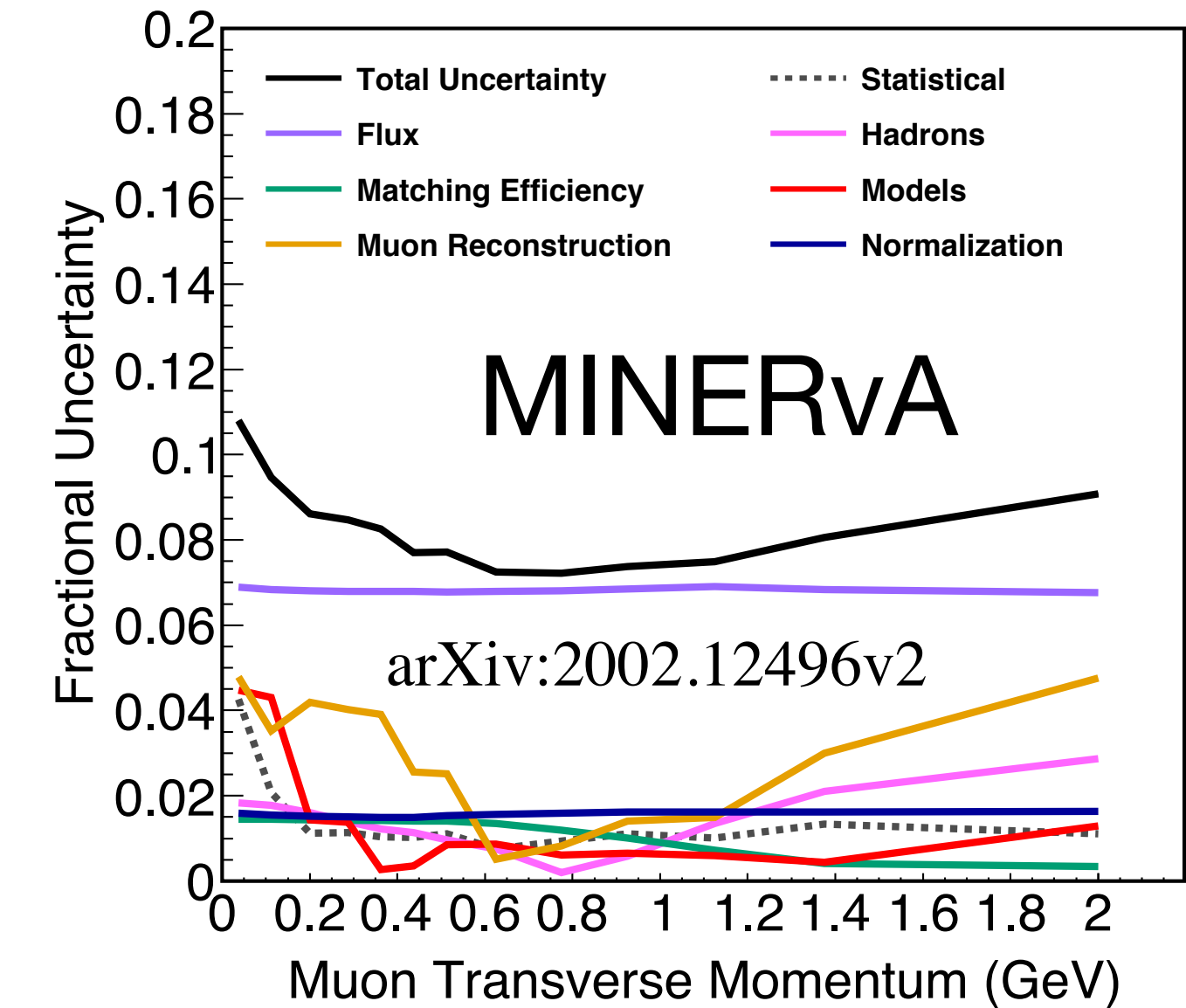
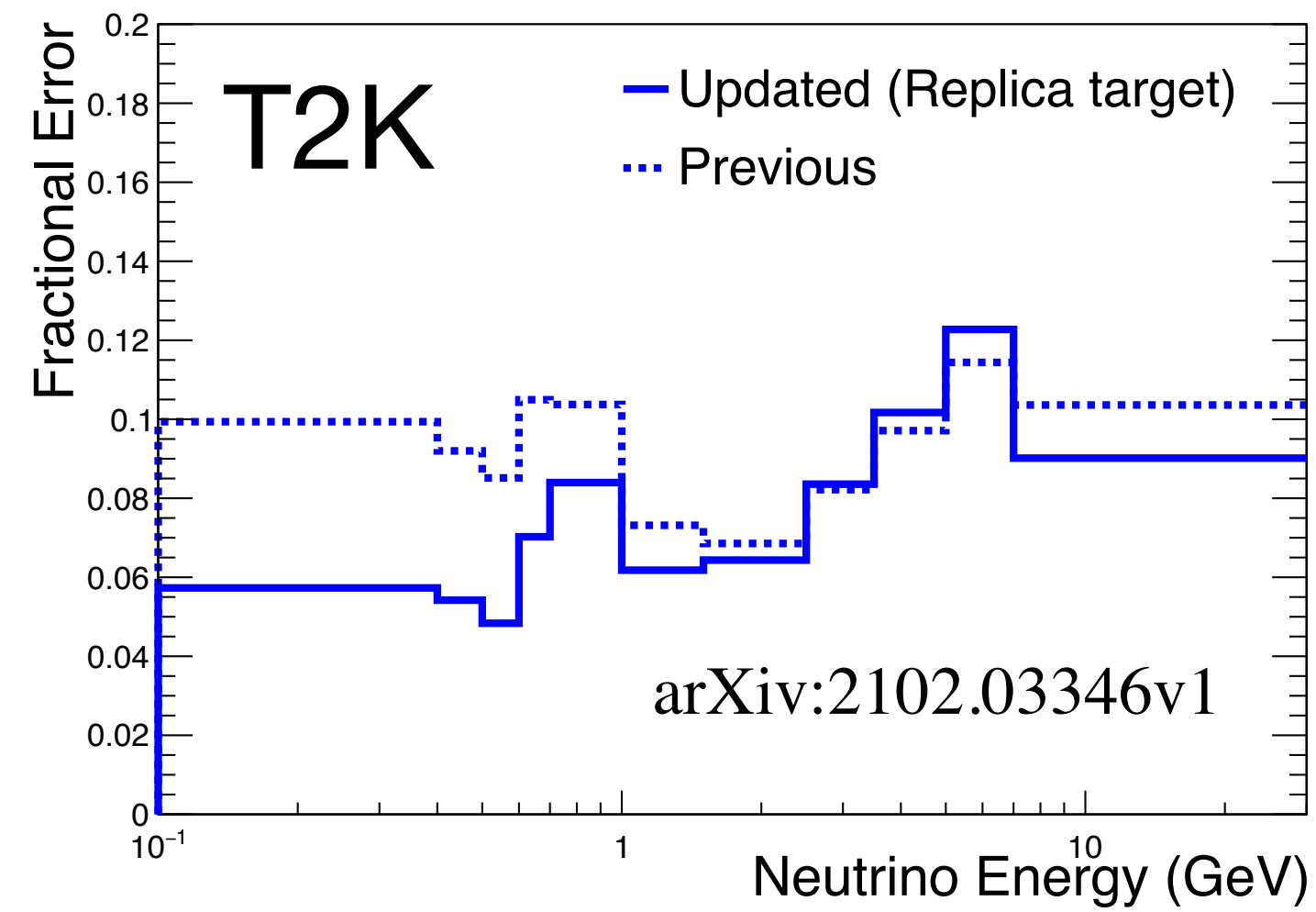
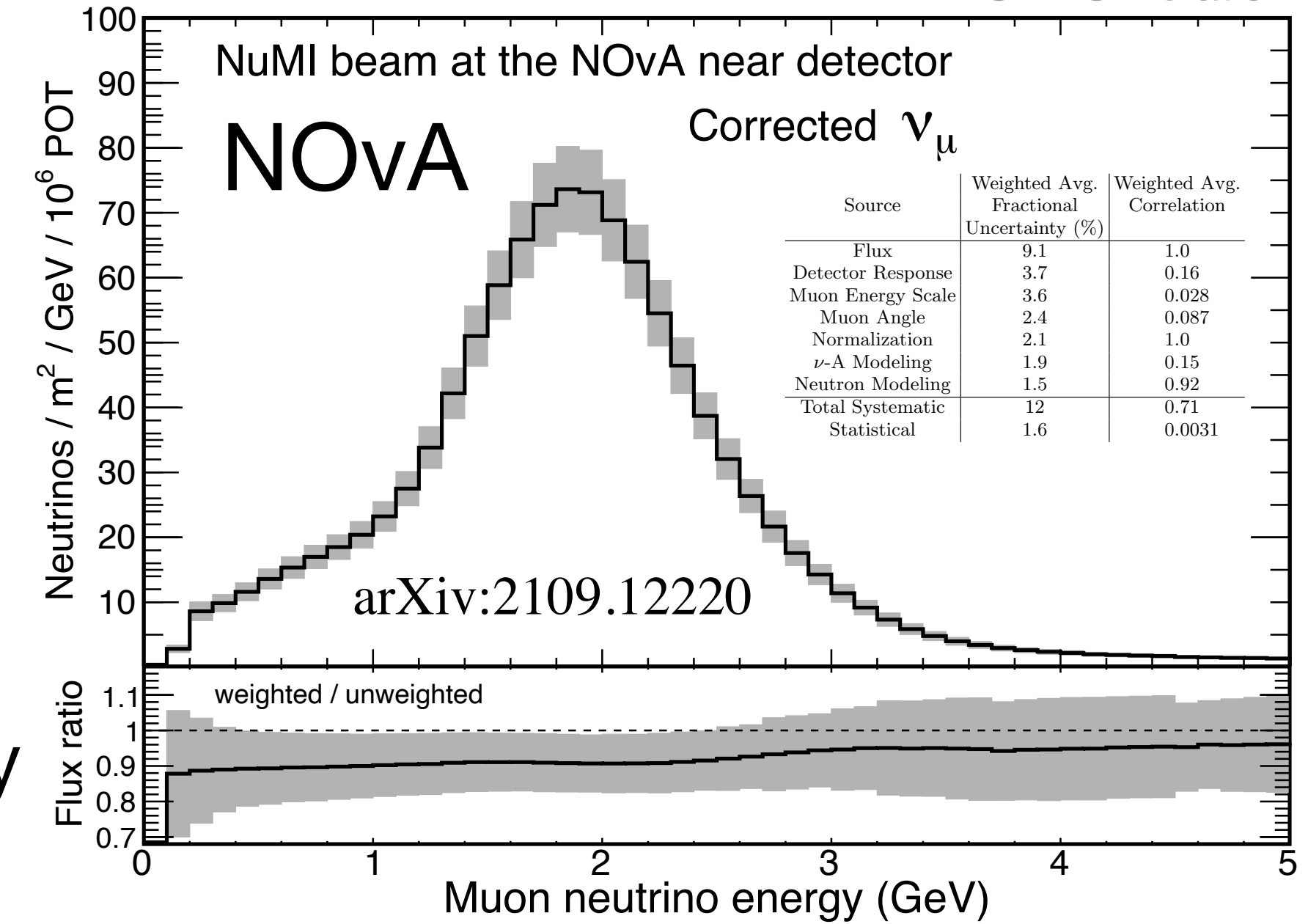


Neutrino Fluxes - A New NuSTEC Topic?

Jonathan Paley, NuSTEC Board Meeting, December 6, 2021

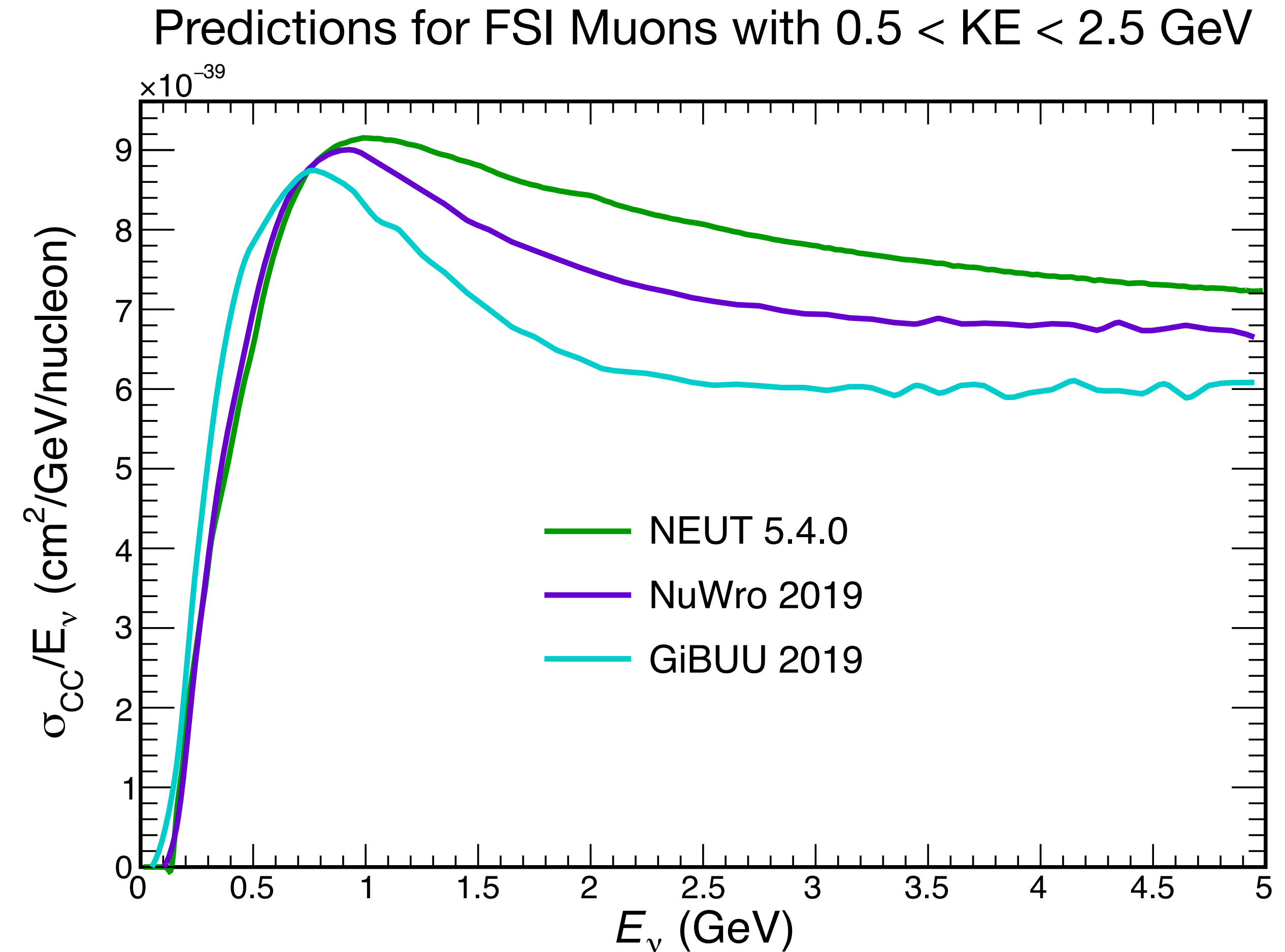
Flux Uncertainties

- Neutrino flux uncertainties currently dominate many neutrino-nucleus cross section measurements.
- Driven by hadron production uncertainties but beam-focusing uncertainties may soon become just as important
- Normalization component of the uncertainty can be significantly reduced from a variety of in-situ and external measurements:
 - nu-electron scattering
 - external hadron production measurements
 - beam/target/horn monitoring
- Shape component of the uncertainty is much more difficult to constrain, and much of it comes from beam focusing uncertainties.



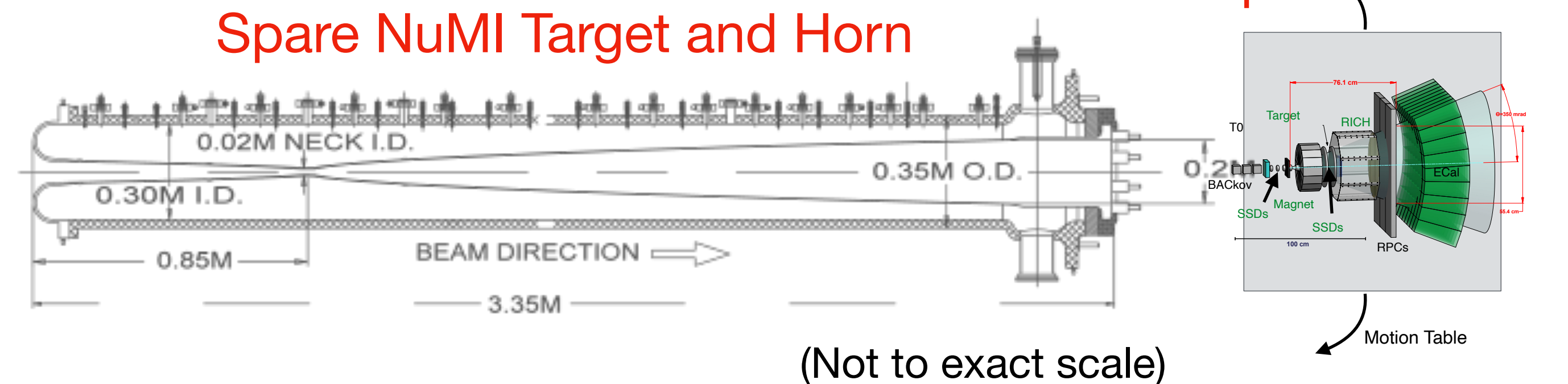
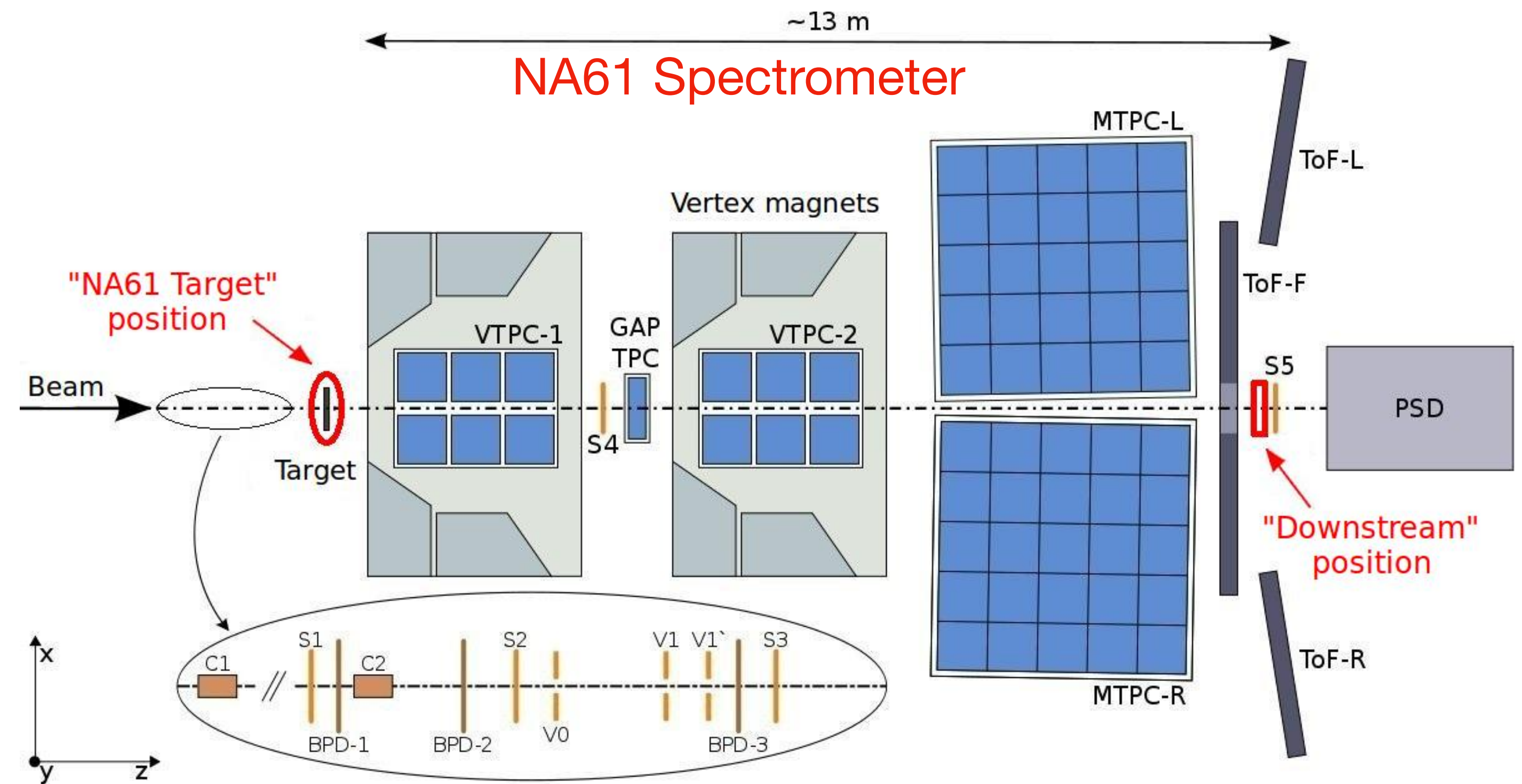
Flux Uncertainties

- But isn't this just a normalization issue?
- For oscillation experiments, to a certain extent, yes. But the “broader the beam”, the more we care about the shape.
- But we want our predictions to get it right from the get-go. We see ~10-20% difference in NOvA's narrow-band beam across generators. With such large flux uncertainties, it is difficult to know what we are getting right vs. wrong.



Flux Constraints

- Ex-situ: Dedicated hadron production experiments
 - NA61 @ CERN: thin- and thick-target HP measurements, beam energies > 20 GeV
 - EMPHATIC @ FNAL: forward-scattering measurements, thin- and thick-target HP measurements, beam energies < 20 GeV, hadron flux downstream of target+horn
- In-situ:
 - hadron- and muon- detectors in beamline
 - nu-e scattering
 - Low-y nu-A measurements



So What Can NuSTEC Do?

- Advertise, advertise, advertise!
- Help make the physics case for better flux constraints. Spread the word in the neutrino community, which will be reflected by priorities of the funding agencies.
- The dedicated HP experiments suffer from lack of effort. They make cross section measurements, and we all know how hard these measurements are. Advertising could draw more people into these efforts (or more people wanting to join these efforts).
- Bring other “flux experts” (who often are also nu-A xsec experts) into NuSTEC.
- Help define the measurements we need.
- Help develop new ideas for both ex-situ and in-situ measurements.
- Help develop/guide efforts at making better flux predictions.
- Link between neutrino and pion scattering.