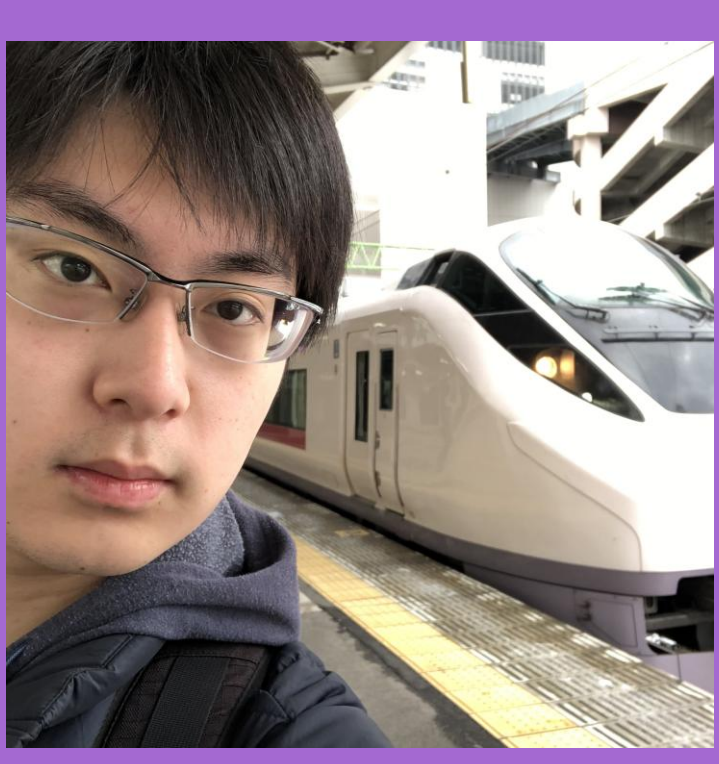


Efficient Modeling of Flux Correlations Between Multiple Detector Locations in an Accelerator Neutrino Beam



Poster #3 Takehiro H. Ishida

Takehiro H. Ishida (Department of Physics, Graduate School of Science, Tohoku University), from T2K Collaboration

T2K and Hyper-K Experiment

Long baseline accelerator neutrino oscillation experiment

Multiple Detectors at Multi Off-Axis Angle

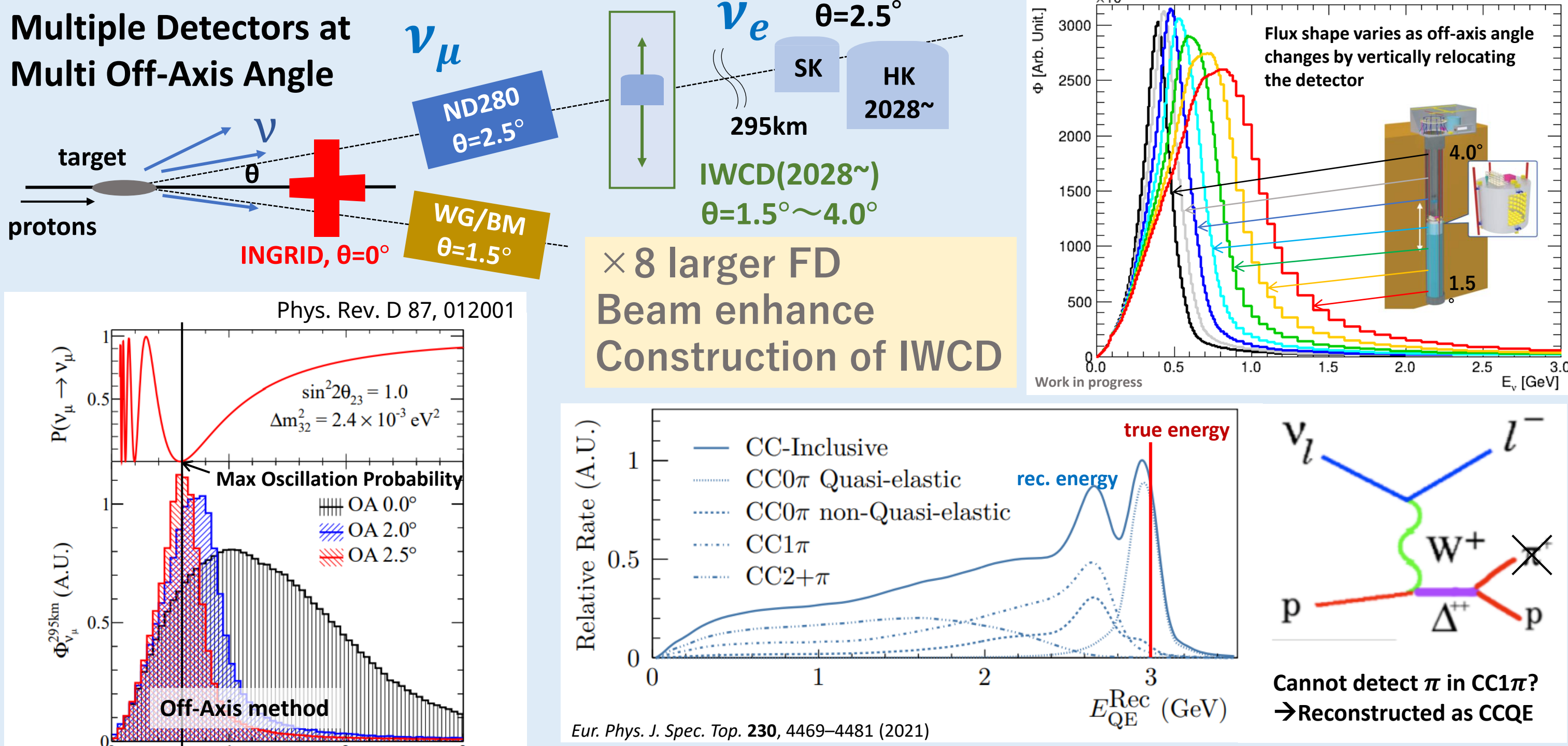
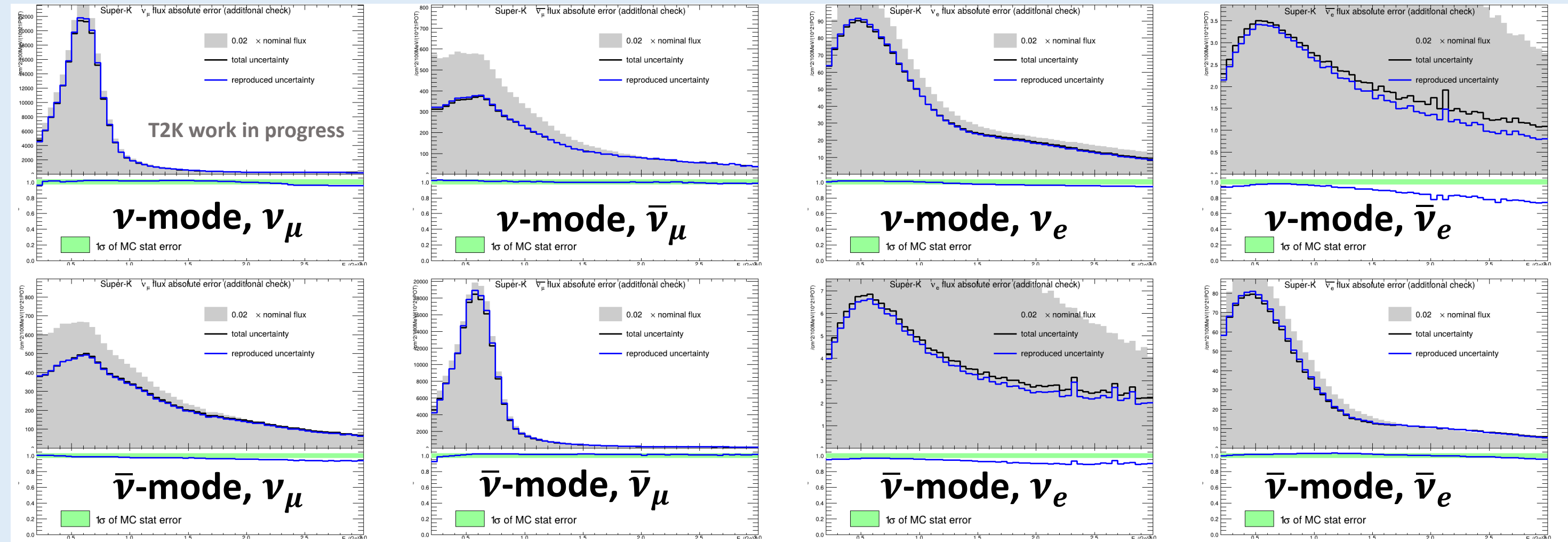


FIG. 1: Muon neutrino survival probability at 295 km and neutrino fluxes for different off-axis angles.

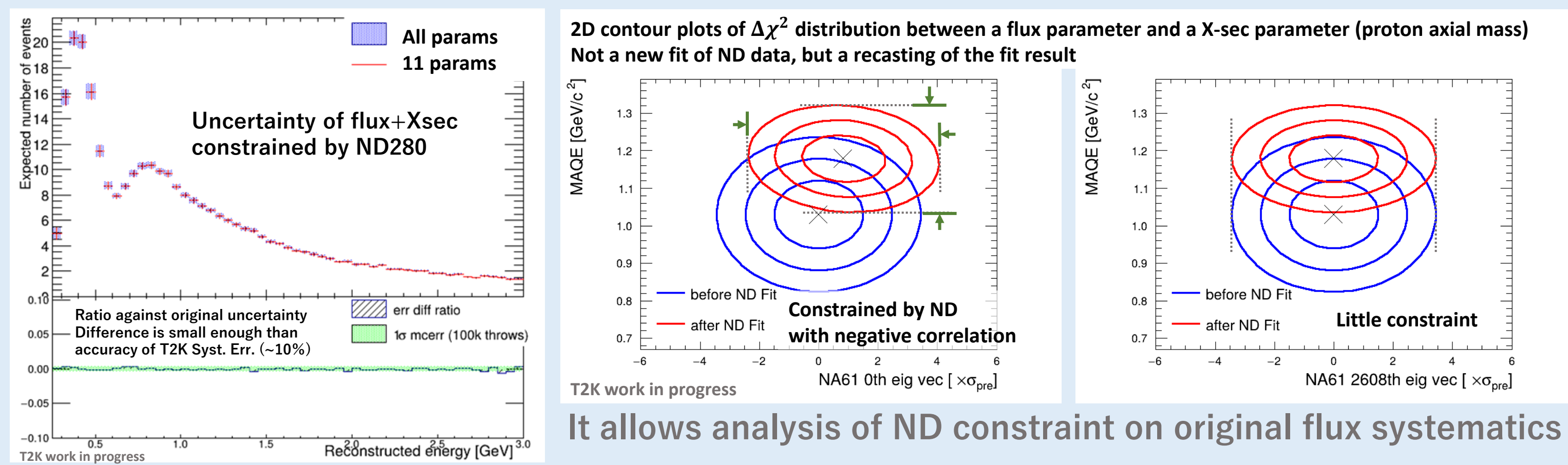
Reduction of NA61 Replica parameters



Flux uncertainty from NA61 Replica is reproduced using only 11 parameters chosen from 2609

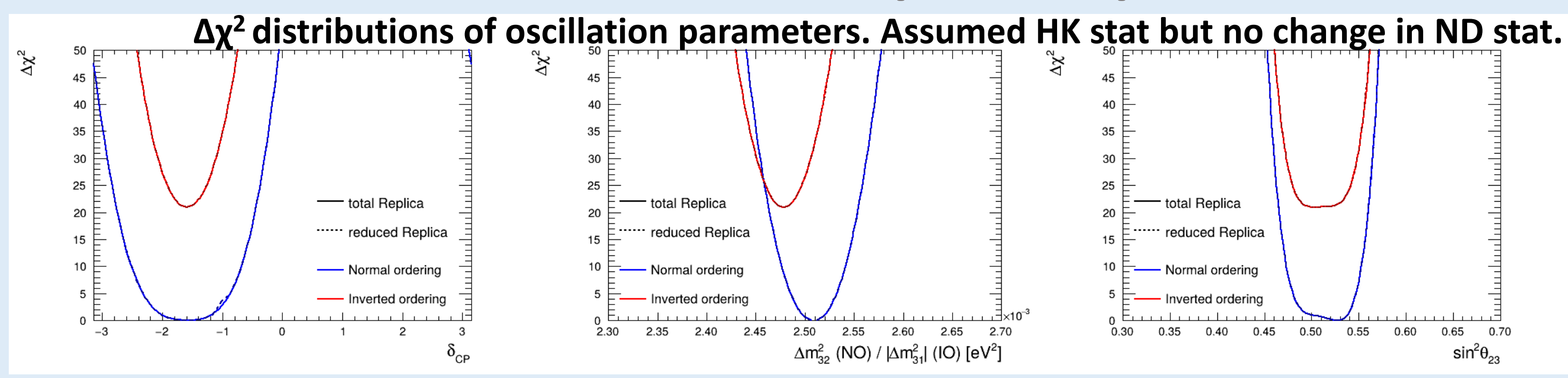
Oscillation analysis with new parameters

1. ND280 analysis with new flux parameters

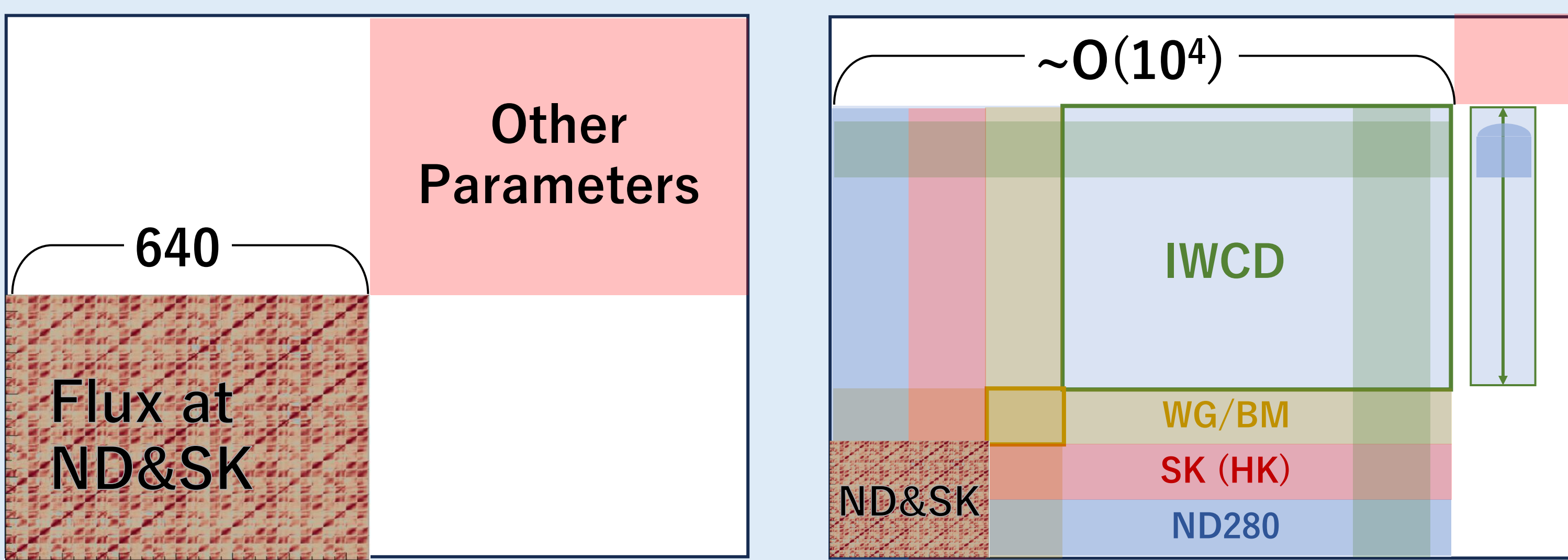


2. Constraint on oscillation parameters

No difference are seen → It can reproduce past results



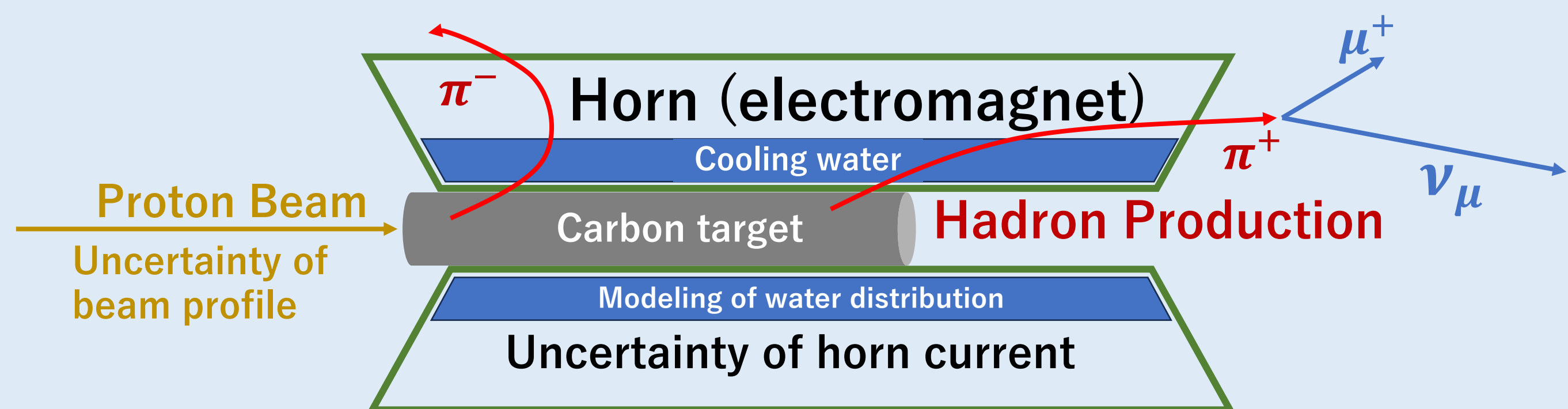
Severe computational cost in Hyper-K era



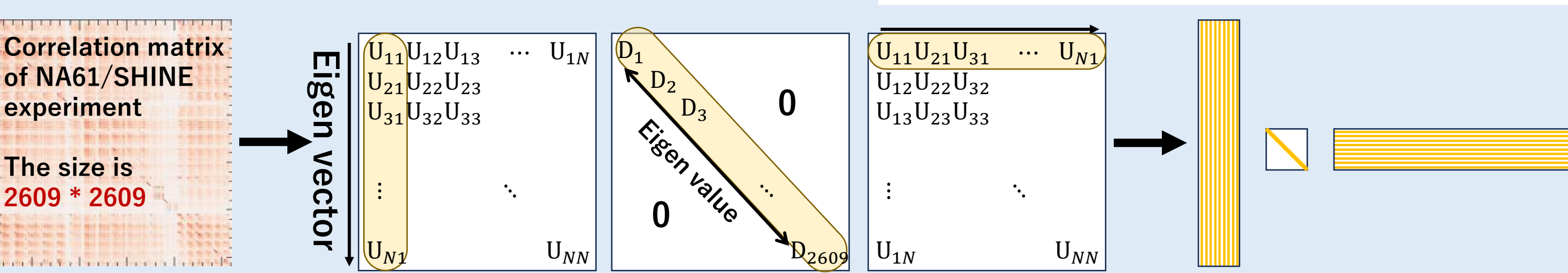
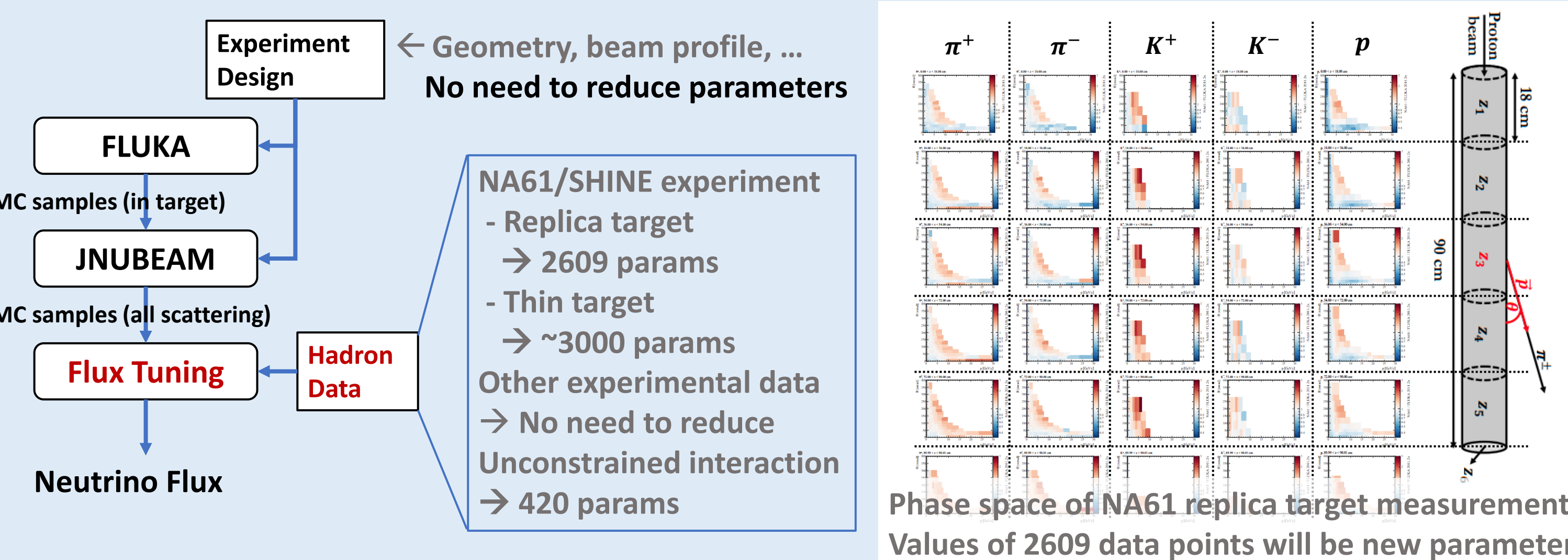
Neutrino flux intensity at each detector and energy bin are used as fitting parameters → Number of them and size of correlation matrix significantly increase to use all detectors

How to reduce parameters

Use original systematic uncertainty parameters as new fitting parameters and its response on neutrino flux



- e.g.) Fit parameter: Flux intensity → Horn current
- Correlation: Flux of ND and FD → Beam position and angle
- Avoid changing number of flux parameters,
 - Understand ND constraint on underlying flux parameters,
 - Flux as continuous (not discrete!) function of off-axis angle



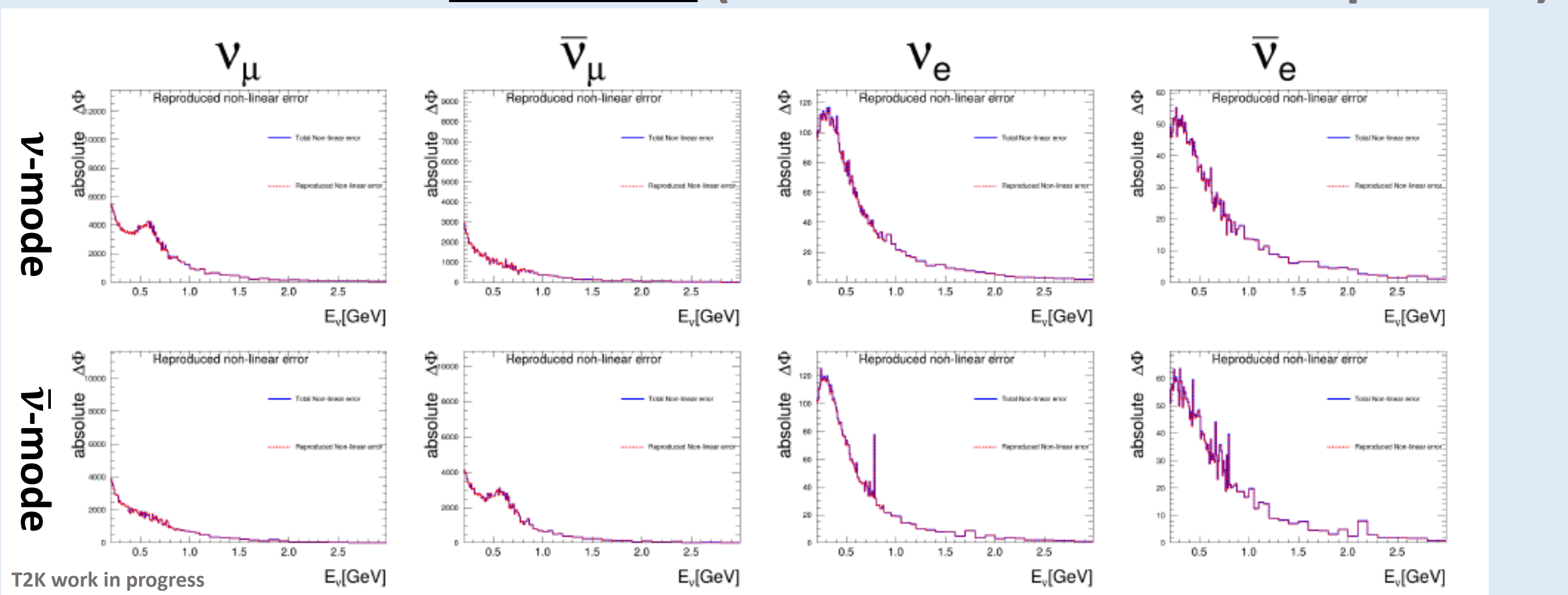
Create new **uncorrelated variables** by eigen decomposition and reduce them by taking out important vectors

Vectors are chosen by its contribution on neutrino flux

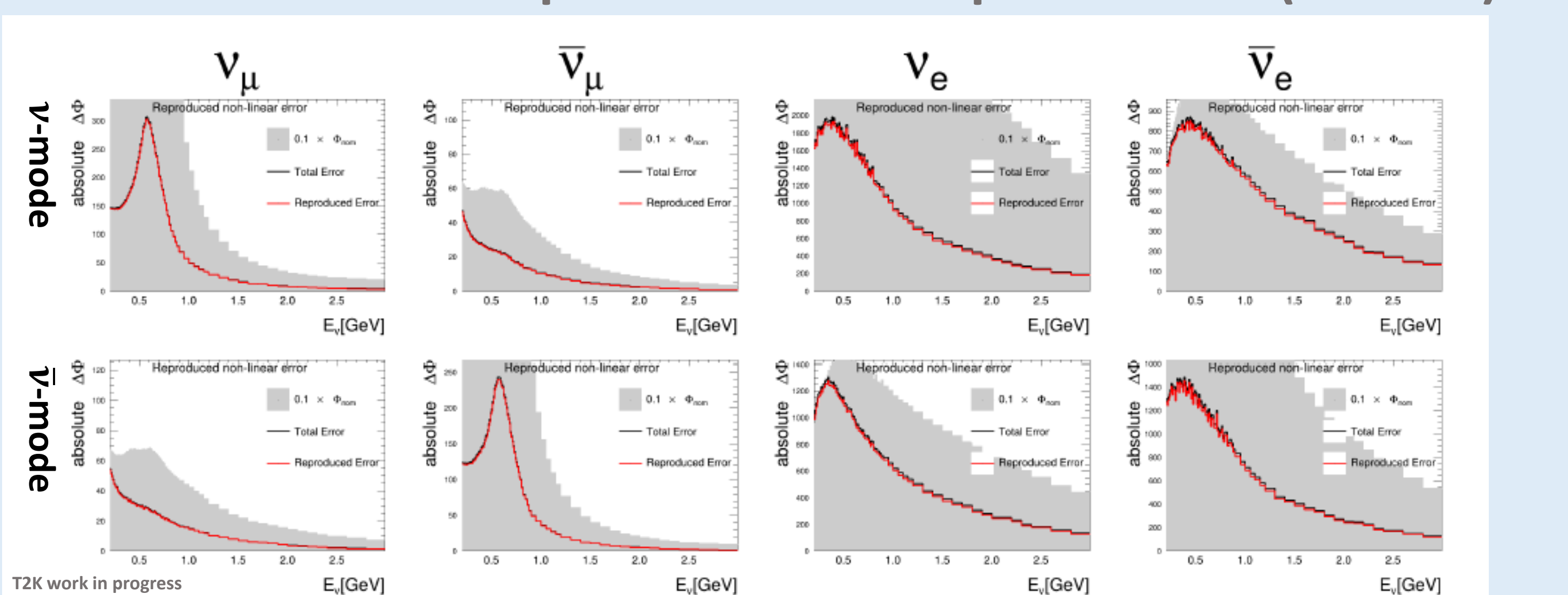
Reduce parameters of unconstrained interactions

Main source is meson re-scattering outside the target

These effects are **not linear** (210 linear + 210 non-lin params)



Non-linear error is reproduced with 5 parameters (210 → 5)



Total error is reproduced by adding 44 linear params (420 → 49)

Summary and Plans

- New method to handle ν flux correlations with reduced number of parameters is necessary for HK experiment
- Reparameterization of flux systematics and reduction of parameters to describe hadron interactions
- Plan: Development for the other flux parameters and implementation of IWCD flux systematics