

# New method to evaluate flux correlations between multiple detection points for accelerator neutrino oscillation experiments

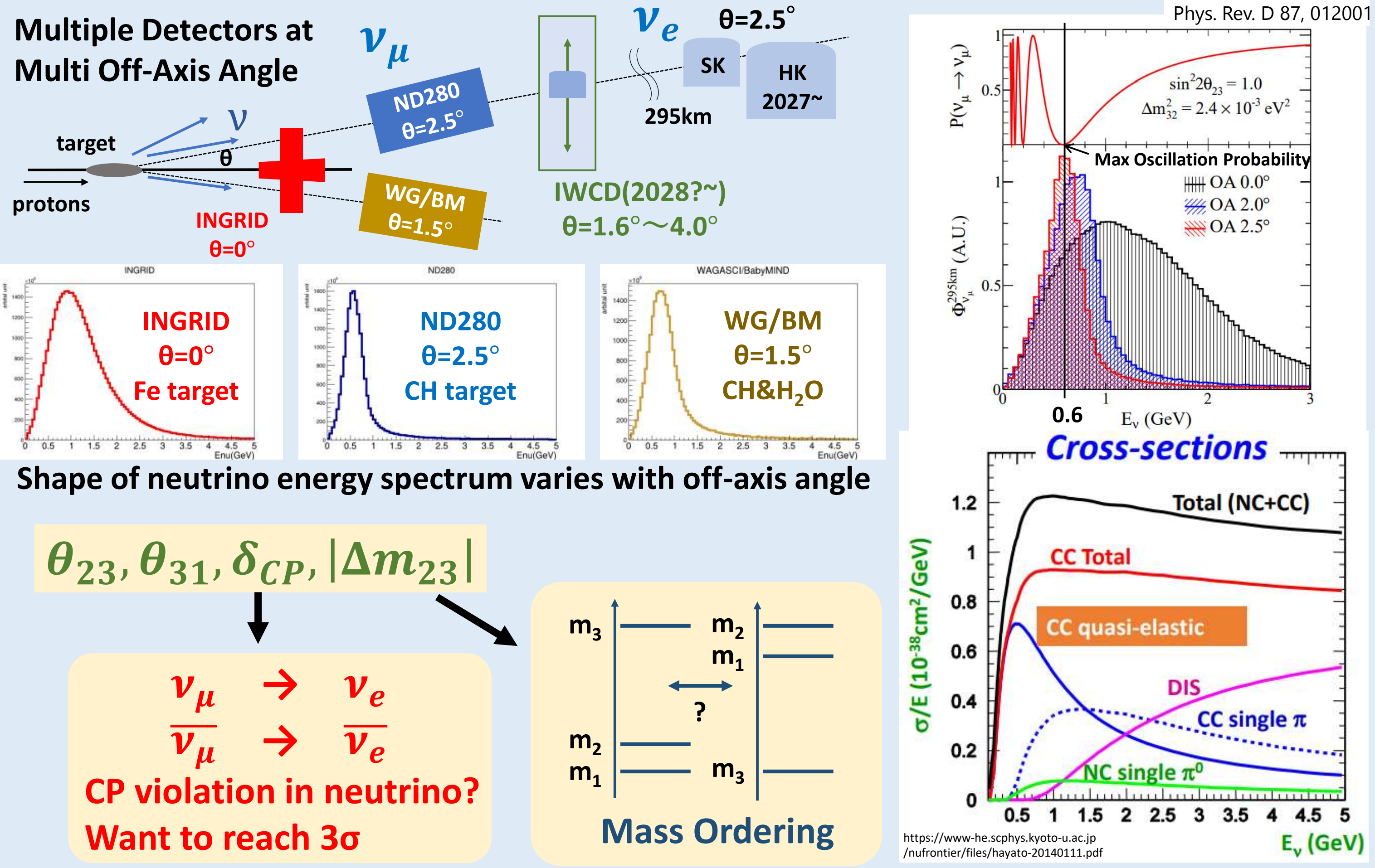


Poster #38 Takehiro H. Ishida

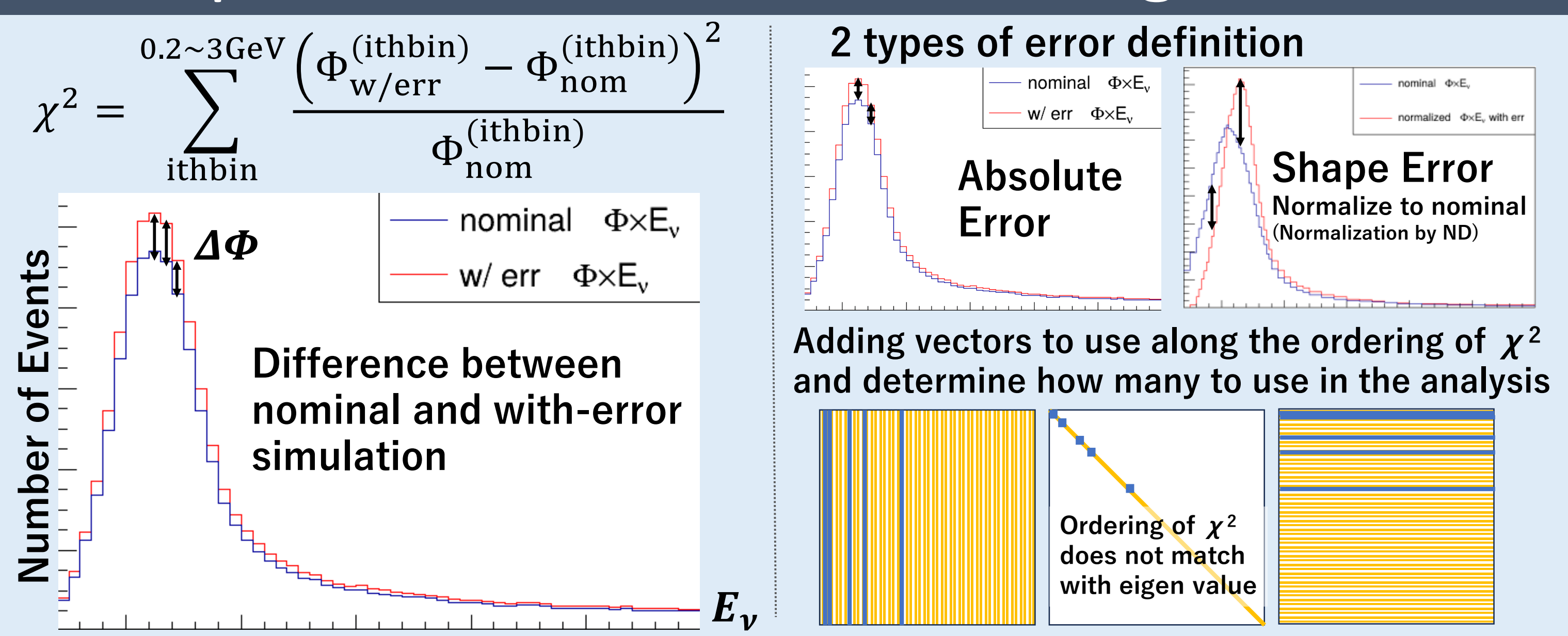
Takehiro H. Ishida<sup>1</sup>, Atsuko K. Ichikawa<sup>1</sup>, Lukas Berns<sup>1</sup>, and T2K Collaboration (<sup>1</sup>Department of Physics, Graduate School of Science, Tohoku University)

## T2K Experiment

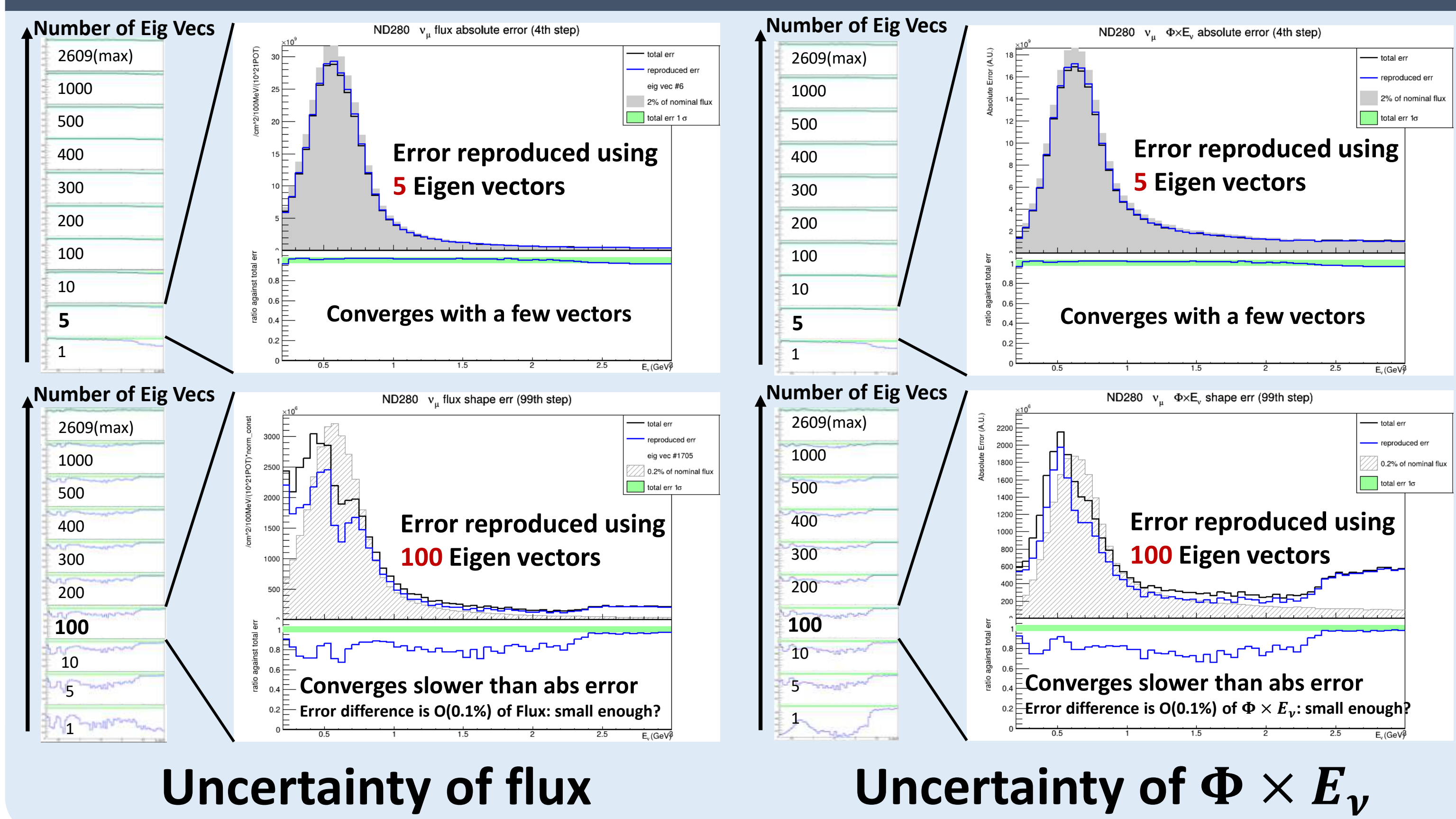
### Long baseline accelerator neutrino oscillation experiment



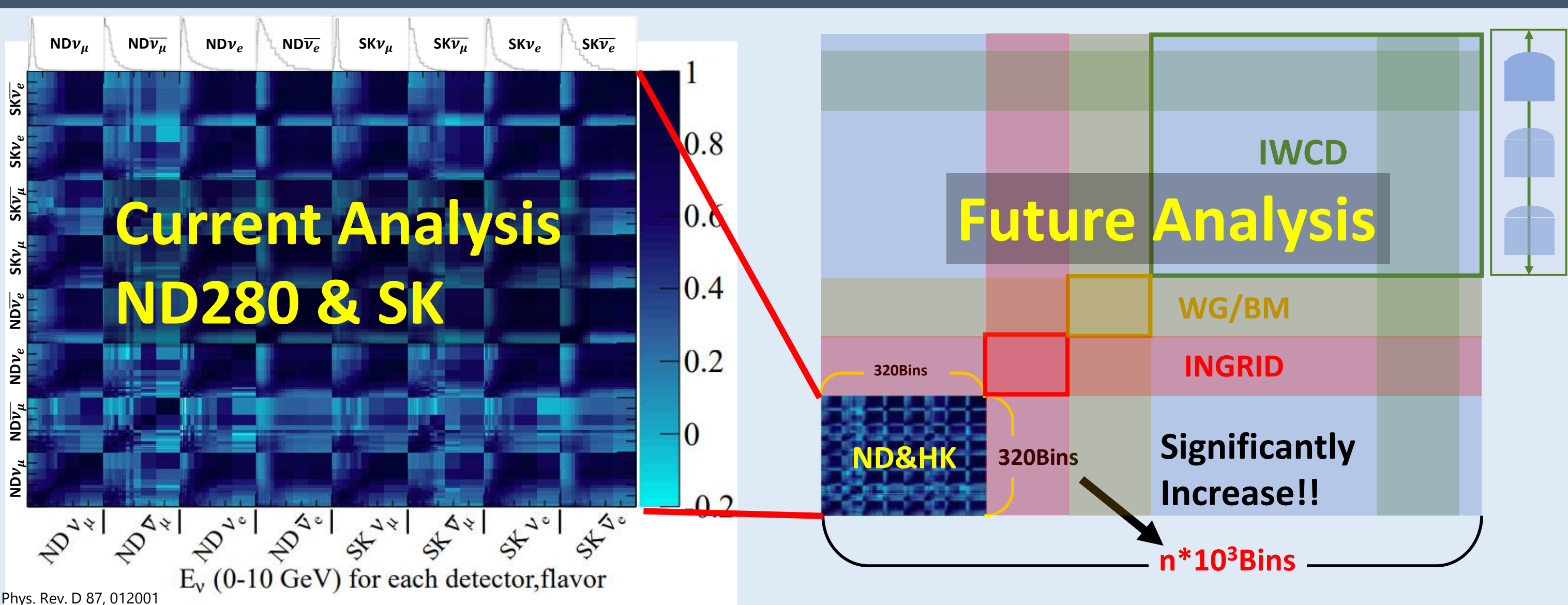
## Compare contribution of each eigen vector



## Flux uncertainty of ND280



## Oscillation analysis with multiple detectors

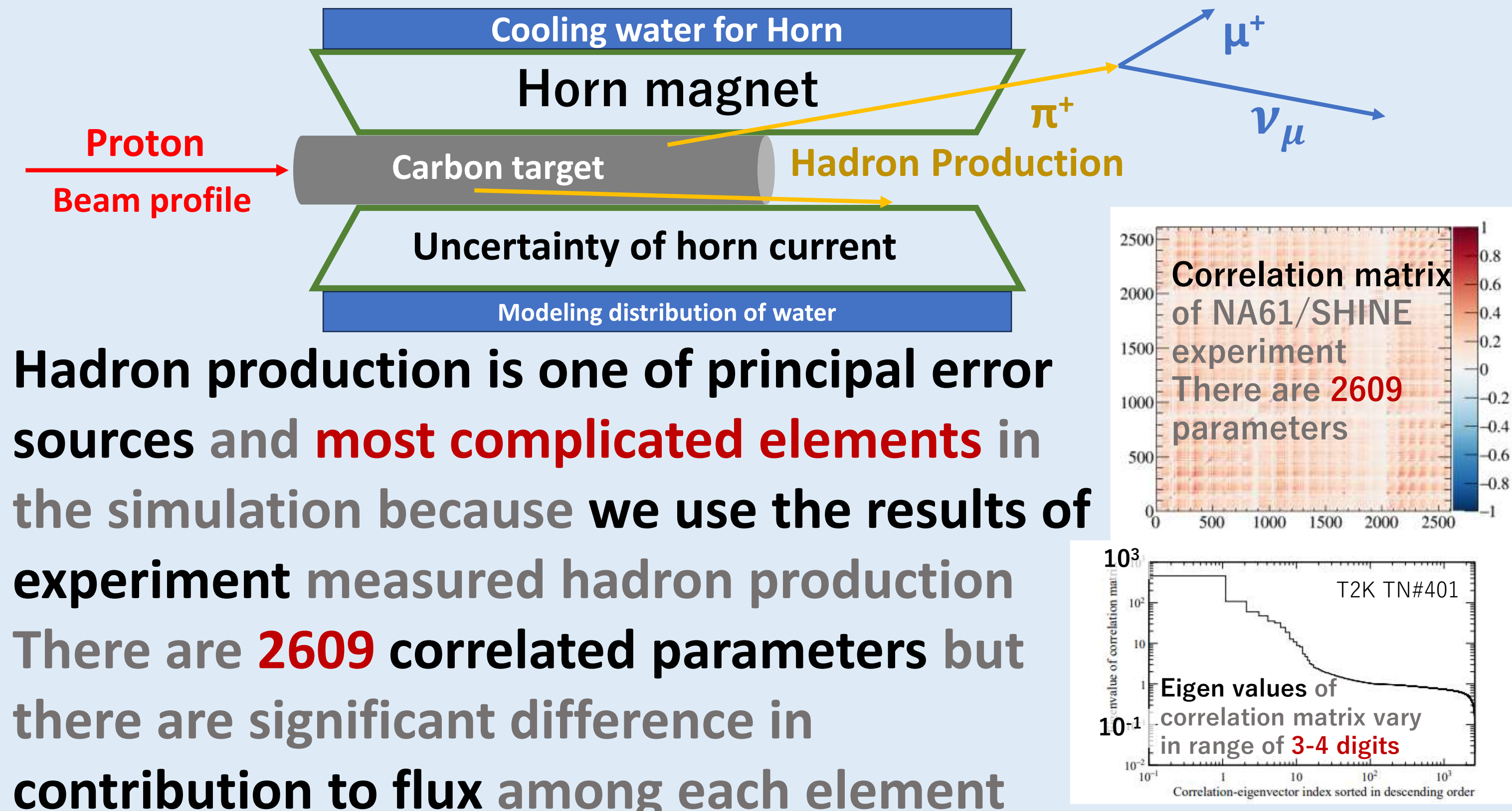


Energy spectra of neutrino flux and their correlation are used for current analysis, but we need a new method with reduced parameters to use all detectors for oscillation analysis

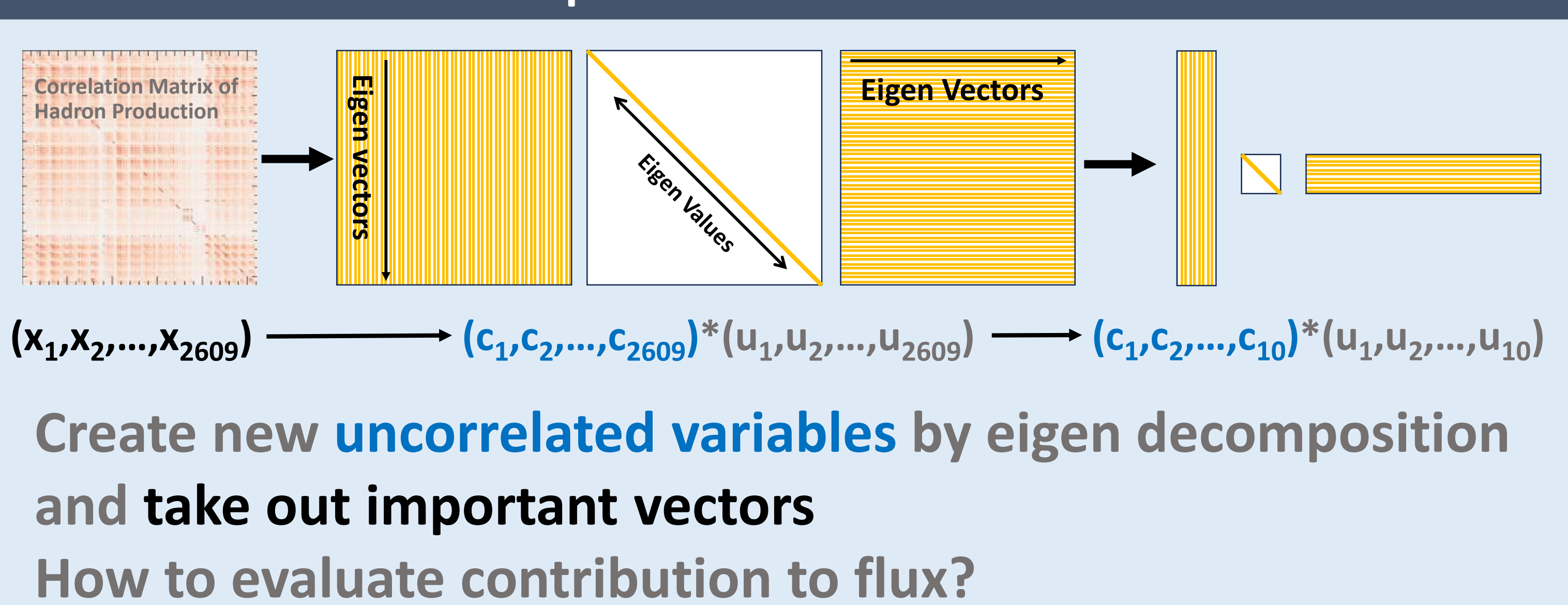
## Sources of neutrino flux uncertainty

Using systematic parameters and errors for analysis instead of flux will reduce fit parameters for the analysis

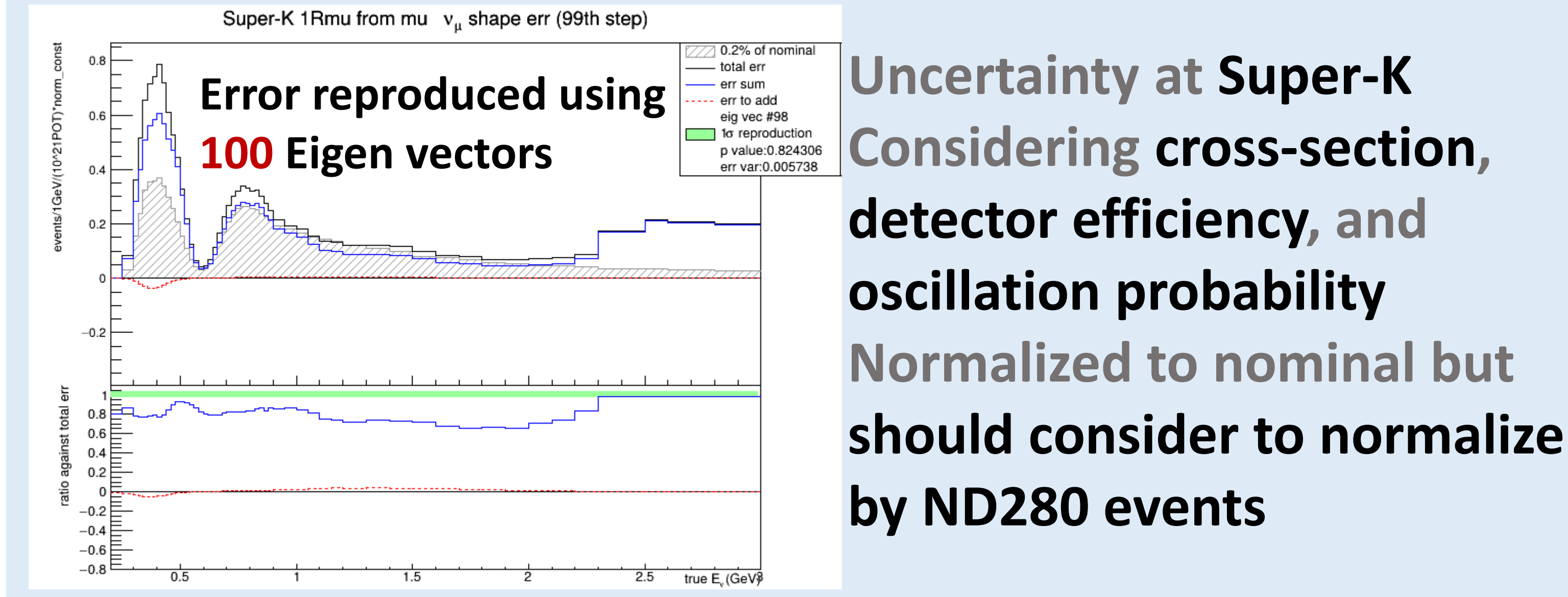
Systematic parameters are also sources of flux uncertainty



## How to reduce parameters



## On-going works



Important vectors are common to all pattern

What is physical mean of each eigen vector?

Eig val	ND280 Flux		ND280 $\Phi \times E_{\nu}$		SK Flux		SK $\Phi \times \sigma \times \epsilon$		SK $\Phi \times \sigma \times \epsilon \times P_{osc}$	
	abs	shape	abs	shape	abs	shape	abs	shape	abs	shape
0	0	1	0	6	0	1	0	6	0	6
1	1	6	1	1	1	6	1	1	1	1
2	2	2	6	4	2	10	2	4	6	2
3	4	4	2	2	6	2	6	0	2	4
4	6	10	4	0	4	4	4	2	4	0
5	5	0	5	3	5	0	5	5	5	5
6	3	5	3	5	10	5	9	3	9	3
7	10	3	9	10	3	3	3	9	3	2066
8	9	12	18	12	9	12	18	12	18	7
9	18	9	10	9	18	9	38	2066	12	2350

Some of eigen vectors correspond to systematic uncertainties of NA61/SHINE

Vec #0: Reconstruction bias

Vec #1: Hadron loss

Vec #3: Backward extrapolation

Vec #6: Particle identification+??

Number of systematic error sources of NA61/SHINE is  $\sim 10$

$\rightarrow$  Using  $\sim 10$  eigen vectors is enough?

## Summary and Plans

We need to reduce the number of parameters of analysis

Worked on reproducing flux uncertainty using only a part of elements of hadron production, and **showed the possibility to reduce parameters 2609  $\rightarrow$   $\sim 10$**

As a plan, will work on development of new analysis which use new fit parameters