NOvA Sensitivities in Light of T2K/MINOS Result

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For the Collaboration

Fermilab

Wine & Cheese Informal Discussion

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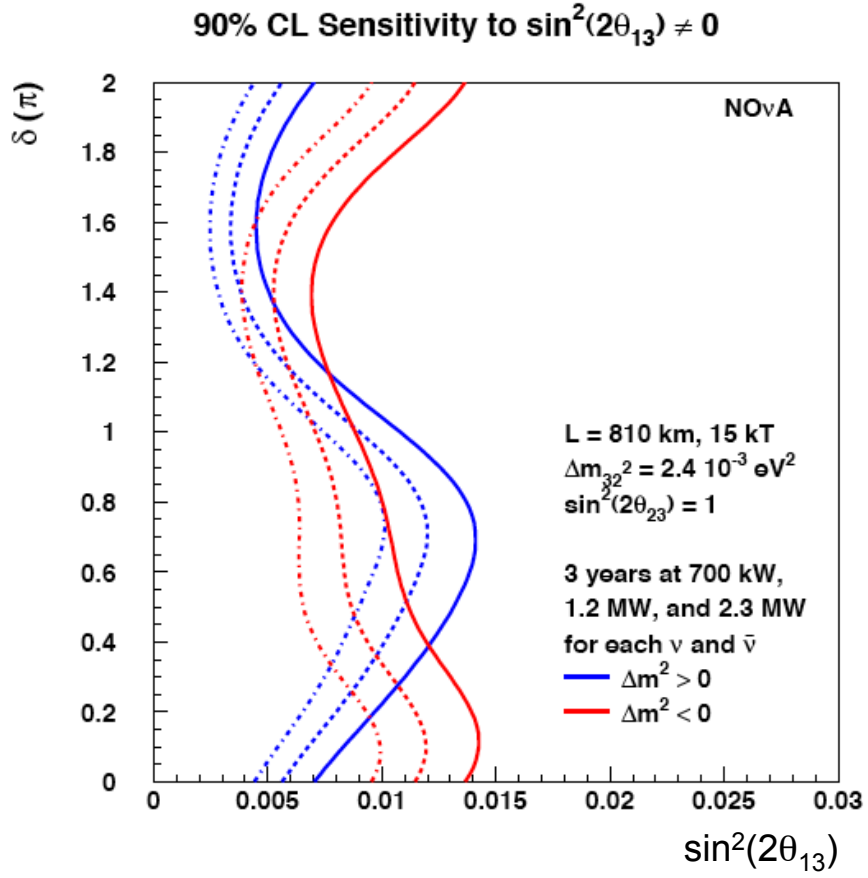
NOvA Physics Sensitivities

- Assumptions for the following plots
  - 15 kT Far Detector
  - 3 years running each for Forward and Reverse Horn Currents for neutrino and anti-neutrino beams
  - 3 beam power scenarios: 700 kW, 1.2 MW, 2.3 MW
- Scale of statistics
  - ~75 (30) signal events on background of 15 (8) events for 3 years (anti-)neutrino running
    - For $\delta_{CP}=0$, no matter effects, $\sin^2(2\theta_{13})=0.1$
- See

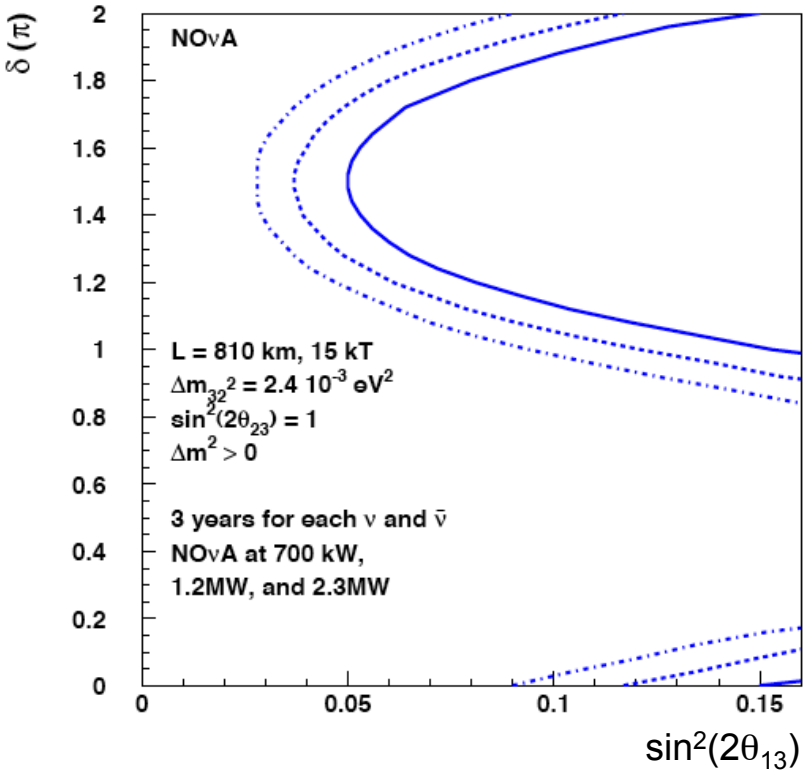
  http://www-nova.fnal.gov/plots_and_figures/plots_and_figures.html

Sensitivity to $\sin^2(2\theta_{13})\neq 0$

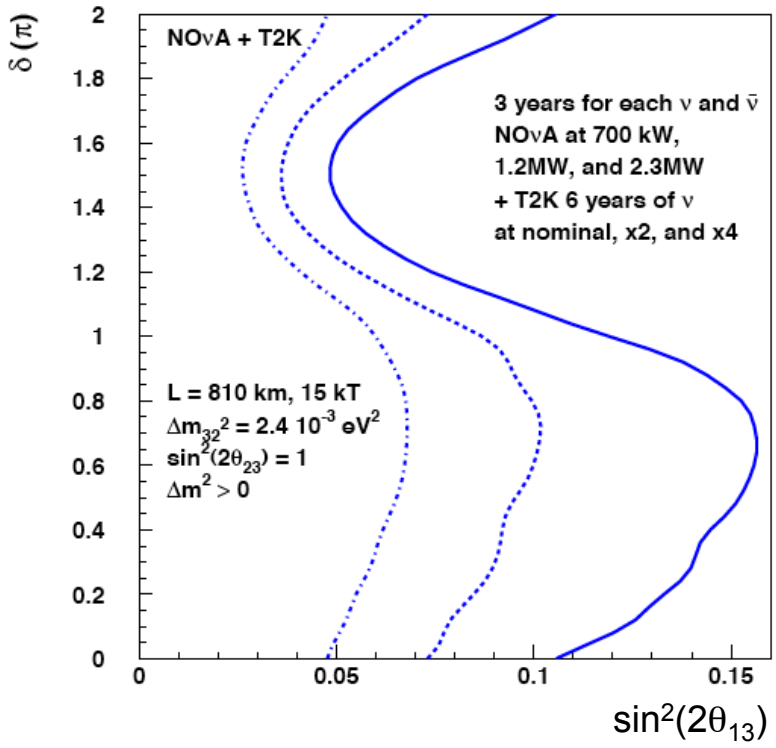


NOvA 90% CL is similar to 90% lower bound of Kopp/Parke fit for T2K and MINOS

95% CL Resolution of Mass Hierarchy (Normal Ordering)

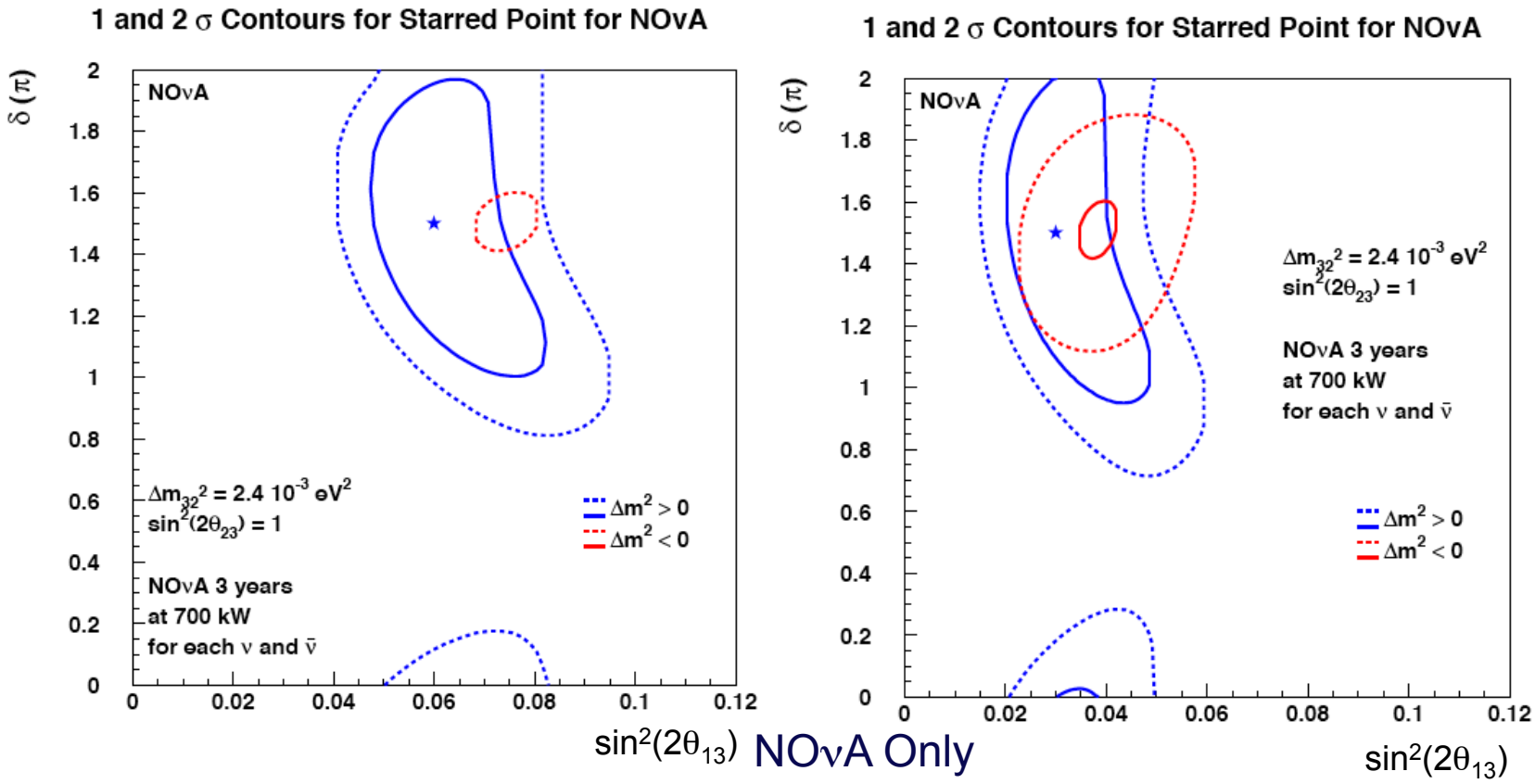


NOνA Only



NOνA + 6yrs T2K

Best-case δ for normal MH



NOνA Only

Both scenarios: δ constrained to upper half of plane

Left: MH resolved at 95% CL

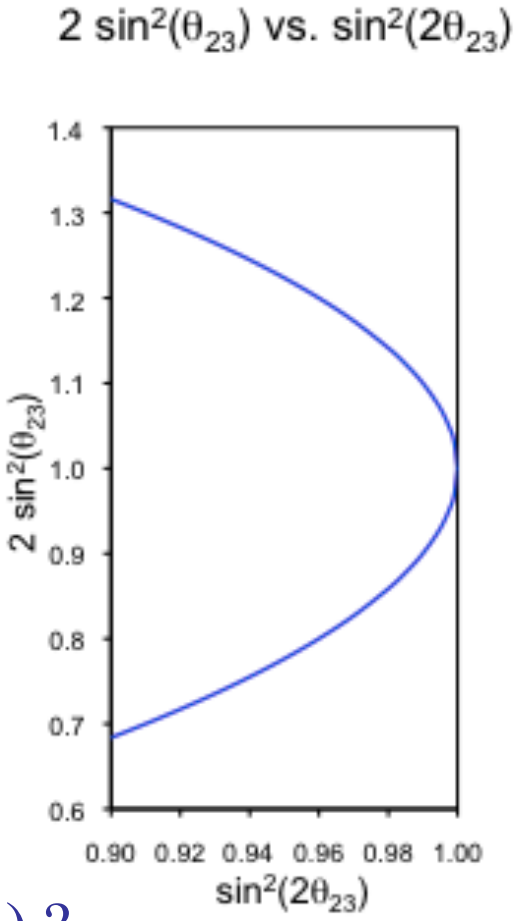
Right: MH not resolved

θ_{23} ambiguity

- Dominant term in $P(\nu_\mu \rightarrow \nu_e)$ for long-baseline accelerator is proportional to $\sin^2(\theta_{23})\sin^2(2\theta_{13})$
- But $\sin^2(2\theta_{23})$ is measured in long baseline ν_μ disappearance experiments

  Difference is significant for $\theta_{23} \neq \pi/4$
- Fortunately, reactor experiments are sensitive to $\sin^2(2\theta_{13})$ without θ_{23} factor
- Comparison of LB appearance and Reactor results can allow resolution ambiguity:

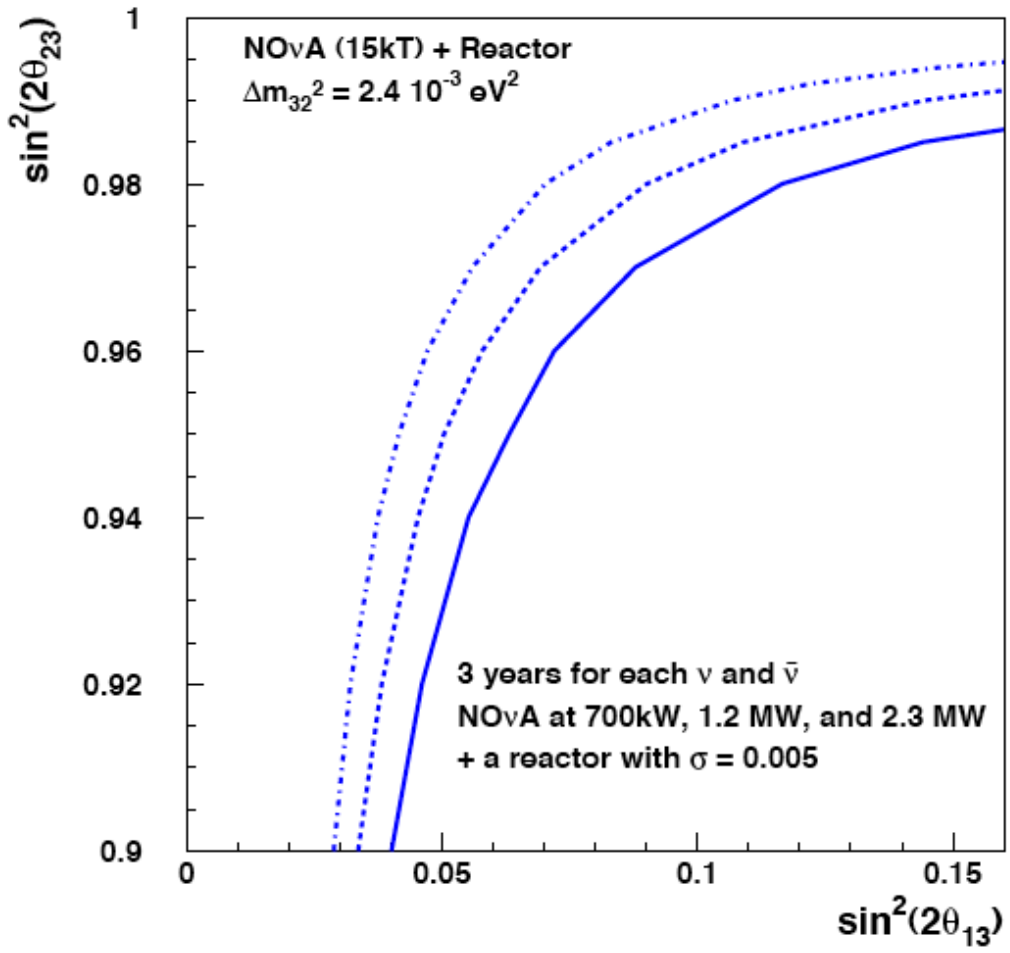
  does ν_3 have more ν_μ ($\theta_{23}<\pi/4$) or ν_τ ($\theta_{23}>\pi/4$) ?



95% CL Resolution of θ_{23} Ambiguity

The curves represent an average over mass hierarchy, CP phase δ, and sign of θ_{23} ambiguity.

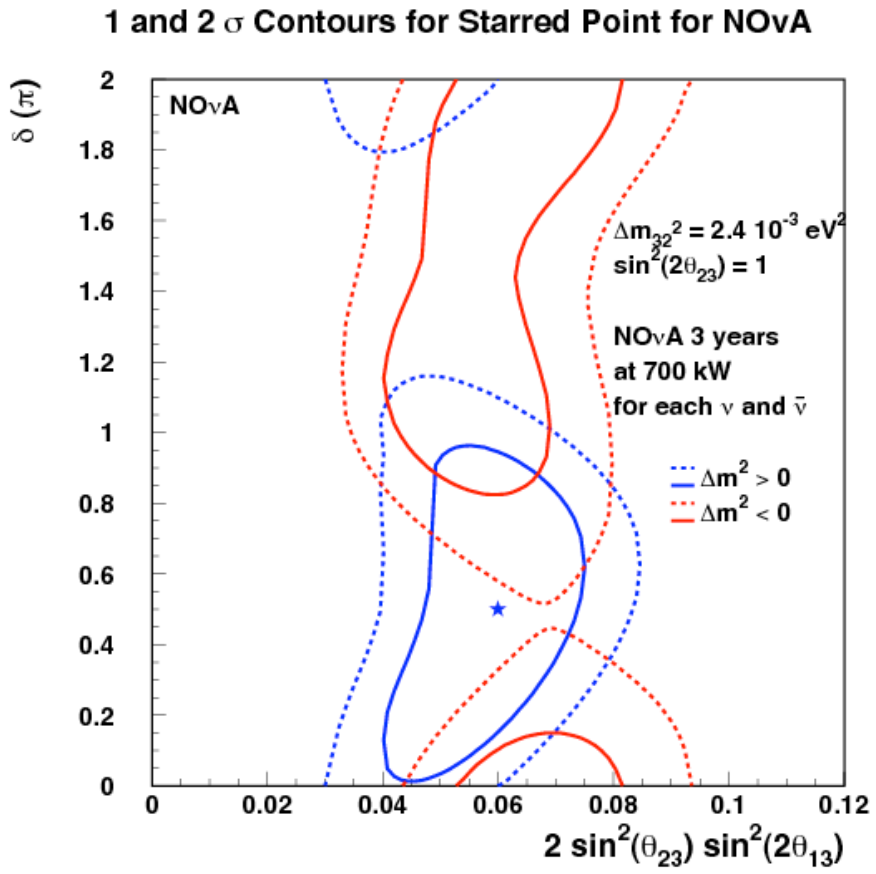
At central value from KP fit, NOνA resolves θ_{23} ambiguity for $\sin^2(2\theta_{23}) < \sim 0.96$



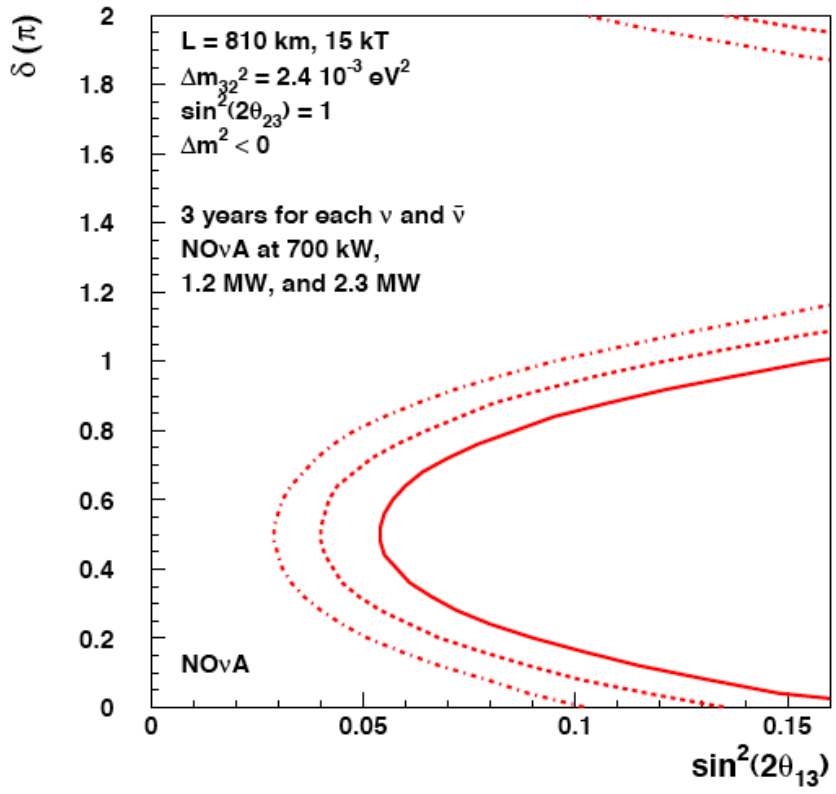
Summary

- θ_{13} range indicated by T2K/MINOS is encouraging for NOνA
  - The most difficult scenarios (very small θ_{13}) appear to be less likely
  - The larger θ_{13} is within the T2K/MINOS range, the more we can do
- Not a "game changer" in terms of NOνA strategy

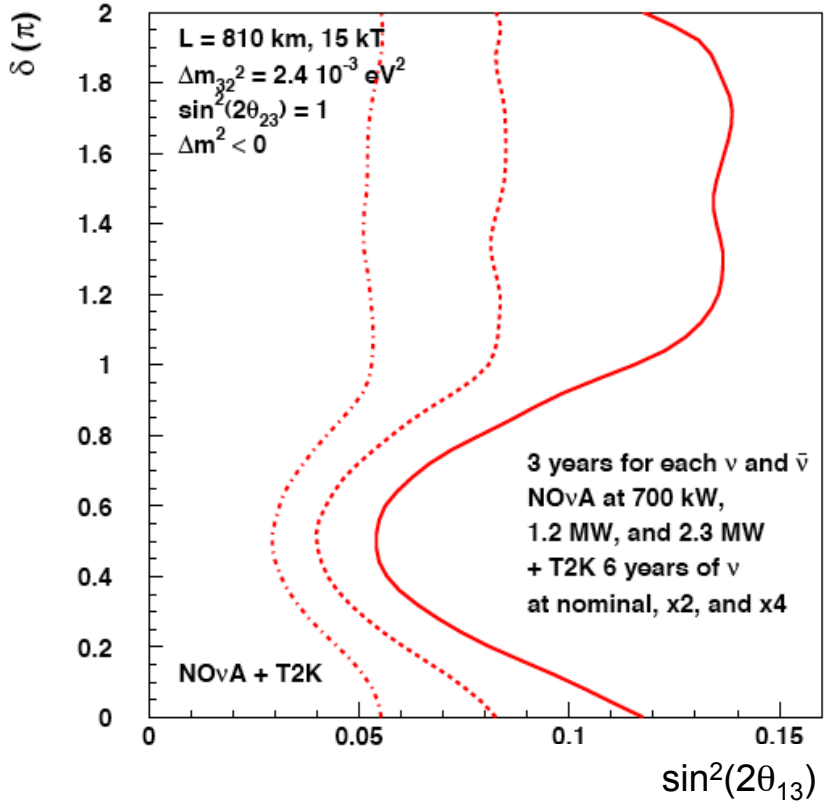
Unfavorable δ for normal MH



95% CL Resolution of Mass Hierarchy (Inverted Ordering)



NOνA Only



NOνA + 6 yrs T2K