Short-Baseline Sterile Neutrino Searches with the NOvA Near Detector

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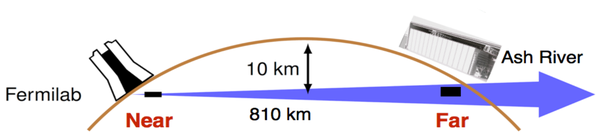
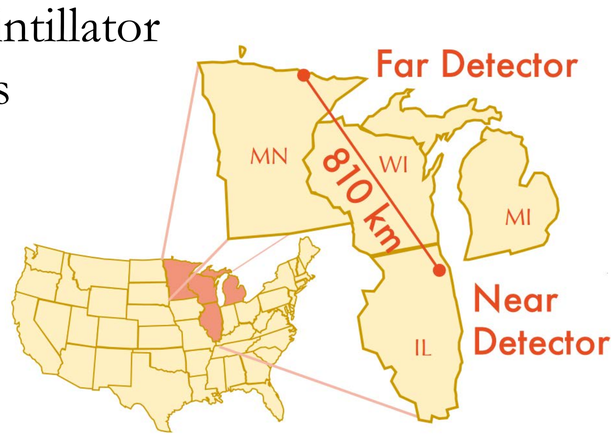
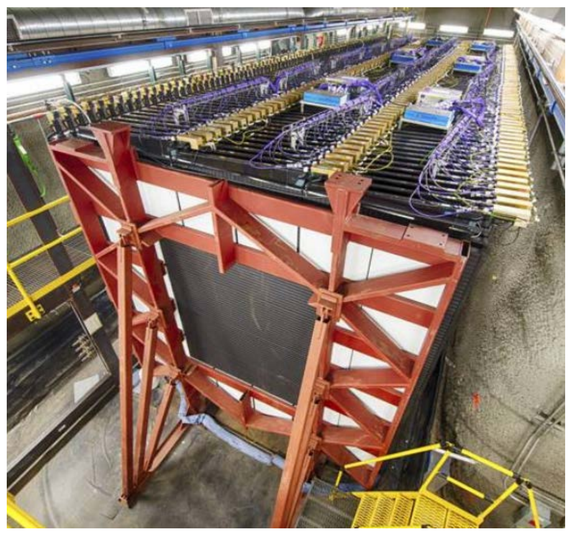
on behalf of the NOvA Collaboration

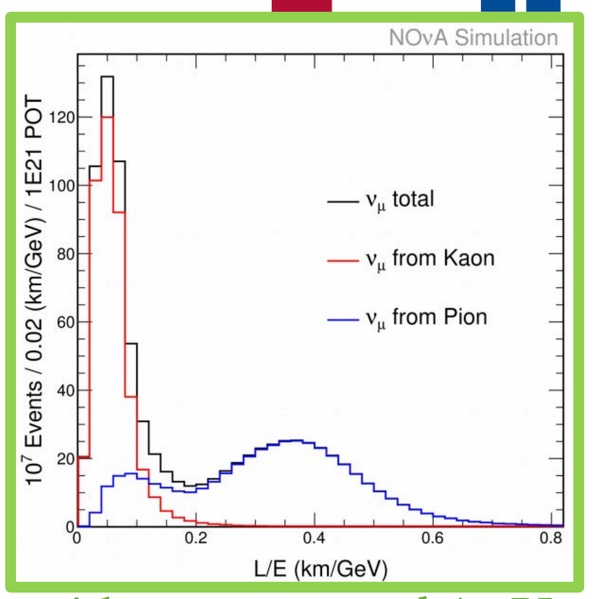
NOvA experiment: Long-baseline, two detectors:

- Fine-grained, low-Z, liquid scintillator calorimeters, 14 mrad off- axis
- *Near Detector (ND):* 300 ton, 1 km from target
- *Far Detector (FD):* 14 kton, 810 km away









With an L/E of ~0.5, ND will be sensitive to oscillations due to light sterile neutrinos with mass around 1 eV

ν_e Appearance + ν_μ Disappearance

Neutrino interactions selected using a convolutional neural network. *See poster by F. Psihas/M. Groh (Wed., #79)*

$$P^{SBL_{3+1}}_{\nu_\mu\to\nu_e} = 4|U_{\mu4}|^2|U_{e4}|^2\sin^2\frac{\Delta m^2_{41}L}{4E} = \sin^2 2\theta_{\mu e}\sin^2\frac{\Delta m^2_{41}L}{4E}$$

$$\sin^2 2\theta_{\mu e} \equiv \sin^2 2\theta_{14}\sin^2\theta_{24}$$

$$P^{SBL_{3+1}}_{\nu_\mu\to\nu_\mu} = 1 - 4|U_{\mu4}|^2(1-|U_{e4}|^2)\sin^2\frac{\Delta m^2_{41}L}{4E}$$

$$= 1 - \sin^2 2\theta_{\mu\mu}\sin^2\frac{\Delta m^2_{41}L}{4E}$$

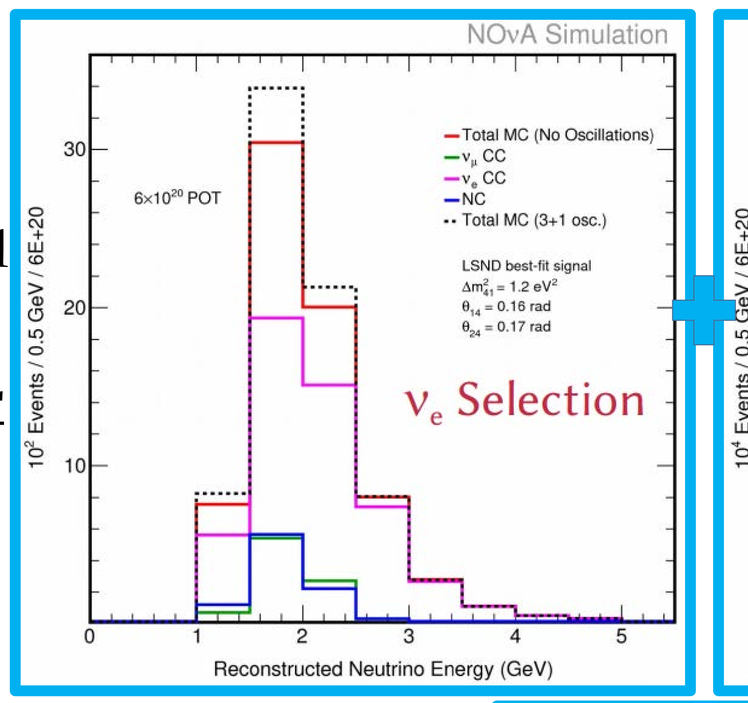
$$\sin^2 2\theta_{\mu\mu} \equiv \cos^2\theta_{14}\sin^2\theta_{24}$$

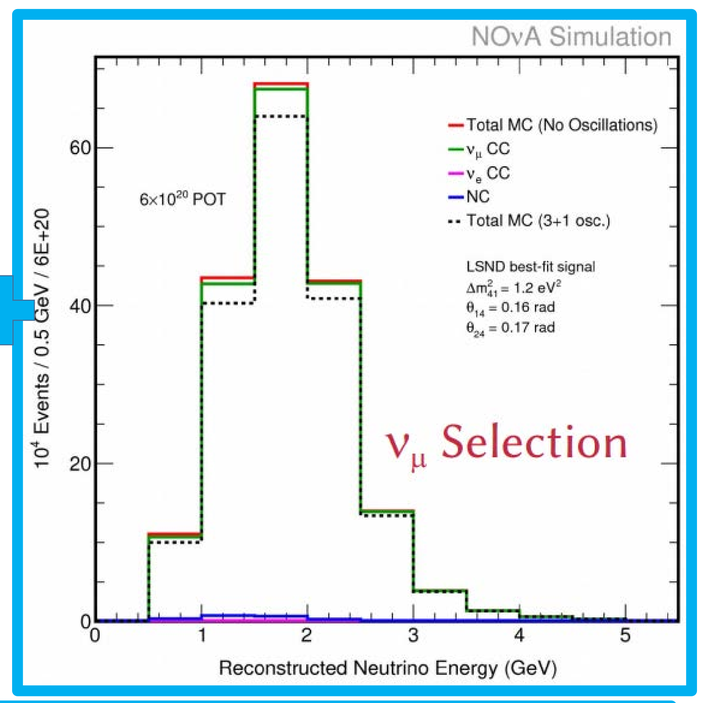
Assume a **3+1 model** and perform a **joint fit**

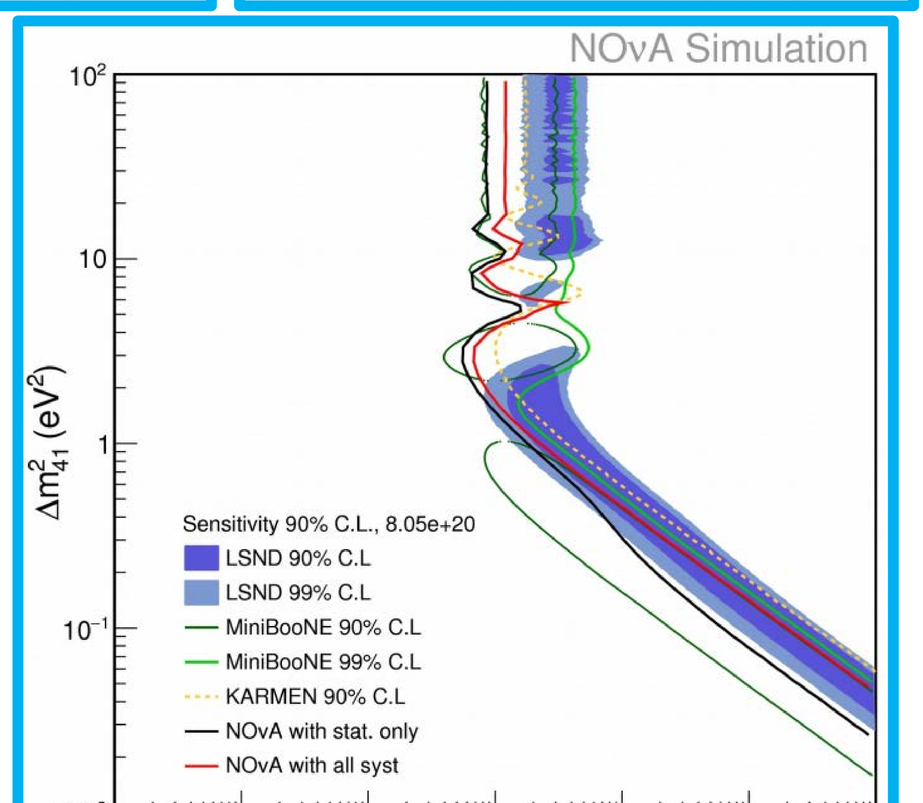
- Use the muon-neutrino sample to constrain the electron-neutrinos

Fit for θ_{24} (θ_{14}) profiling over θ_{14} (θ_{24}) and θ_{34} and keeping all other parameters fixed.

Fit both θ_{14} and θ_{24} to produce limits on $\sin^2\theta_{\mu e}$

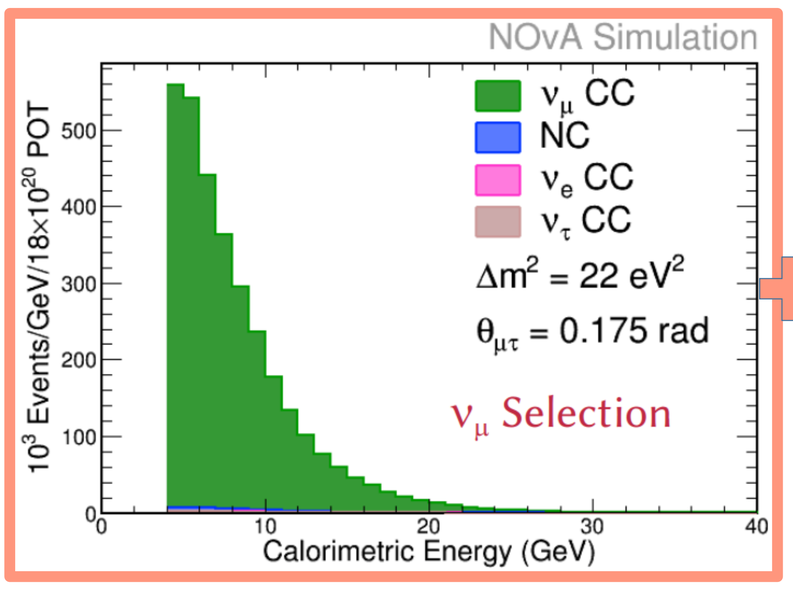


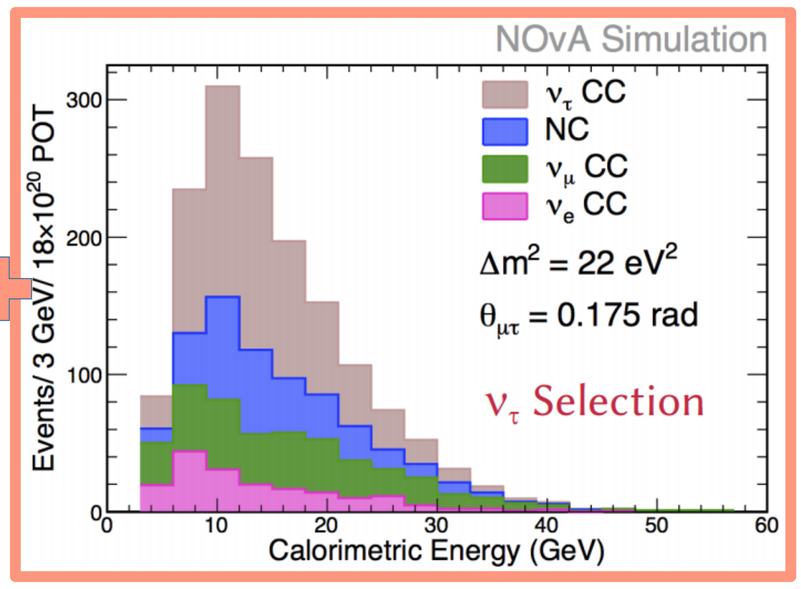




Sensitivities for 1 year of NOvA ND data, 6e20 POT

ν_τ Appearance + ν_μ Disappearance

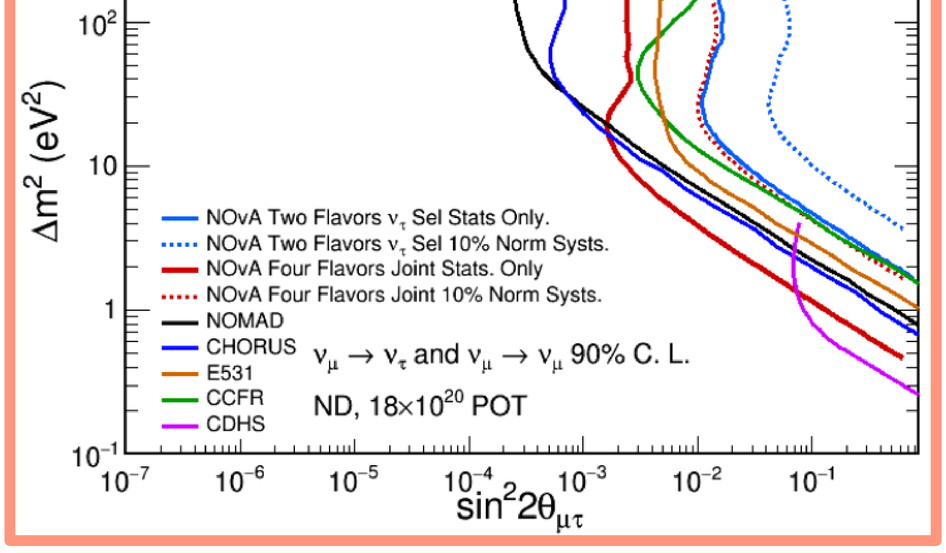




High energy kaon peak is above the tau creation threshold (~3.5 GeV) giving access to anomalous tau neutrino appearance

$$P^{SBL_{3+1}}_{\nu_\mu\to\nu_\tau} = 4|U_{\mu4}|^2|U_{\tau4}|^2\sin^2\frac{\Delta m^2_{41}L}{4E} = \sin^2 2\theta_{\mu\tau}\sin^2\frac{\Delta m^2_{41}L}{4E}$$

$$\sin^2 2\theta_{\mu\tau} = \cos^4\theta_{14}\sin^2 2\theta_{24}\sin^2\theta_{34}$$



Sensitivities for 3 years of NOvA ND data, 18e20 POT

http://novaexperiment.fnal.gov