An unstable beam case study

Guang Yang

Motivation

- Show the importance of beam shape stability monitoring in the context of DUNE-PRISM

    - Spectrum monitoring is important regardless of PRISM.

DUNE-PRISM analysis steps

- Predicted ND off-axis flux fit to FD oscillated flux → provides a map between oscillation parameters and linear combination coefficients

- Apply the linear combination coefficients to ND off-axis data to match the FD data

- As far as best coefficient list found that to make ND data match FD data, oscillation parameters is known.

Nominal PRISM flux fit

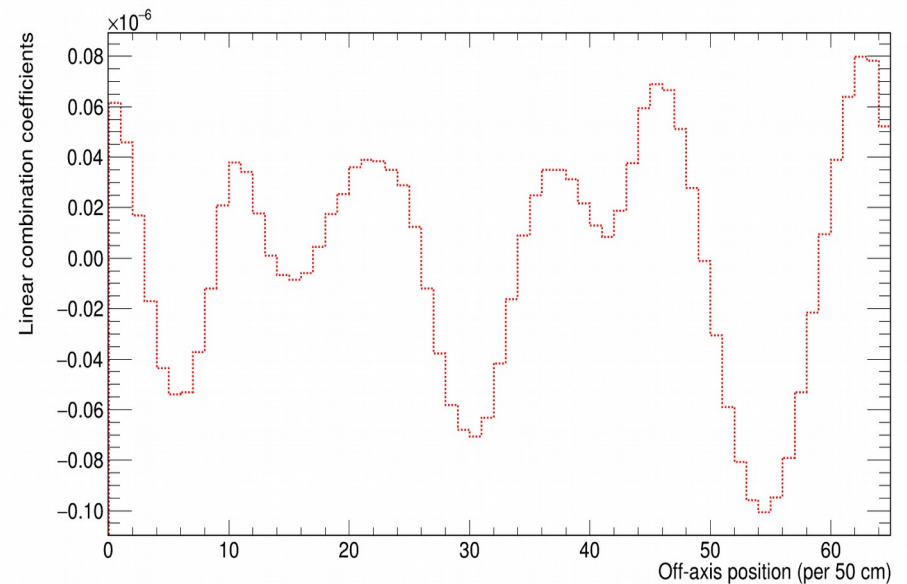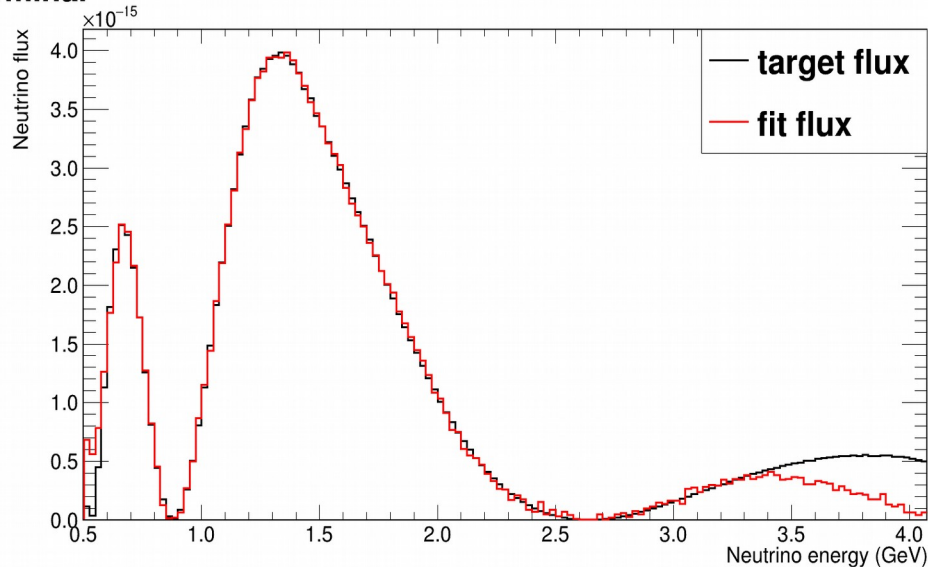- Use off-axis ND flux to match FD oscillated flux

Original
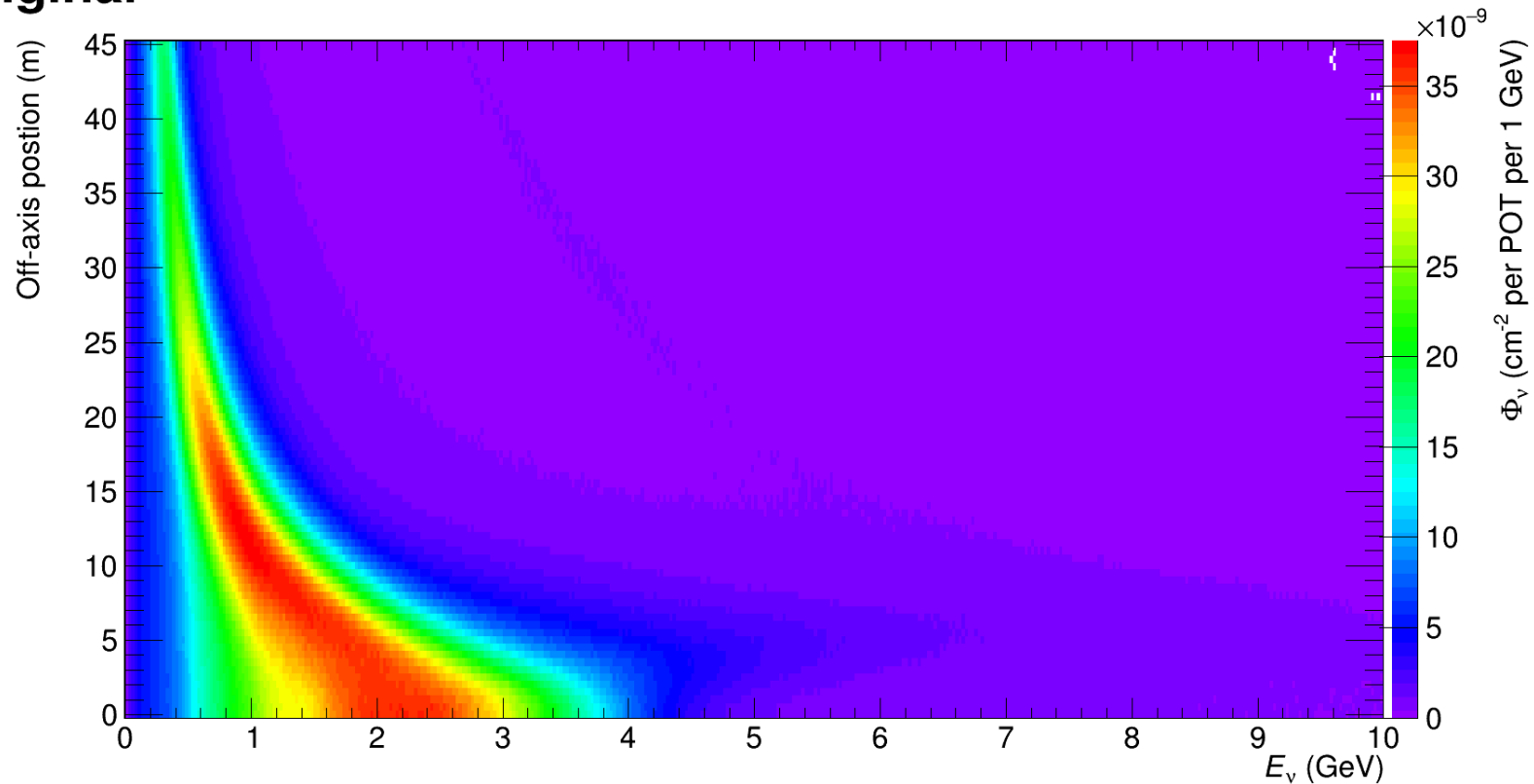
Nonimal PRISM flux fit

- ND flux matching FD flux → Linear combination coefficients tell oscillation

- Each coefficient list corresponds to one oscillation parameter set.

- Apply this map to ND and FD data, without xsec model, find the oscillation parameters.
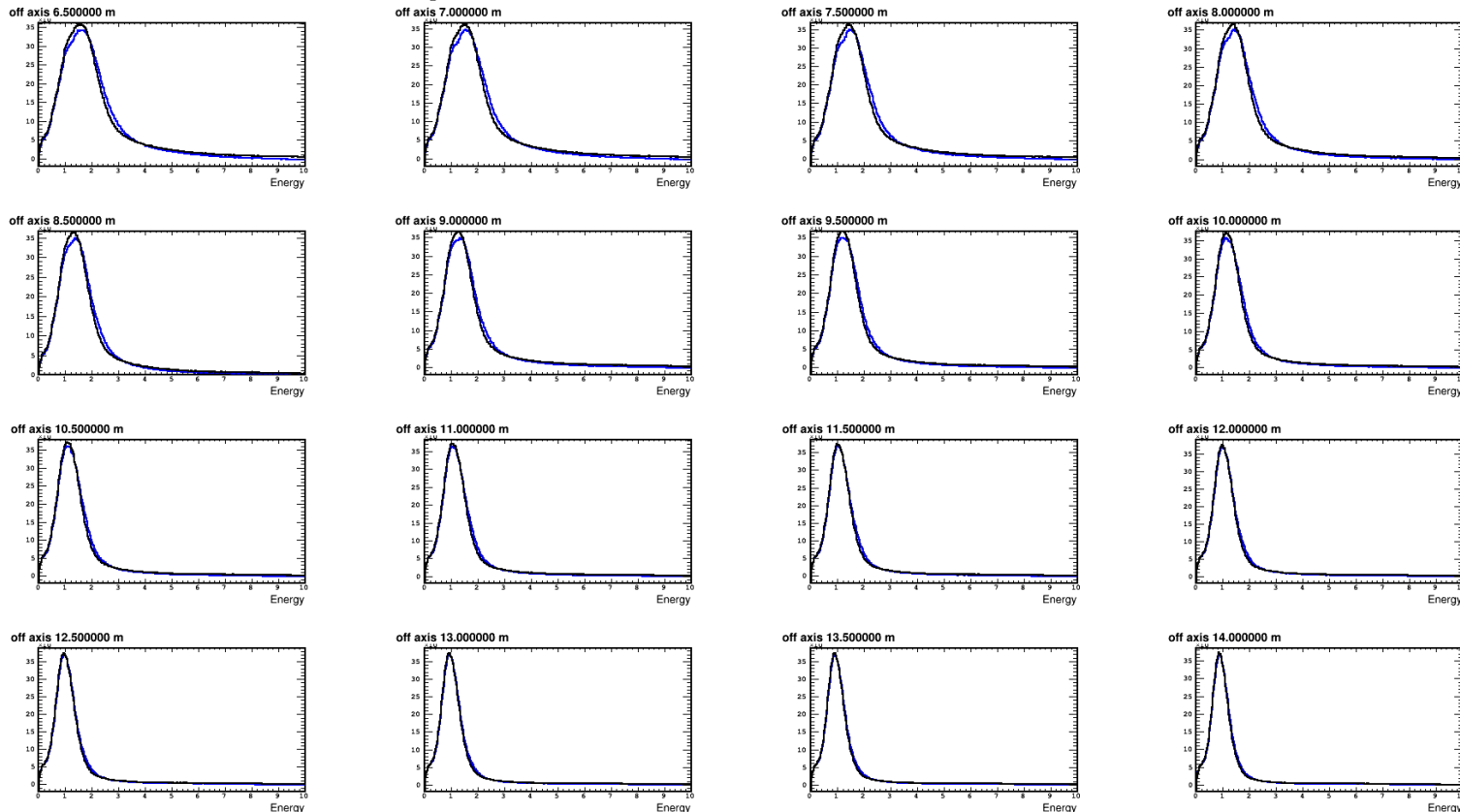
Beam shape changes

- When detector goes off-axis, beam changes in shape.

- This case was made with ~6 mm horn 1 X direction shift + overall rate compensation.
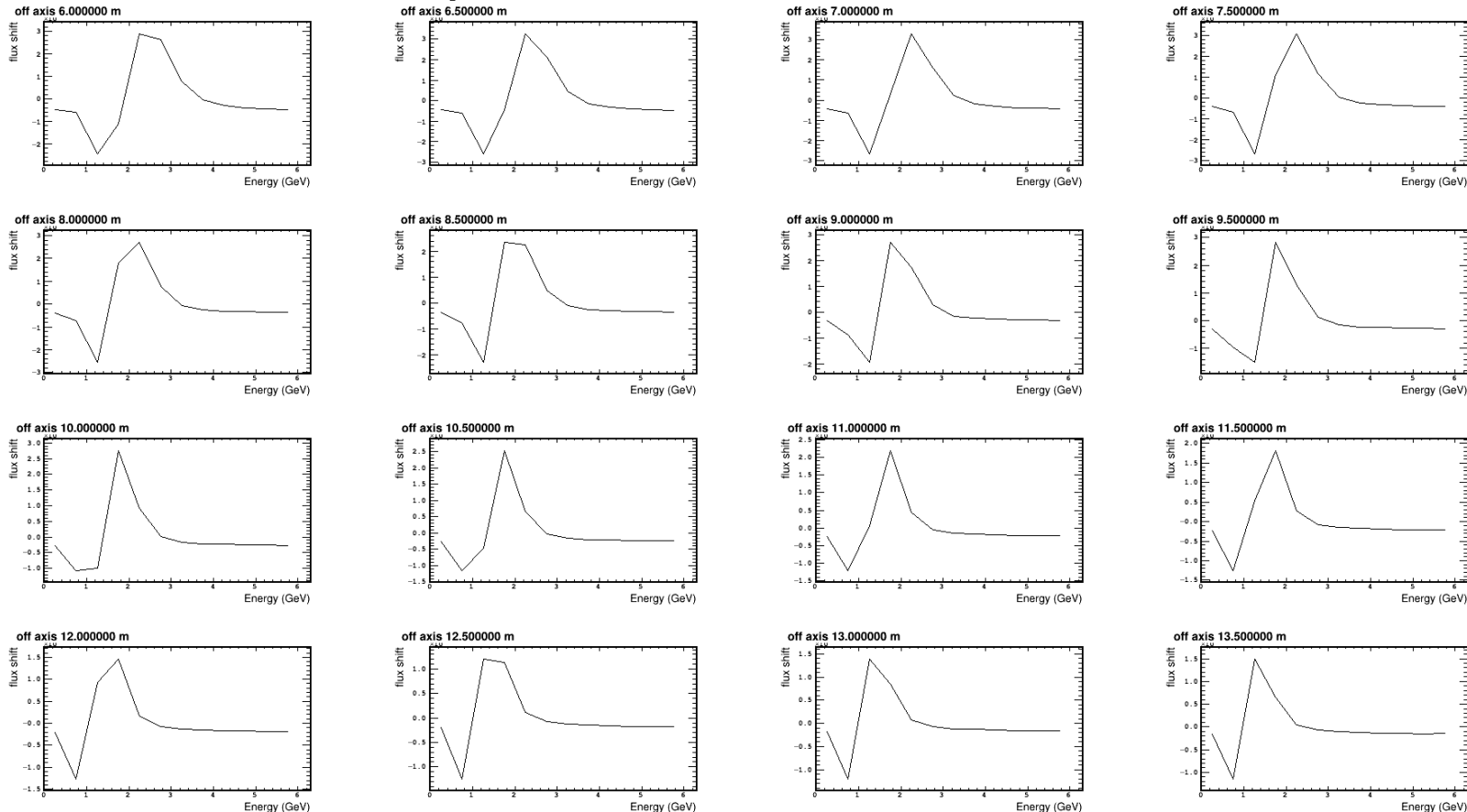
Beam shape changes

- When detector goes off-axis, beam changes in shape.

- This case was made with ~6 mm horn 1 X direction shift + overall rate compensation.
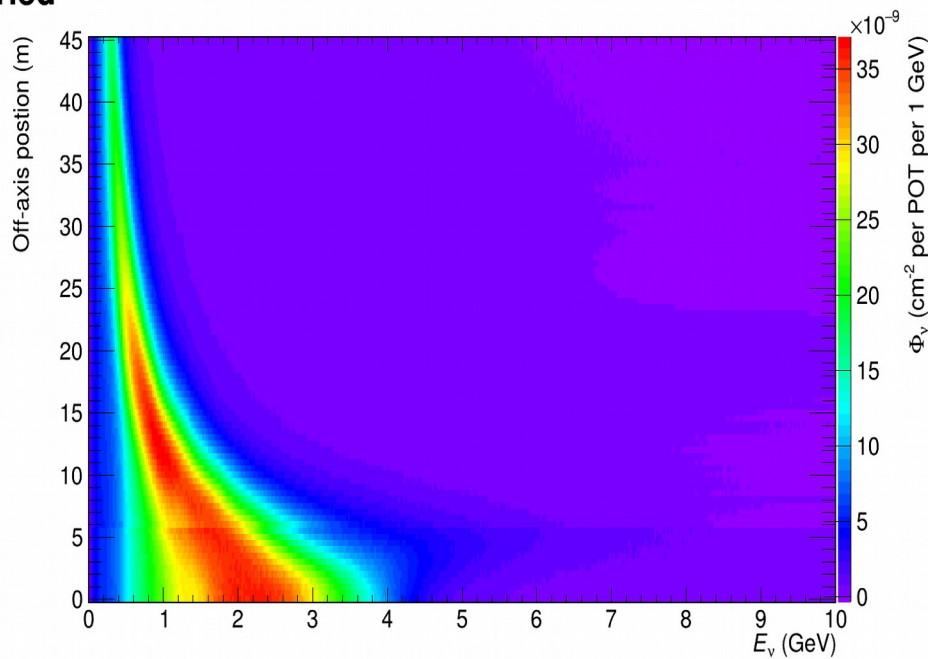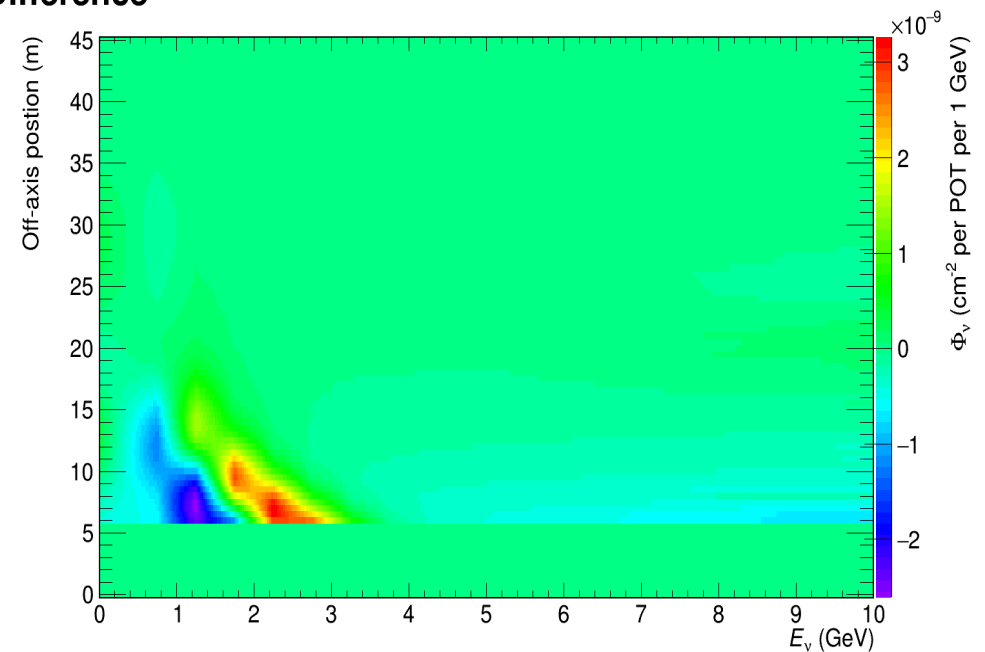
Beam changes at off-axis positions

- Rate not changed

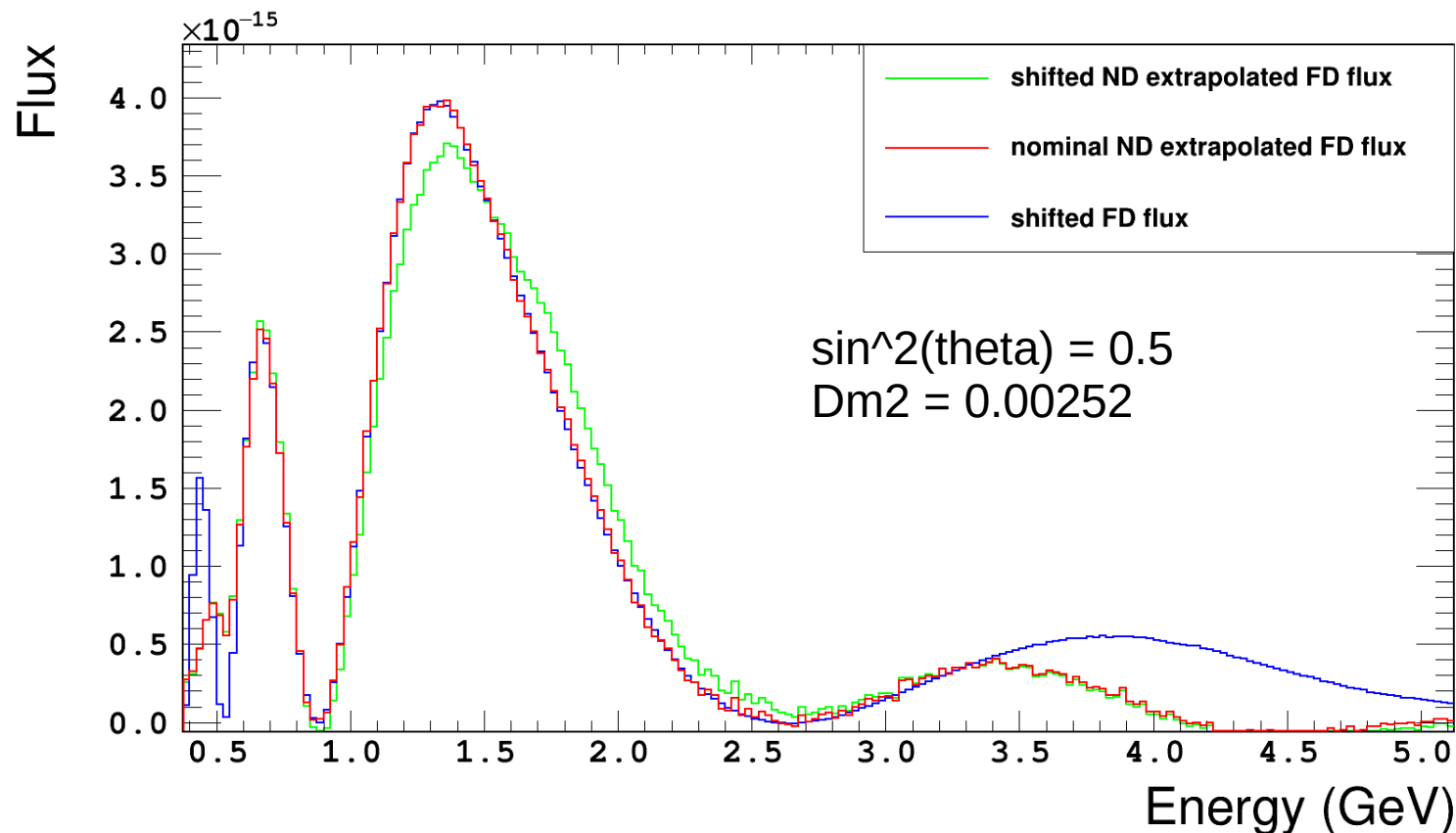- This case was made with ~3 mm horn 1 X shift + overall rate compensation.

varied

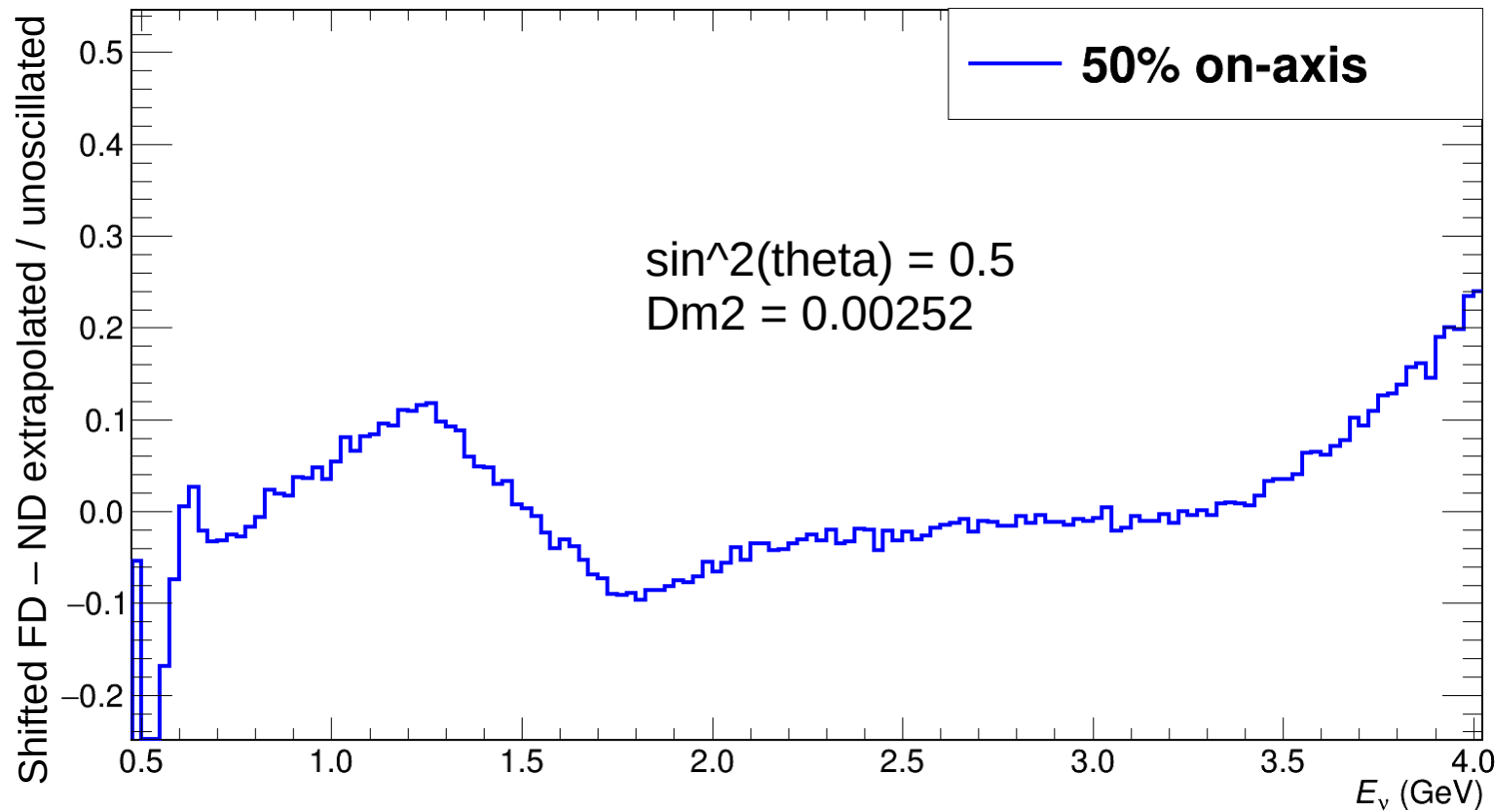**Difference**

Flux fit biased

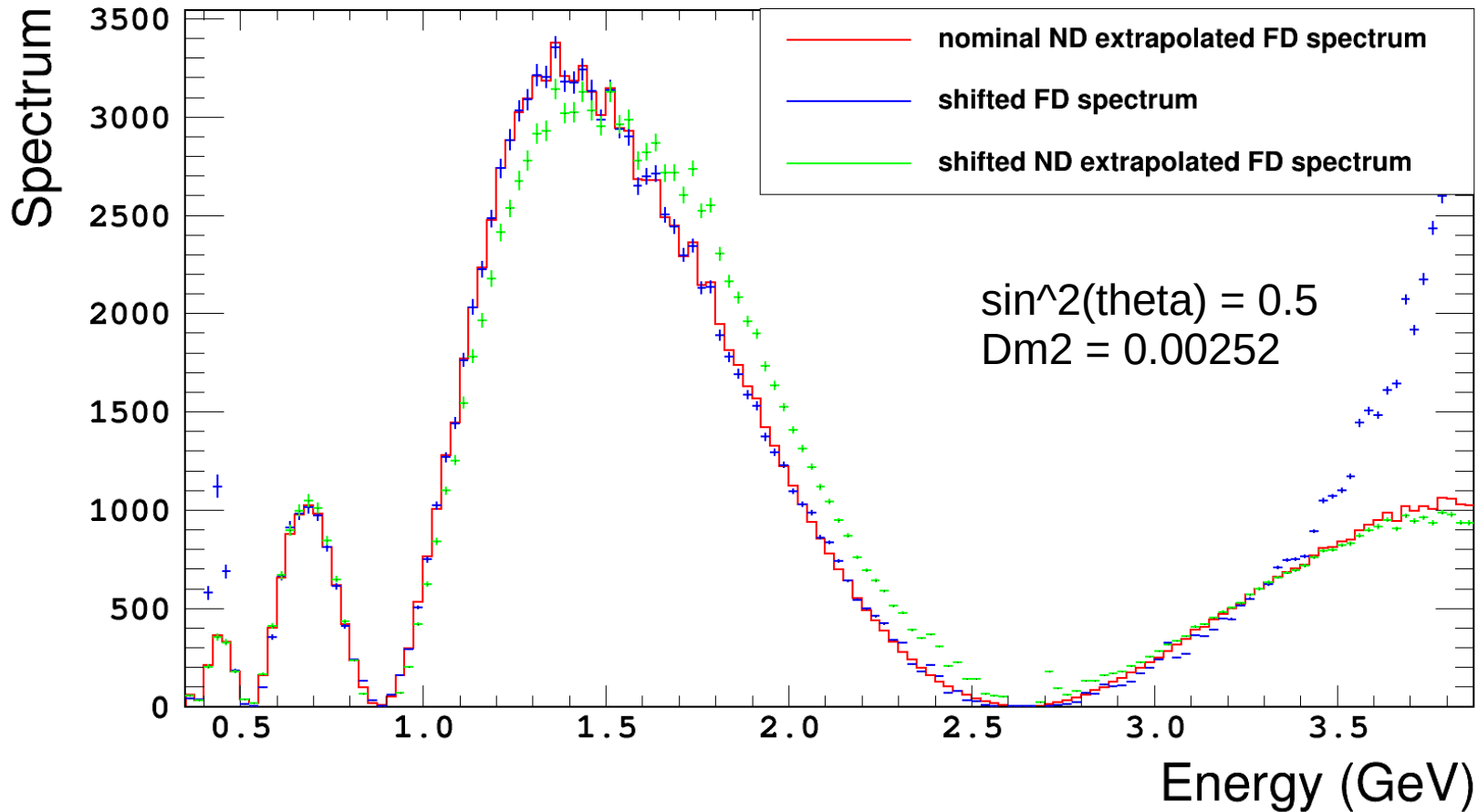- Applying the linear combination coefficients to the changed ND; FD shifted as well (50% of time)

Flux fit biased

- Shifted FD – ND extrapolated / unoscillated
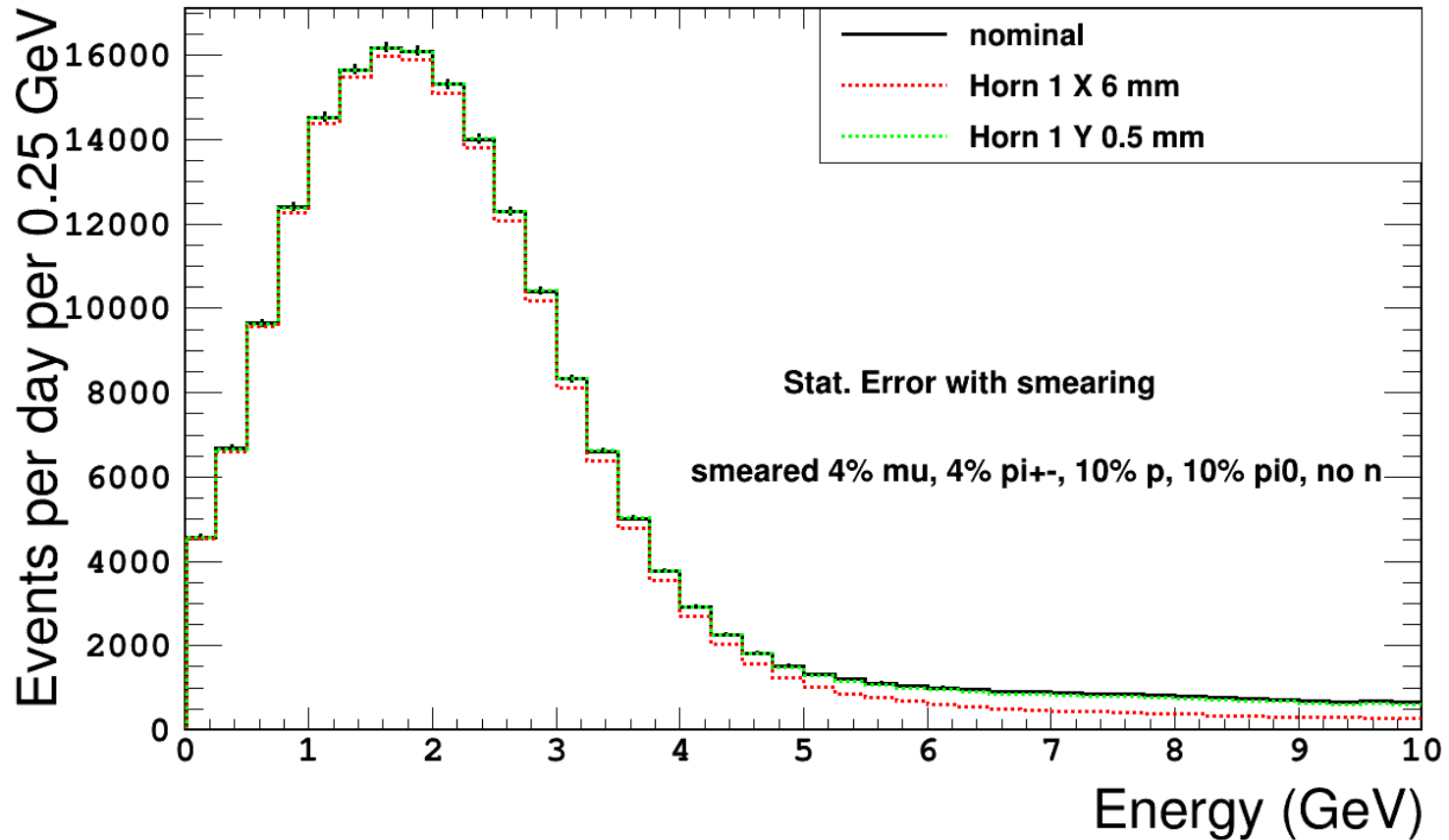- Assume different beam change times

Projecting to event rate

sin^2(theta) = 0.5
Dm2 = 0.00252

Legend:
- nominal ND extrapolated FD spectrum
- shifted FD spectrum
- shifted ND extrapolated FD spectrum

Spectrum monitoring with 3DST

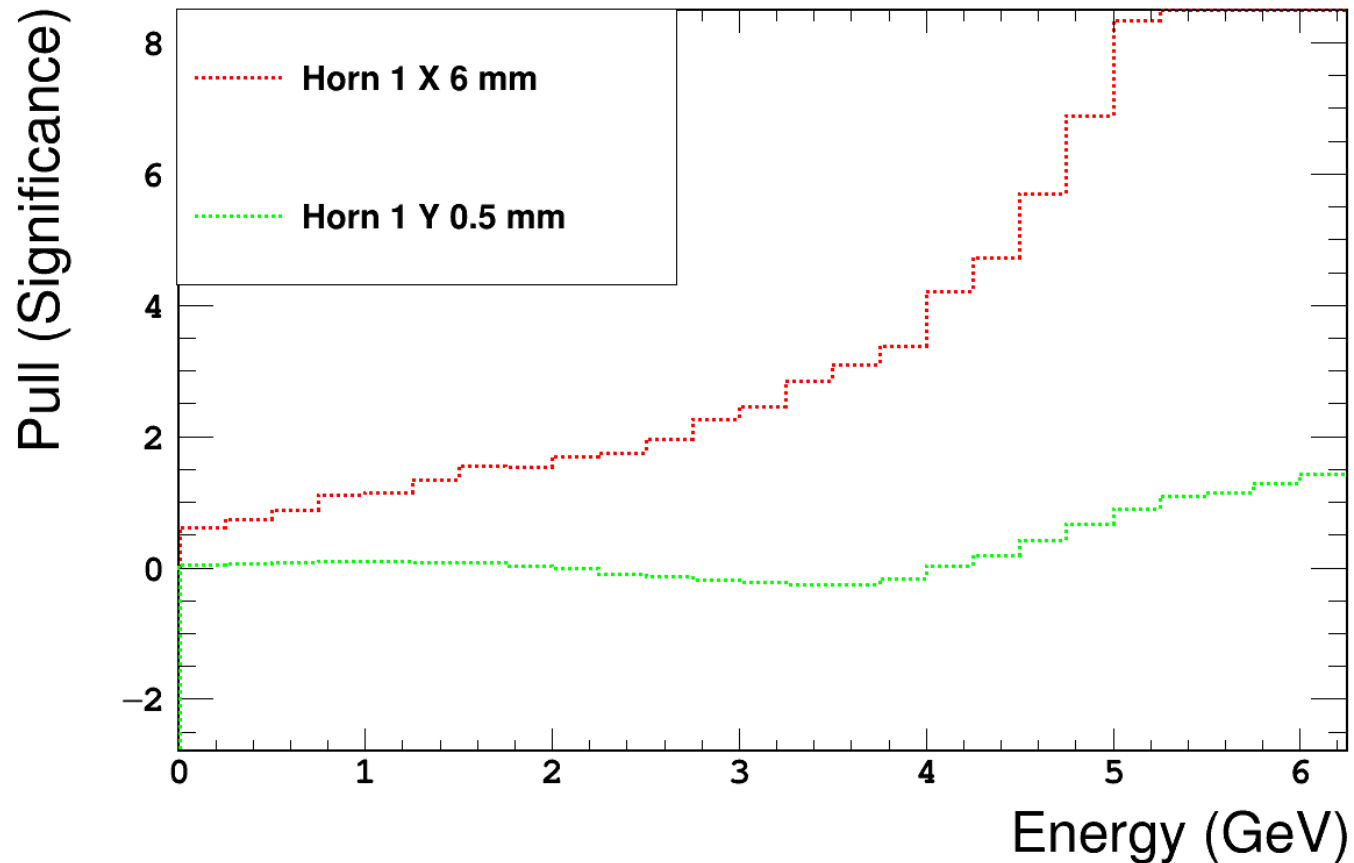
per 7 day(s) spetrum comparison

- No overall rate change applied.

Spectrum monitoring with 3DST

Stat. Error and detector effect (smearing + efficiency applied)

- No overall rate change applied.

Summary

- We will need to monitor the spectrum.

- This kind of sample could be a PRISM fake data.