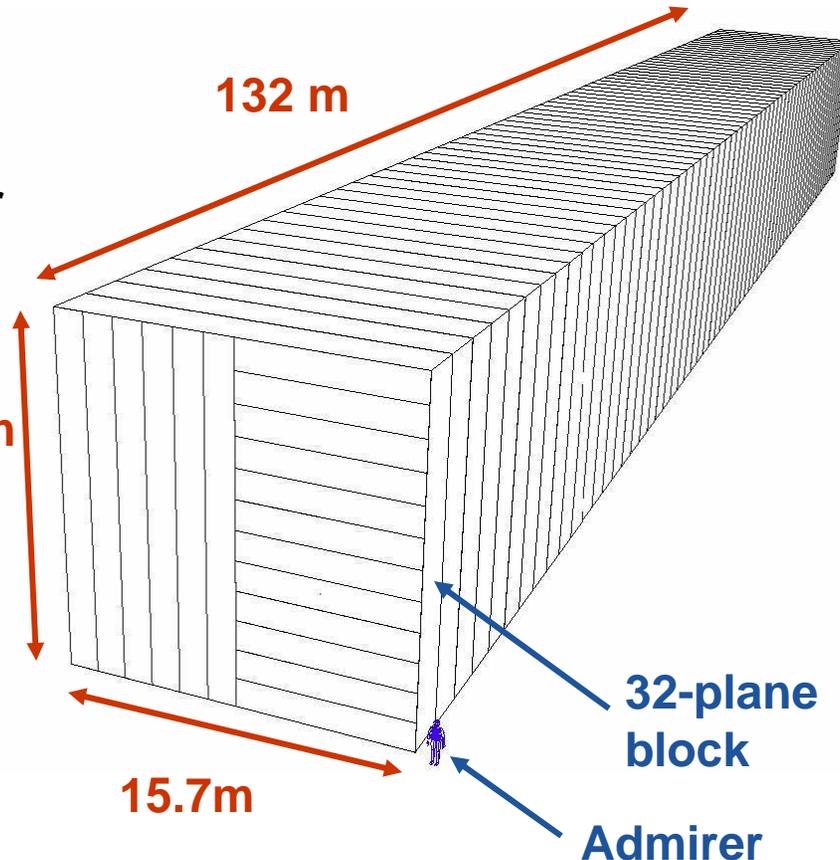
15.7m

132 m

15.7m

**32-plane
block**

Admirer

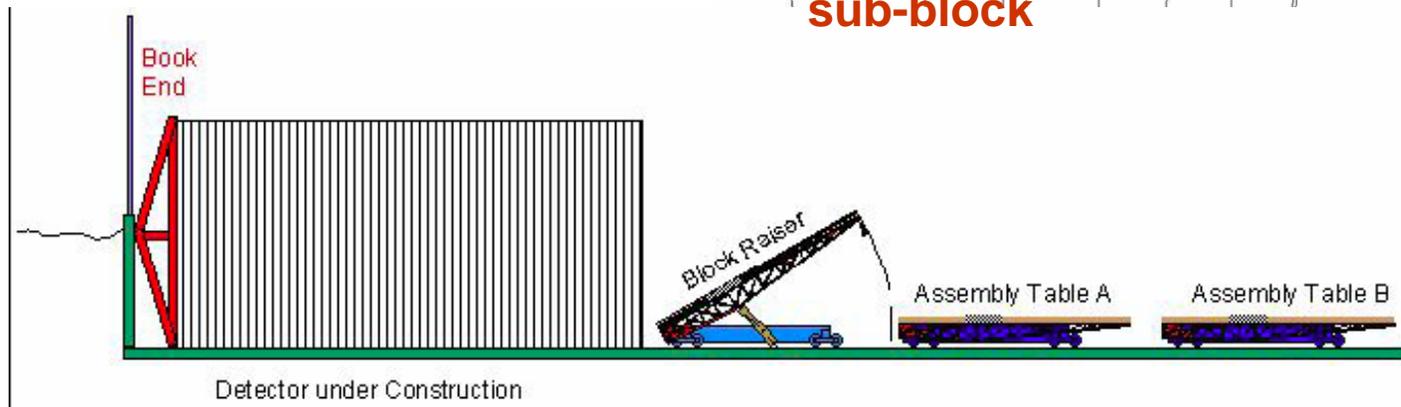
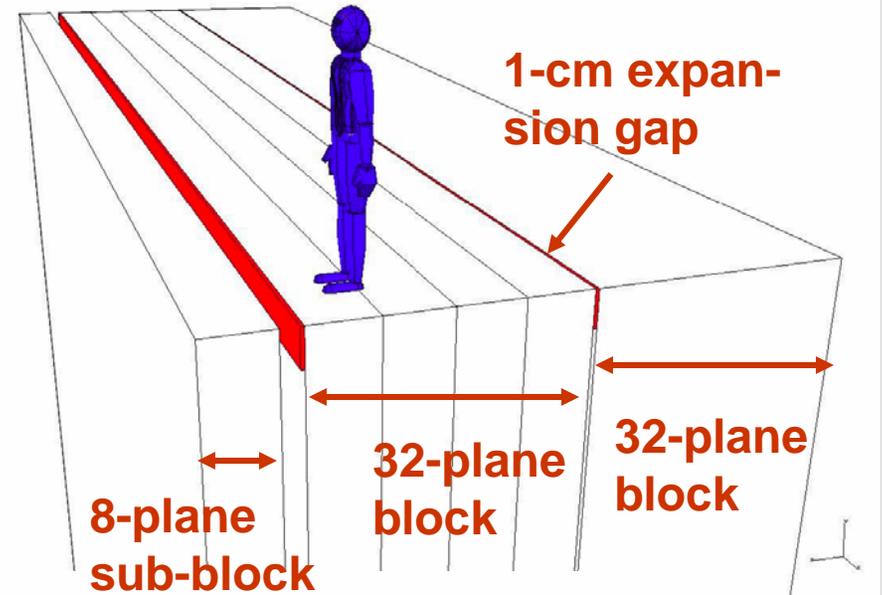




Far Detector Assembly

One 8-plane sub-block assembled per day

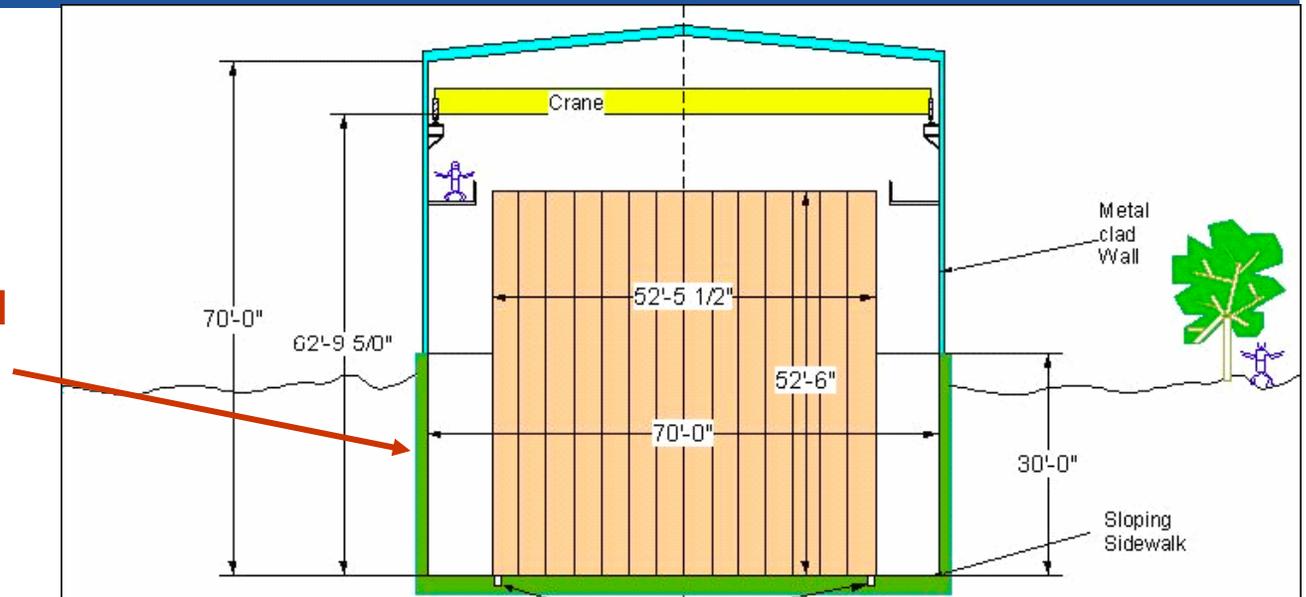
Detector has 248 sub-blocks





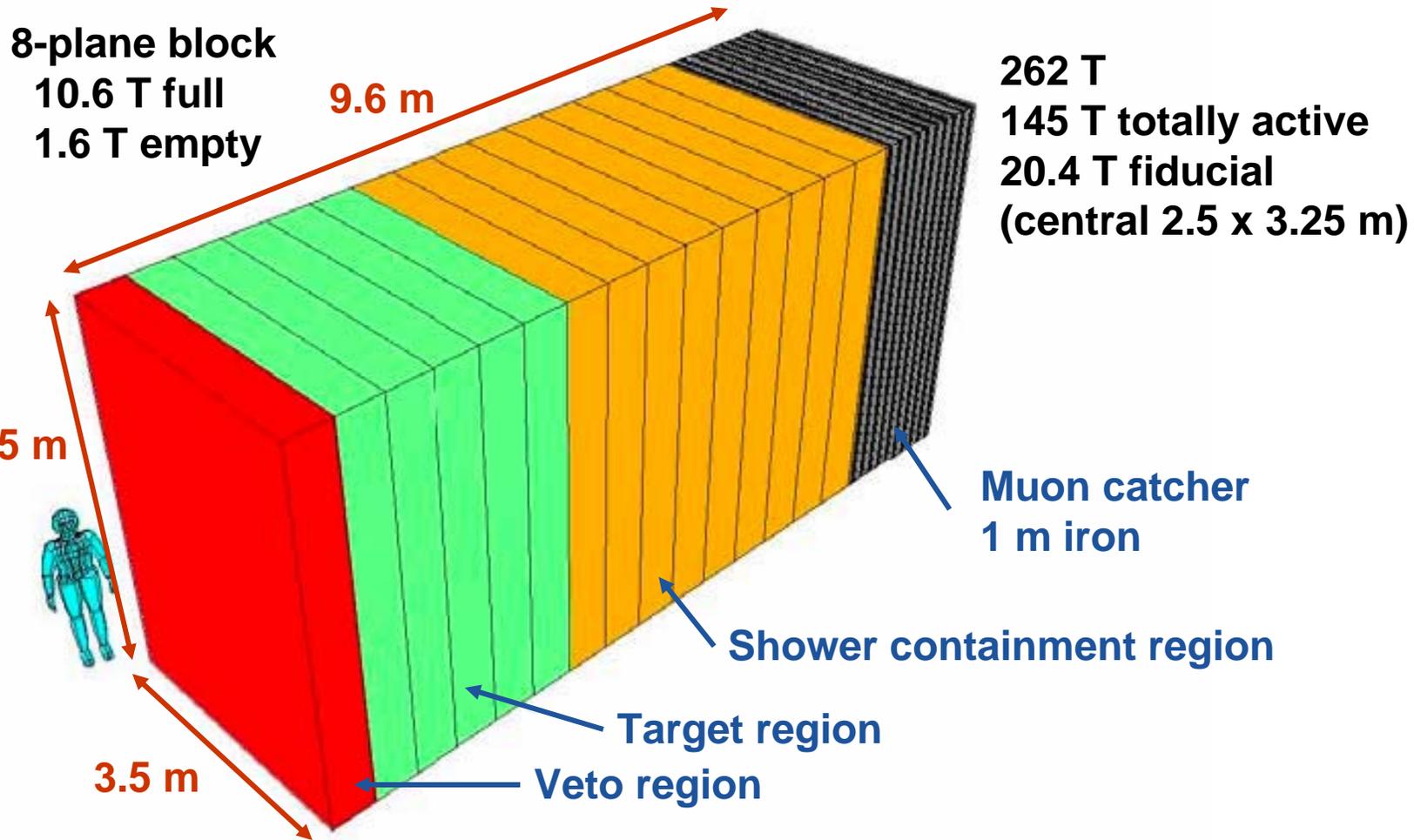
Far Detector Building

Bathtub for full containment



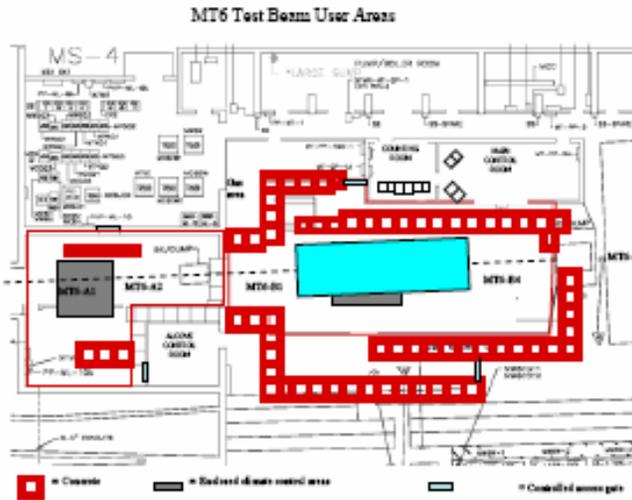


Near Detector

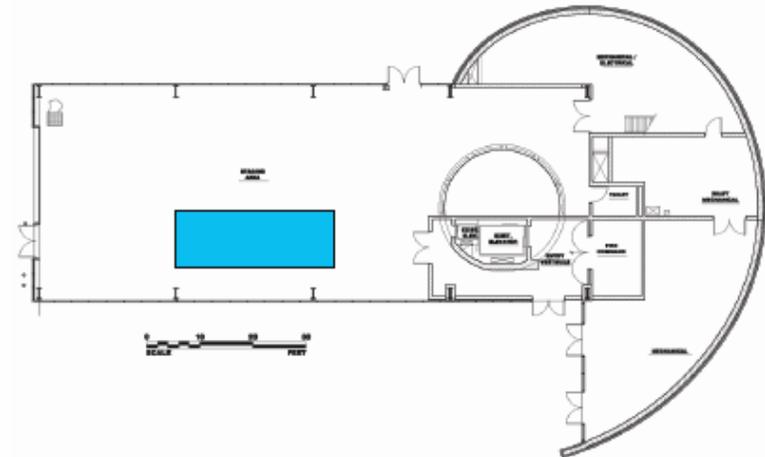




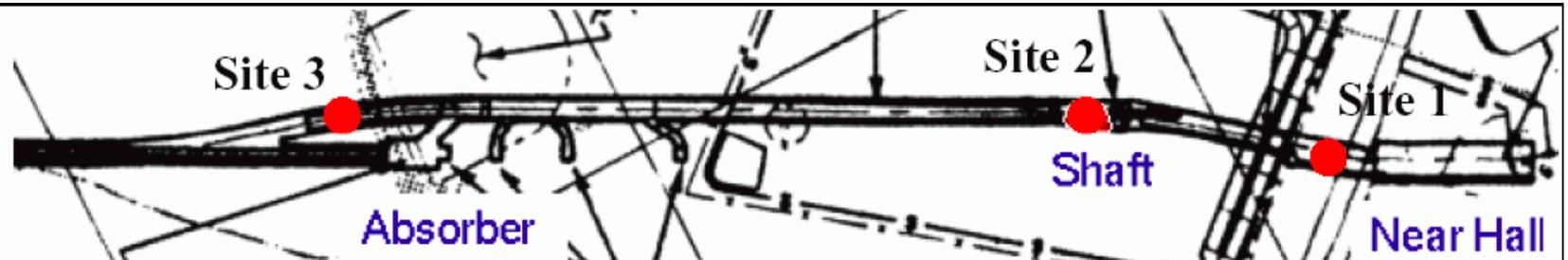
Near Detector: Modular and Mobile



M Test



MINOS Surface Building



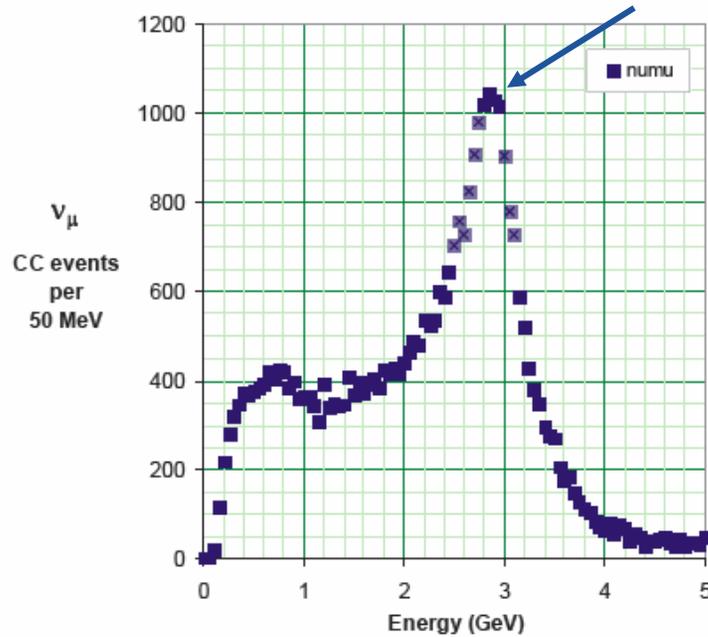
NuMI Access Tunnel



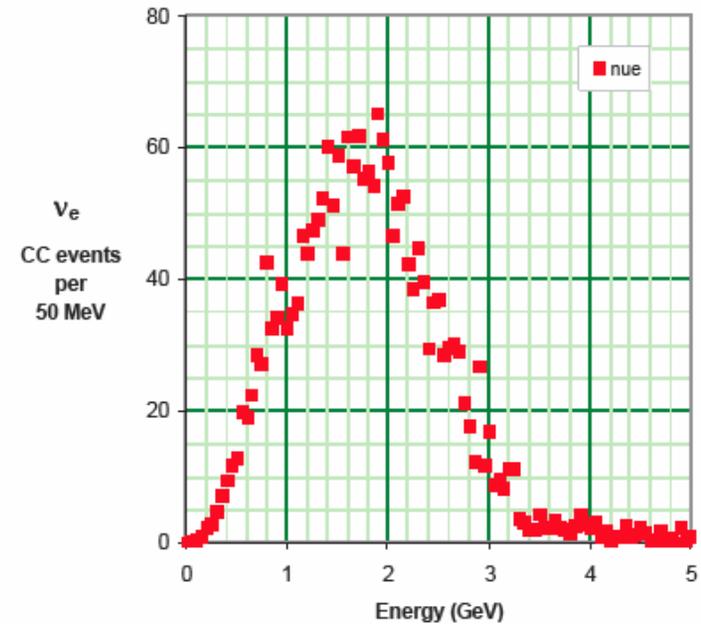
Near Detector in MINOS Surface Building

6.5×10^{20} pot in 75 mrad off-axis beam

Kaon peak



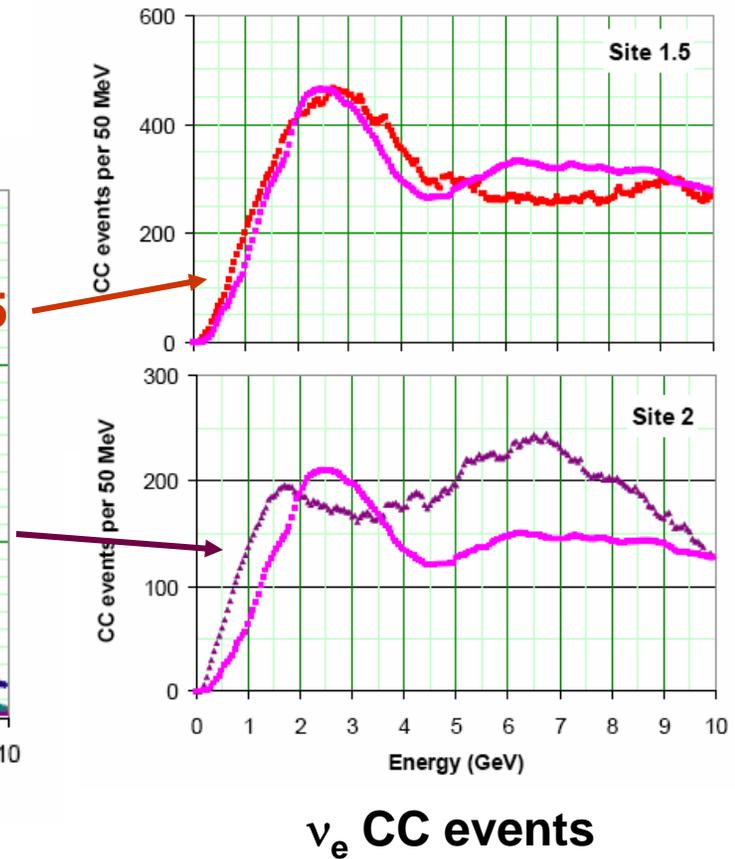
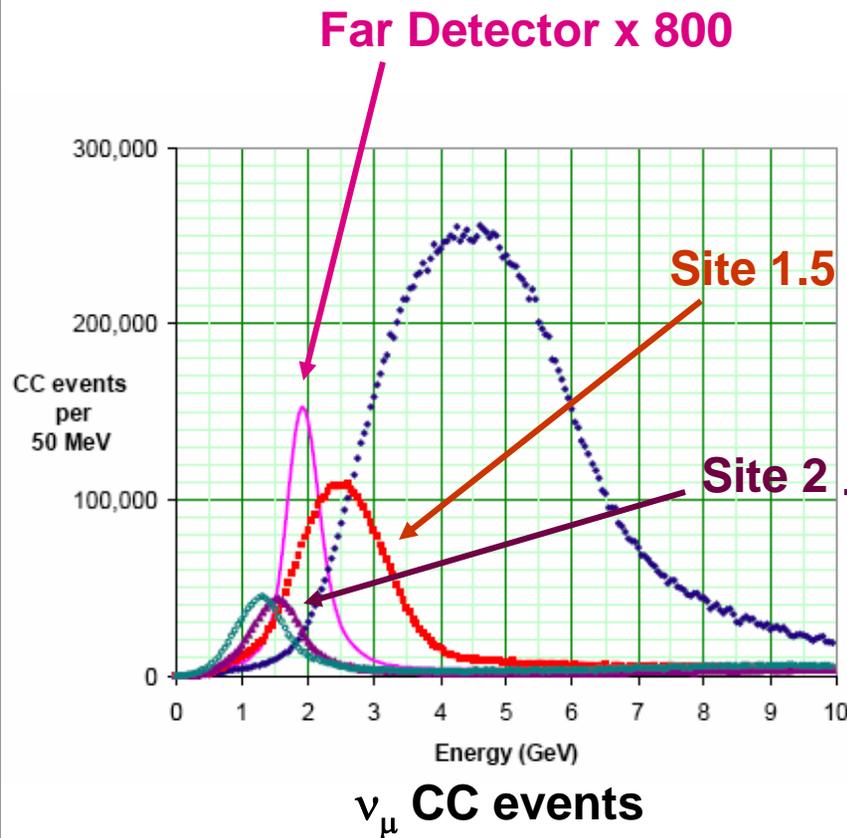
45,000 ν_μ CC events



2,200 ν_e CC events



Near Detector in the Access Tunnel





Light Measurement

- **First light measurements are low compared to expectation by 13%.**

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

**Measurements
in progress at
Minnesota on
a full length
prototype**

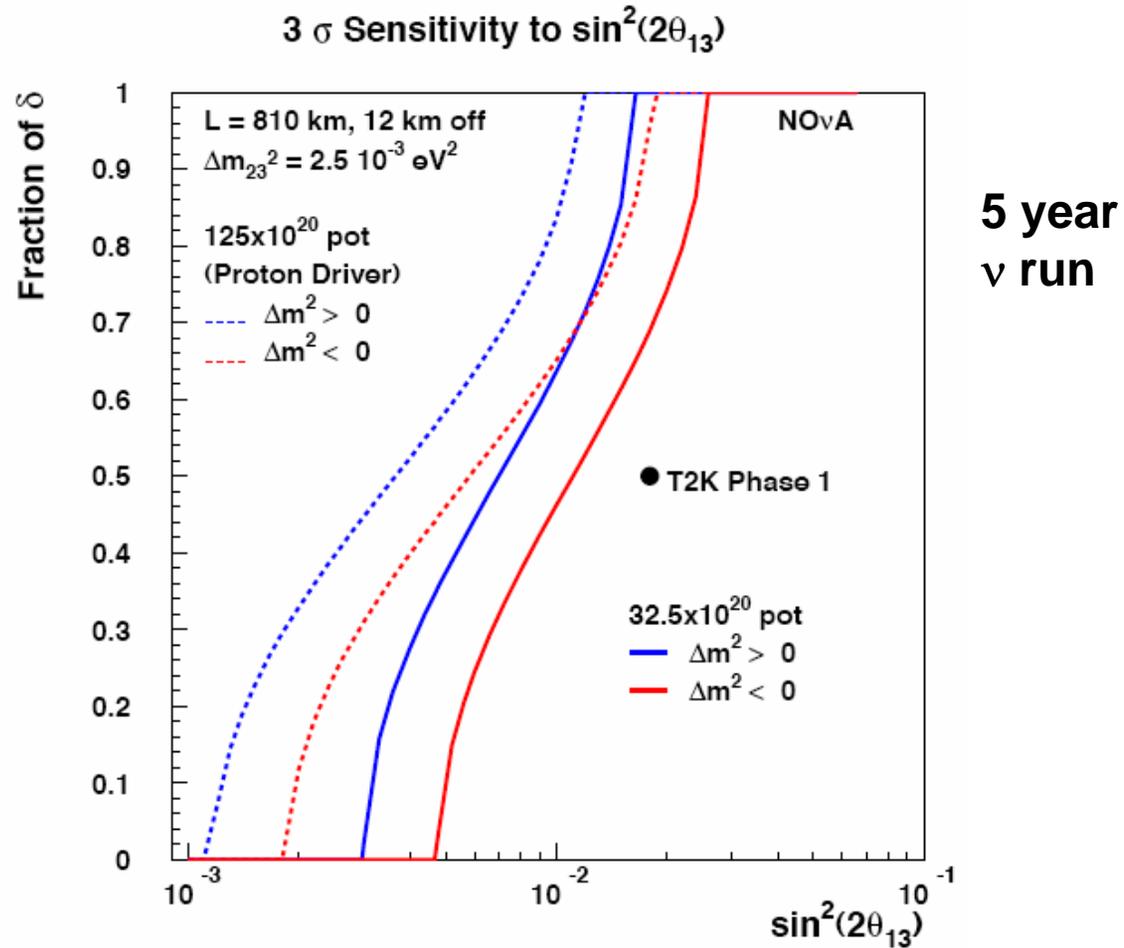


Post-Collider Proton Plan

- **Proton Plan with Collider**
 - 9/11 Slip-stacked Booster batches at 5.5×10^{12} p/batch
 - Repetition rate = 0.8 s (Booster) + 1.4 s (Ramp) = 2.2 s
 - 10% for Collider shot setup + 5% for antiproton transfer
 - $\Rightarrow 3.4 \times 10^{20}$ protons/yr
- **Post-Collider Proton Plan**
 - 11 batches for neutrinos $\Rightarrow 11/9 = 1.22$ factor
 - Hide Booster filling time in Recycler $\Rightarrow 0.8$ s $\rightarrow 0.067$ s
 $\Rightarrow 2.2$ s $\rightarrow 1.467$ s = 1.50 factor
 - Save 10% shot setup and 5% antiproton transfer = 1.17 factor
 - $\Rightarrow (3.4 \times 10^{20} \text{ protons/yr})(1.22)(1.50)(1.17) = (7.3 \times 10^{20} \text{ protons/yr})$
- **Negotiated rate is 90% of this: $(6.5 \times 10^{20} \text{ protons/yr})$**

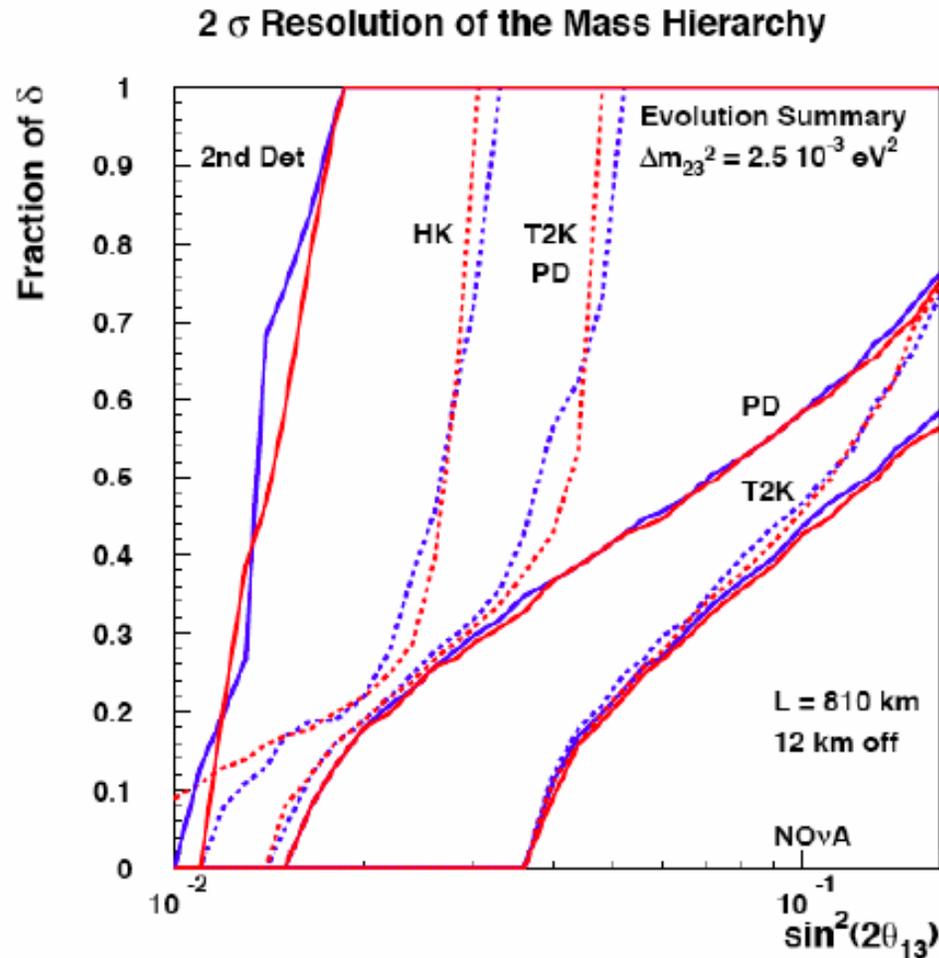


3 σ Sensitivity to $\nu_{\mu} \rightarrow \nu_e$





2 σ Resolution of the Mass Hierarchy



3 years
each ν and
 $\bar{\nu}$ -bar runs

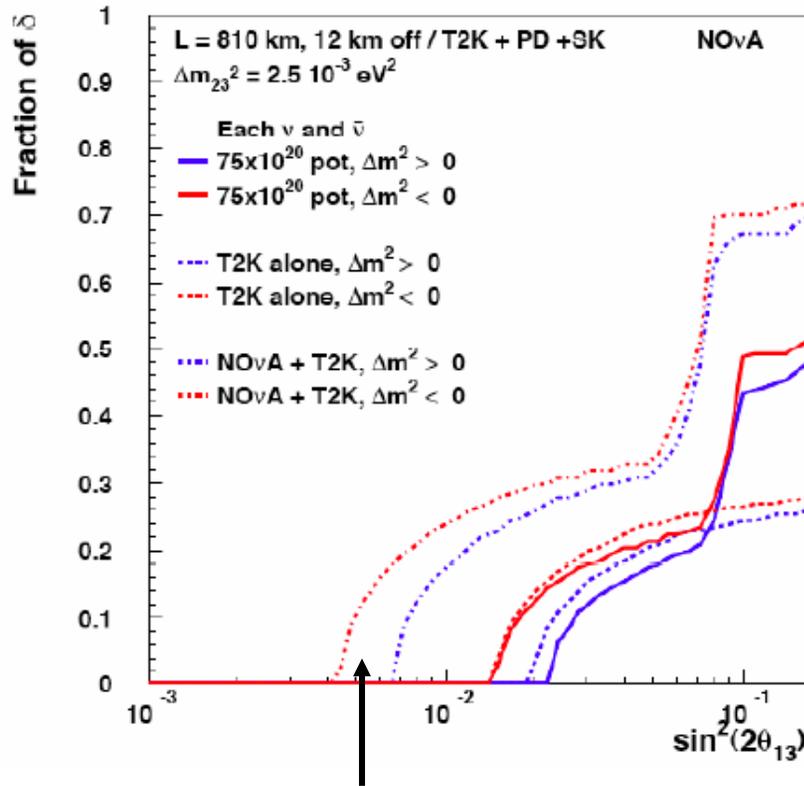
Note:

$\Delta m_{21}^2 \sin^2(2\theta_{12})$
has increased
by 16%



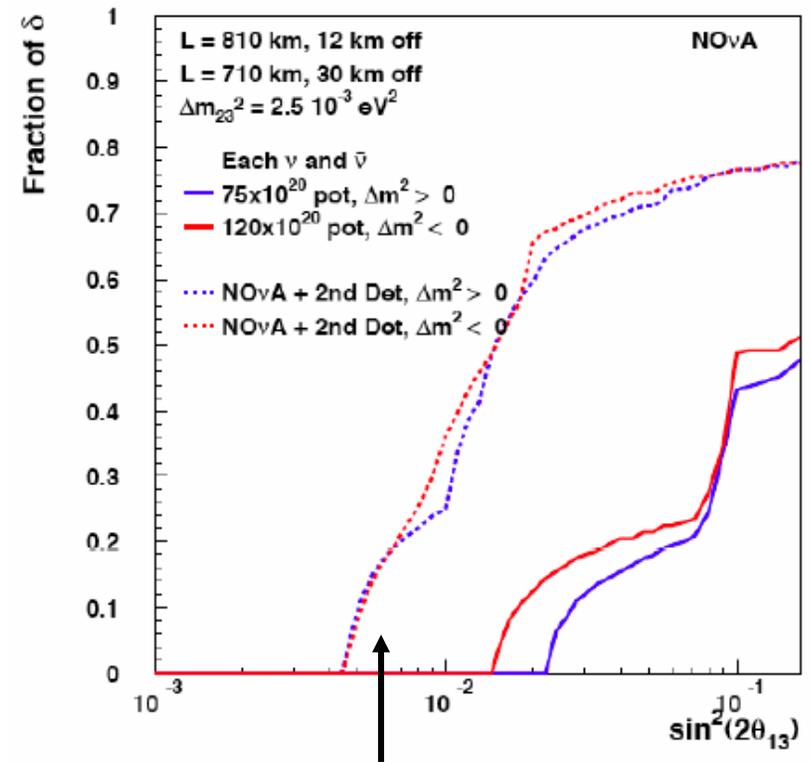
3 σ Determination of CP Violation

3 σ Determination of CP Violation



NOvA with upgraded T2K to SK

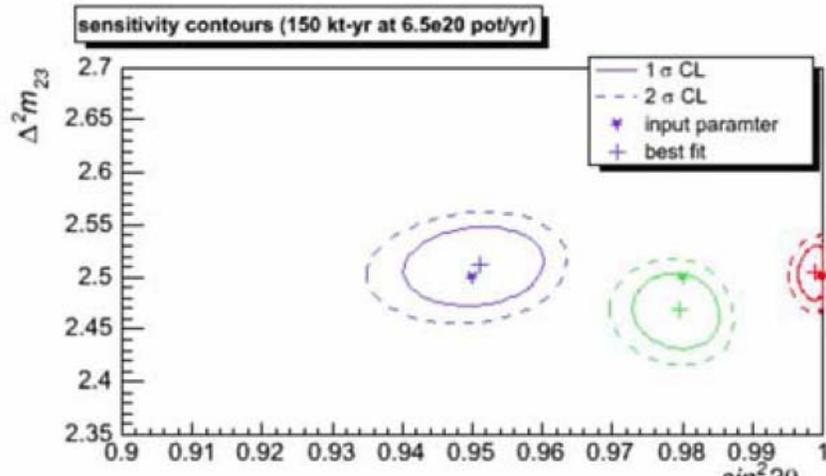
3 σ Determination of CP Violation



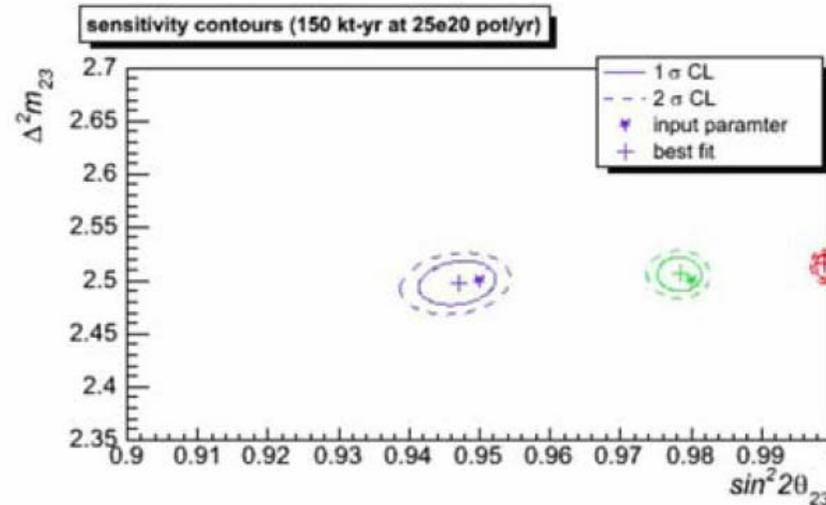
NOvA with 2nd NuMI off-axis detector



Measurement of Δm_{32}^2 and $\sin^2(2\theta_{23})$



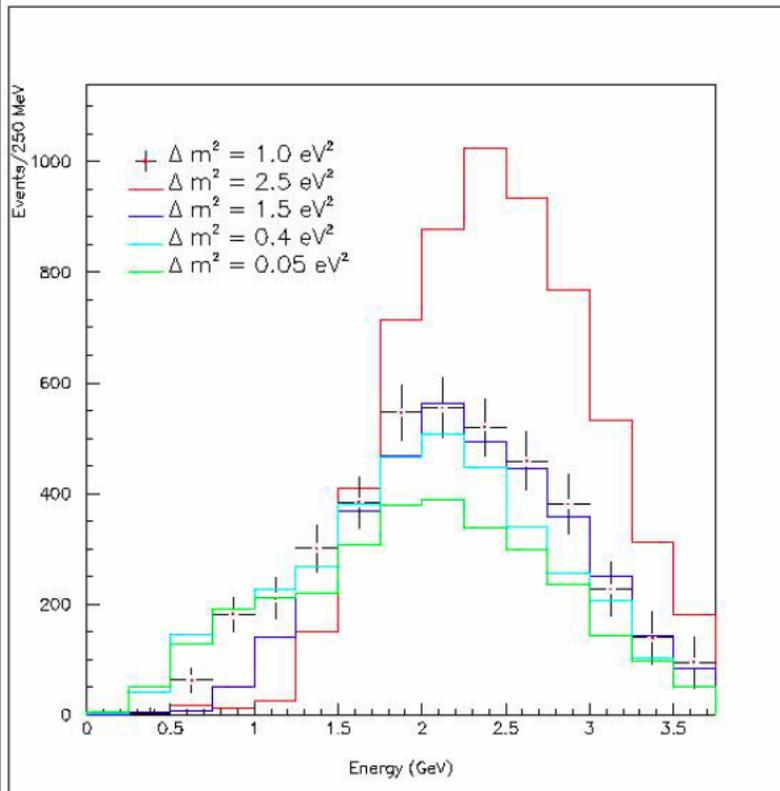
5-year ν run



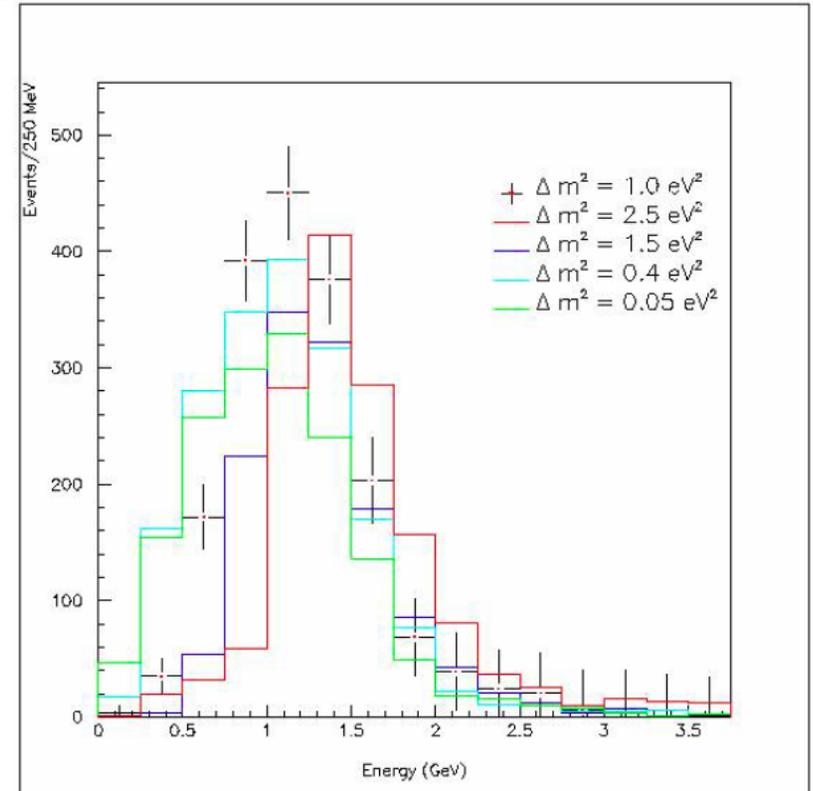
5-year ν run
with Proton Driver



Study MiniBooNE Signal



Site 1.5

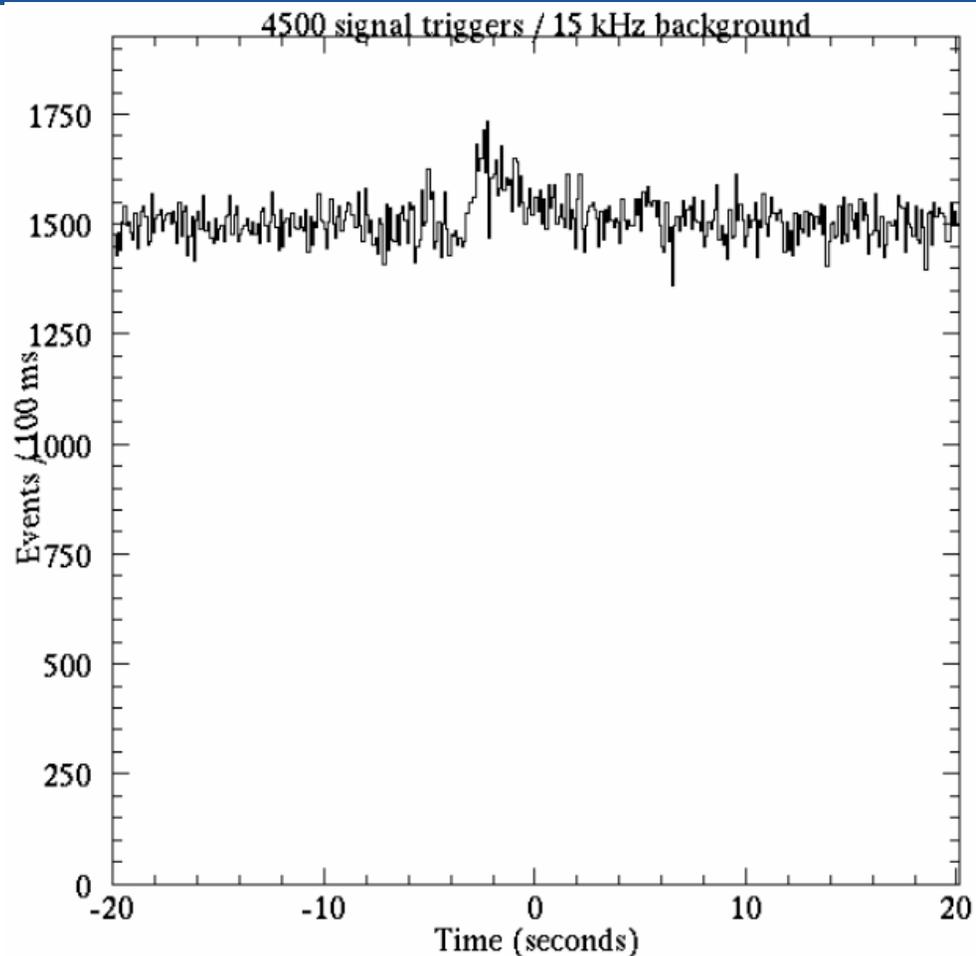


Site 3

1-year ν run



Sensitivity to a Galactic Supernova



**1800 events in
the 1st second
for a supernova
10 kps away**



Cost

	Contingency	Total Cost M\$
Far Detector		
Active detector	30%	79.5
Electronics and DAQ	55%	13.4
Shipping	21%	7.0
Installation	43%	13.5
Near Detector	44%	3.1
Building and outfitting	58%	29.3
Project management	25%	4.7
Additional contingency		14.1
Total	50%	164.7



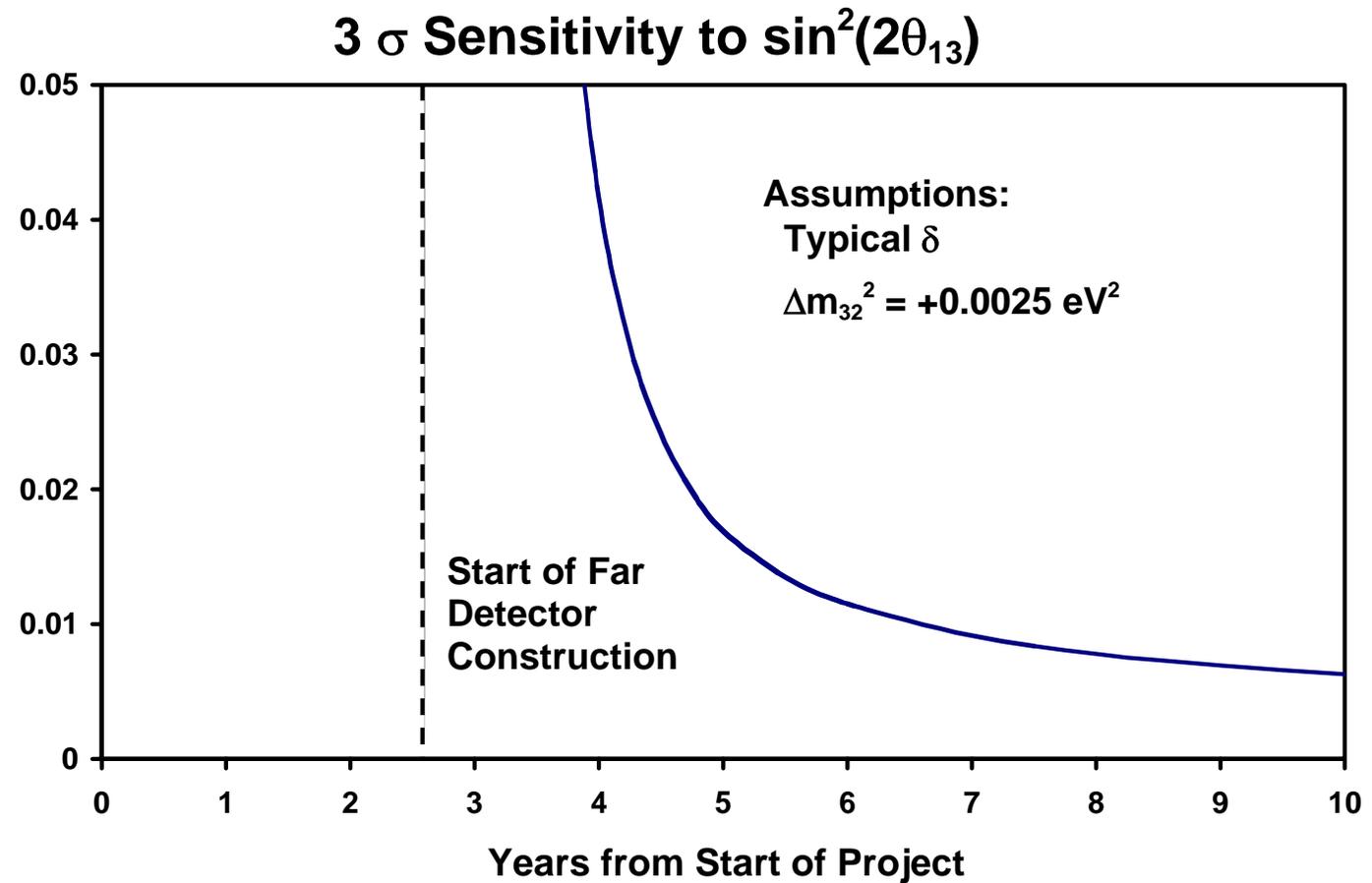
Schedule

(10 of 29 Milestones)

Project start	Oct 2006
R&D prototype Near Detector complete	Mar 2007
Site work complete	Jul 2007
Start receiving packaged APDs	Oct 2007
Start extrusion module factories	Oct 2007
Start construction of Near Detector	Dec 2007
Start operation of Near Detector	Jul 2008
Start Far Detector construction	May 2009
First kiloton operational	Oct 2009
Full 30 kilotons operational	Jul 2011



Sensitivity vs. Time





Outlook

- **Assuming that we can get on the fast track we are proposing, there is a great deal of R&D and conceptual design that needs to be done quickly. (\$3M R&D request).**
- **Next collaboration meeting Thu-Fri, May 5-6 at Fermilab**