

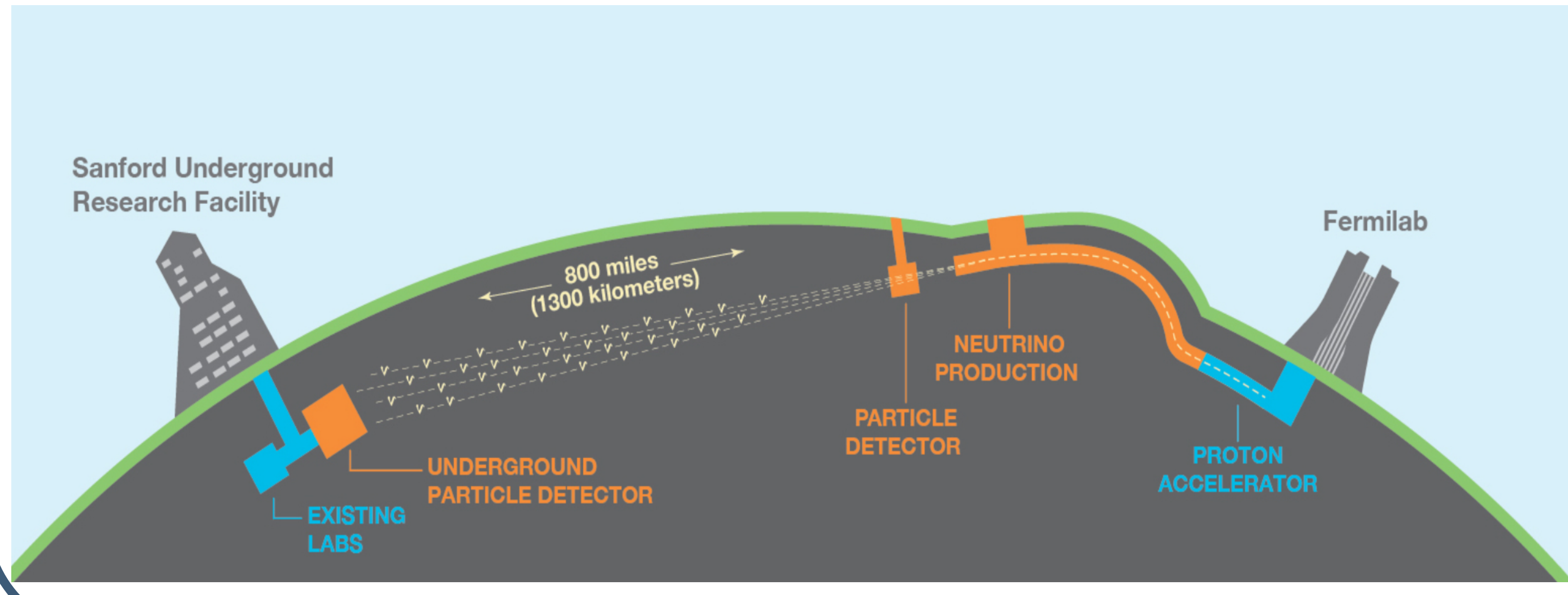
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## Deep Underground Neutrino Experiment (DUNE)

– DUNE is a next generation long baseline (1300 km) neutrino experiment, designed to make precise measurements of CP violation in the lepton sector, determine the neutrino mass hierarchy ( $\Delta m_{32}^2$ ) and measure the **neutrino oscillation parameters** [1].

– DUNE will have both  $\nu_\mu$  and  $\bar{\nu}_\mu$  beams and will measure the  $\nu_\mu \rightarrow \nu_e$  appearance probability, as well as the  $\nu_\mu \rightarrow \nu_\mu$  survival spectrum at the DUNE Far Detector (FD).

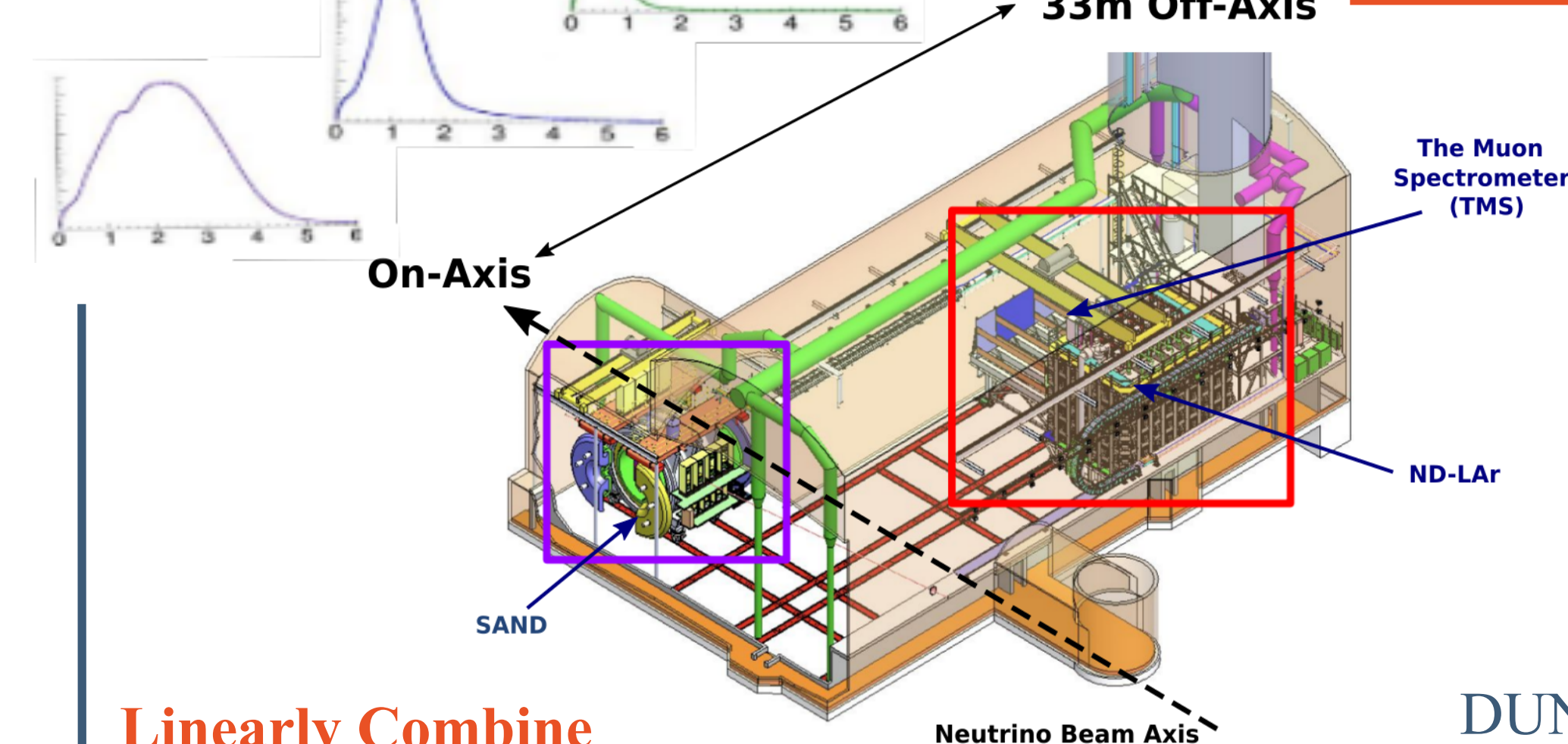
– One of the most important systematics sources in the long baseline neutrino oscillation experiments is the **neutrino cross-section model**.



## Movable Near Detector: off-axis fluxes

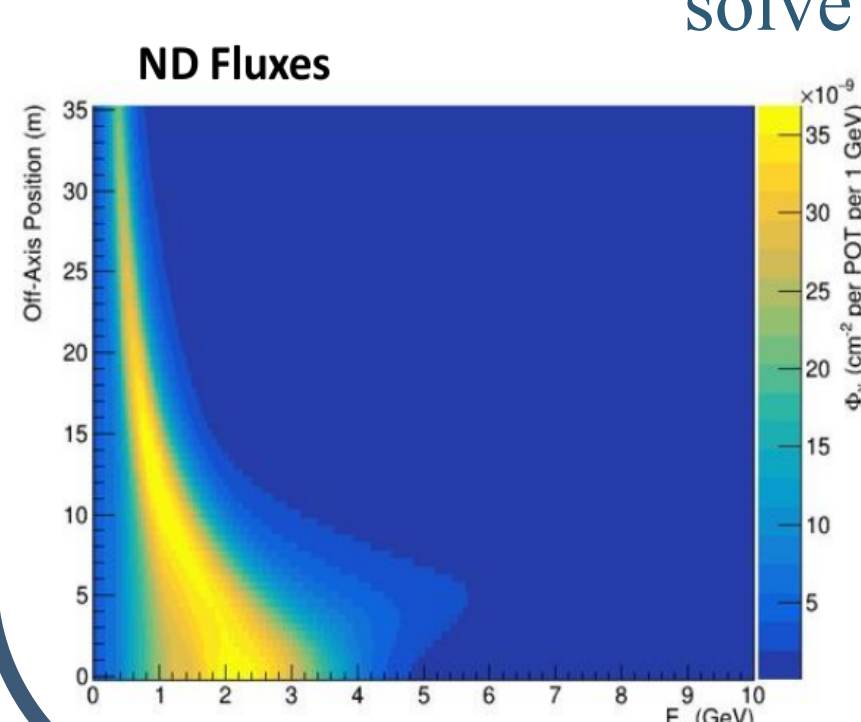


**Neutrino fluxes narrow and peak at lower energies with increasing off-axis distances**

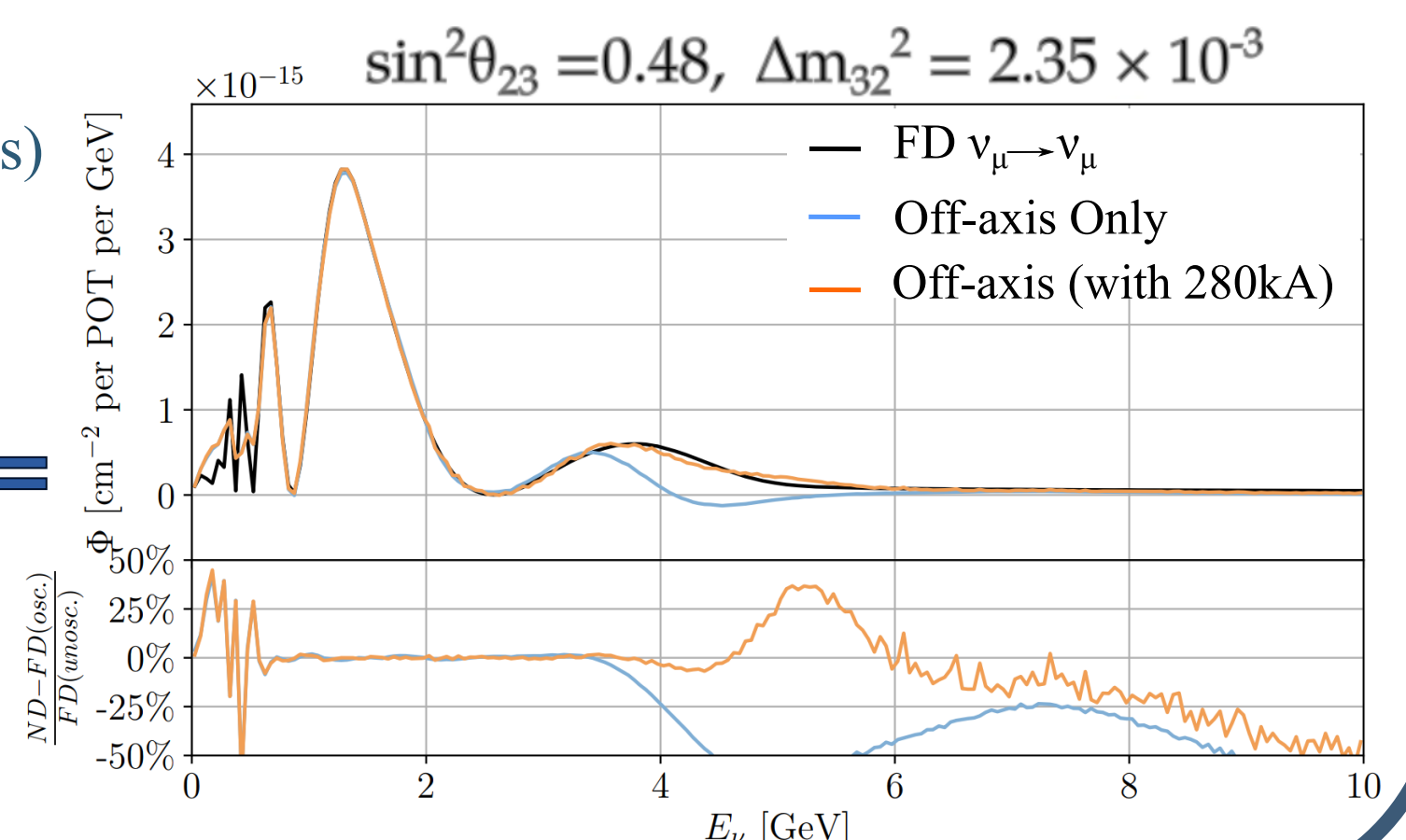
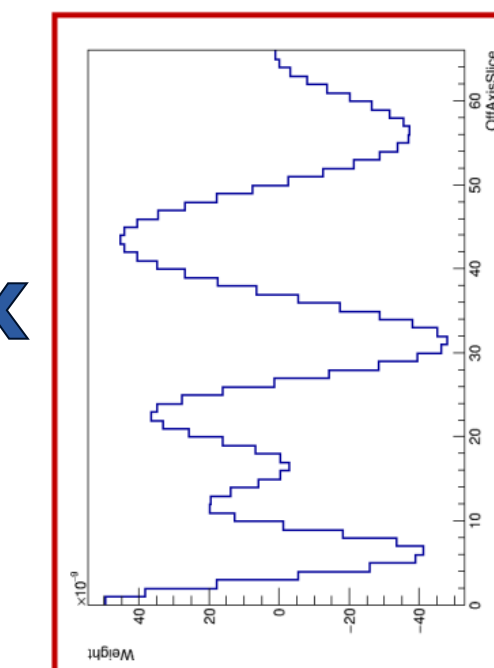


Linearly Combine ND Fluxes (PRISM)

$$\text{ND Fluxes} \times \bar{C} = \text{FD Flux}$$

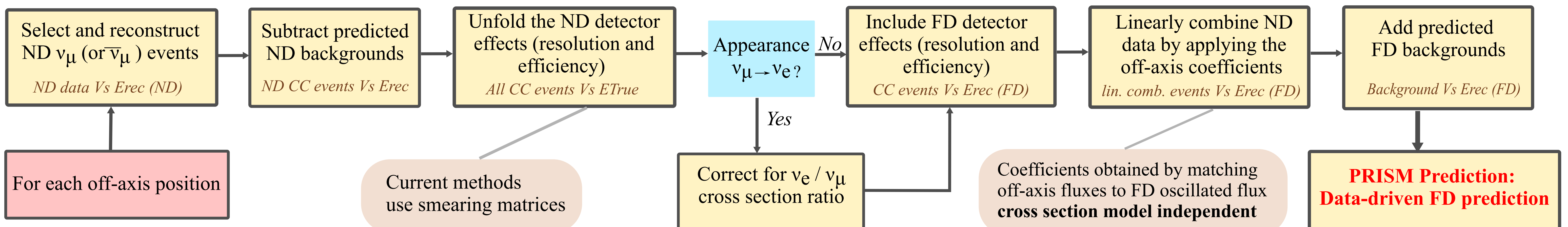


solve for  $\bar{C}$  (coeff vs off-axis)

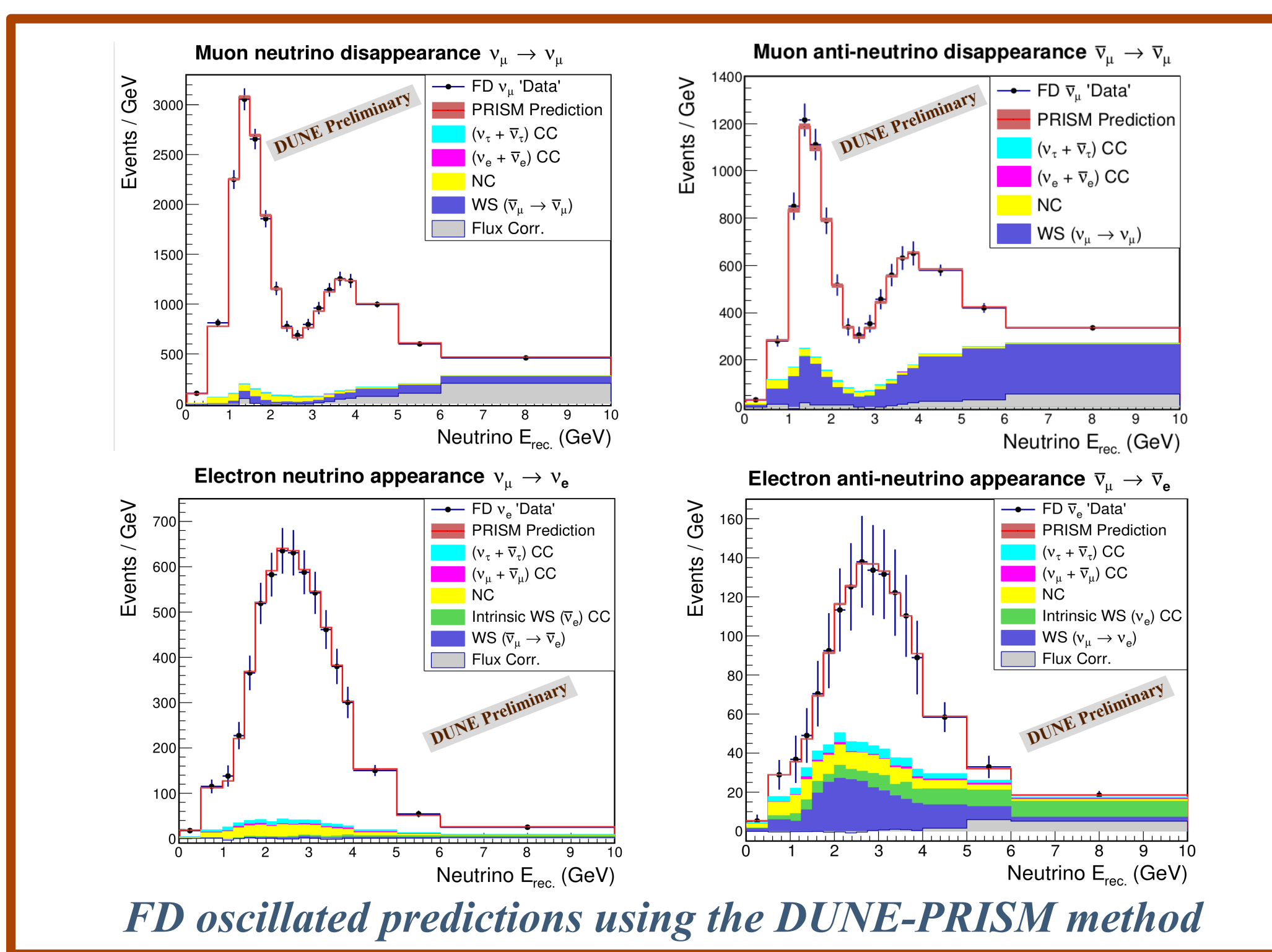


DUNE Near detector will move at several positions off-axis  
More details in [1] and [2].

## Mechanism for producing a data-driven prediction of the oscillated spectrum

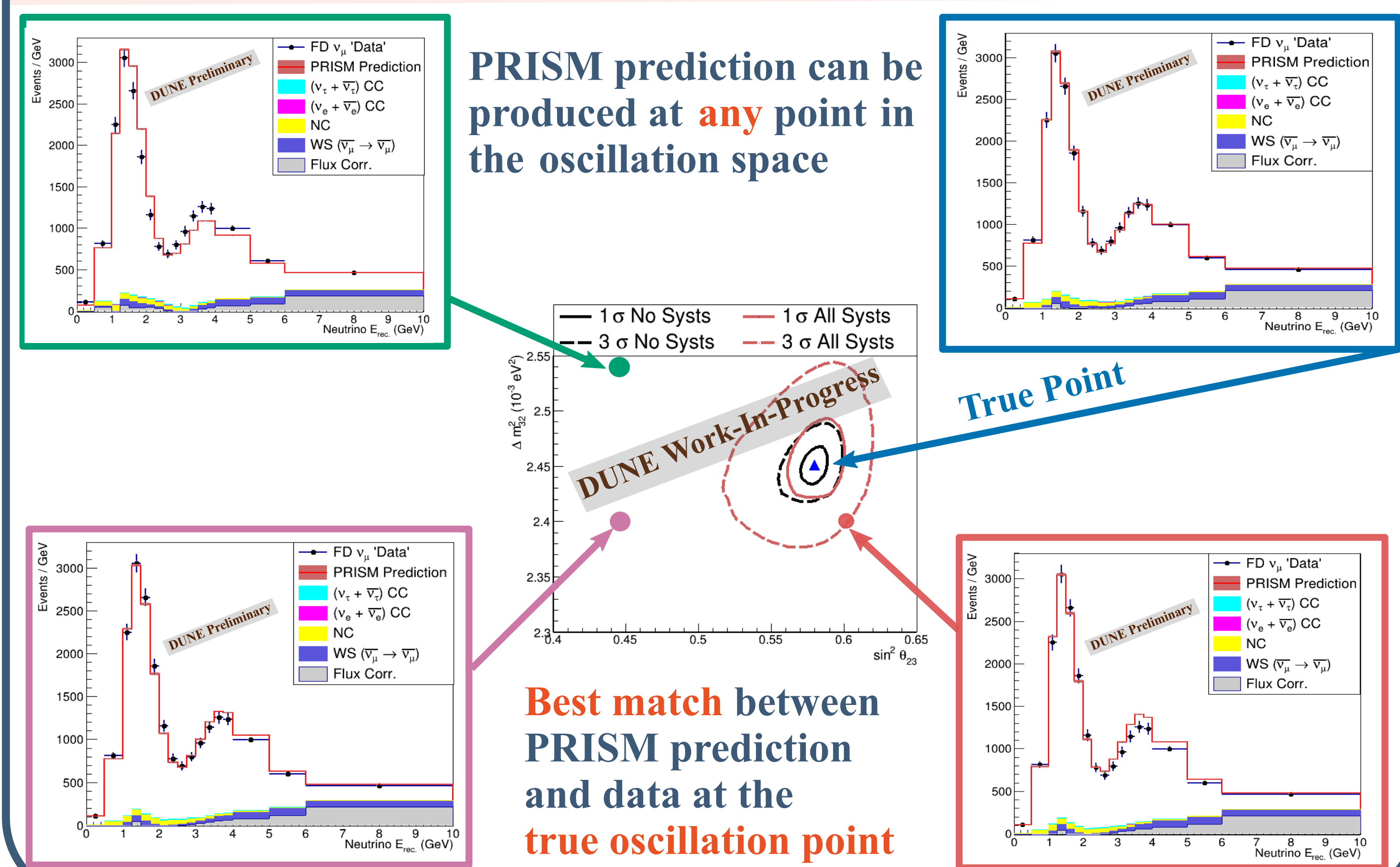


## DUNE-PRISM Predictions for the FD oscillated spectrum



All the cross section modeling systematics are naturally included in a data-driven prediction (PRISM)

## DUNE-PRISM Oscillations Measurement



PRISM prediction can be produced at any point in the oscillation space

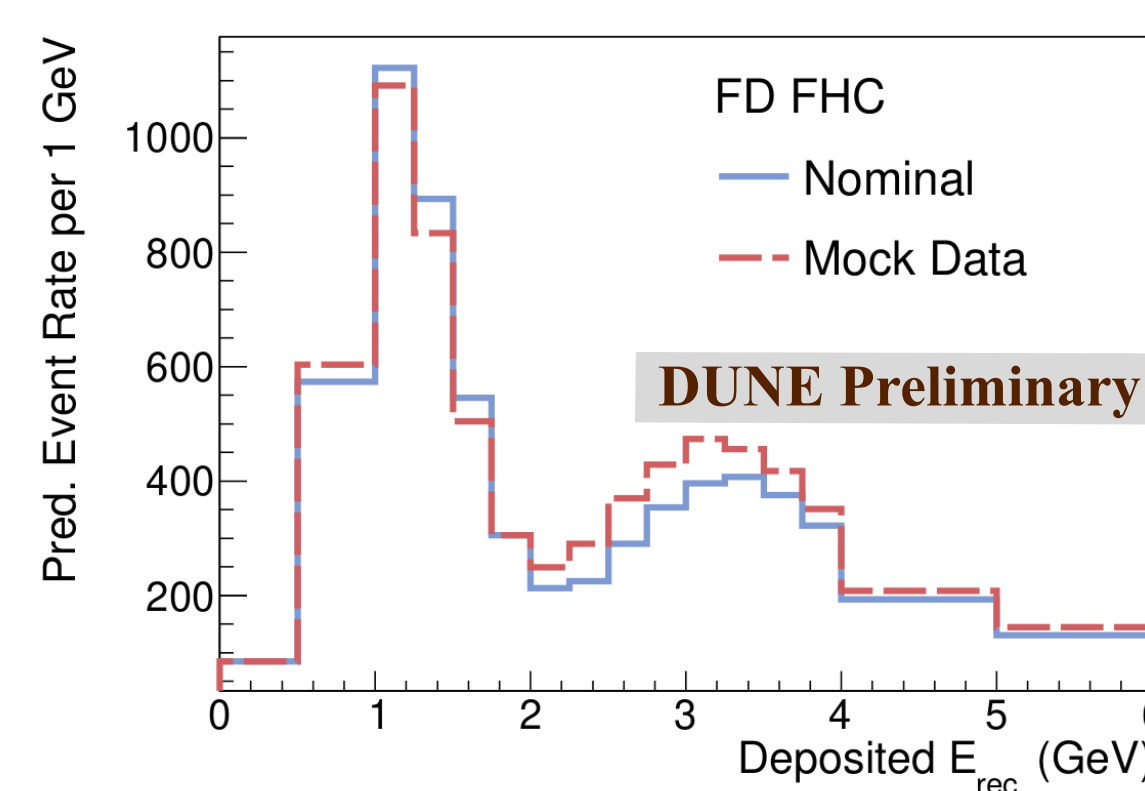
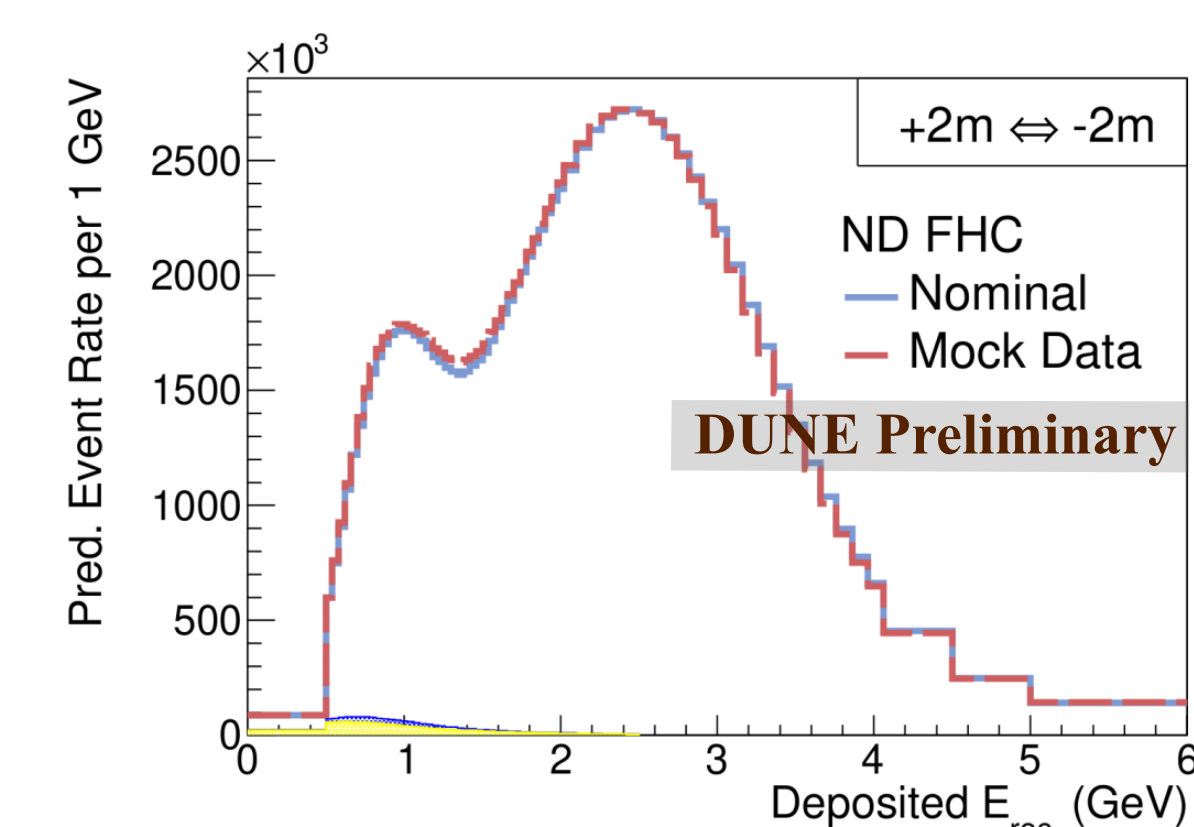
Best match between PRISM prediction and data at the true oscillation point

## DUNE results with wrong interaction modeling

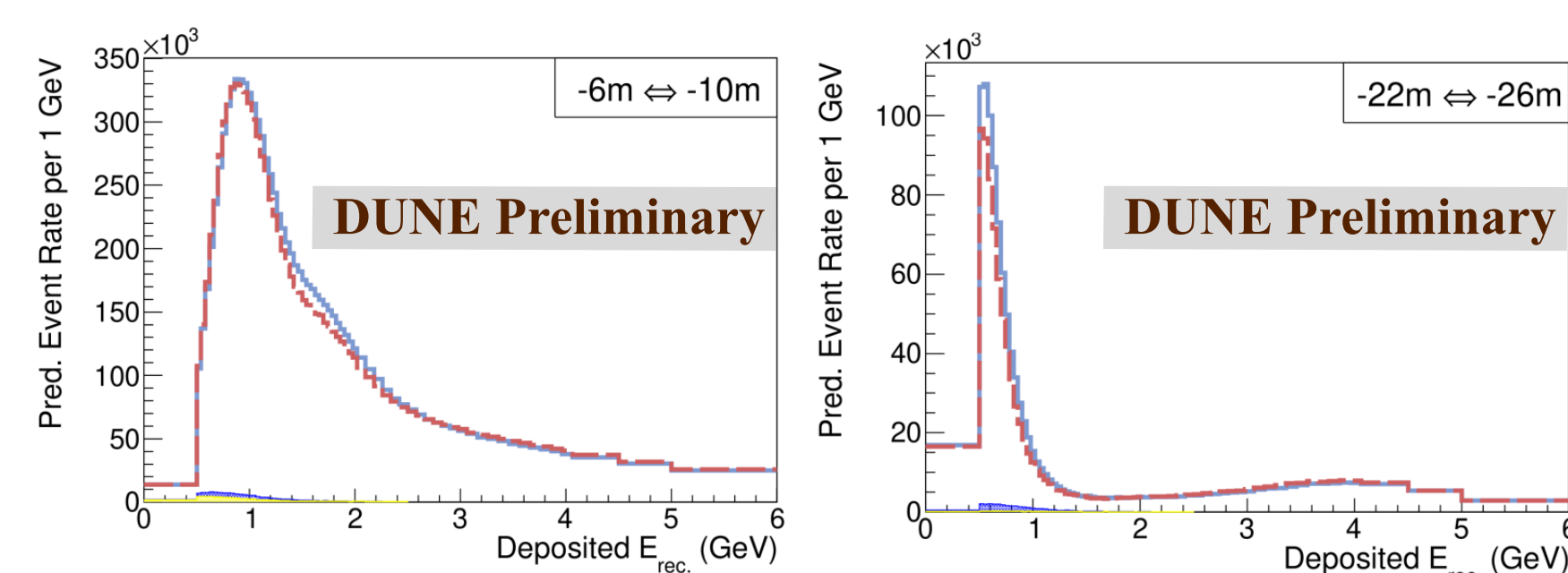
Neutrino interaction model is wrong: 20% of proton energy unobserved

– good fit at the on-axis ND: modified interaction model fits the observed data  
– propagate it to the FD

– poor agreement between FD oscillated data and modified interaction model (despite good on-axis ND agreement)



– more off-axis fluxes point out the miss-match between modified model and observed data



No bias in the oscillation parameters when using data-driven prediction (PRISM) despite wrong interaction model!

