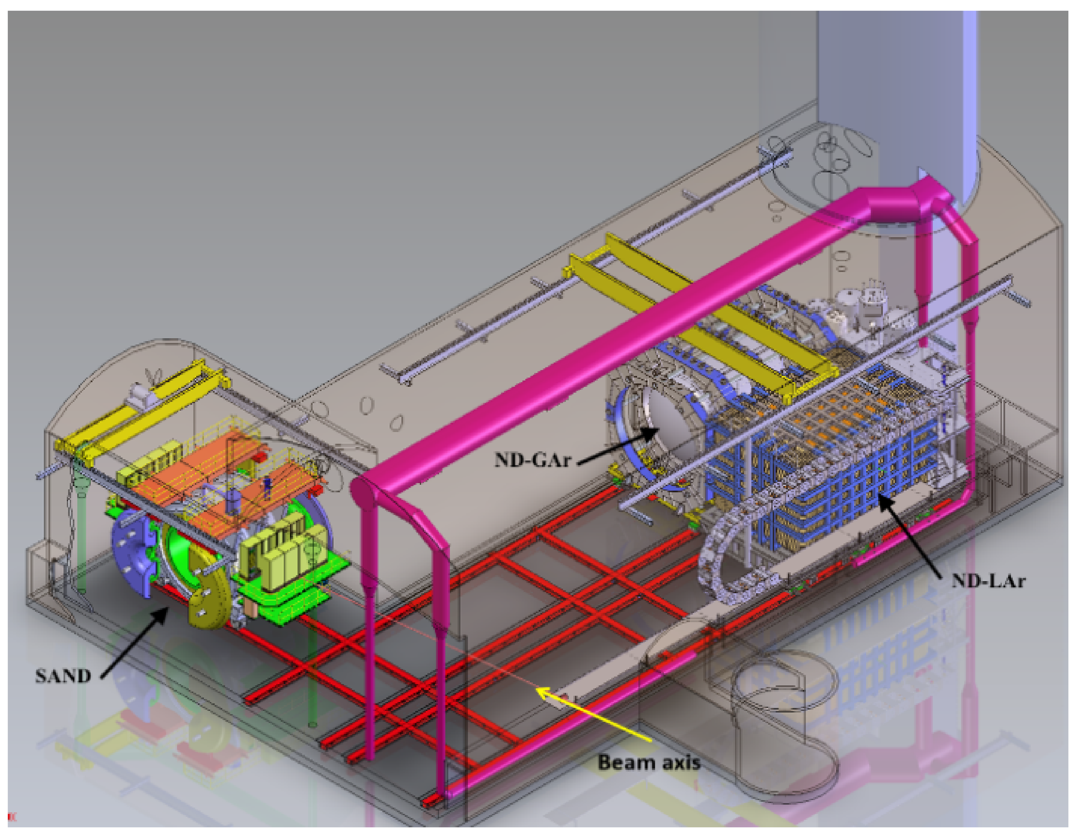
The PRISM method of the DUNE accelerator neutrino experiment for predicting the "wrong" sign background in the $\overline{\nu}_\mu$ disappearance mode

A. Stepanova. DLNP, JINR



Deep **U**nderground **N**eutrino **E**xperiment:

- the future accelerator neutrino experiment that is located in the USA;
- movable TMS/GArTPC, LArTPC as parts of the near detector;
  - measuring neutrino energy spectra at different off-axis positions based on neutrino–pion energy dependence

To determine neutrino oscillation parameters (sign of Δm^2_{32} [NO/IO], $\delta_{\rm CP}$)

$\Downarrow$

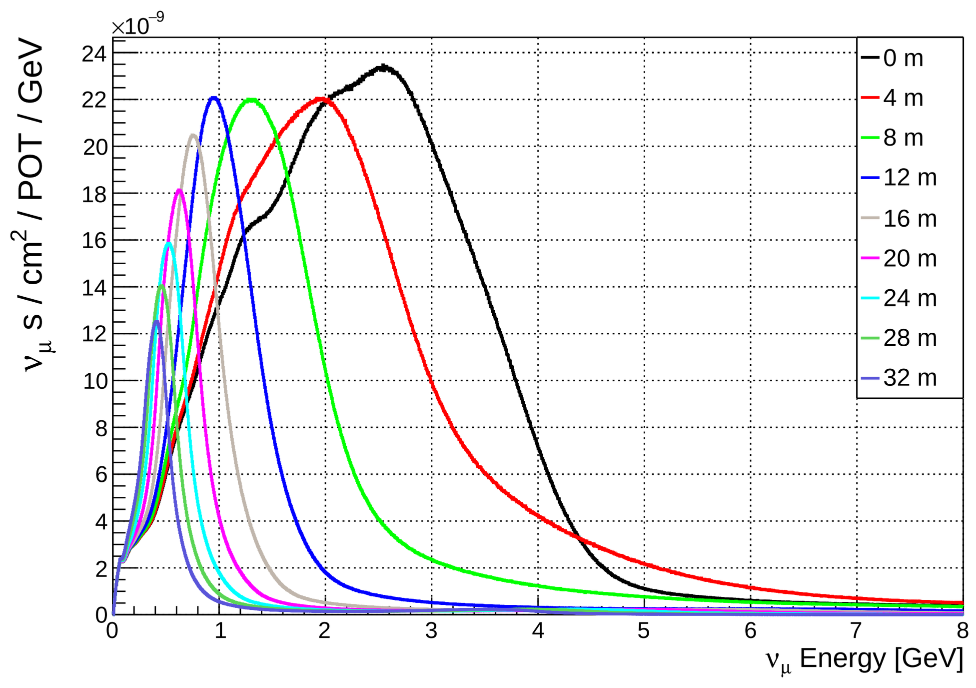
Precision **R**eaction **I**ndependent – **S**pectrum **M**easurement

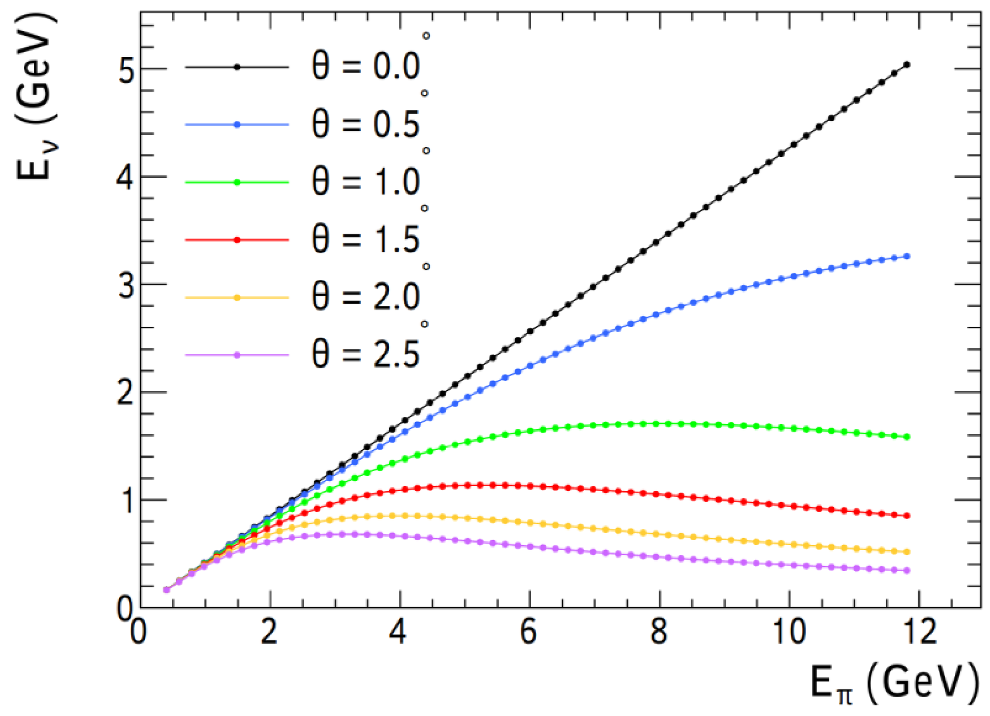
The task:

To predict the "wrong" sign background in the muon antineutrino disappearance mode within the modified DUNE-PRISM method. It is the biggest background in FD modes.

The result:

The WSB prediction via the DUNE-PRISM method is implemented in the neutrino oscillation analysis that makes it almost Monte-Carlo independent.





The linear combination of ND off-axis measurements N to predict FD oscillated flux $\vec{F}$:

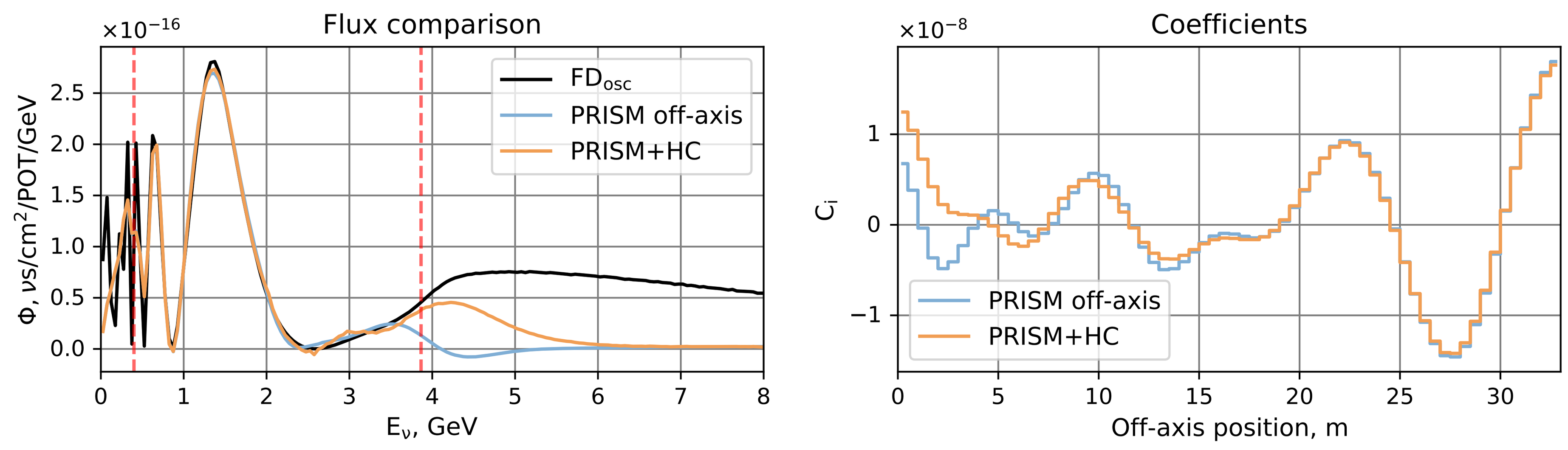
The coefficients $\vec{C}$ might be found by solving a system of equations:

$$N \times \vec{C} = \vec{F}$$

The best solution as a result of Tikhonov regularization for ill-posed problem:

$$\vec{C} = [N^T P N + (\lambda A)^T (\lambda A)]^{-1} N^T P \vec{F},\ \lambda \approx 10^{-9}$$

This is a matching in a fitting range:



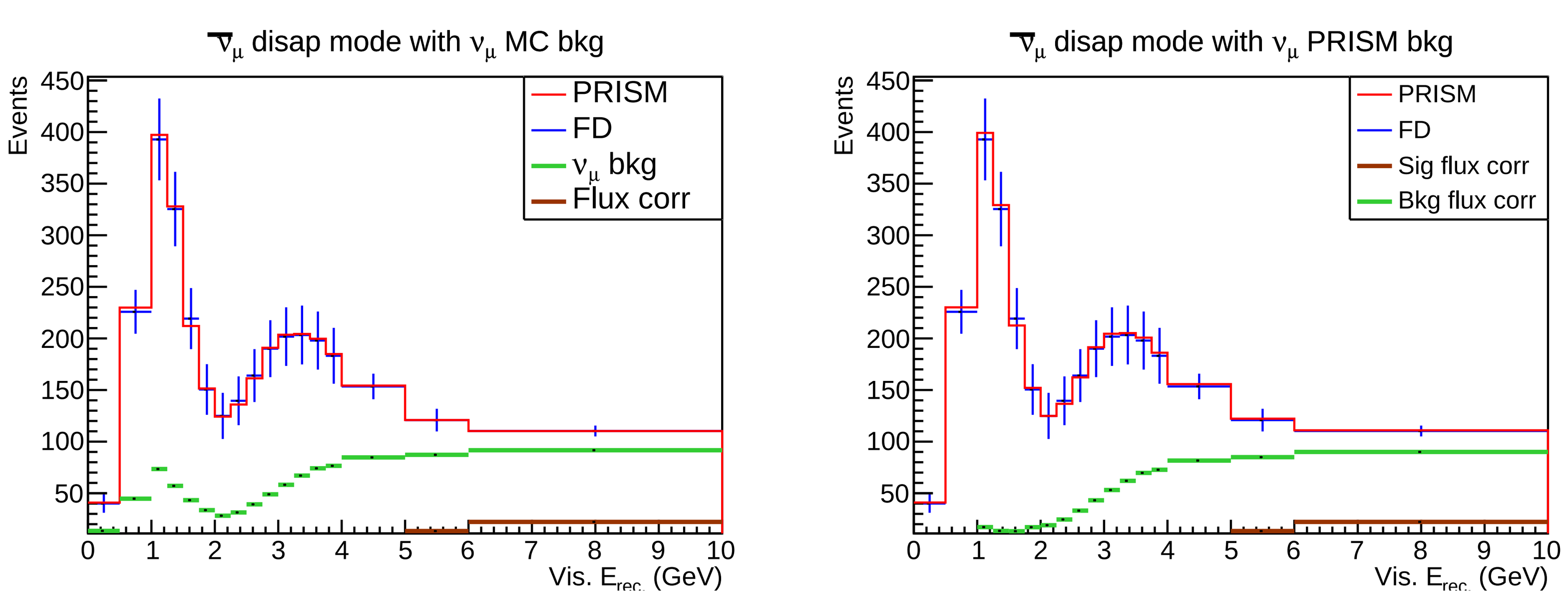
PRISM off-axis – the linear combination of ND off-axis fluxes in neutrino regime
PRISM + HC – the same + on-axis flux made with a lower horn current

To calculate event rates R_{FDP} one should:

- extract ND background; make a LC;
- add irreducible FD background; make flux corrections.

$$R_{FDP}(H_{OA}, E_{rec}) = M_{NF} \sum_i c_i(H_{OA})[R_{ND,i}(E_{rec}) - B_{ND,i}(E_{rec})] +$$

$$+ B_{FD}(E_{rec}) + F(E_{rec}),\ F(E_{rec}) = \sum_k \Delta\Phi(E_\nu) P_{osc}(H_{OA}, E_{\nu,k}) Y(E_{rec})$$



- Stat. analysis: $\nu_\mu + \nu_e + \overline{\nu}_\mu + \overline{\nu}_e$ modes. Exposure: 336 kt-MW-yrs

Sensitivities to Δm^2_{32} and $\sin^2\theta_{23}$