The NOvA Experiment

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http://www-nova.fnal.gov

3rd Workshop on Physics with a high intensity proton source
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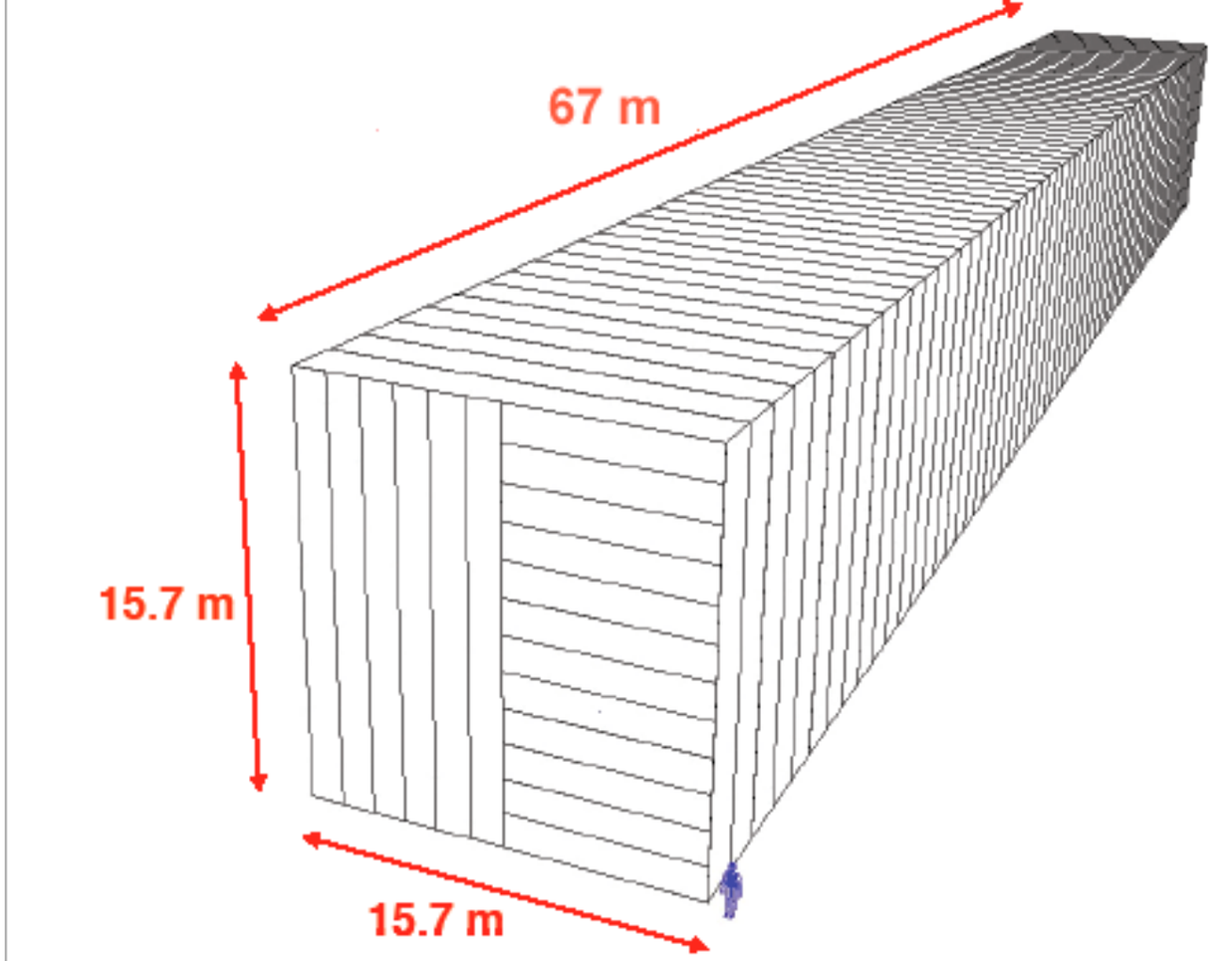
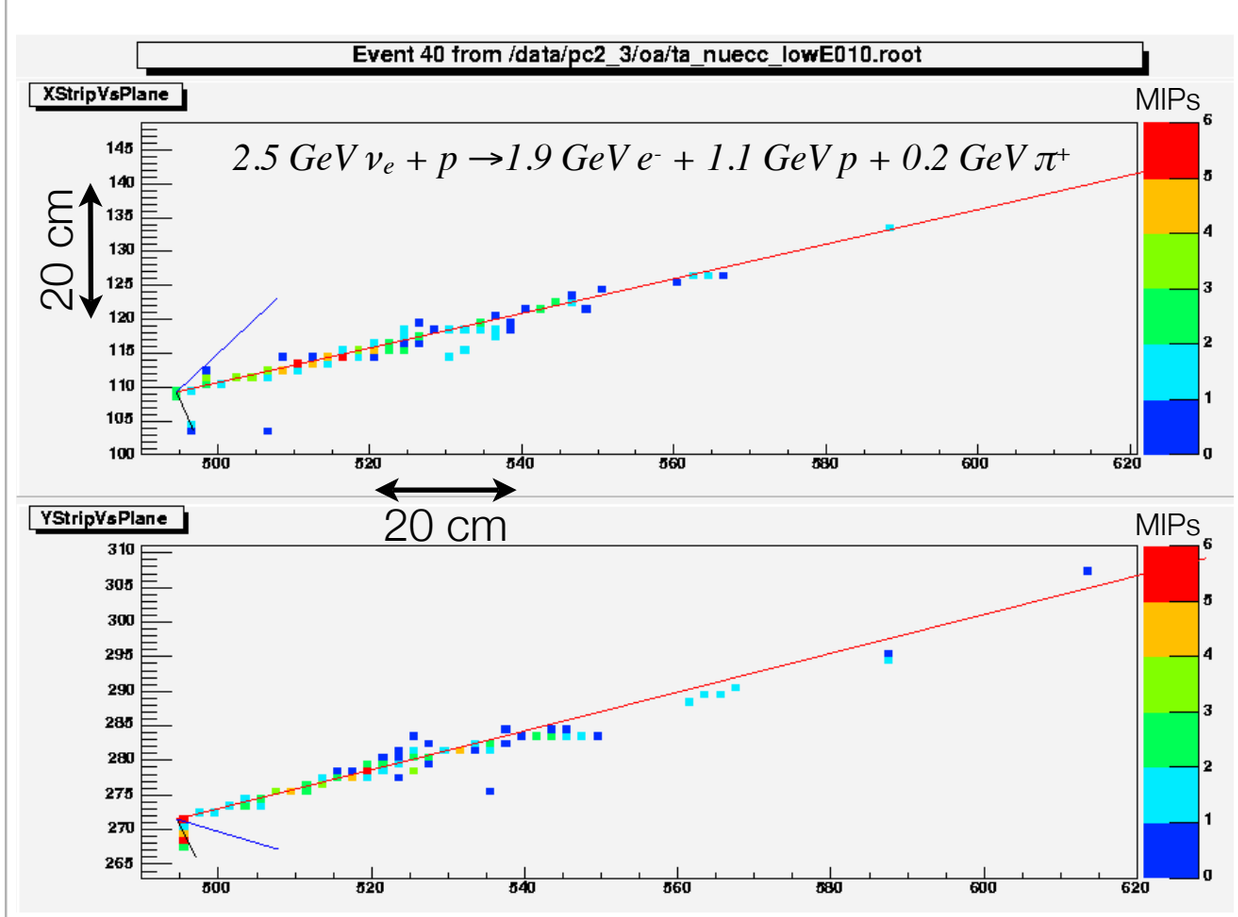
Fermilab

The NOvA Experiment

- NOvA is a second generation experiment on the NuMI beamline which is optimized for the detection of $\nu_\mu \rightarrow \nu_e$ and $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ oscillations
- NOvA is:
  - An upgrade of the NuMI beam intensity from 400 kW to 700 kW
  - A 15 kt “totally active” tracking liquid scintillator calorimeter sited 14 mrad off the NuMI beam axis at a distance of 810 km
  - A 215 ton near detector identical to the far detector sited 14 mrad off the NuMI beam axis at a distance of 1 km





Questions for the future

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4) Is θ_{23} maximal (45 degrees)? if so, why? Will the pattern of neutrino mixing provide insights regarding unification of the fundamental forces? Will it indicate new symmetries or new selection rules?

5) Are neutrinos their own antiparticles? Do they give rise to lepton number violation, or leptogenesis, in the early universe? Do they have observable laboratory consequences such as the sought-after neutrinoless double beta decay in nuclei?

6) What can we learn from observation of the intense flux of neutrinos from a supernova within our galaxy? Can we observe the neutrino remnants of all supernovae that have occurred since the beginning of time?

7) What can neutrinos reveal about other astrophysical phenomena? Will we find localized cosmic sources of very-high-energy neutrinos?

8) What can neutrinos tell us about new physics beyond the Standard Model, dark energy, extra dimensions? Do sterile neutrinos exist?

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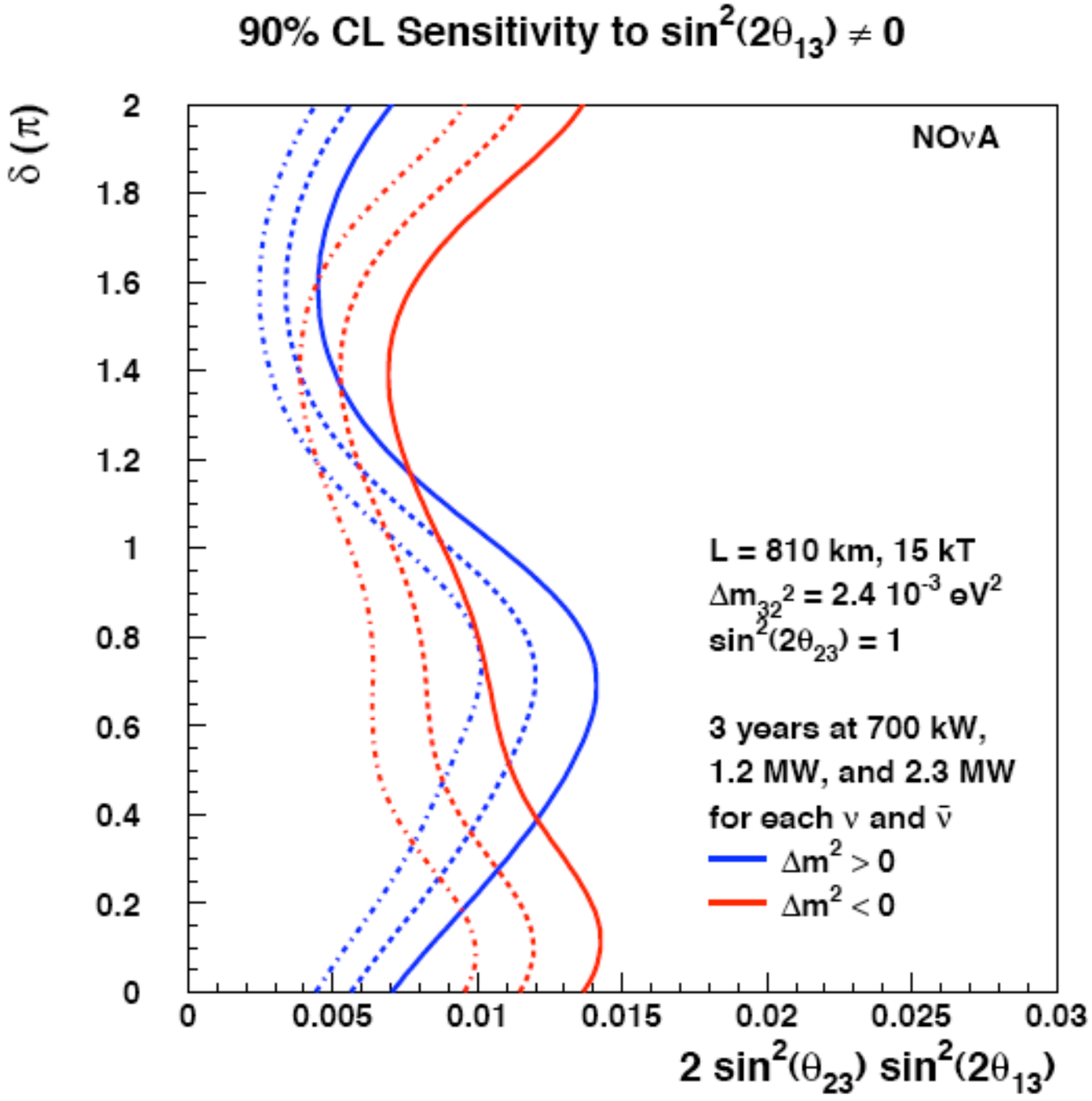

NOvA searches for electron neutrino appearance down to ~0.01 at 90% CL

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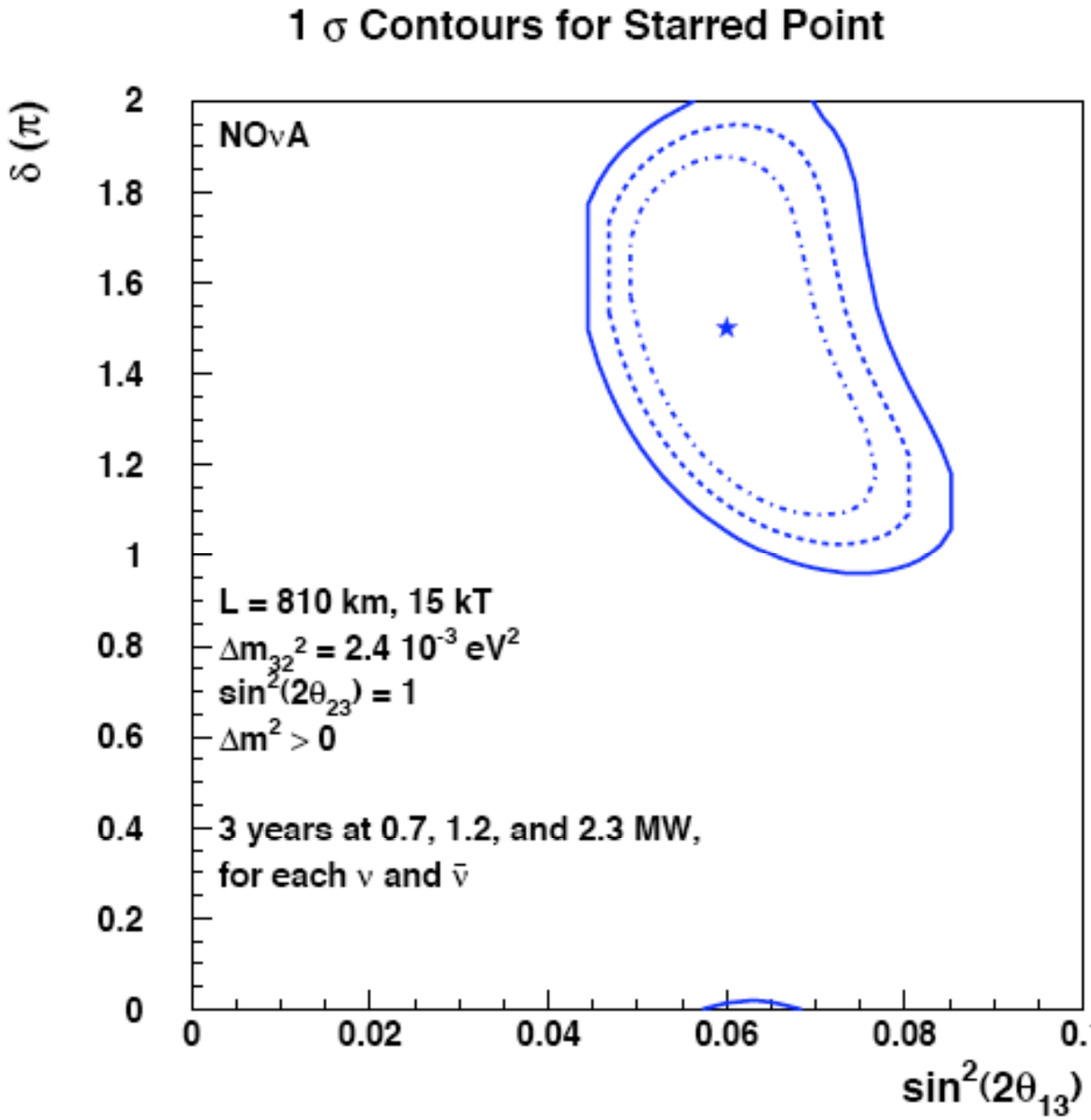

NOvA provides the first look into the CPV parameter space

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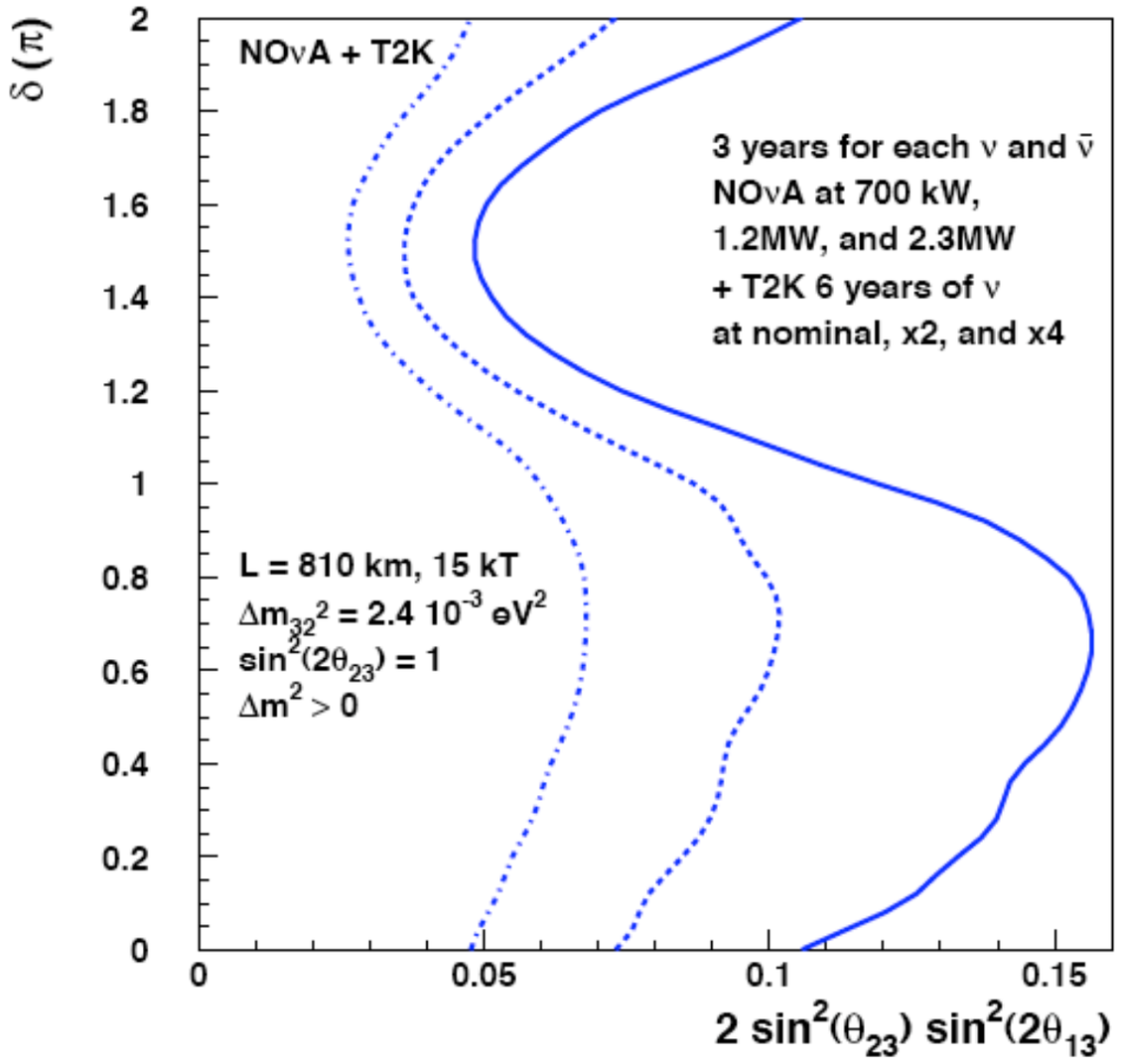

NOvA's long baseline makes it sensitive to the mass ordering

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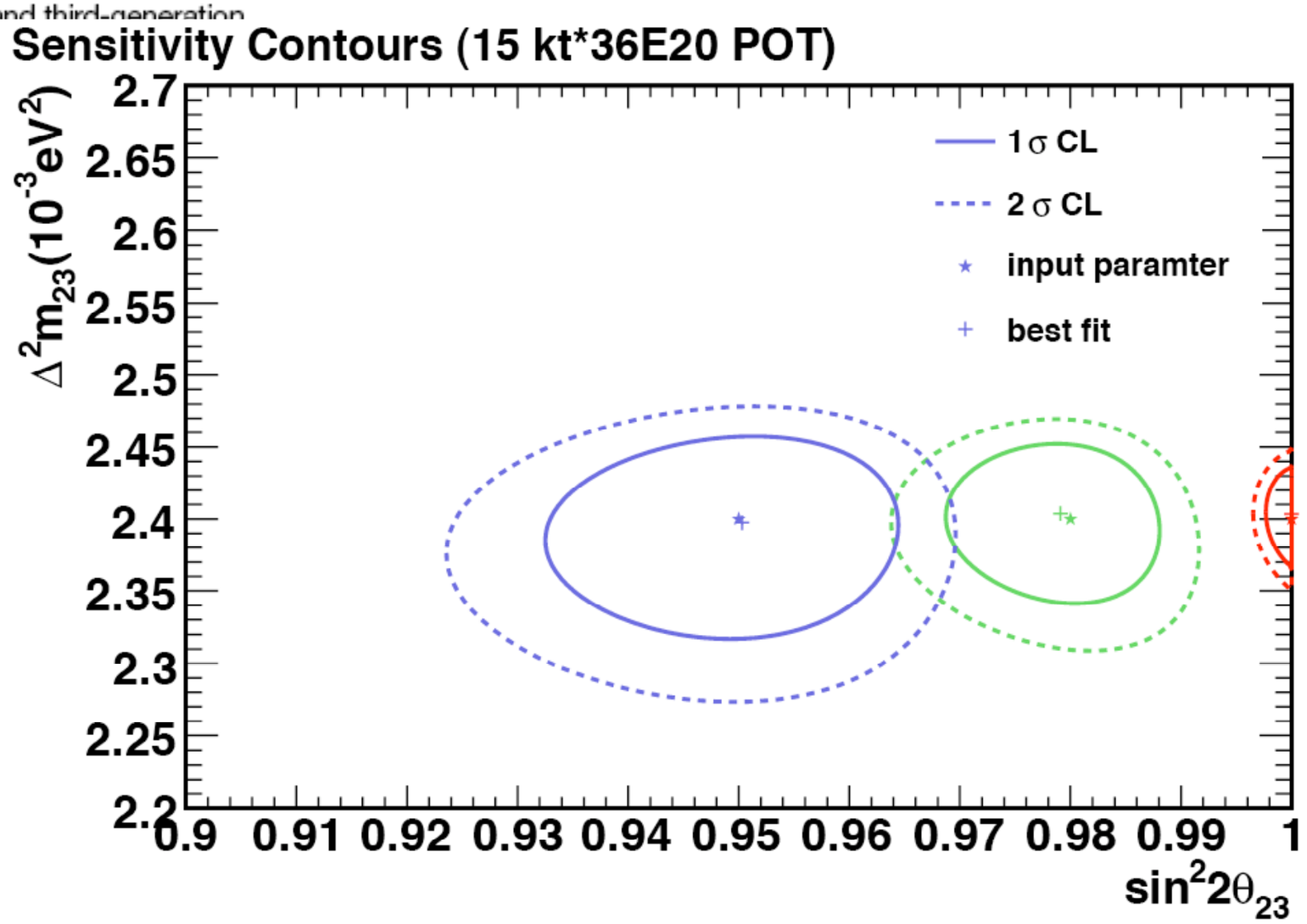

Because of its excellent energy resolution NOvA can make ~1% measurements of muon neutrino disappearance using quasi-elastic channel

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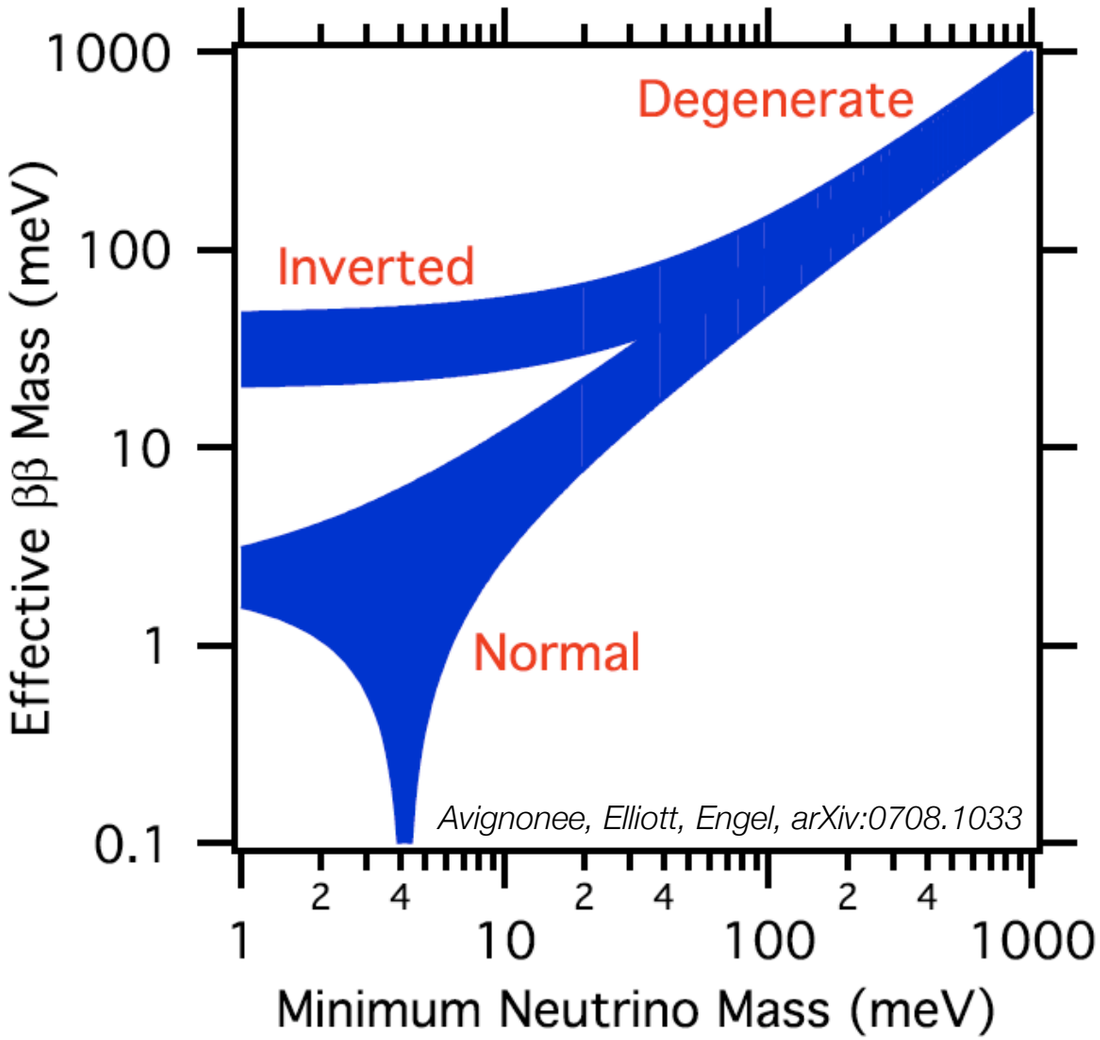

If NOvA establishes inverted hierarchy and next generation of 0νββ experiments see nothing, then it is very likely that neutrinos are Dirac particles

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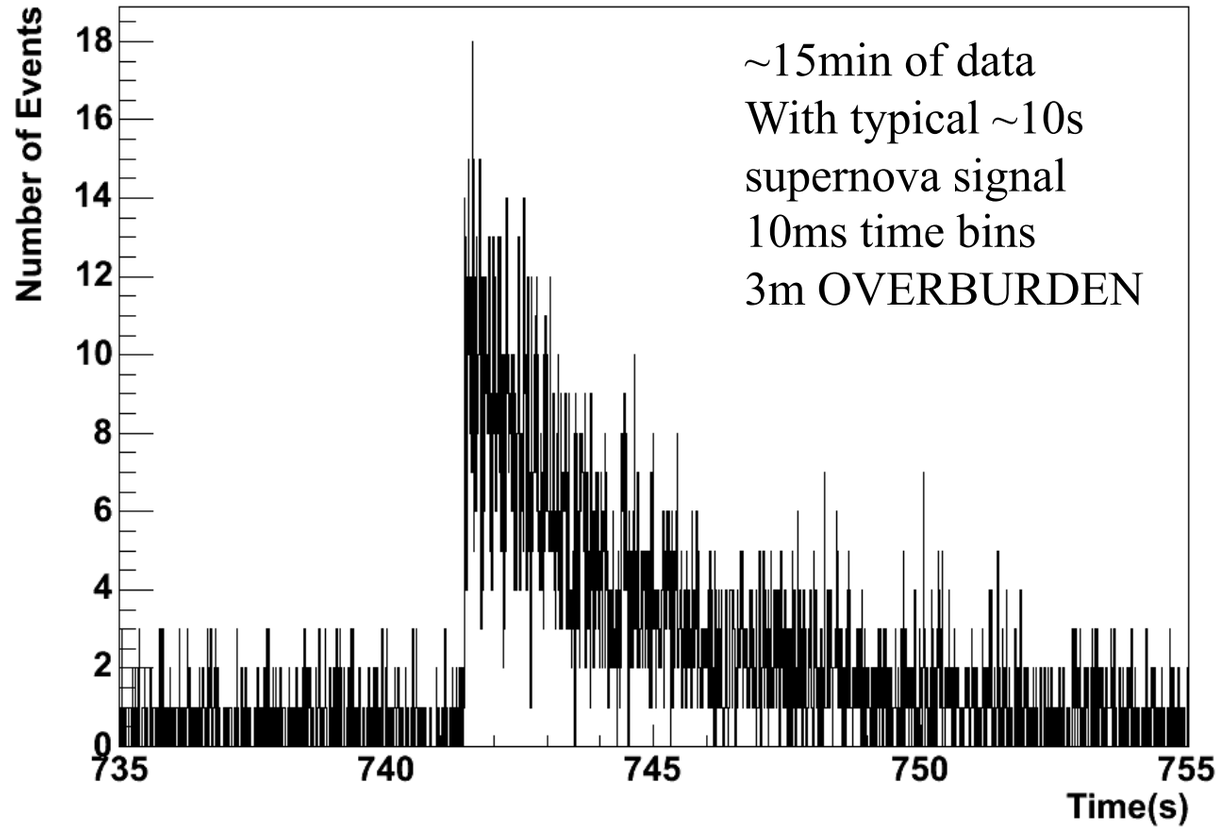

NOvA would see burst of 5000 events for a supernova at the center of the galaxy

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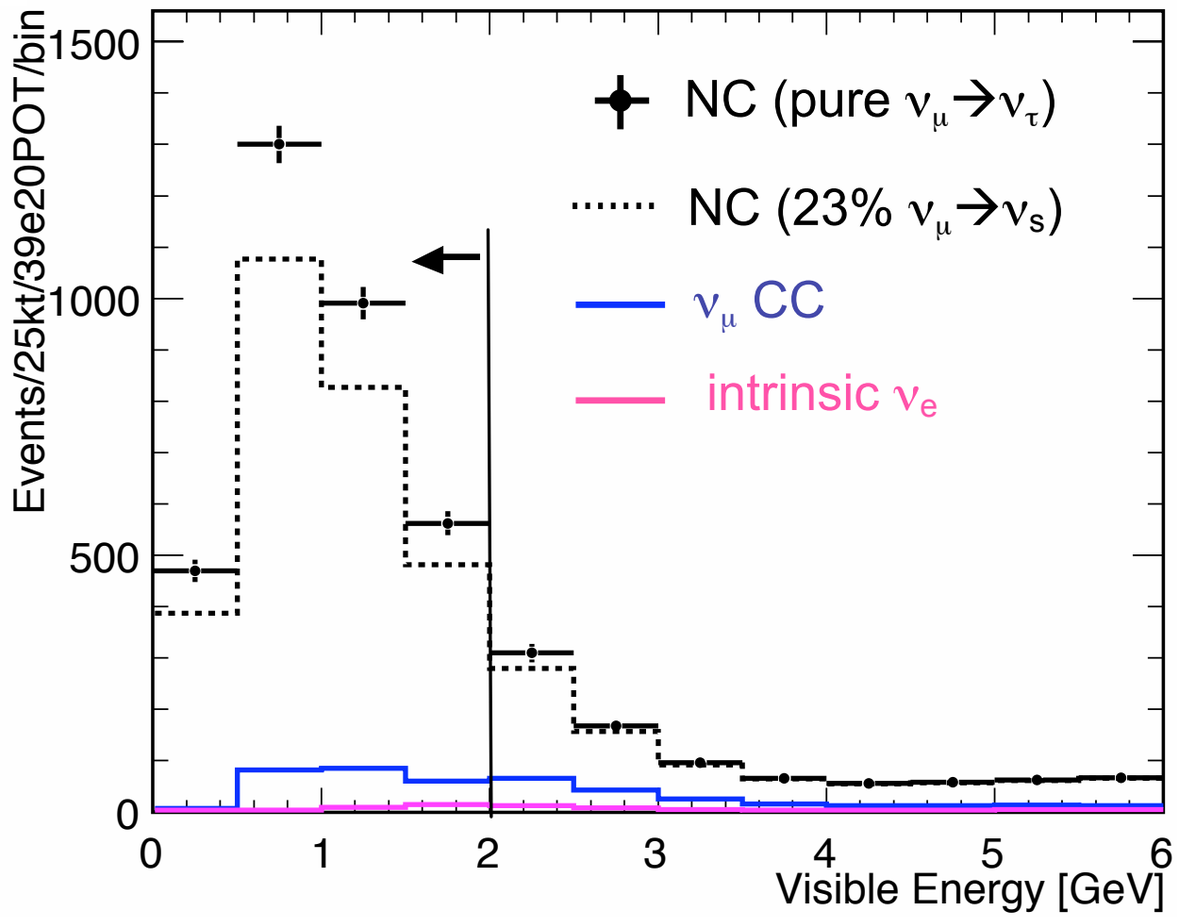
Reconstructed visible energy for NC sample



NOvA's granularity allows for clean neutral-current measurements facilitating searches for sterile neutrinos

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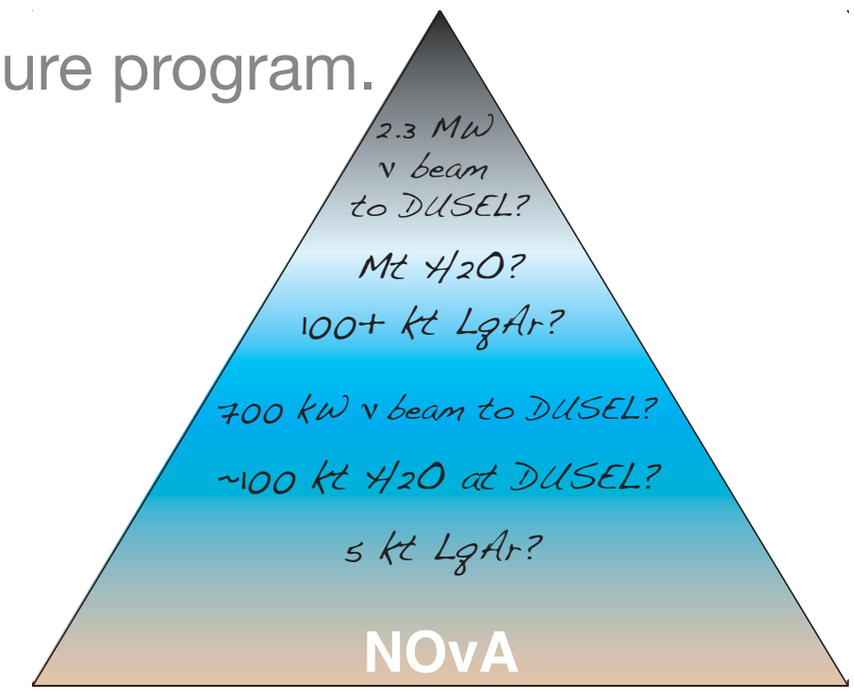
Schedule

- Despite FY08 omnibus work continues
  - NOvA passed DOE Office of Science CD2/3a in Oct. 2007.
  - Passed External Independent Review (EIR) in Nov. 2007
  - FY08 Omnibus required repeats. Passed DOE Office of Science CD2 review again in April 2008. EIR scheduled for June 19.
  - Expect CD3a in Feb. 2009, CD3b in Sept. 2009
    - Were it not for the omnibus, construction would have started 3 months ago
- Cost & schedule adjusted to include FY08 omnibus and anticipated 4 month continuing resolution in FY09
  - Start of construction April 2009
  - First 2.5 kt taking data August 2012
  - Detector complete January 2014
- NOvA construction schedule is driven by funding profile. We know what we want to build and we could build it faster.

NOvA and the P5 roadmap

NOvA is the foundation of the US accelerator neutrino program

- It addresses 7 of the 8 physics questions called out by P5 as the focus of the neutrino program over the next decade
- Among the next generation experiments, NOvA uniquely provides information on the mass hierarchy and CP phase
- NOvA provides the incentive and continuity to increase the NuMI beam power from 400 to 700 kW and ultimately to 2.3 MW
- Ensures a robust future program.