

Electron Neutrinos at MicroBooNE

- MicroBooNE is a liquid argon time projection chamber at Fermilab and observes electron neutrinos from two beams: BNB and NuMI
- Only one measurement of electron neutrinos alone [1]
- Two new complimentary measurements from MicroBooNE, NuMI [2] and BNB [3]: same energy, different off-axis angle, ν_e fraction, uncertainties, background
- Input for generator tuning to enable precision DUNE measurements

	BNB	NuMI
Av. E_ν (GeV)	~ 0.8	~ 0.9
Angle	0°	8°
ν_e frac.	0.5%	$\sim 1.5\%$
anti- ν_e frac	0.05%	$\sim 1\%$

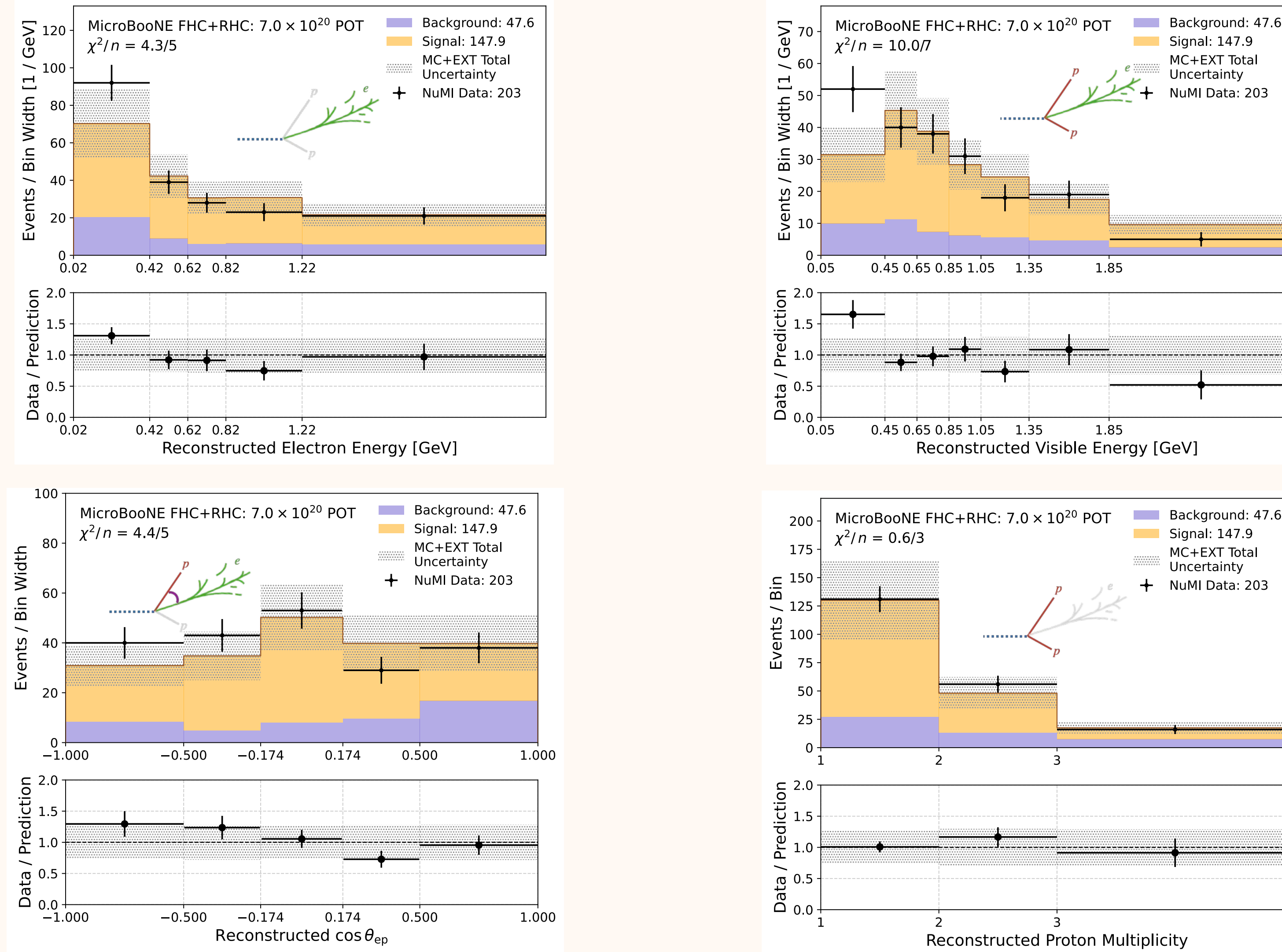
Selection and Cross Section Extraction

- Pandora event reconstruction [4], BDTs to reject background
- Unfolding with WSVD first derivative regularization [5]

$$\left\langle \frac{d\sigma}{dx} \right\rangle_i = \frac{\sum_j (R_{ij}^{-1} (N_j - B_j))}{N_{\text{target}} \times \phi \times \Delta x_i}$$

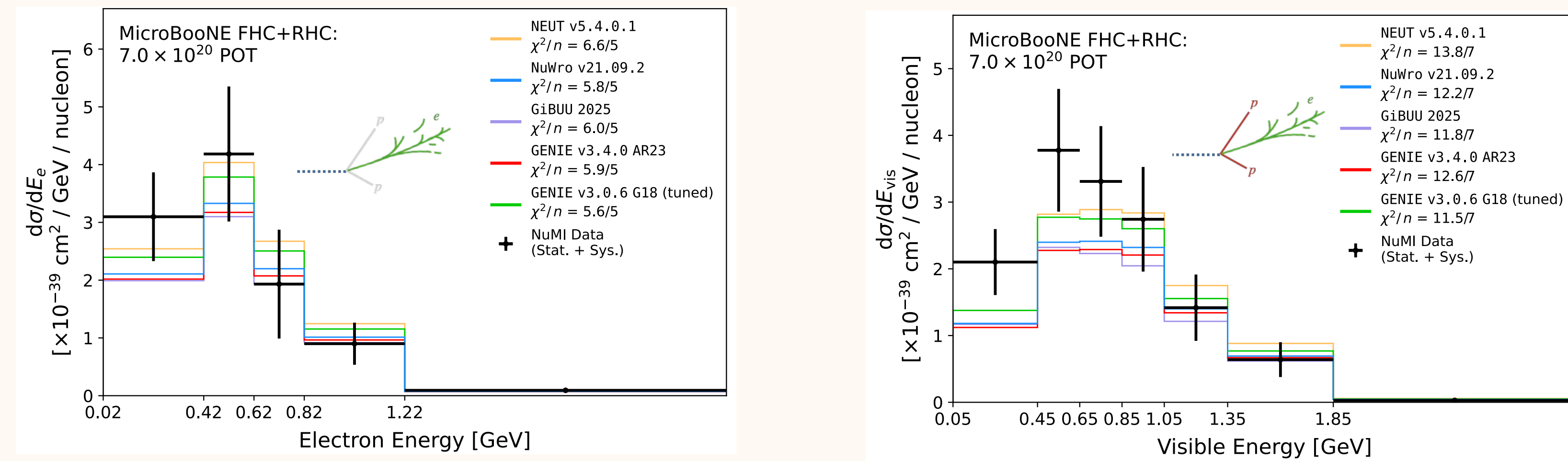
NuMI: Signal: $1eNp0\pi$ ($N>0$)

Event distributions agree with base model:



Forward and reverse horn currents combined

Unfolded Results:

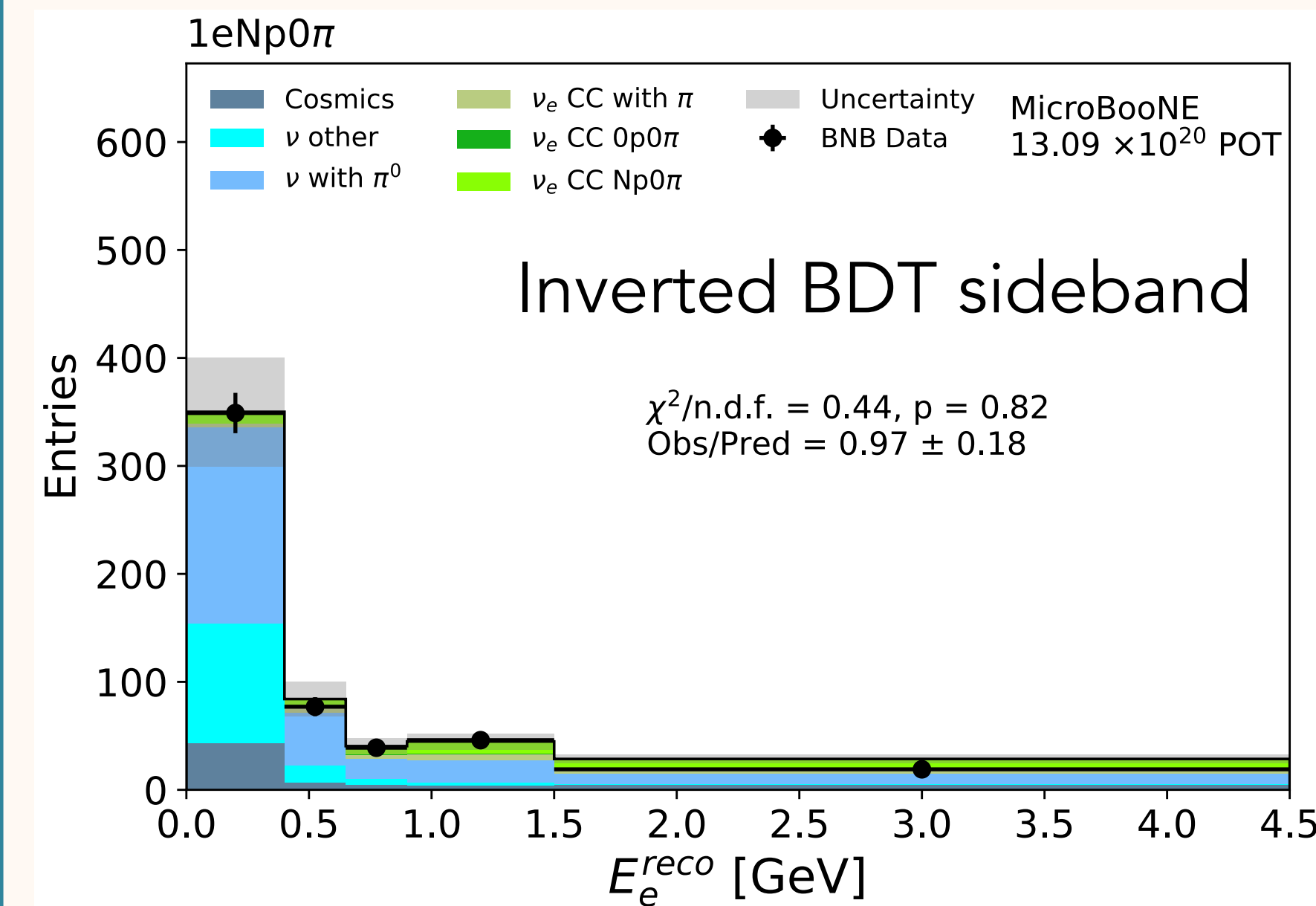


- Models consistent with data
- Lower agreement in visible energy, hadronic portion more difficult to measure

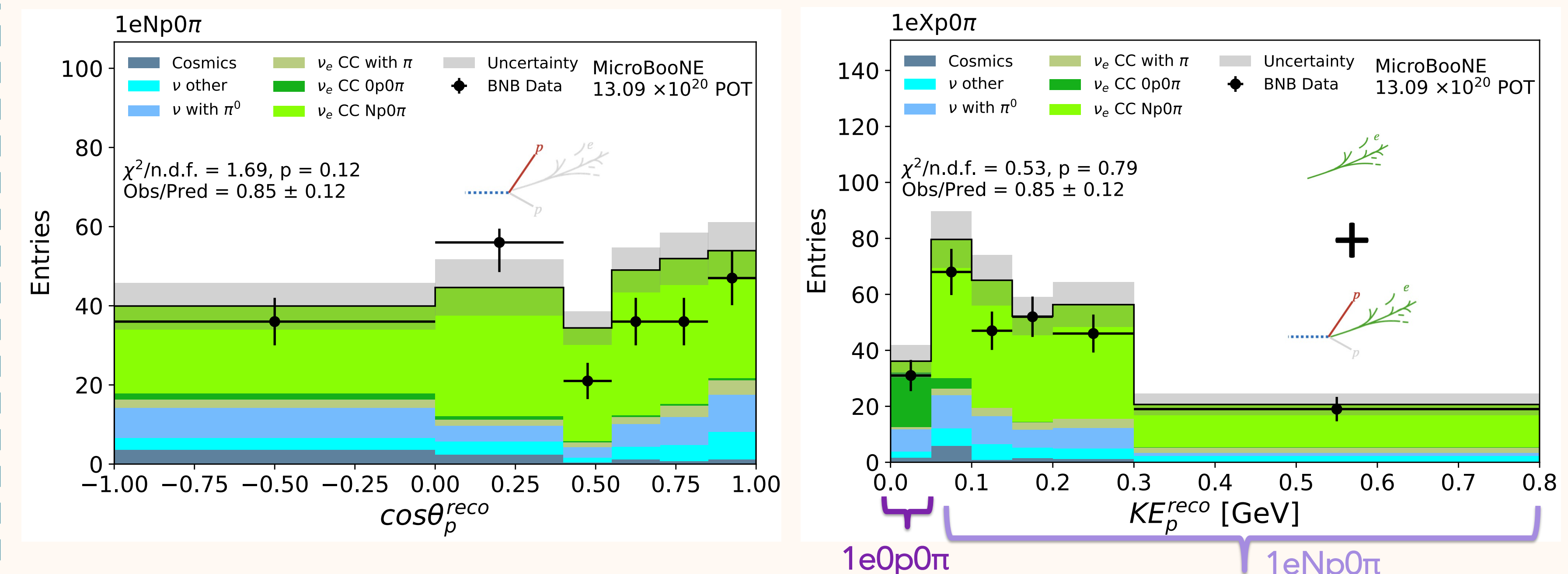
Main uncertainty is off-axis flux

BNB: Signal: $1eNp0\pi$ ($N>0$) and $1e0p0\pi$

Background modeling validated with sidebands:

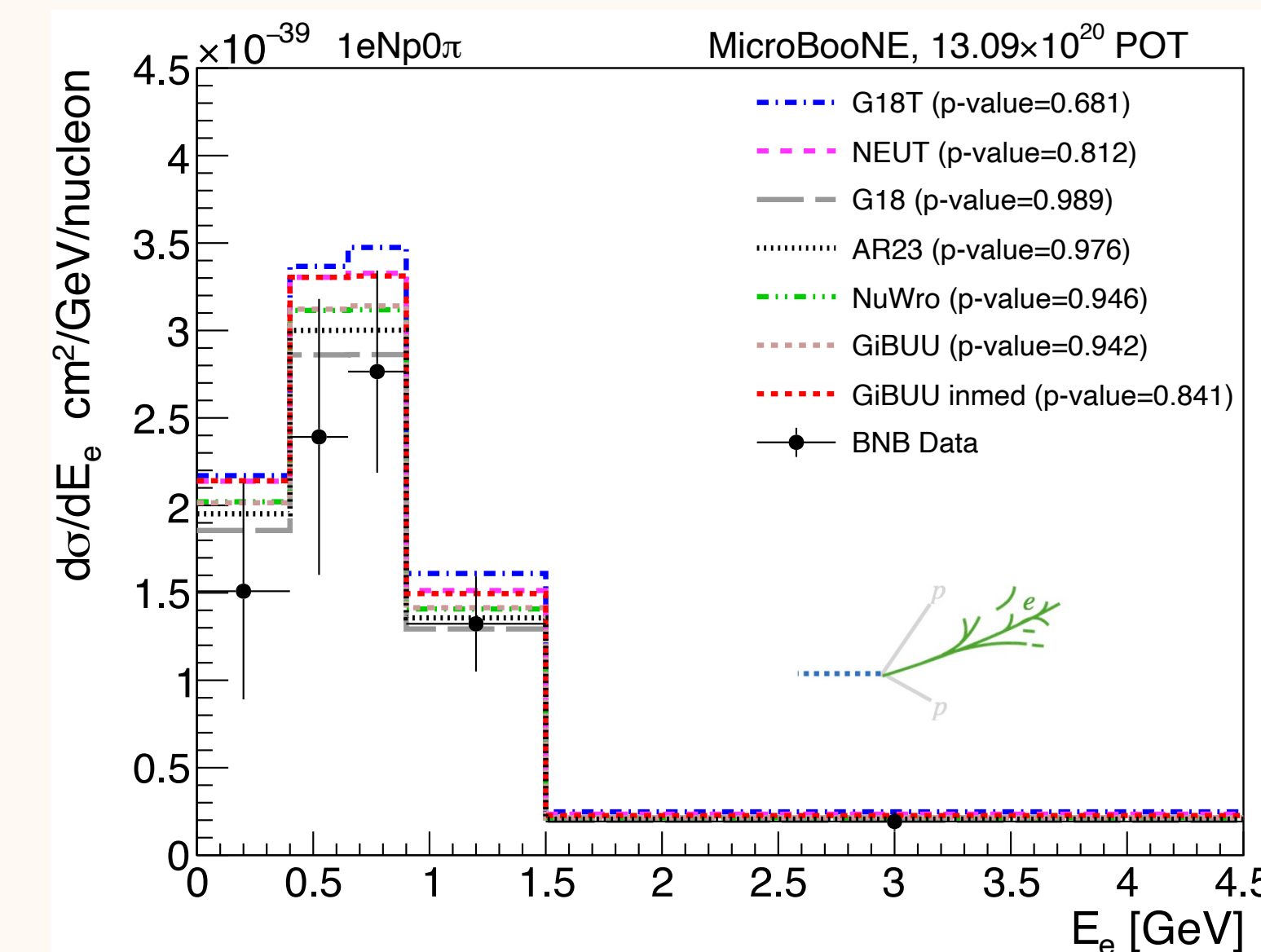


Event distributions agree with base model:

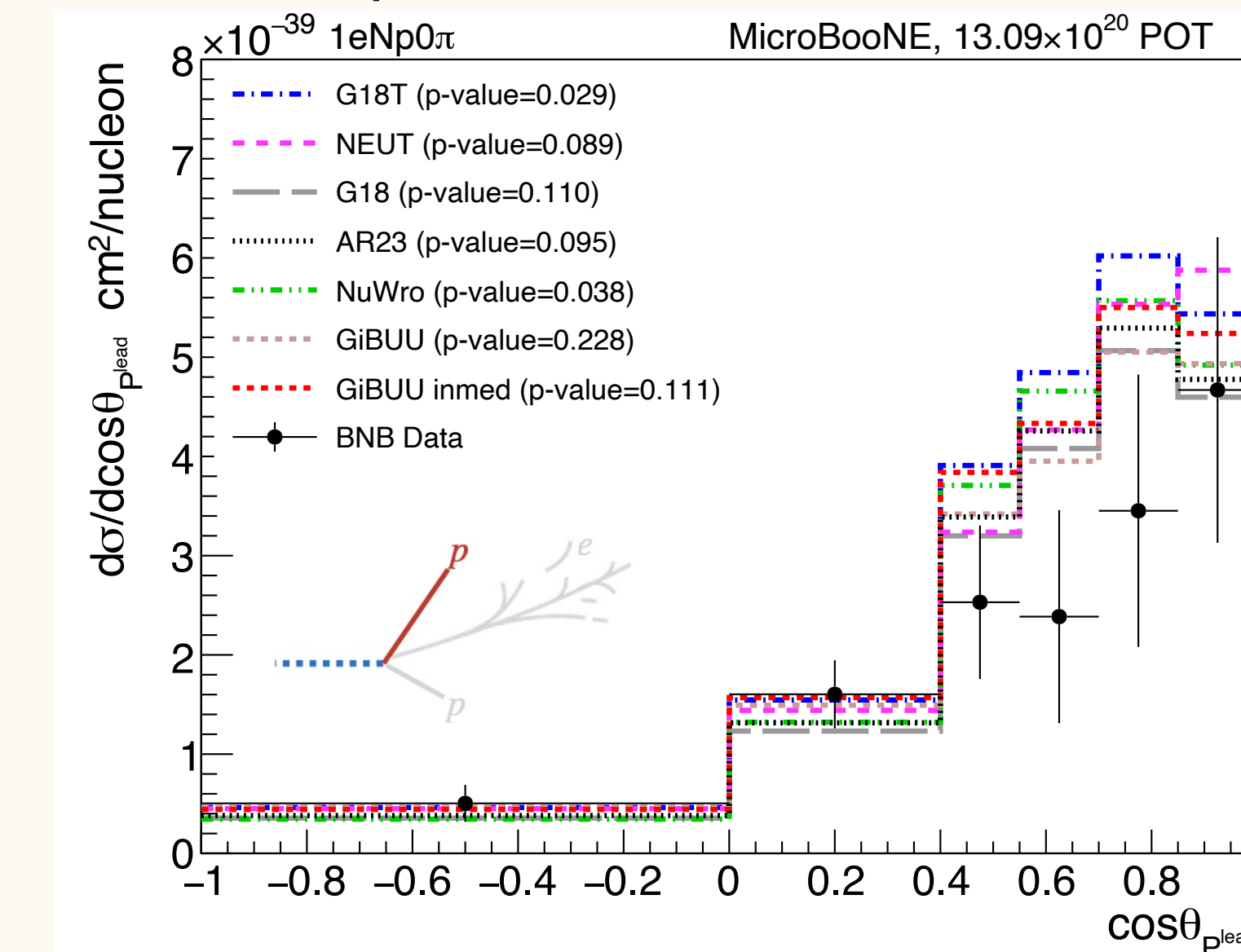


Unfolded Results: Statistical uncertainty is largest

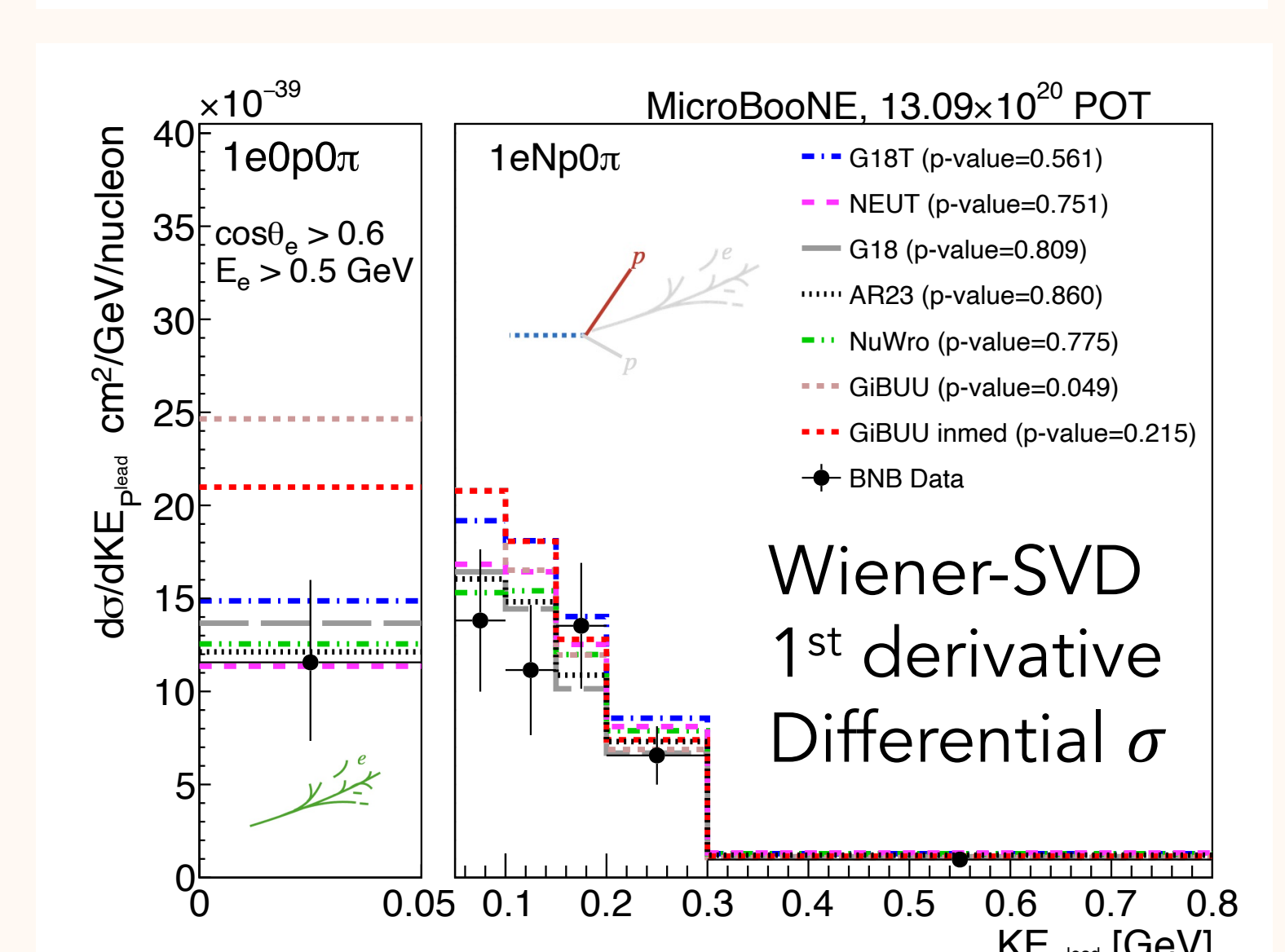
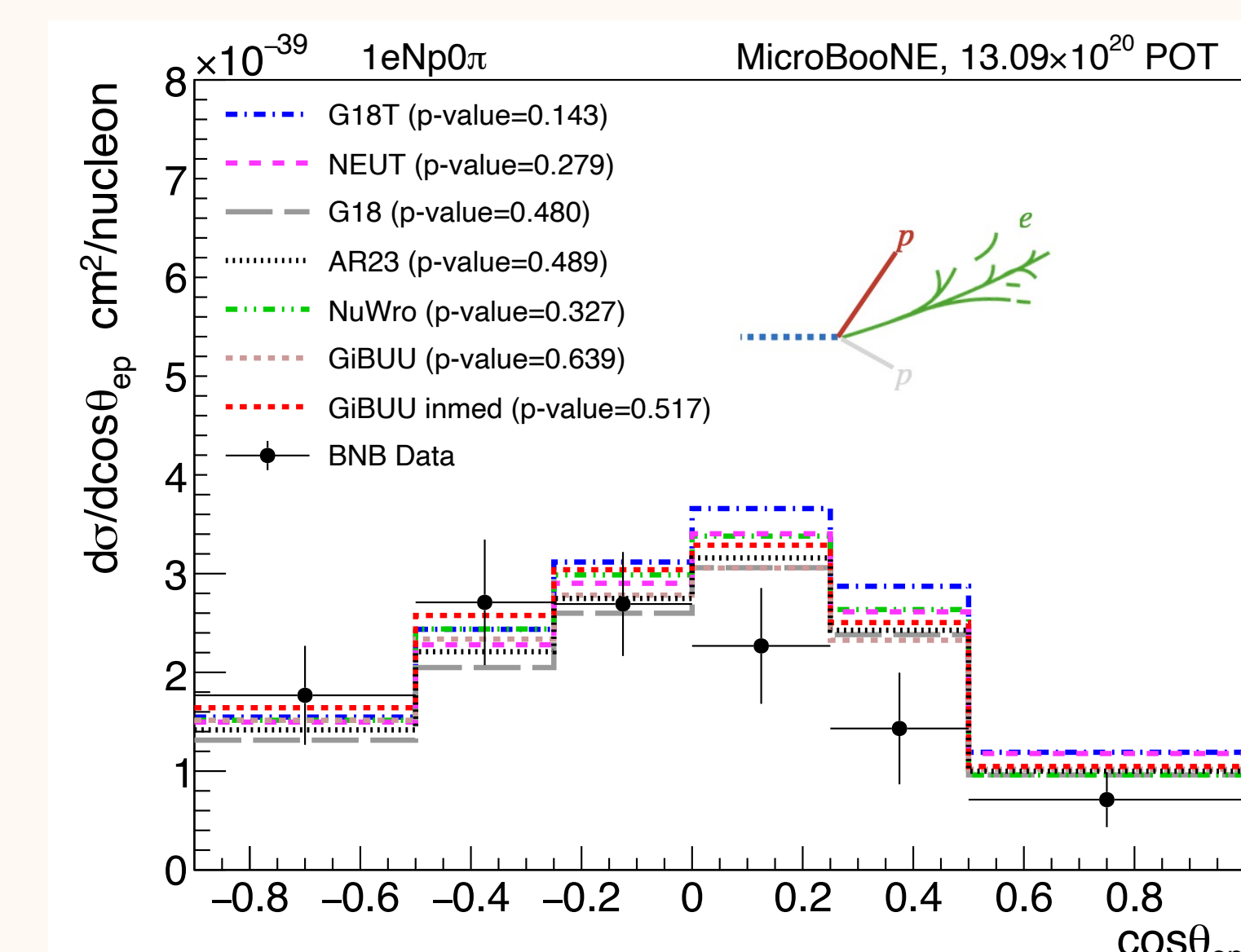
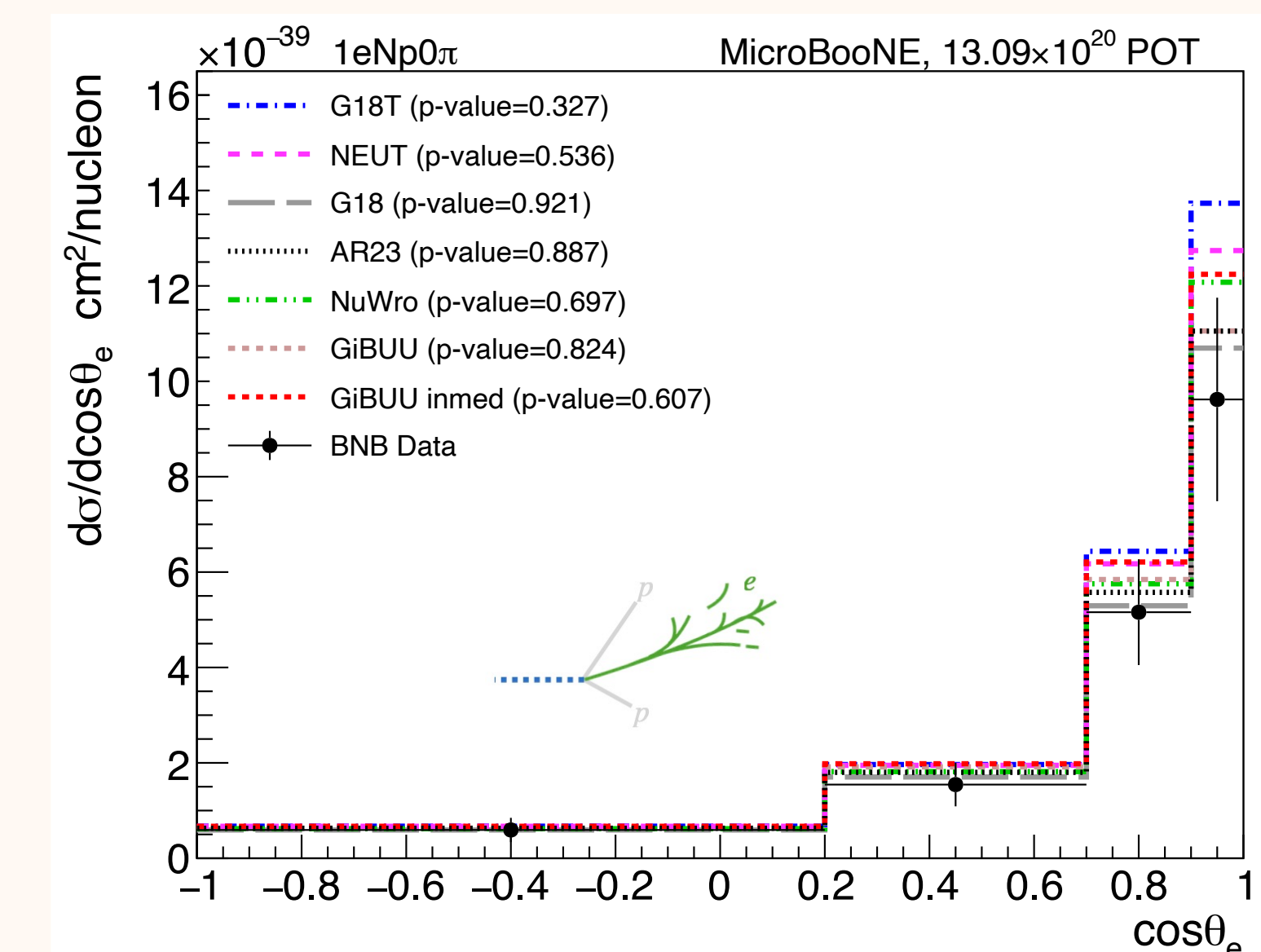
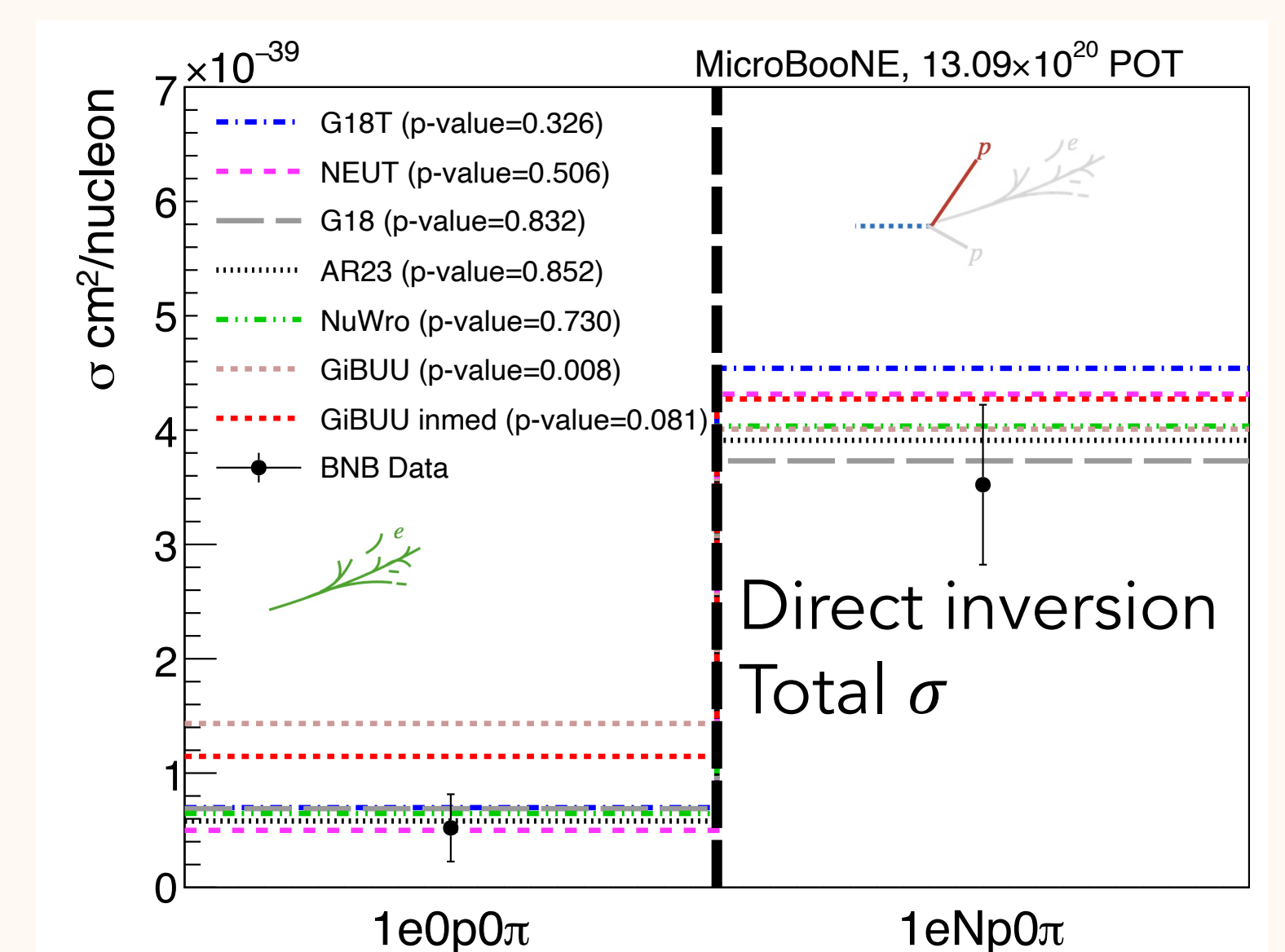
1. Good agreement in lepton kinematics



2. Lower p-values in proton and opening angle



3. Disfavor GiBUU across proton threshold



Separate model configurations in GENIE: 1. QE/MEC model has small impact, 2. FSI prefer hA model

Conclusion: Two new measurements of electron neutrinos with MicroBooNE, agreement with generators
Common features emerging, to be explored in future measurements
Future measurements: more data (all NuMI data), new reconstruction tools, new observables

Citations: [1] Phys. Rev. D 106, L051102 (2022)
[2] arXiv:2511.17342 [hep-ex]
[3] arXiv:2603.13593 [hep-ex]
[4] Eur.Phys.J.C 78 (2018) 1, 82
[5] J. Instrum. 12 P10002 (2017)