

Constructing Data-Driven Predictions at the Far Detector for NOvA's Neutrino



Oscillation Analysis

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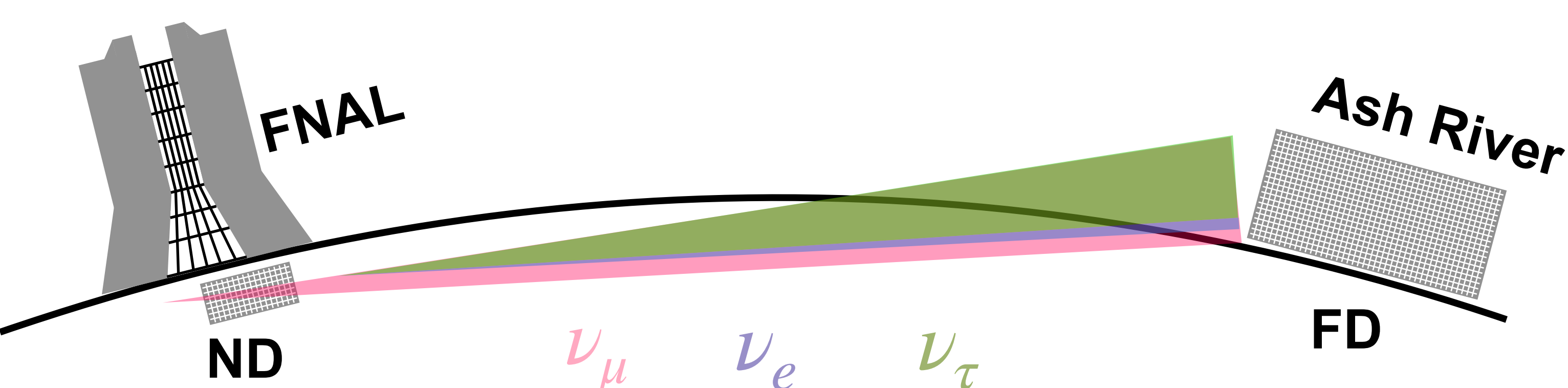


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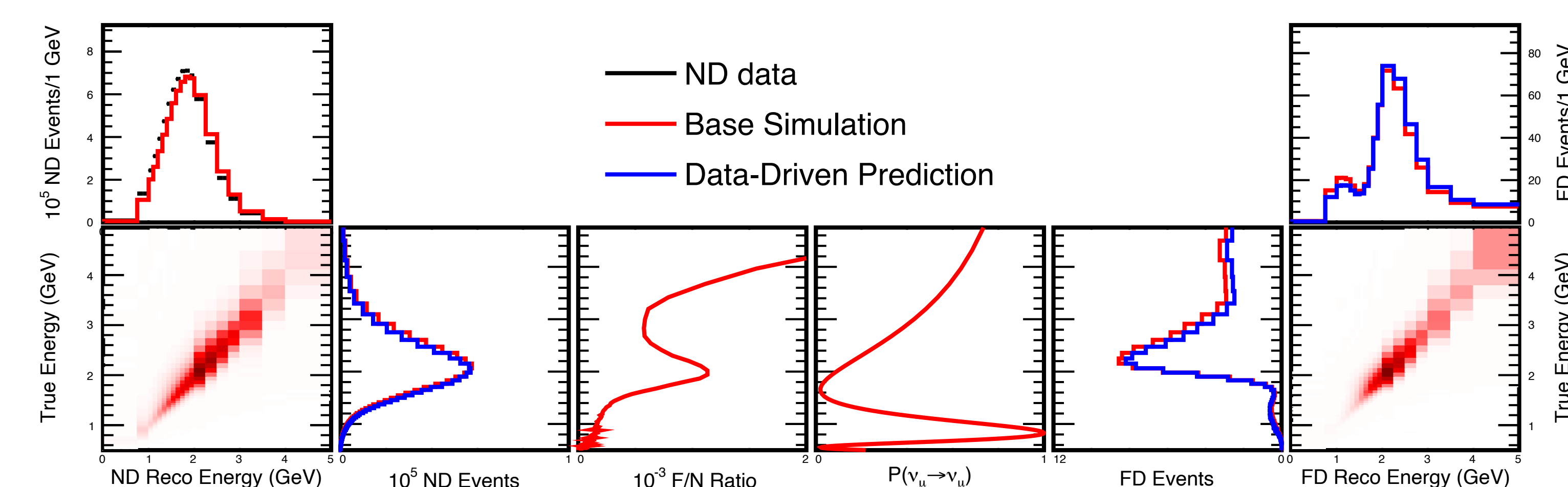
The NOvA Experiment

- NuMI Off-axis ν_e Appearance Experiment (NOvA)
- A long-baseline neutrino oscillation experiment
- Fermilab's NuMI beam line provides an intense ν_μ ($\bar{\nu}_\mu$) beam
- Two functionally identical liquid scintillation detectors
 - Situated 809 km apart
 - 14.6 milli-radians Off-axis
- Primary Goal is to constrain parameters of 3-flavor neutrino oscillations
- Oscillation Channels:
 - ν_μ ($\bar{\nu}_\mu$) Disappearance and ν_e ($\bar{\nu}_e$) Appearance

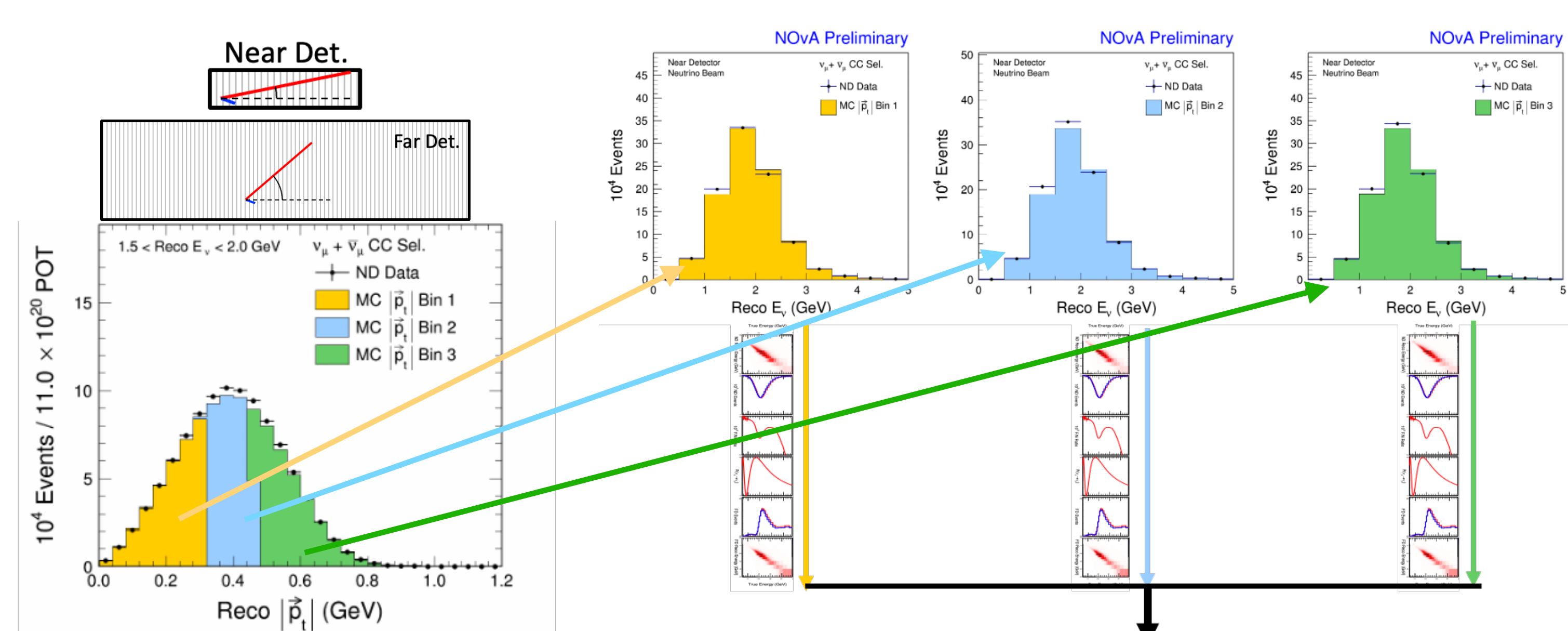


Near-to-Far Extrapolation

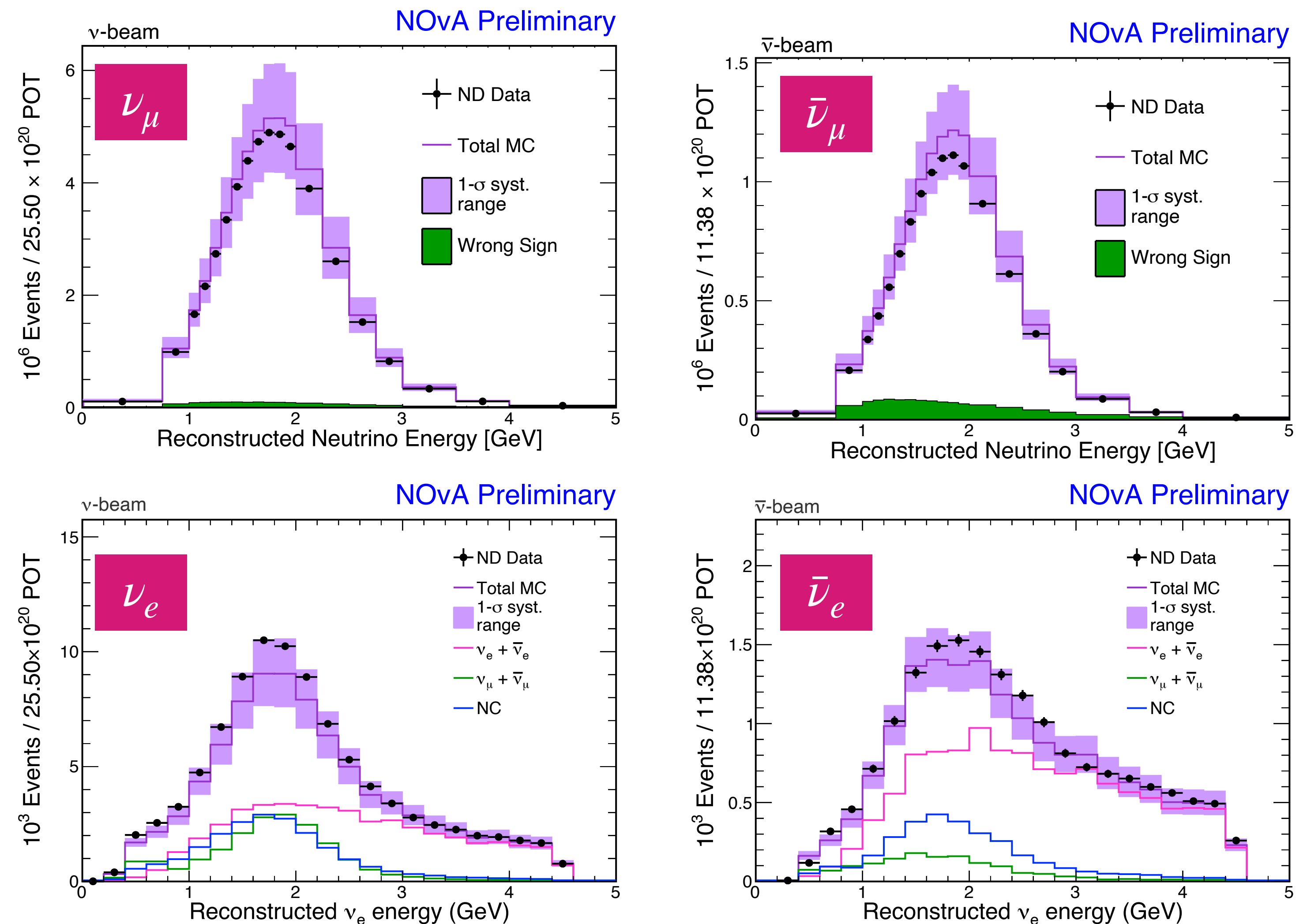
- Functionally identical detectors (partially) cancel out systematic uncertainties on the best fit neutrino oscillation parameters
- The near detector (ND) data-MC differences are extrapolated in true energy bins to provide data-driven predictions of un-oscillated ν_μ ($\bar{\nu}_\mu$) and oscillated ν_e ($\bar{\nu}_e$) events at the far detector (FD)



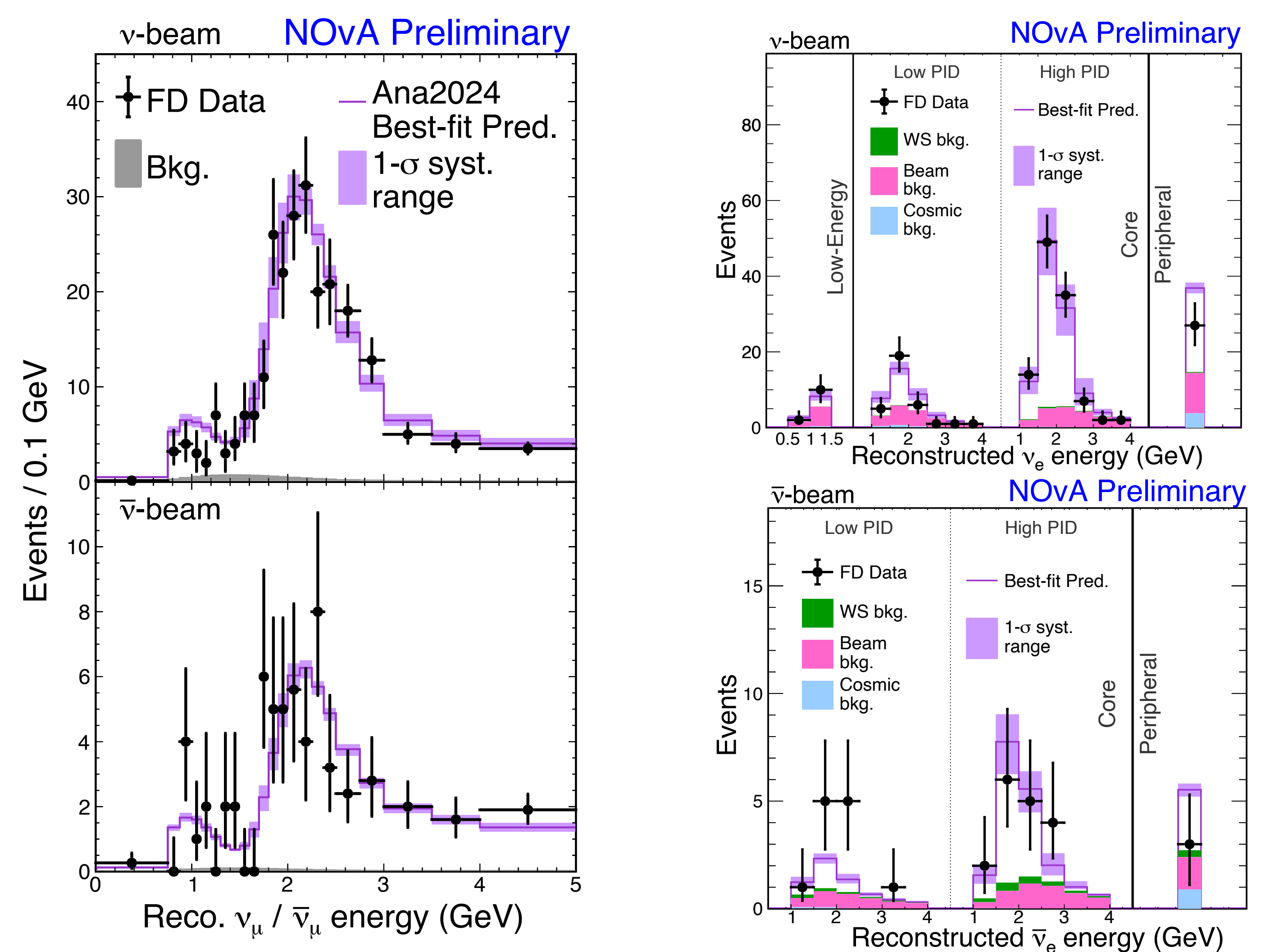
- The ν_μ ($\bar{\nu}_\mu$) extrapolation is divided into 4 hadronic energy fraction quartiles to improve the sensitivity of the experiment
- Extrapolation is further divided into 3 bins of final state lepton transverse momentum (p_T) which takes into account the neutrino interaction mis-modeling and the differences in ND and FD selection efficiency and acceptance



Near Detector Spectra

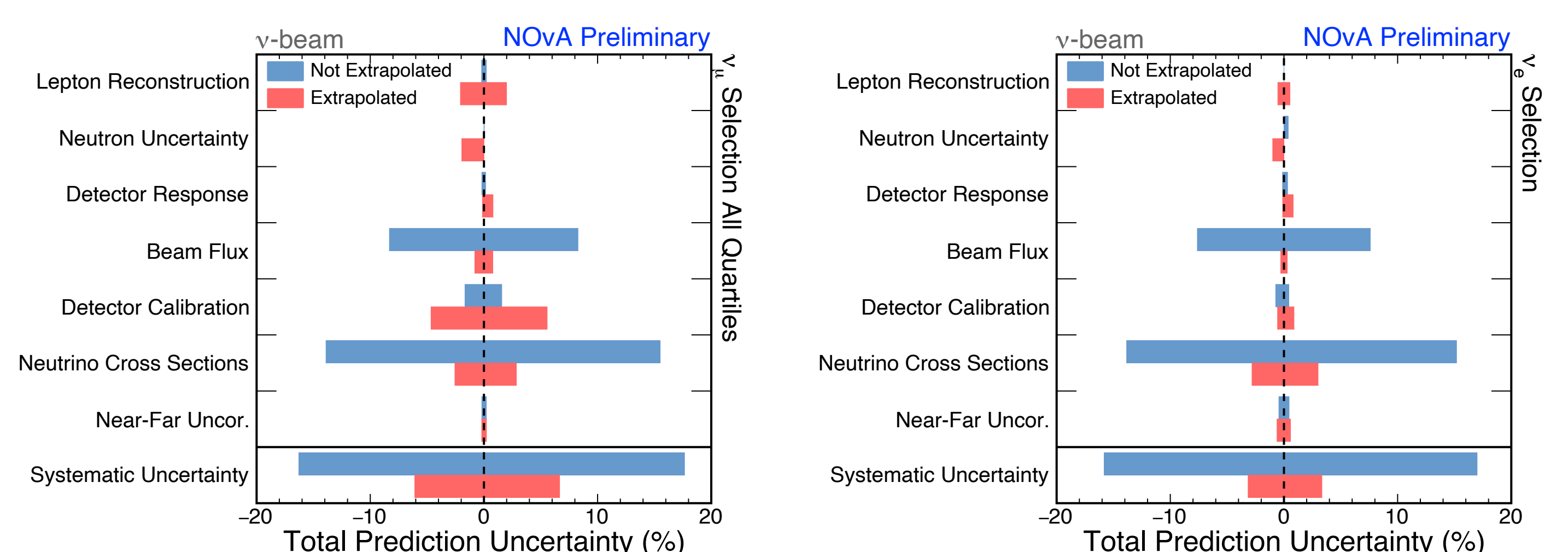


Far Detector Observations



NOvA Data	ν_μ	$\bar{\nu}_\mu$	ν_e	$\bar{\nu}_e$	lowE ν_e
Observed Events	384	106	169	32	12
Background	11.3	1.7	54.9	12.2	6.8

Uncertainties on FD Predictions



Conclusions

- NOvA uses ND data to correct the predicted number of un-oscillated ν_μ ($\bar{\nu}_\mu$) and oscillated ν_e ($\bar{\nu}_e$) events at the FD.
- This leads to small systematic uncertainties for the best-fit oscillation parameters

