DUNEPRISM LINEAR COMBINATIONS

DUNEPRISM PHONE MEETING

OCTOBER 30TH 2017

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INTRODUCTION

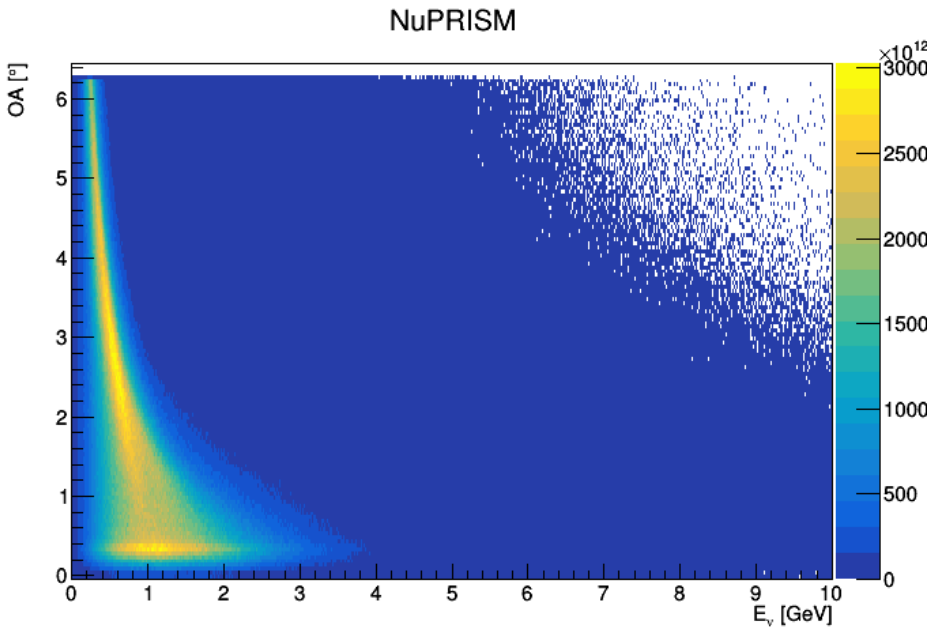
- Using the E61/NuPRISM analysis scripts to produce linear combinations of DUNE fluxes.
- Changes made to the analysis scripts:
  - Range of off axis-angles increased from [1, 4]° to [0, 6]°
    - This results in a ~doubling of coefficients to fit – takes a long time to converge (~1/2 hr)…
  - Changed near/far flux ratio for oscillated spectrum fits – not sure how to normalize fluxes properly.
    - For now use "arbitrary units" – fine for understanding how well the linear combinations fit the oscillated spectra.
  - For Gaussian fits range of neutrino energy to fit over changed from [0.3, 6.0] GeV to [0.2, 9.0] GeV

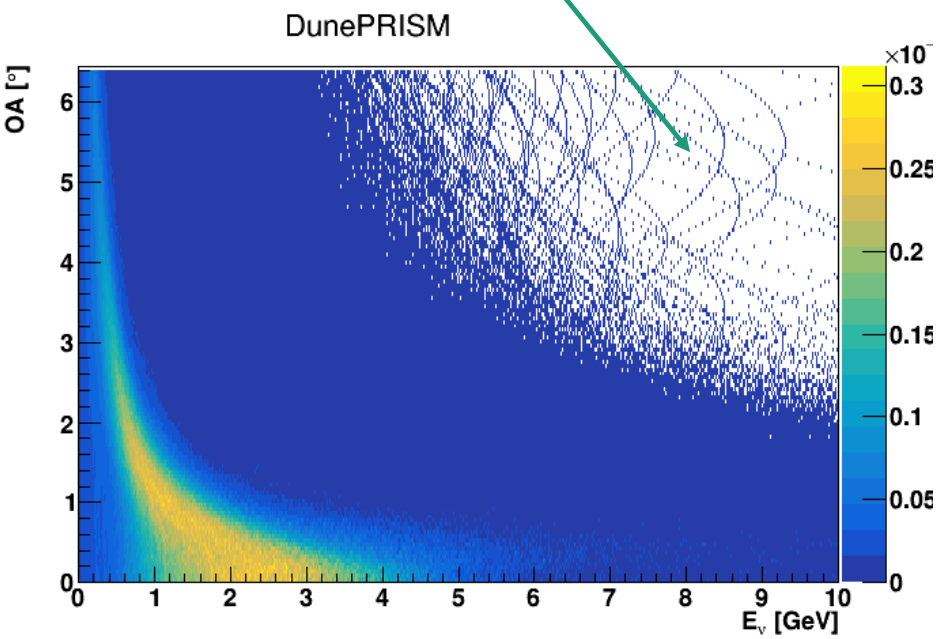
INPUTS

- Use “eventRates.C” code to produce off-axis fluxes for numu CC component.
  - Use 0.05° steps up to 6.45°
  - Not sure how this code works in detail but each “step” uses the same beam simulation files – no statistical independence between different off-axis slices!
  - Where can I get / how can I generate more beam simulation files?
- Build 2D histogram (Enu vs OA) in the same format as the one used in NuPRISM.
- For oscillated flux, use “eventRates.C” with detector Z set to 1300 km.

INPUTS

Structure arises from statistical correlation between OA bins?

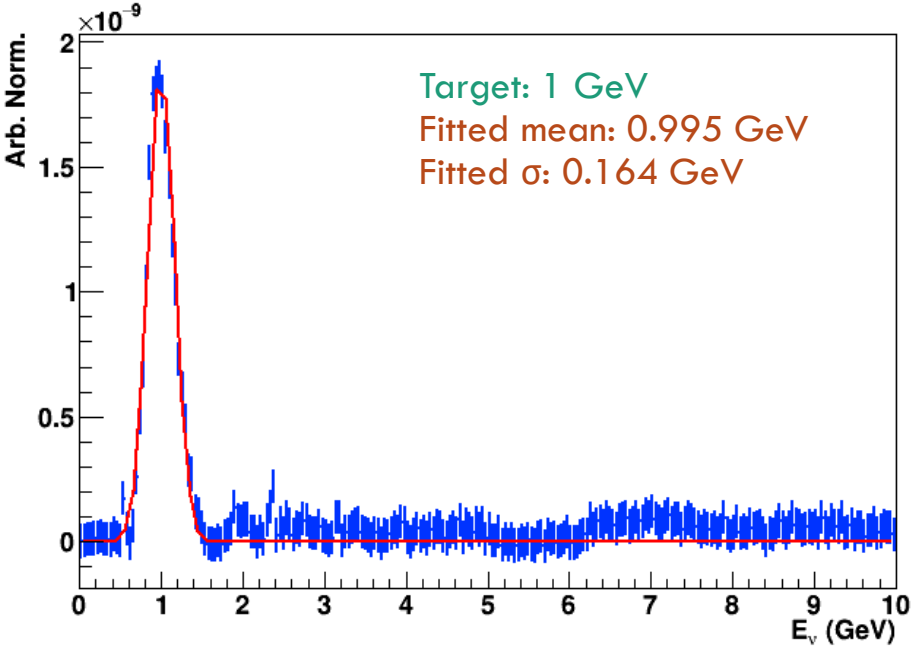




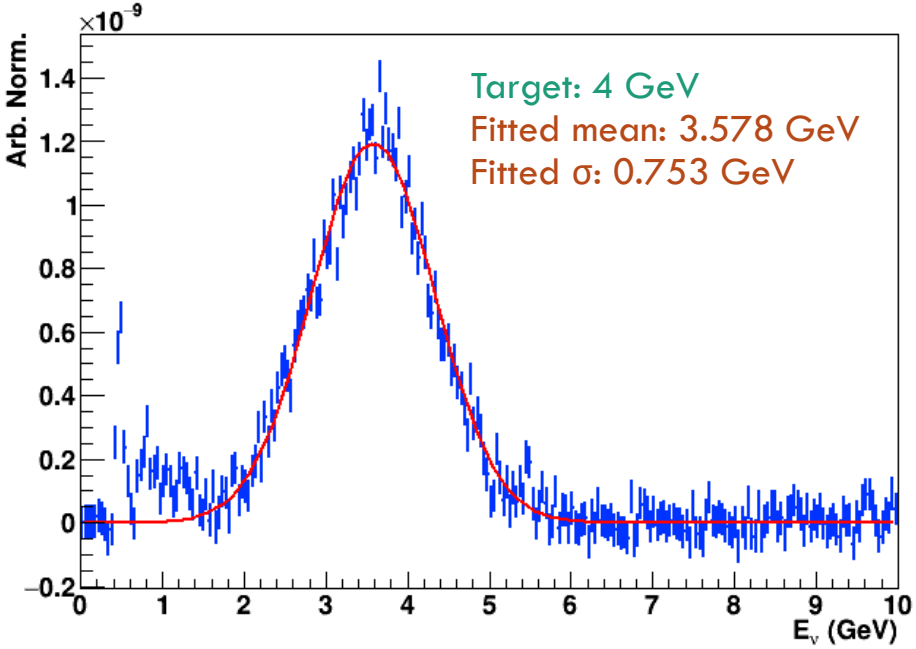
- Artifacts from lack of statistical independence visible.
- Would be nice to have more statistics in any case.
- Need more flux simulation files.

GAUSSIAN FITS

- Try to get Gaussian fits with means between 0.5 and 6.0 GeV with a 10% σ.

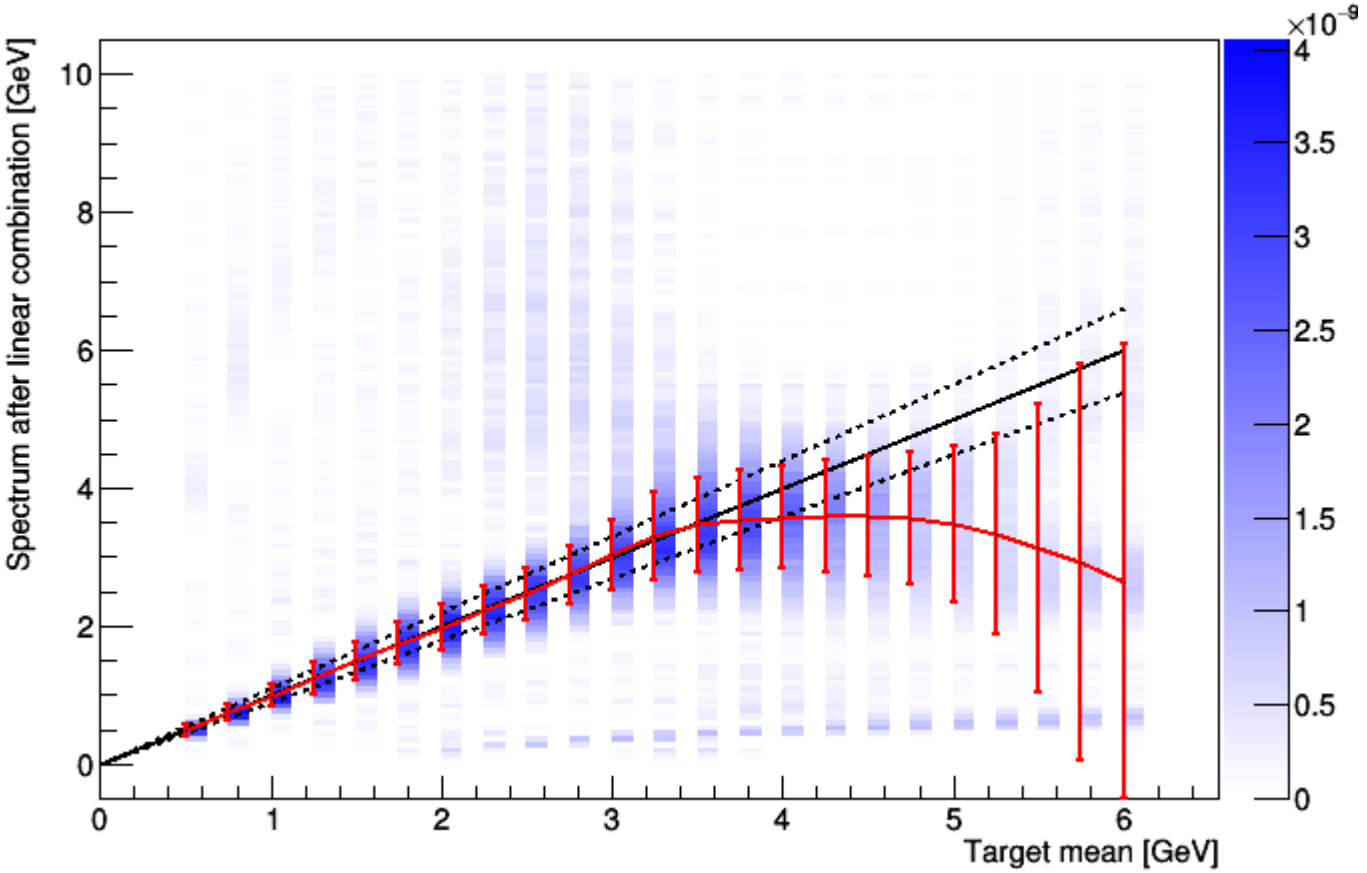


Very nice fits for low mean energies.



Fits start breaking down at ~3.5 GeV.
In this case flux still looks Gaussian,
but target mean is badly missed.

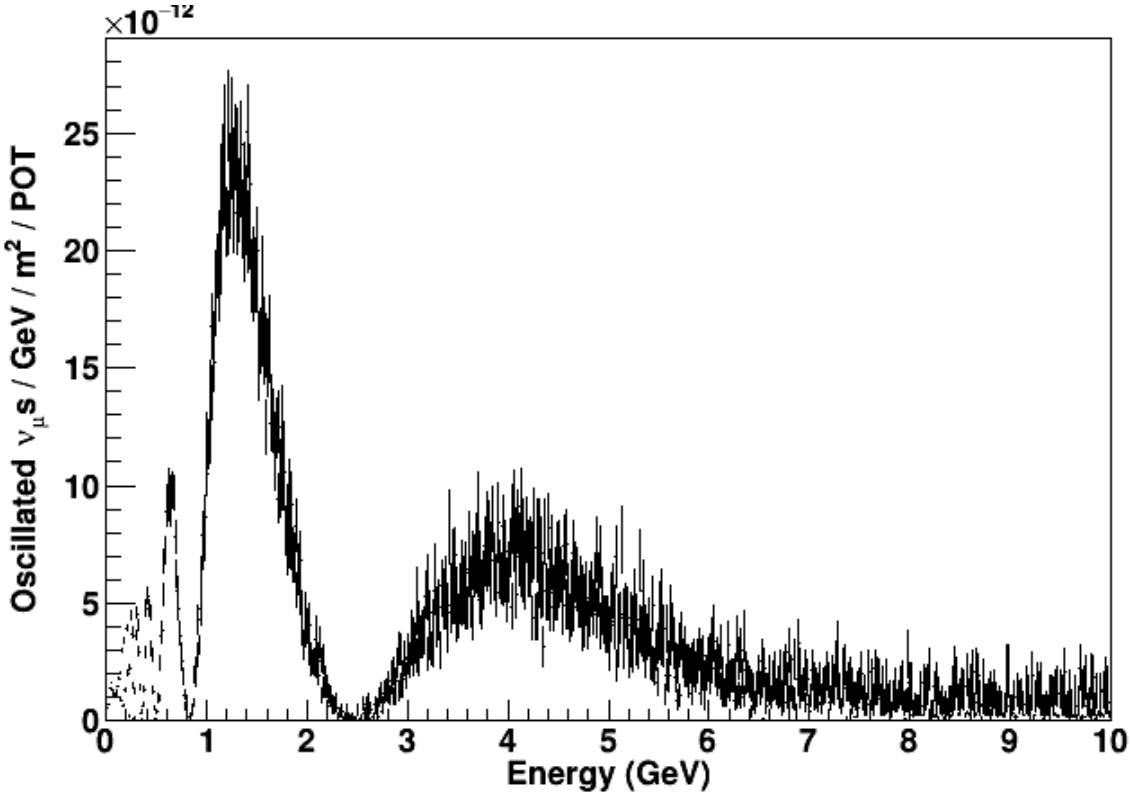
GAUSSIAN FITS



- Target Gaussian parameters in black, fitted in red.
- Indicates we might be able to resolve features up to ~3.5 GeV.

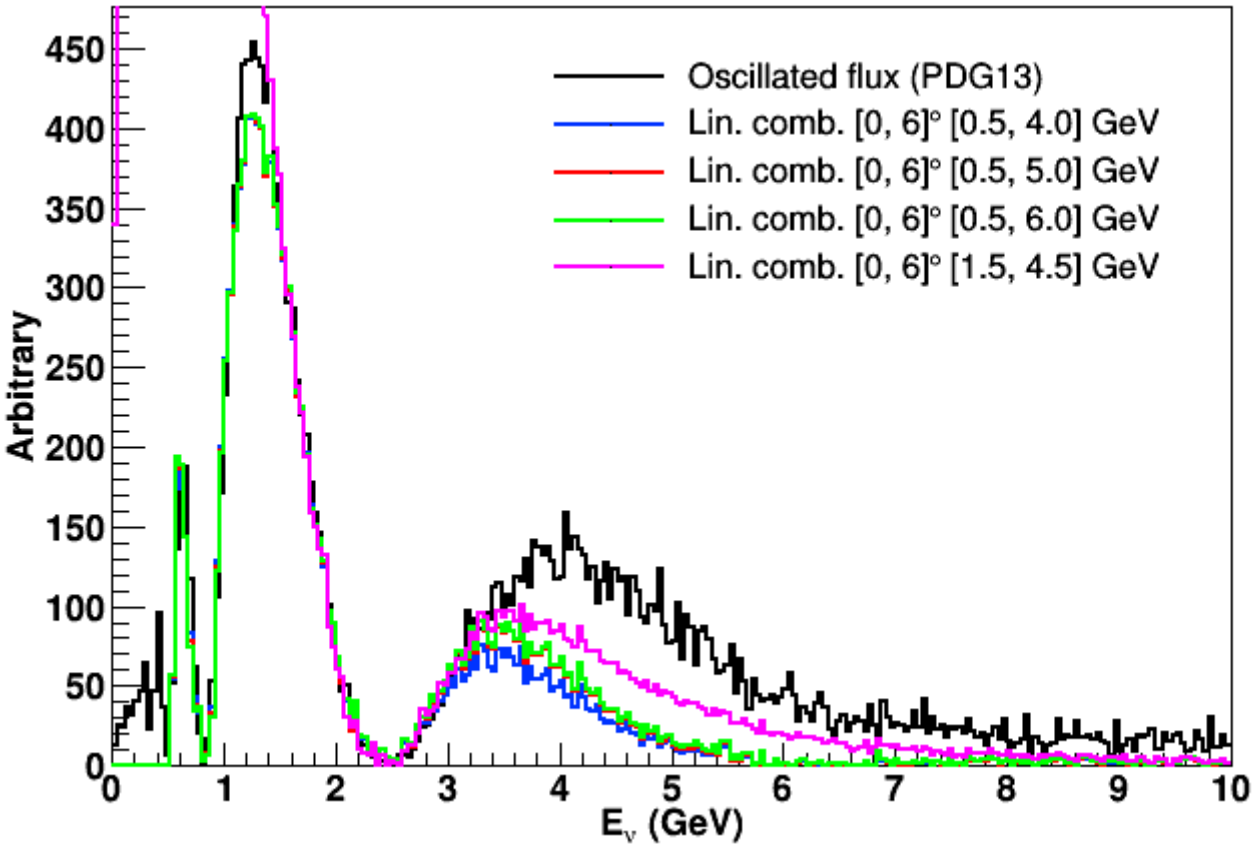
OSCILLATED FLUX

- Use “eventRates.C” to produce oscillated flux at far detector using PDG13 oscillation parameters.



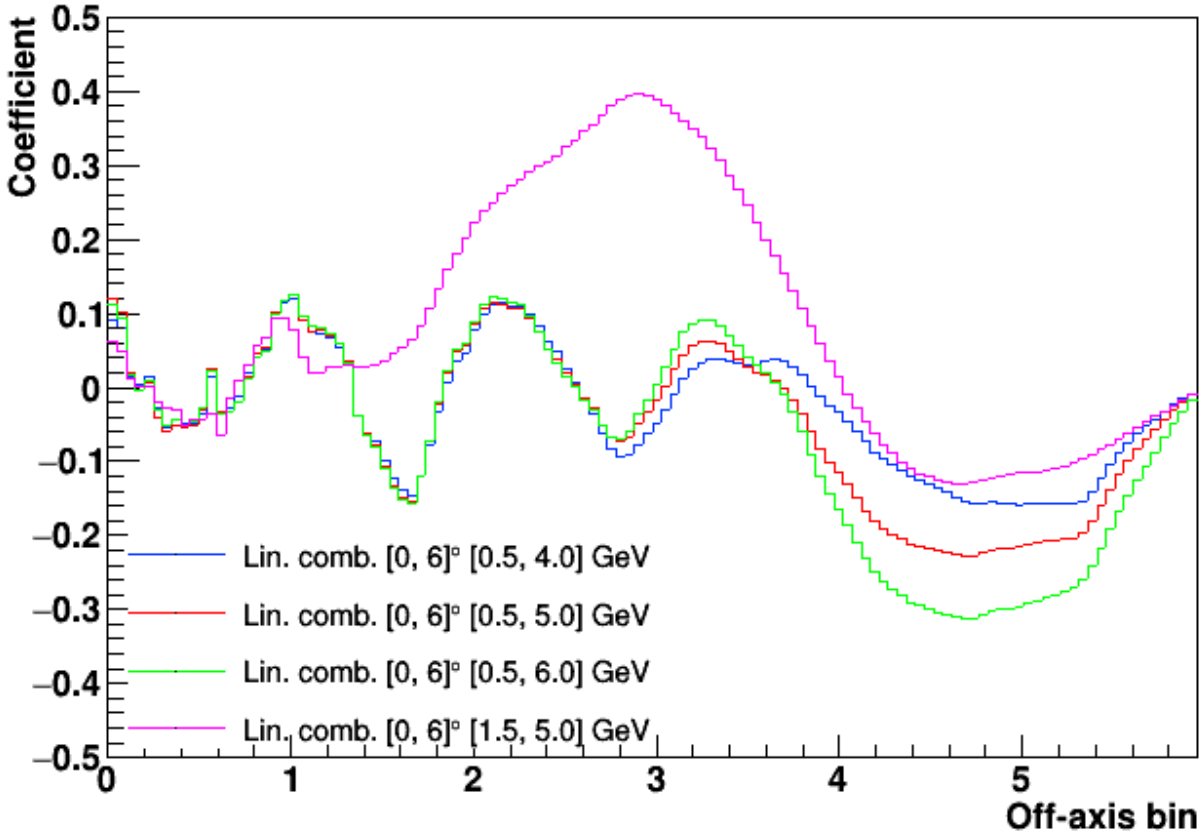
OSCILLATED FLUX

- Try several energy ranges for fit.
- Difficult to fit structure above ~3.5 GeV, as expected.
- Clear trade off between fitting structure at low vs high energy.
  - Might be able to fit one dip at a time better than both at once?



OSCILLATED FLUX

- Coefficients for the fits in the last slide.
- Very different coefficients if low energy part of the spectrum is ignored.



SUMMARY

- Used NuPRISM/E61 code to produce linear combinations of DUNE fluxes in the off-axis angle range of [0, 6]°
- Successful fits for both Gaussian and oscillated spectra.
- Difficult to get good fits beyond ~3.5 GeV

- Next steps:
  - Get more flux simulation files and repeat these fits with higher statistics and independent samples.
  - Investigate if we can get further up in energy by looking at a few more energy ranges.
  - Investigate fits in more points in the allowed oscillation parameter space.
  - Start thinking about including this in an oscillation analysis framework for sensitivity studies…