Flux Systematics for Fermilab SBN

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Review of Methodology

We have used MiniBooNE's MultiSim package to estimate the flux errors on our simulation.

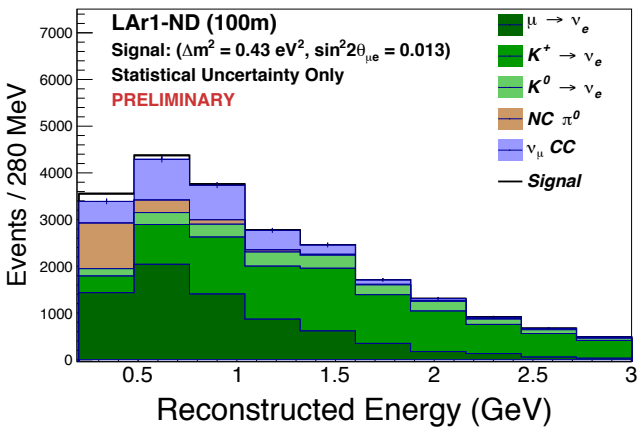
- A comprehensive explanation can be found from Joseph's old talk: LArTPC 1257
- And from our technical note: Flux Technote

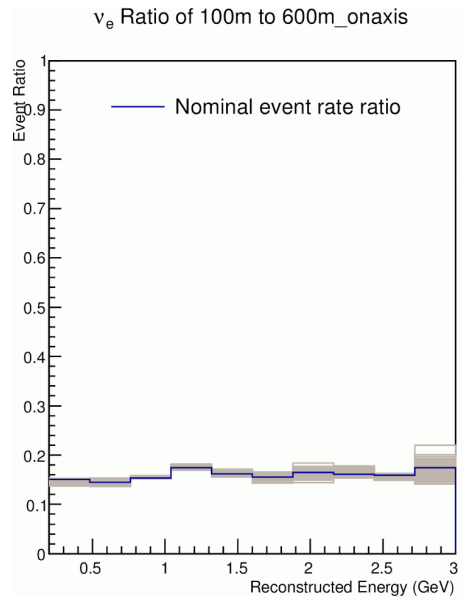
Ratio Plots

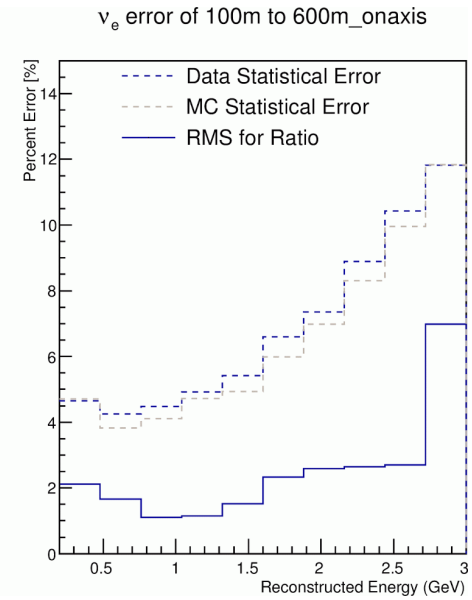
We can take the ratio of the event distributions - **and the corresponding spread in the ration -** in the different locations as a visualization for our ability to extrapolate a flux from near to far.

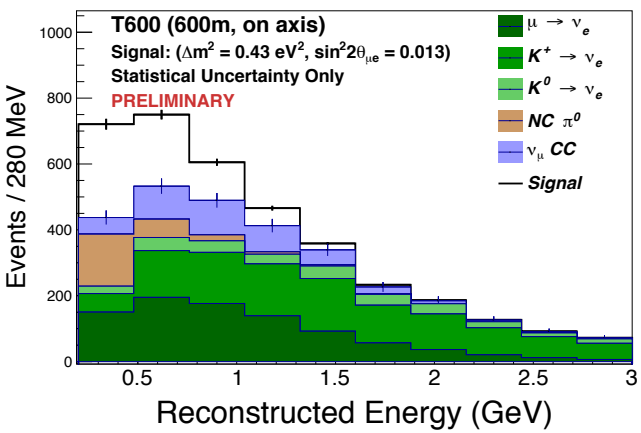
The spread is computed by calculating this ratio in every “universe” of the multi-weight simulation.

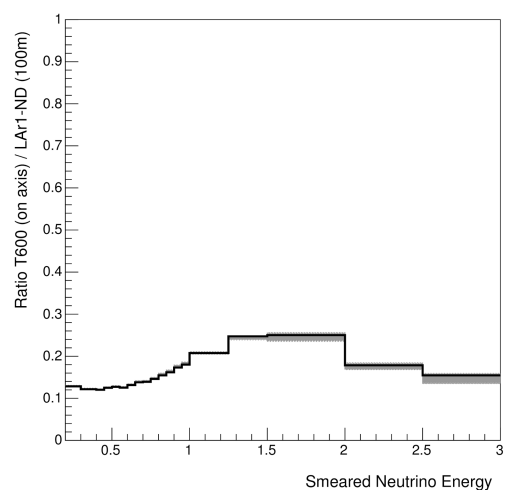
Ratio Plots: 100m to 600m On Axis

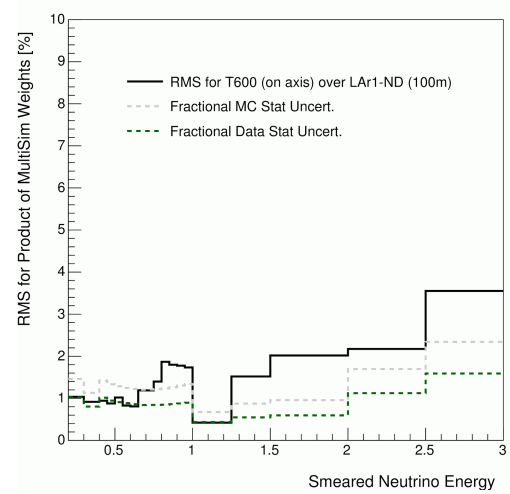




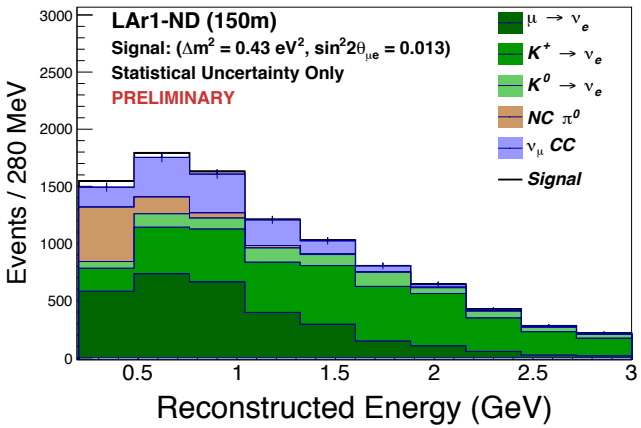


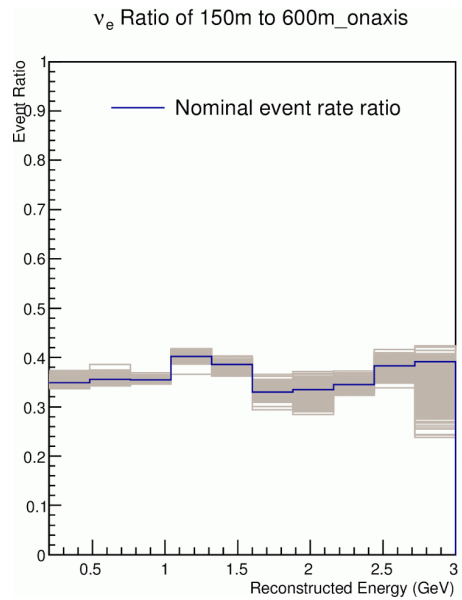


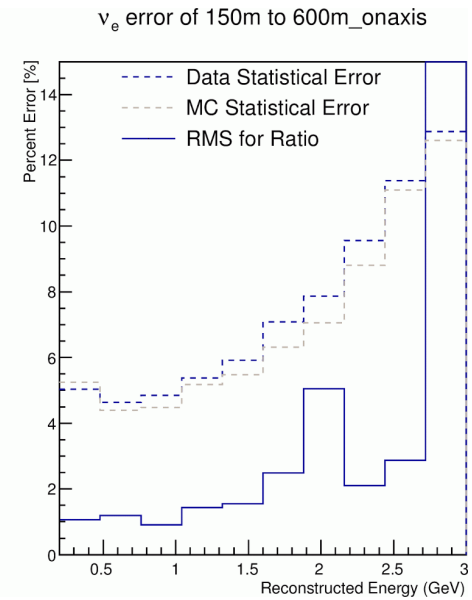


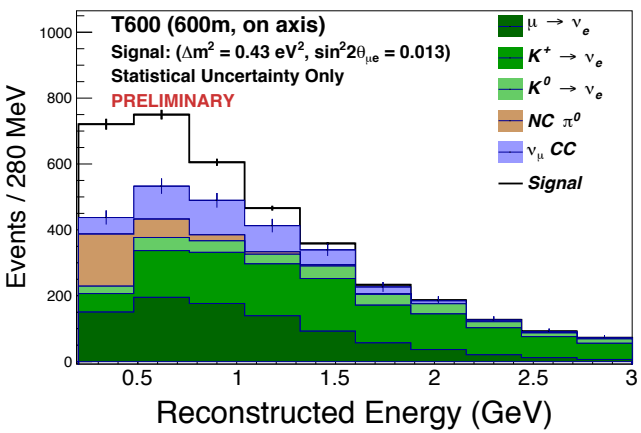


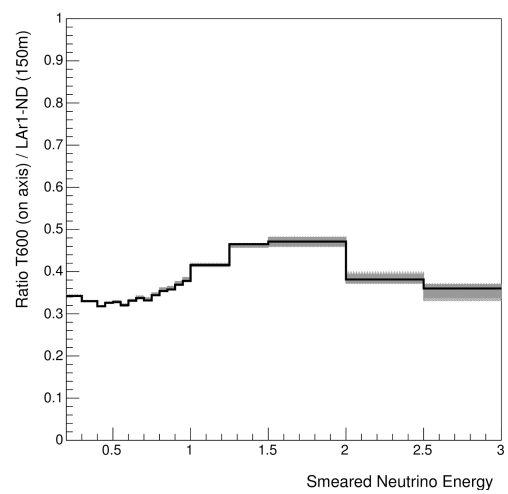
Ratio Plots: 150m to 600m On Axis

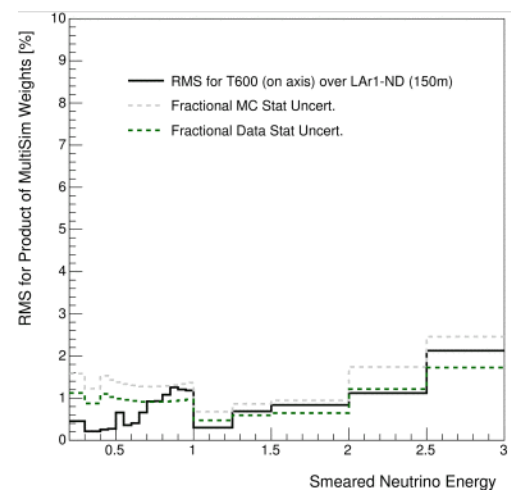




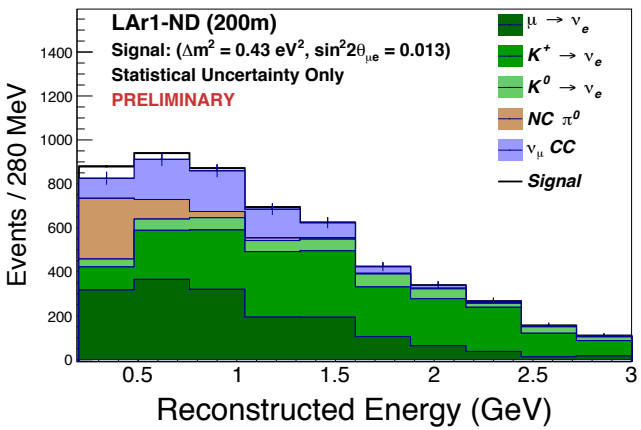


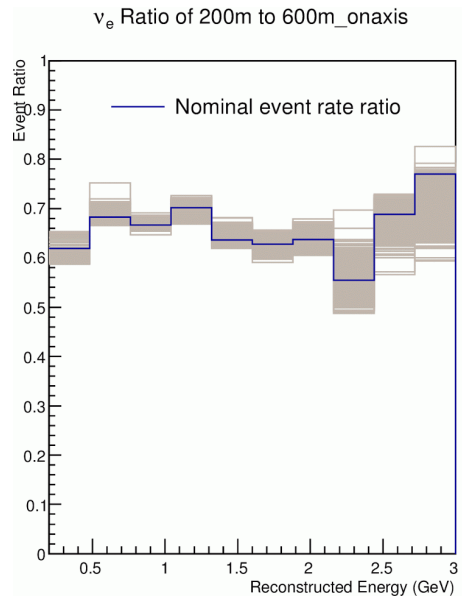


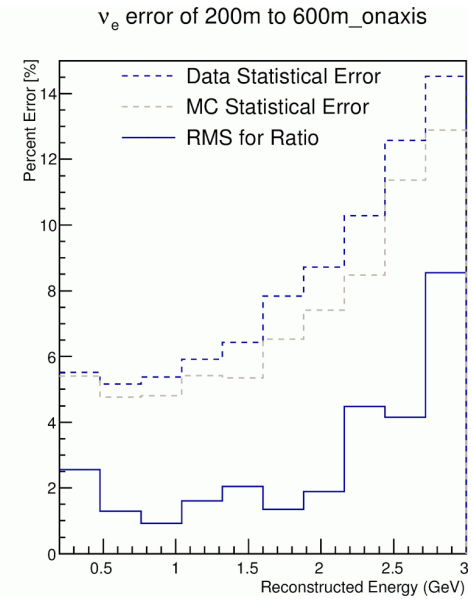


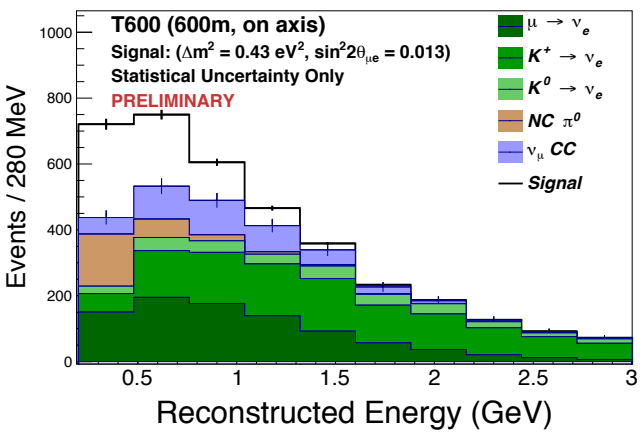


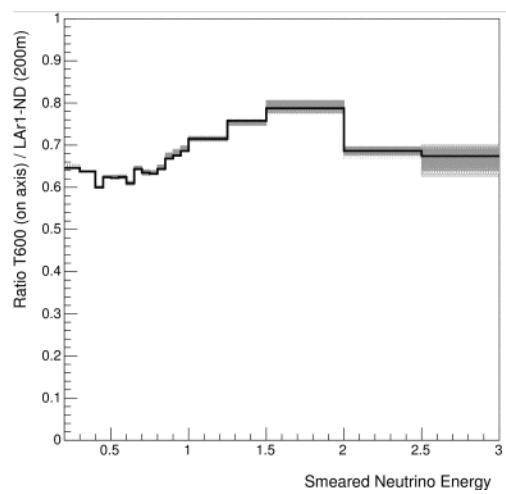
Ratio Plots: 200m to 600m On Axis

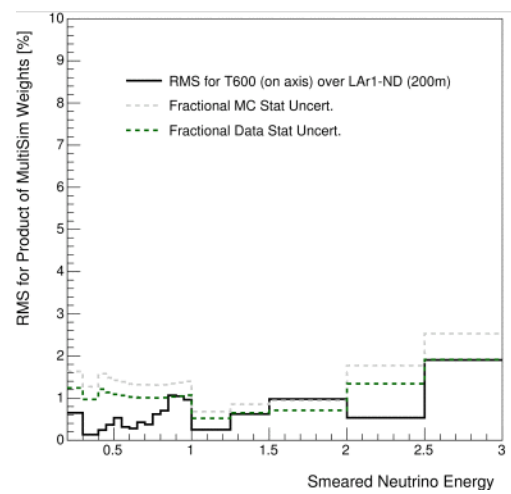




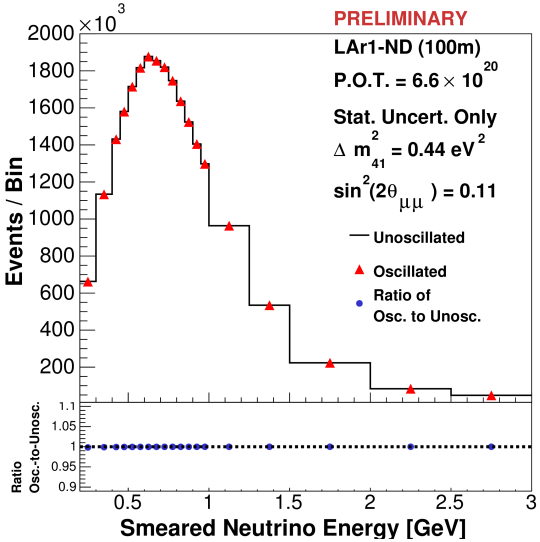


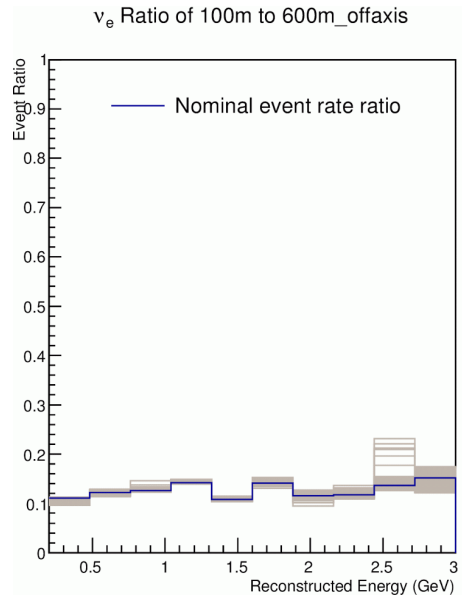


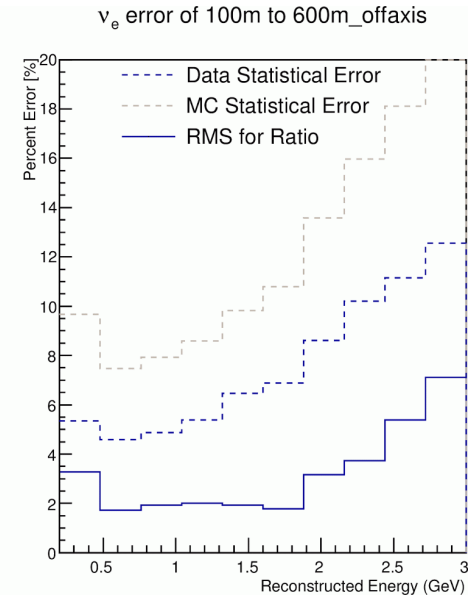


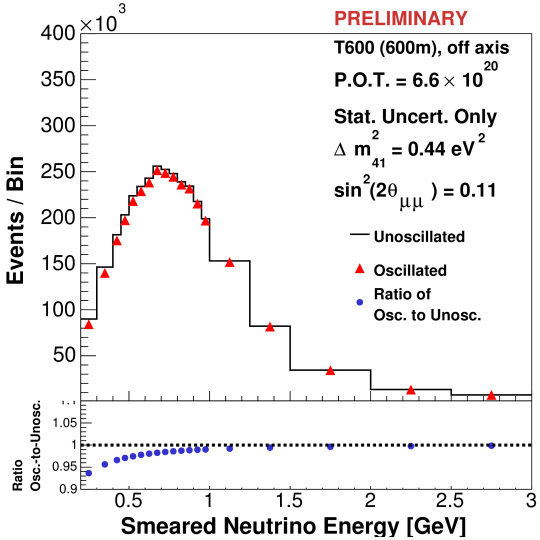


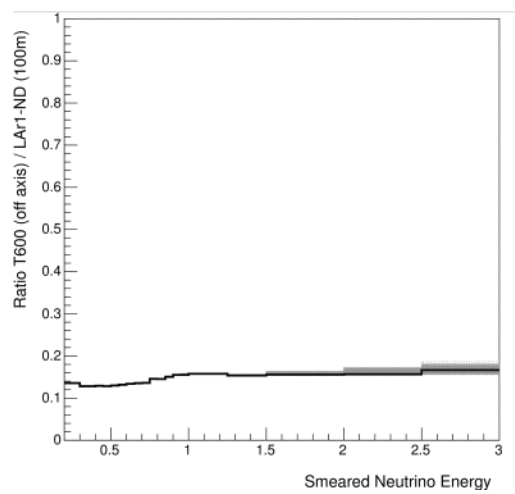
Ratio Plots: 100m to 600m Off Axis

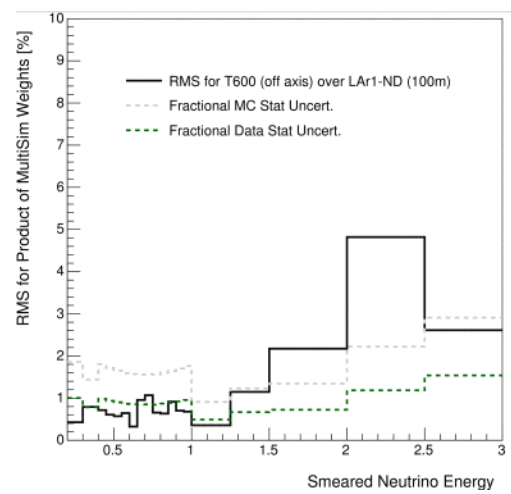




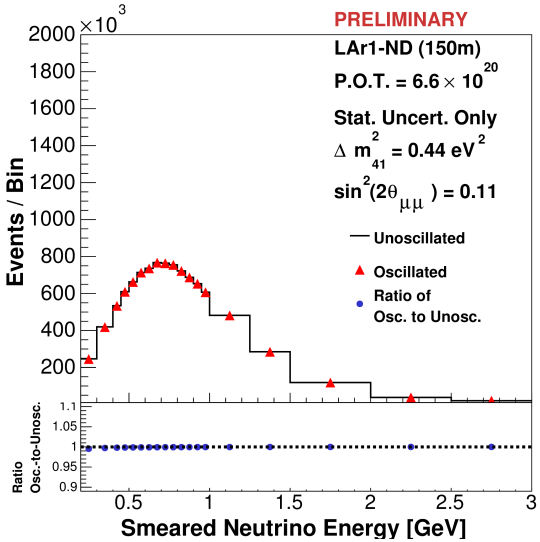


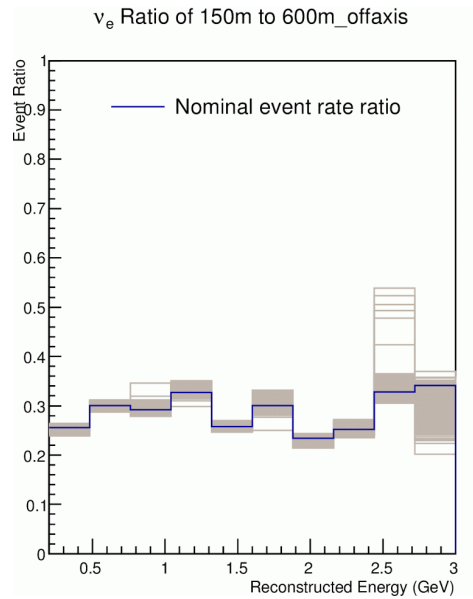


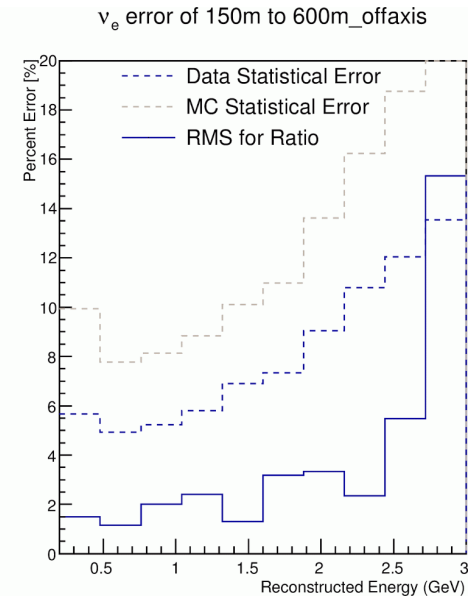


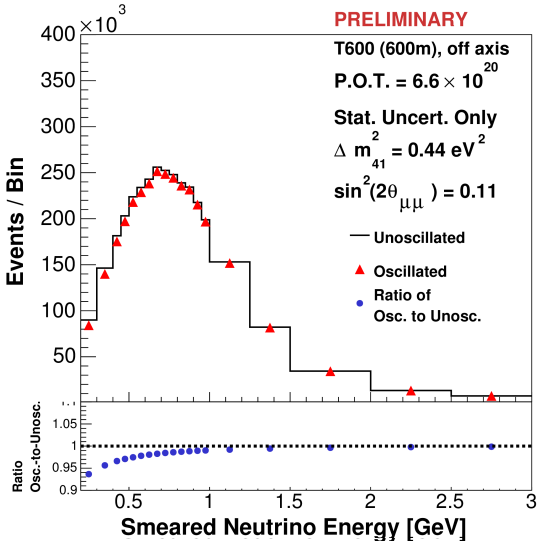


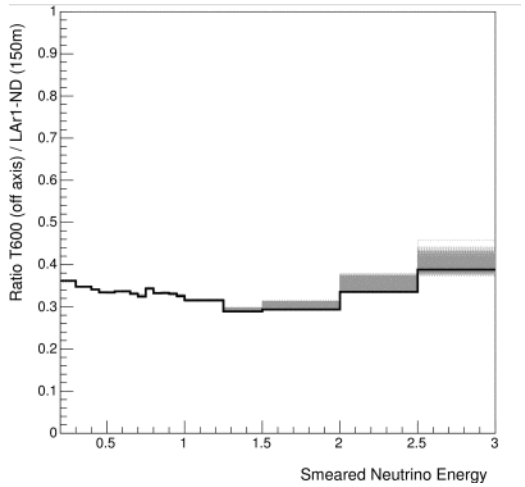
Ratio Plots: 150m to 600m Off Axis

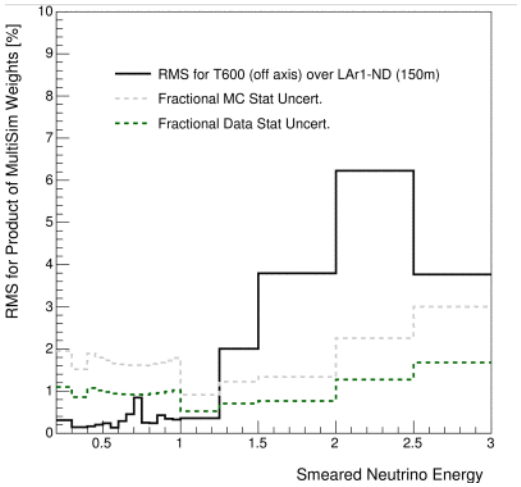




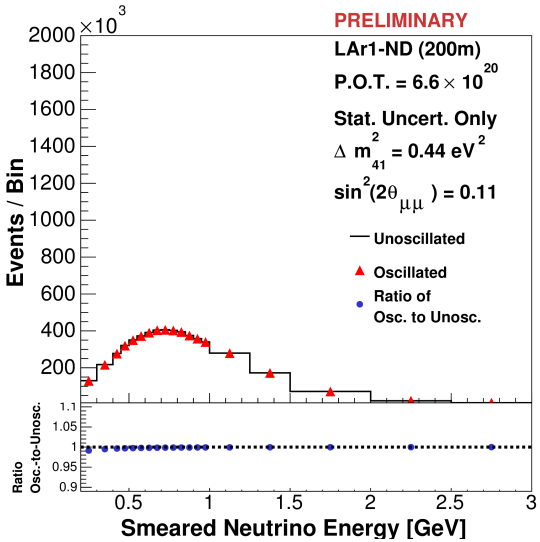


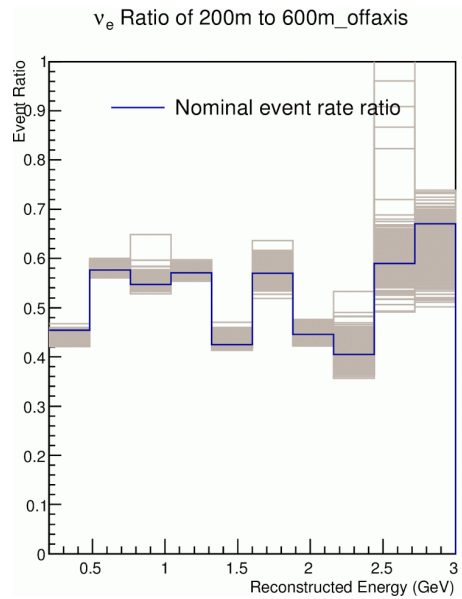


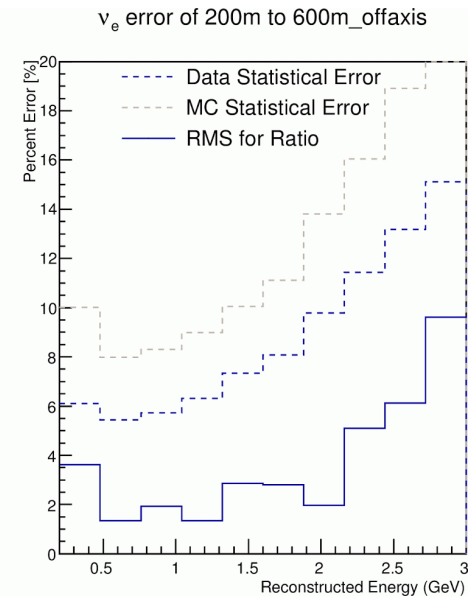


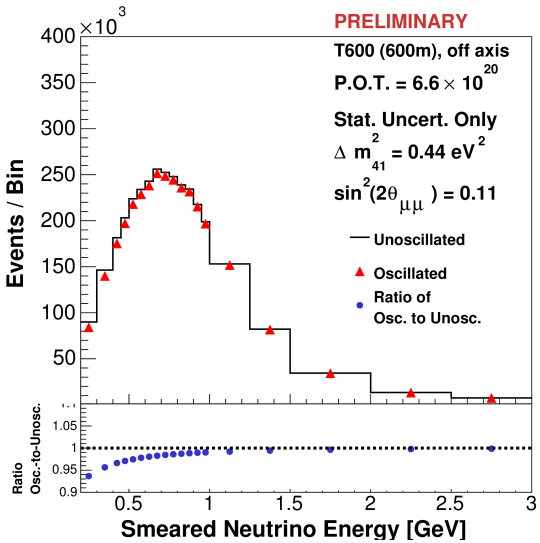


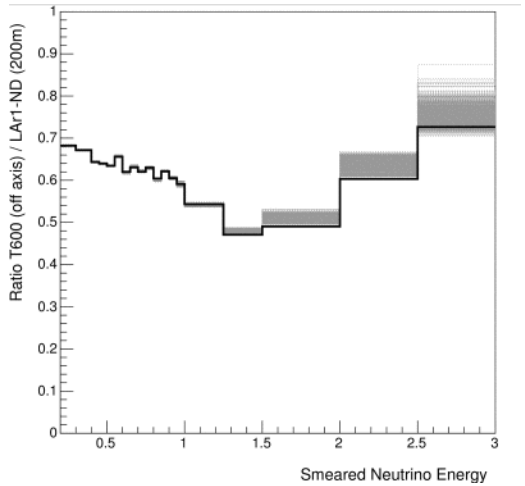
Ratio Plots: 200m to 600m Off Axis

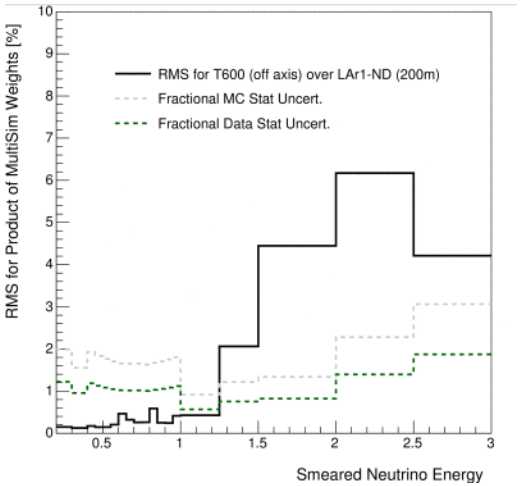






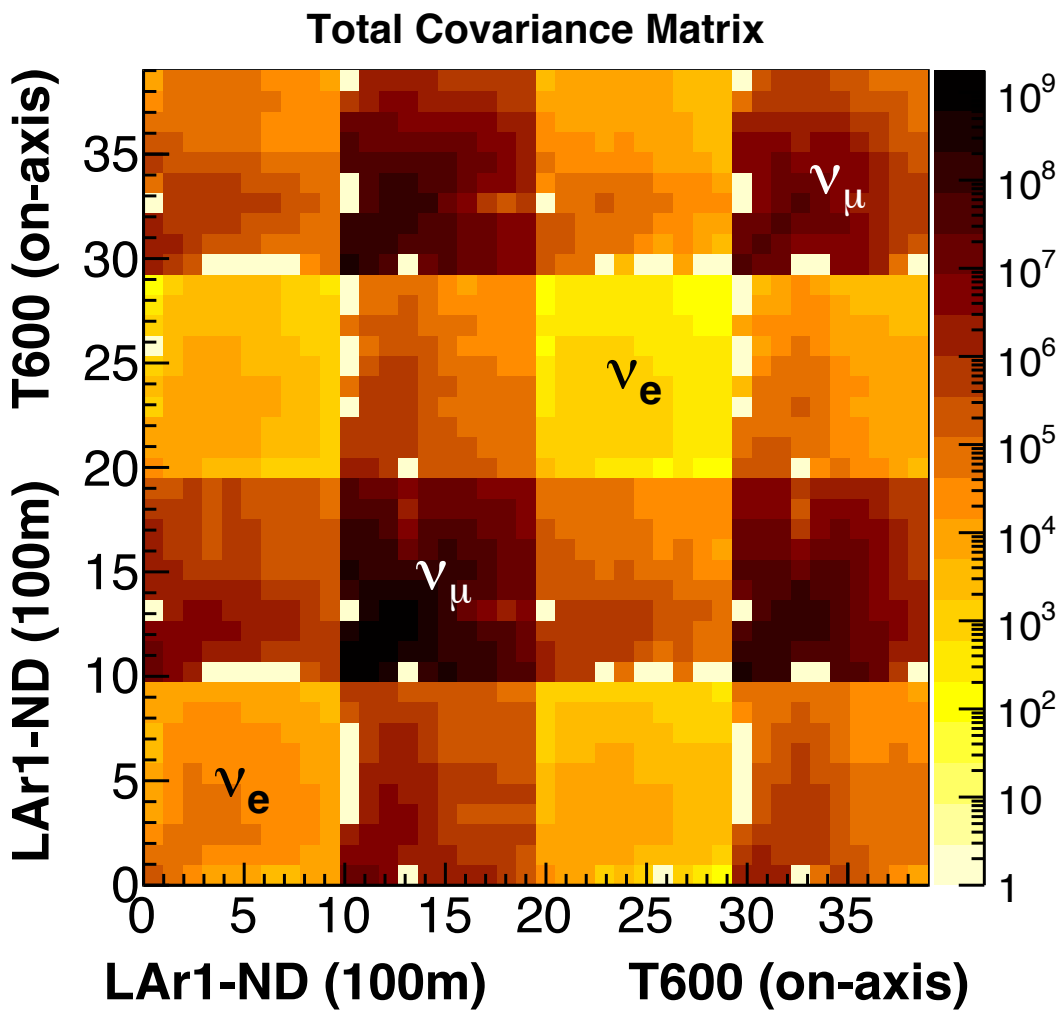






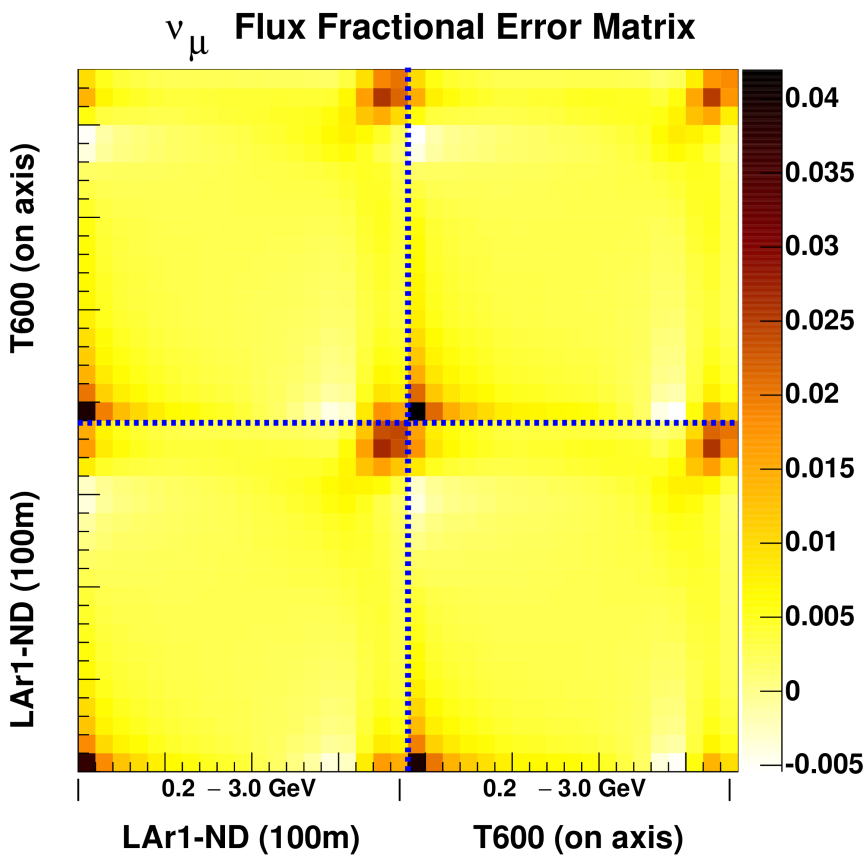
Covariance Matrices

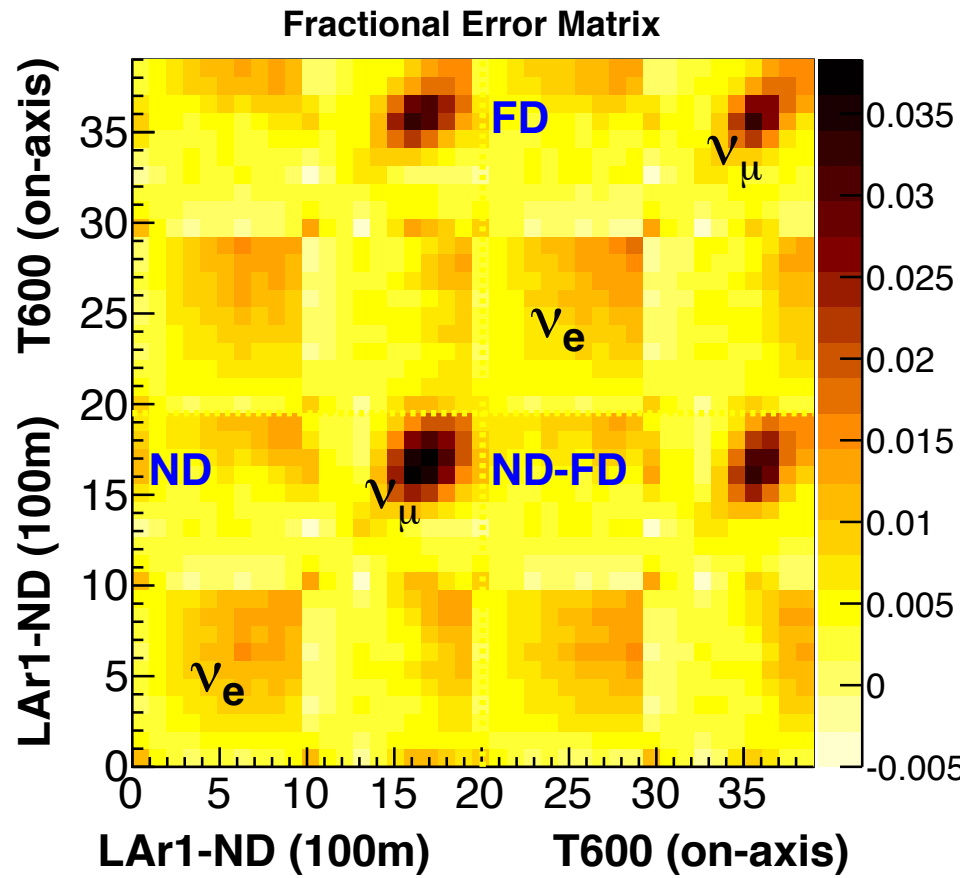
$$E_{i,j} = \frac{1}{\mathcal{N}} \sum_{m=1}^{\mathcal{N}} [N^i_{\mathrm{CV}} - N^i_m] \times [N^j_{\mathrm{CV}} - N^j_m].$$



Fractional Error Matrices

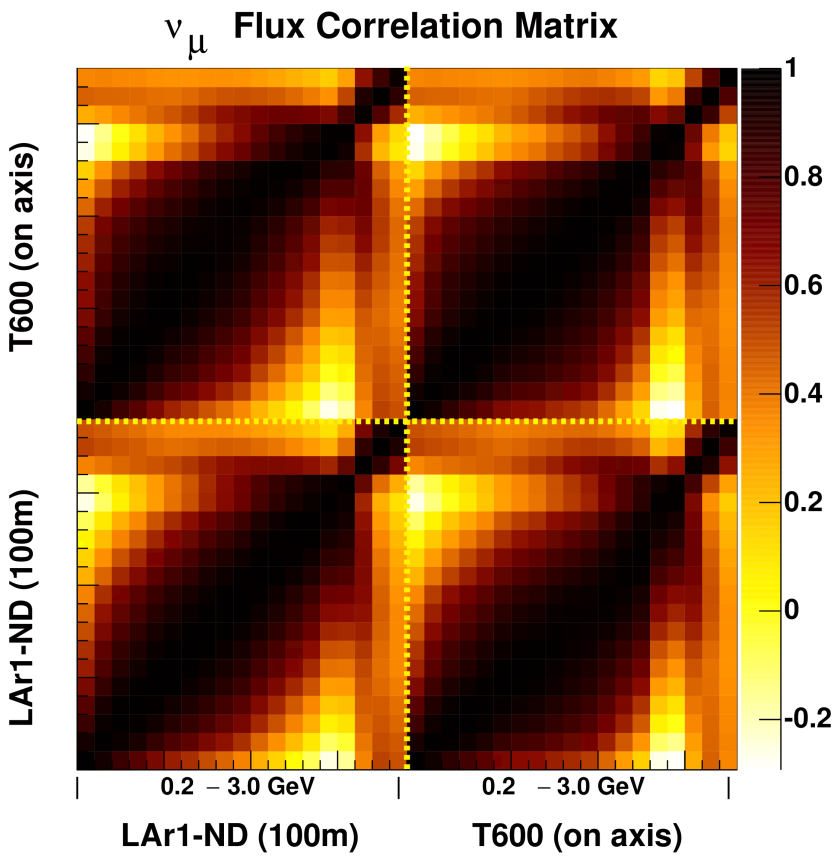
$$F_{i,j} = \frac{E_{i,j}}{(N^i_{\mathrm{CV}} N^j_{\mathrm{CV}})}.$$

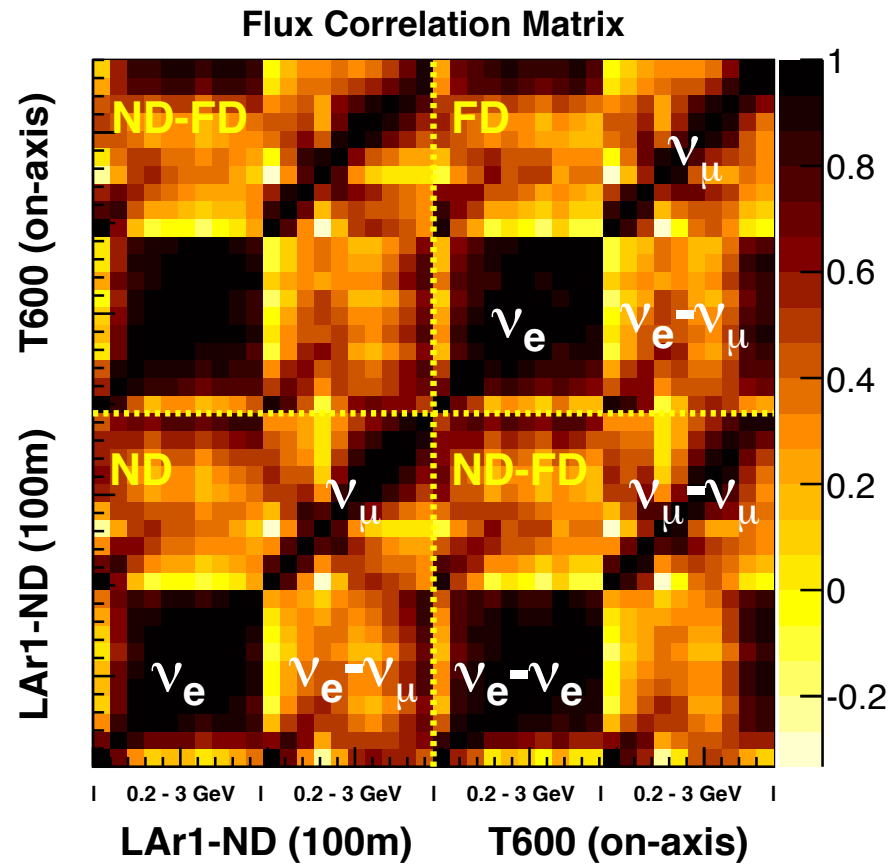




Correlation Matrices

$$C_{i,j} = \frac{E_{i,j}}{\sqrt{E_{i,i}E_{j,j}}}$$



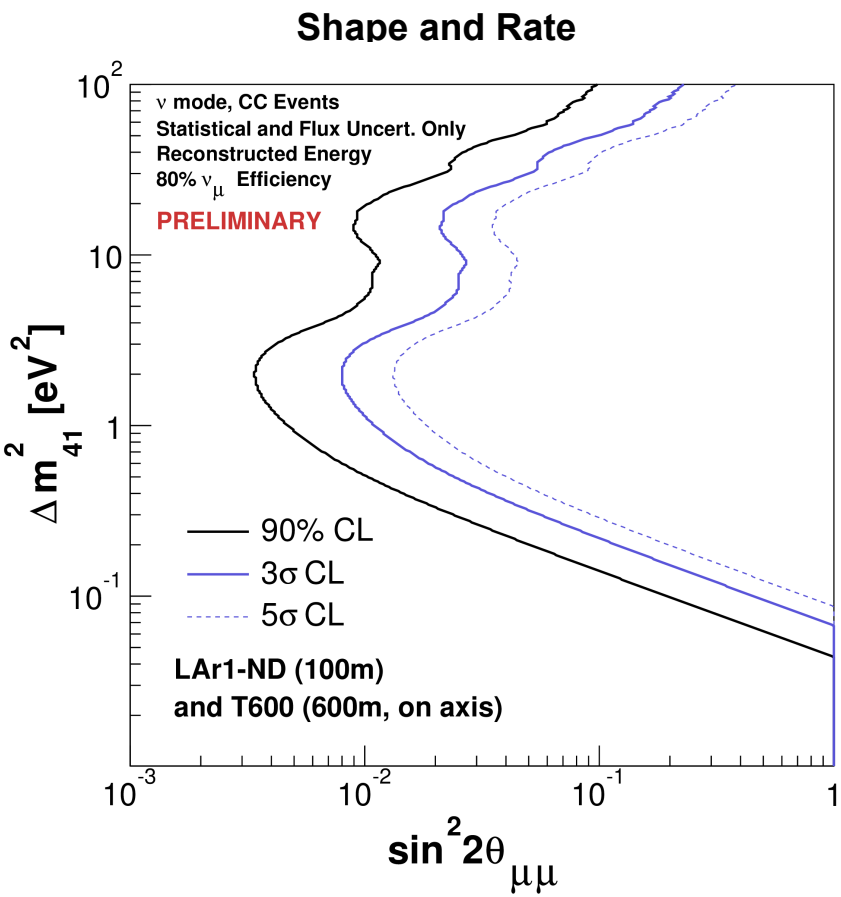


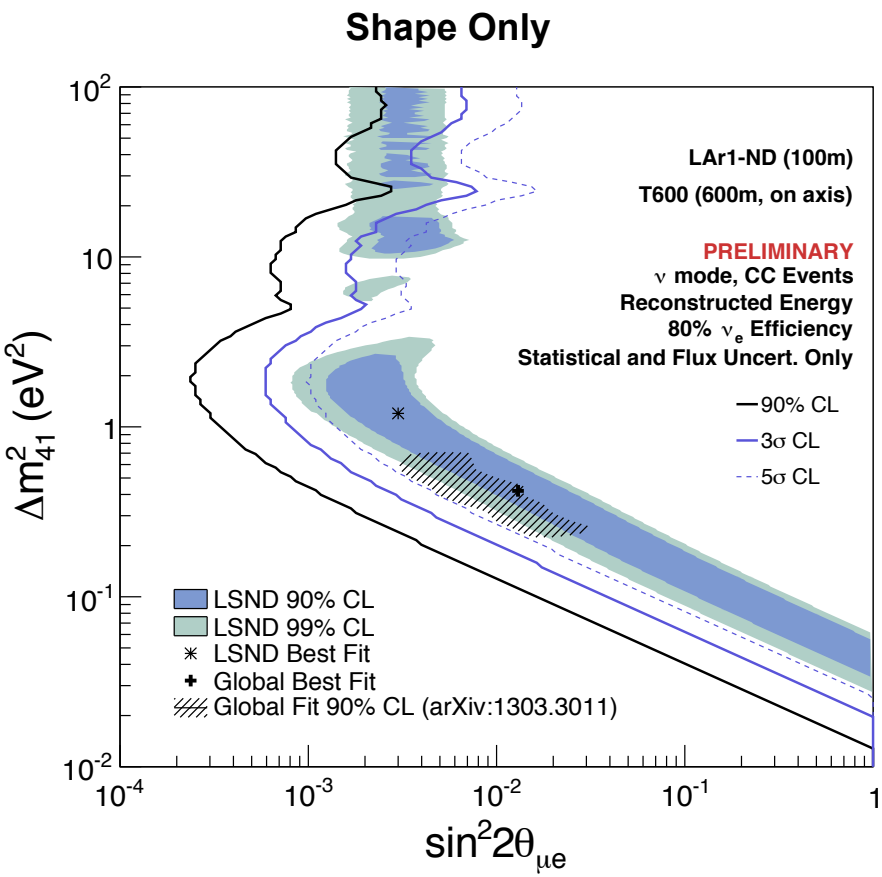
Nominal Sensitivities

Using the error matrices shown above, we can compute the sensitivity to a 3+1 oscillation signal.

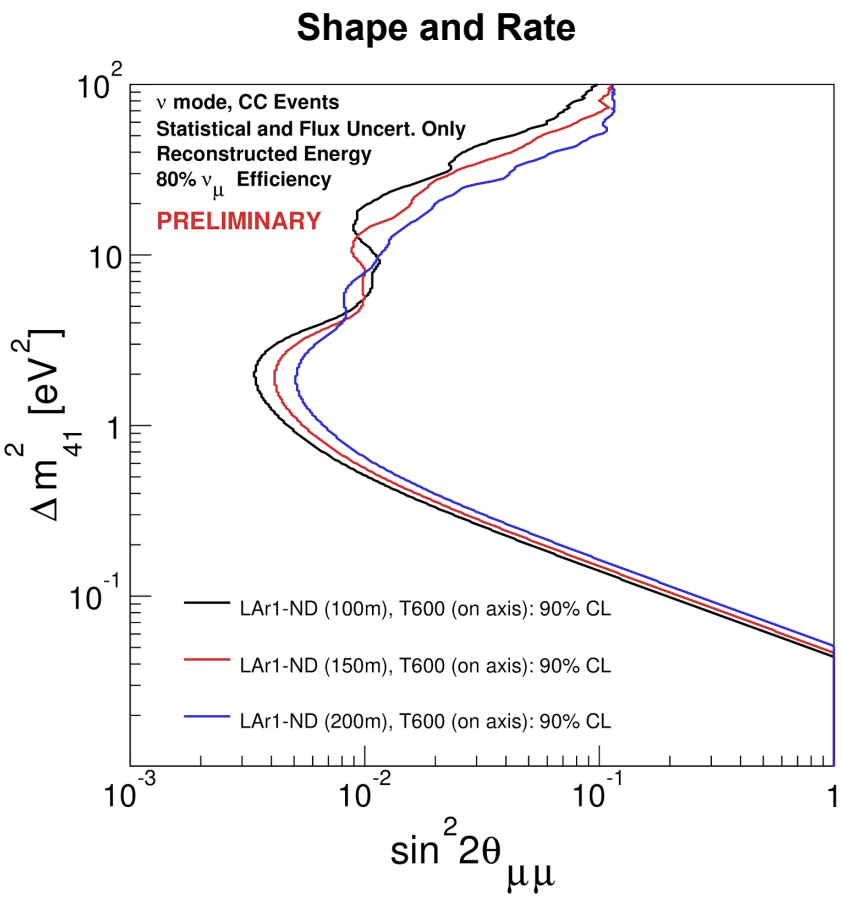
This takes advantage of bin to bin correlations in the same detector and amongst multiple detectors. For electron neutrino appearance, it also uses correlations between ν_e and ν_μ.

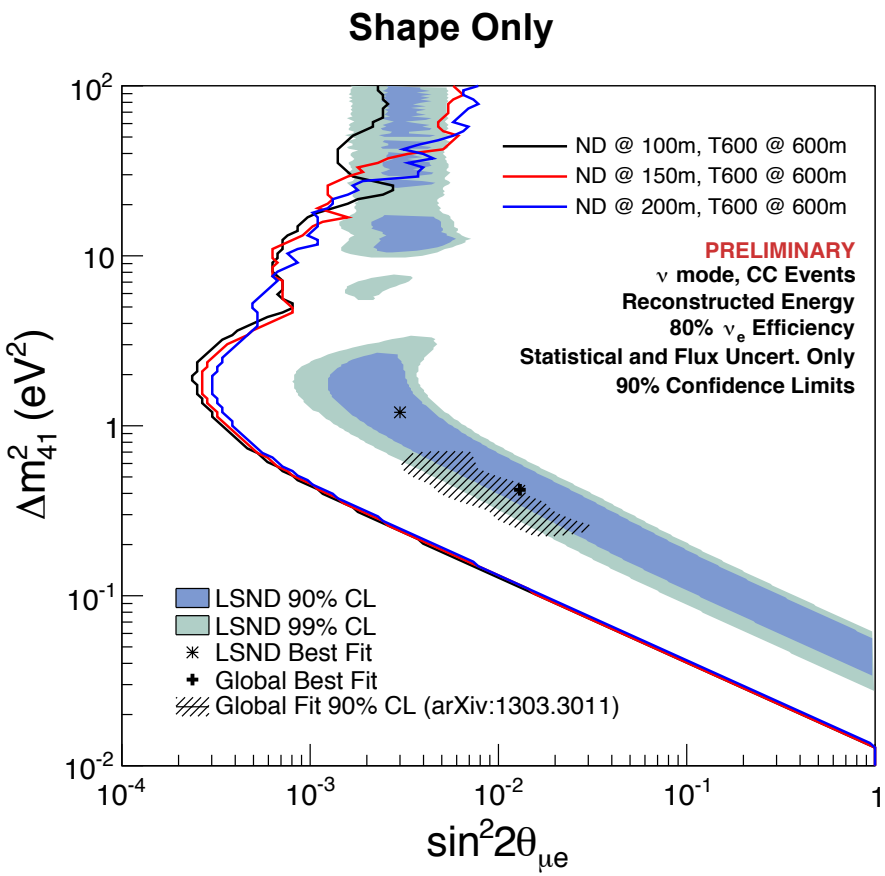
100m and 600m On Axis



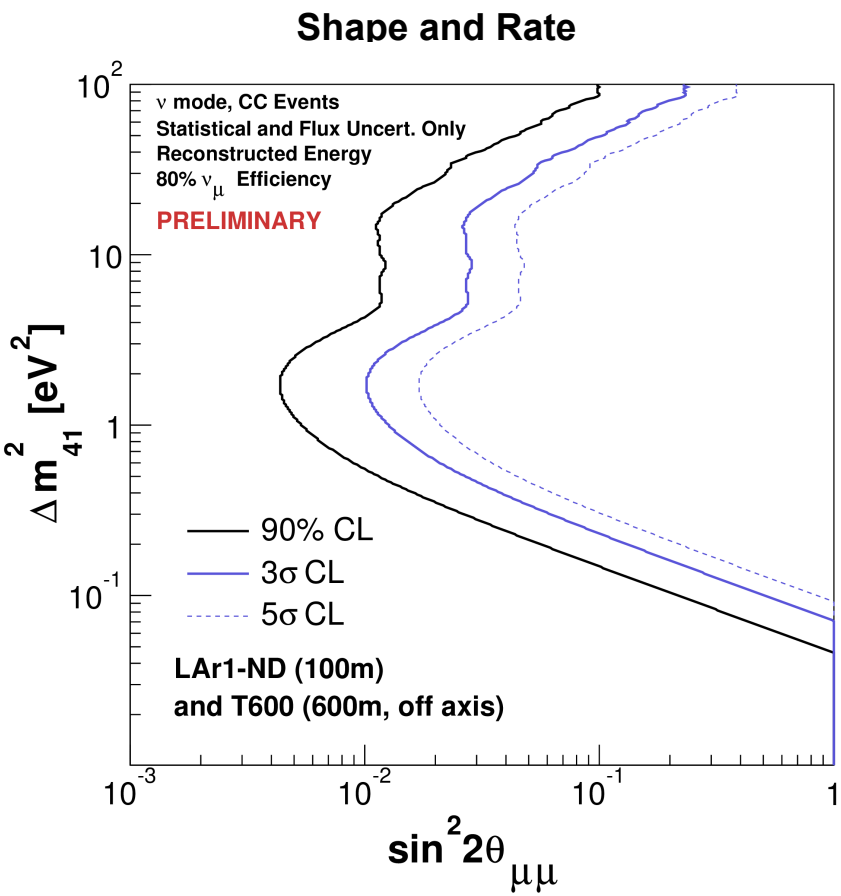


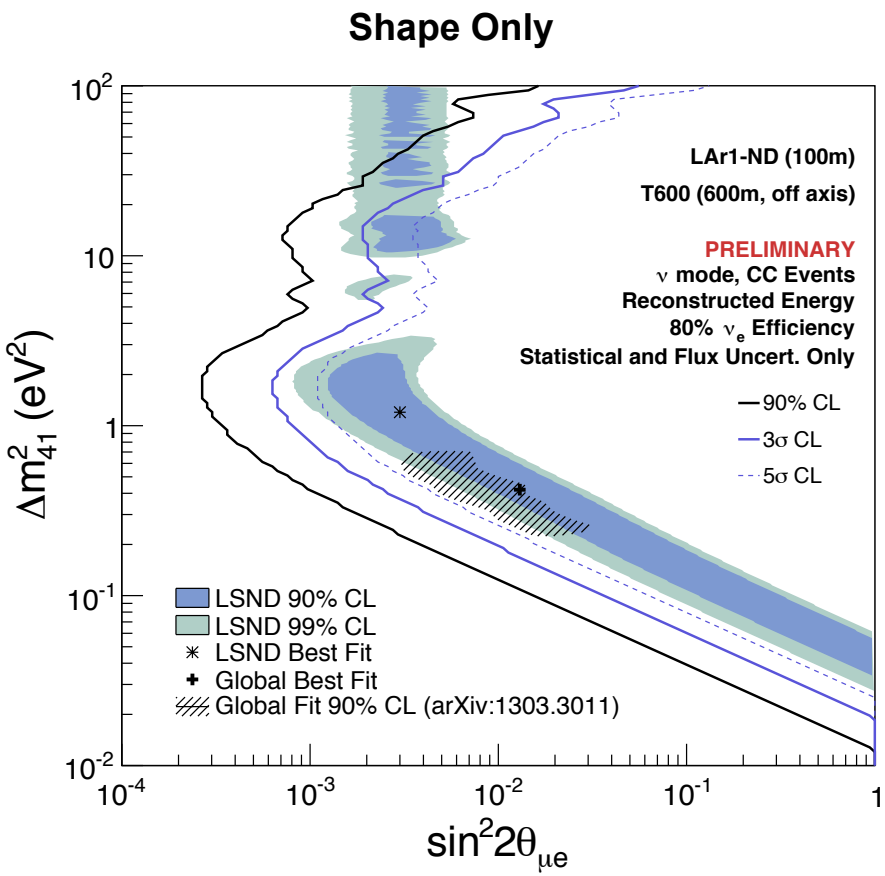
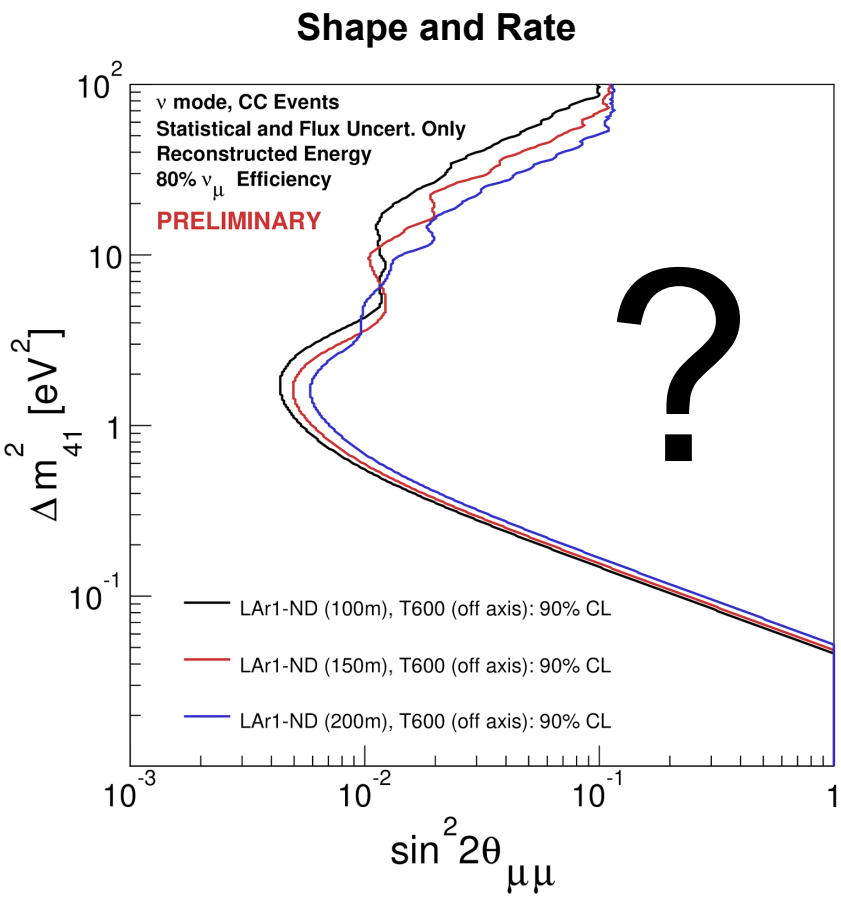
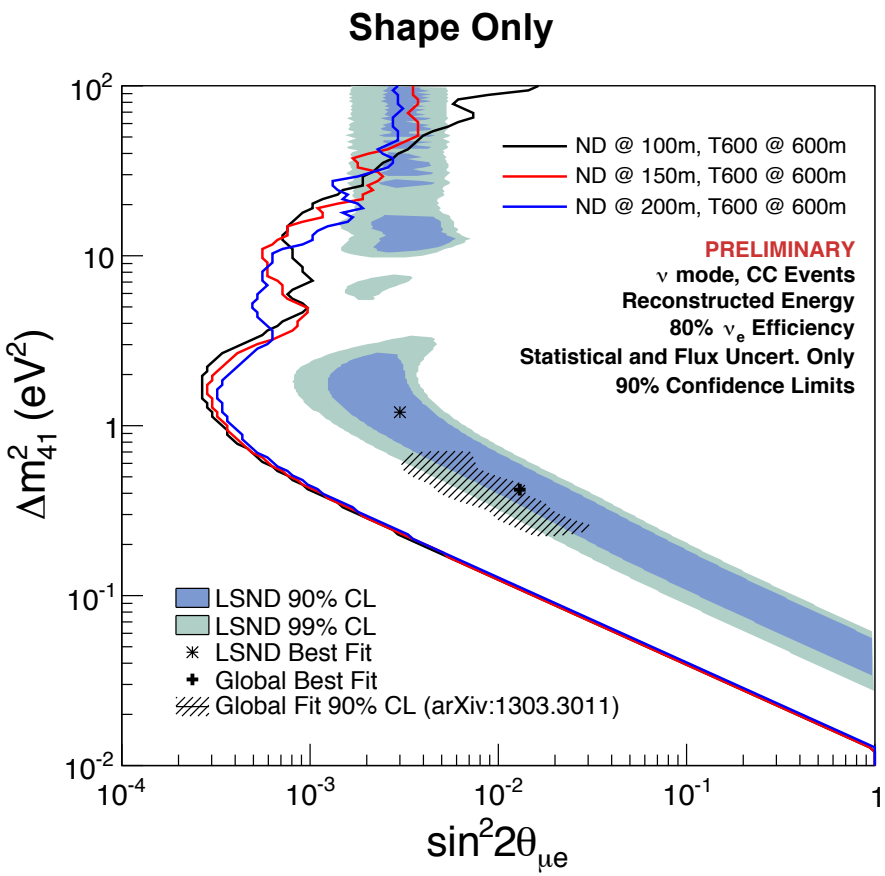
100m, 150m, 200m Comparison





100m and 600m Off Axis





100m, 150m, 200m Comparison