

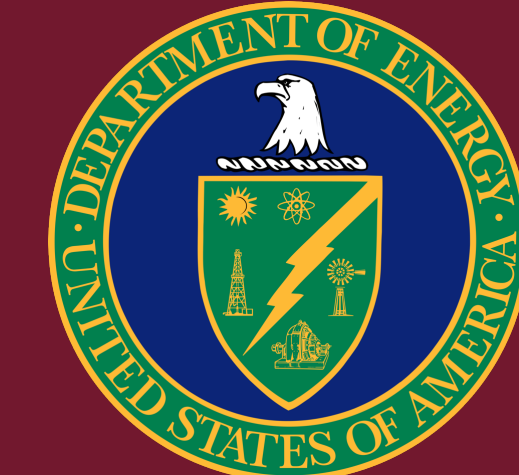
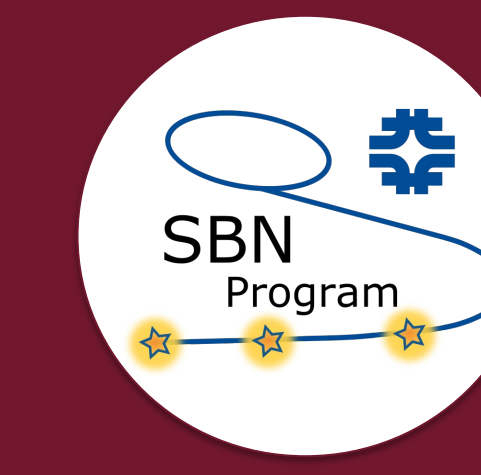
Multi-Topology ν_μ CC events for sterile searches through muon disappearance at SBN

Shweta Yadav and Manuel Dall'Olio, on behalf of the SBN Program

The University of Texas at Arlington

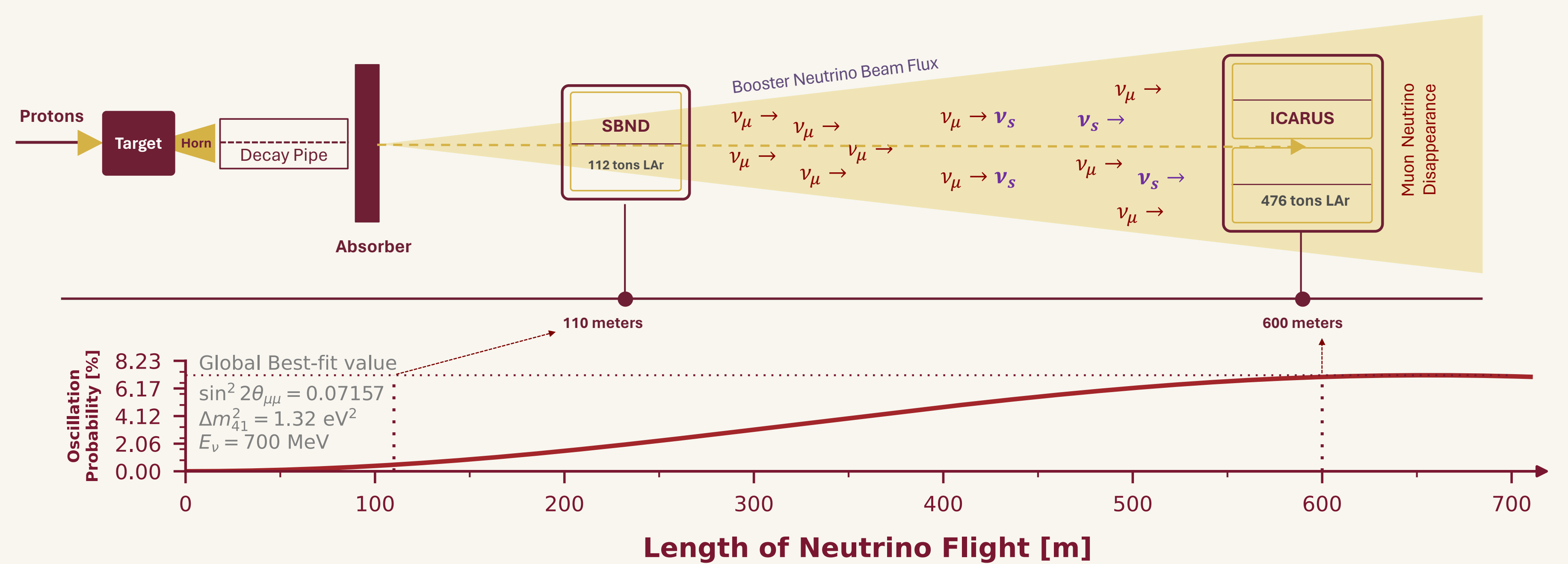
(sxy1439@mavs.uta.edu)

FERMILAB-POSTER-26-0078-V



This work is supported by DOE under grant no. DE-FOA-SC0011686

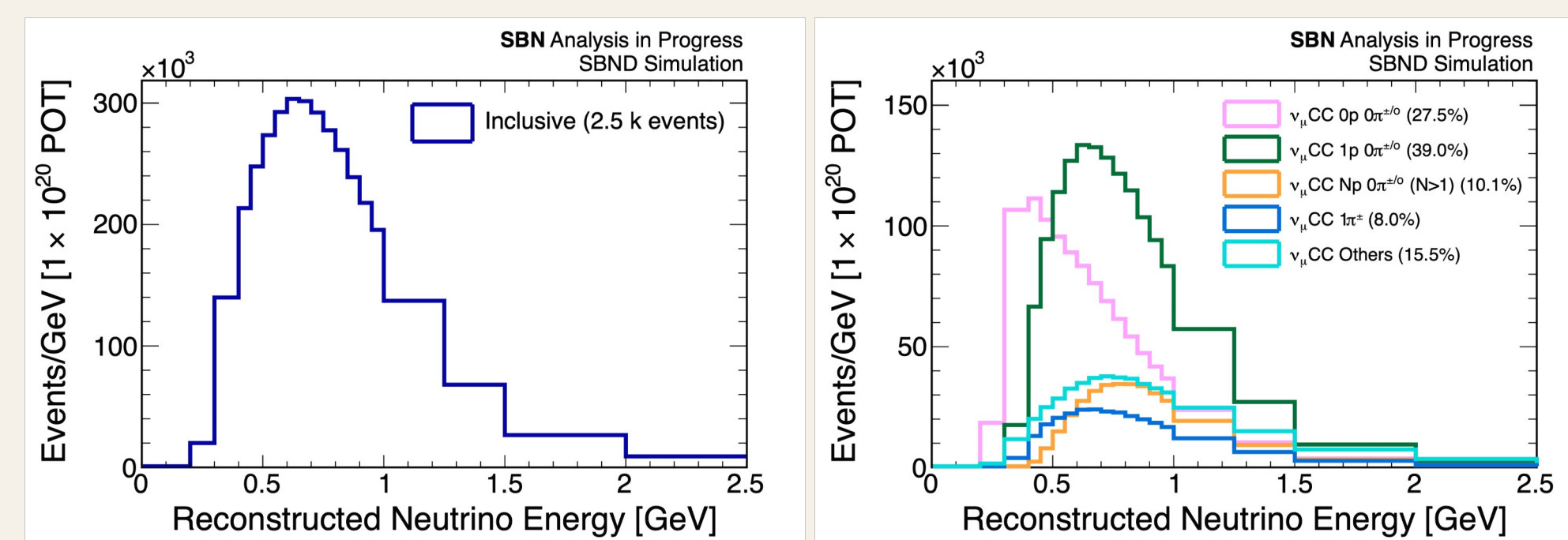
1 The Short Baseline Neutrino (SBN) Program



- Sterile searches are limited by systematic effects at SBN
- SBN is designed to maximize the sterile sensitivity by employing two detector setup

2 Strategy for Sterile-Neutrino Search

Why multi-topology? Different final states have different flux and interaction-model dependence. A simultaneous fit uses these differences to constrain nuisance parameters and reduce degeneracies with sterile-neutrino oscillations.



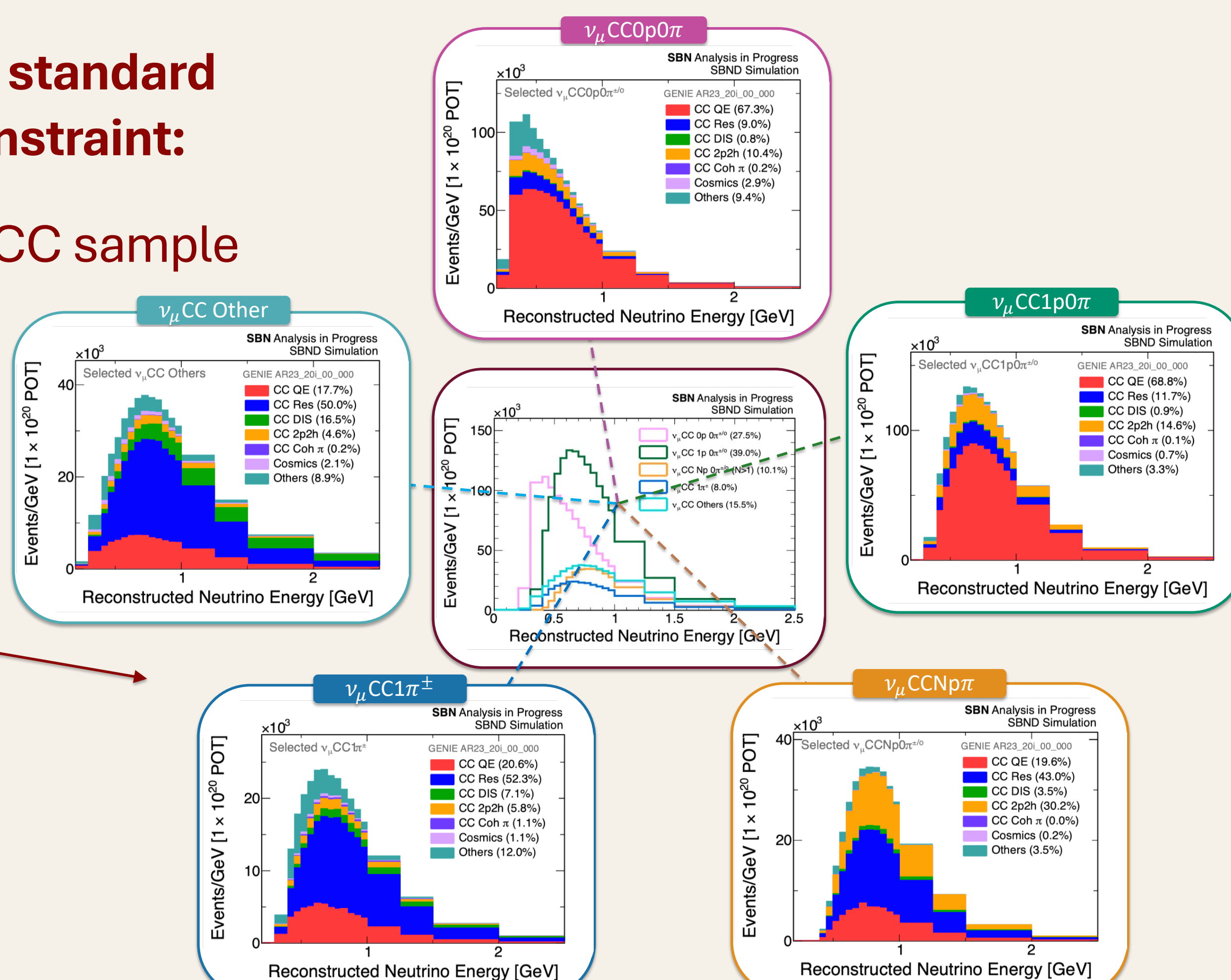
- Distinct peak and width of spectra
- Constrains both cross-section and flux systematics

Beyond the standard near-far constraint:

Inclusive ν_μ CC sample

Split into mutually exclusive topologies

- CC QE
- CC Res
- CC DIS
- CC 2p2h
- CC Coh π
- Cosmics
- Others

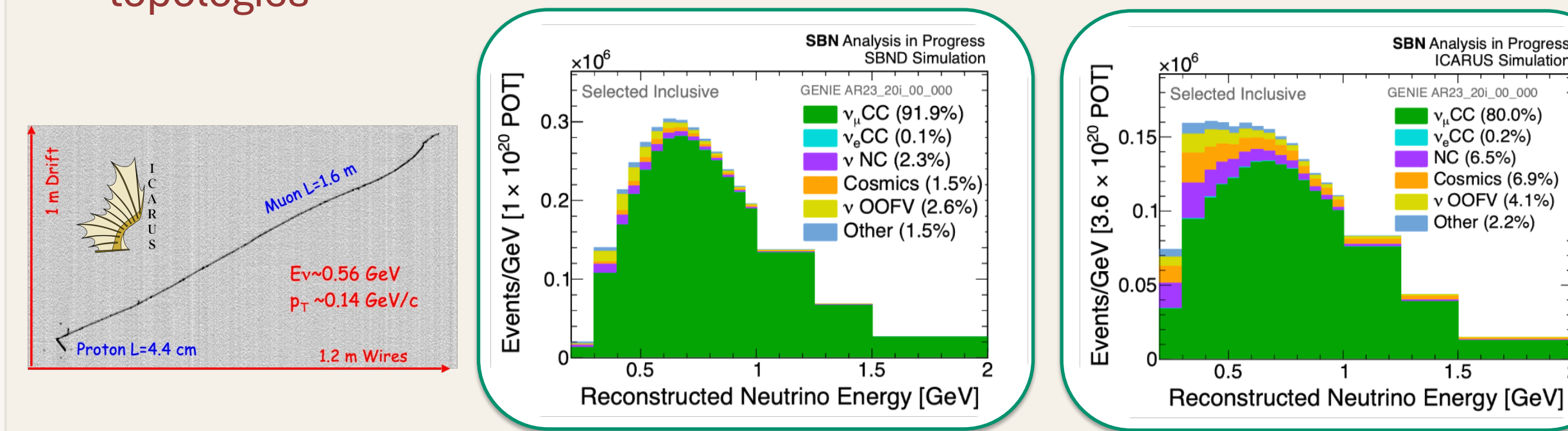


3 Samples and Fit Inputs

SBND and ICARUS inclusive ν_μ CC performance

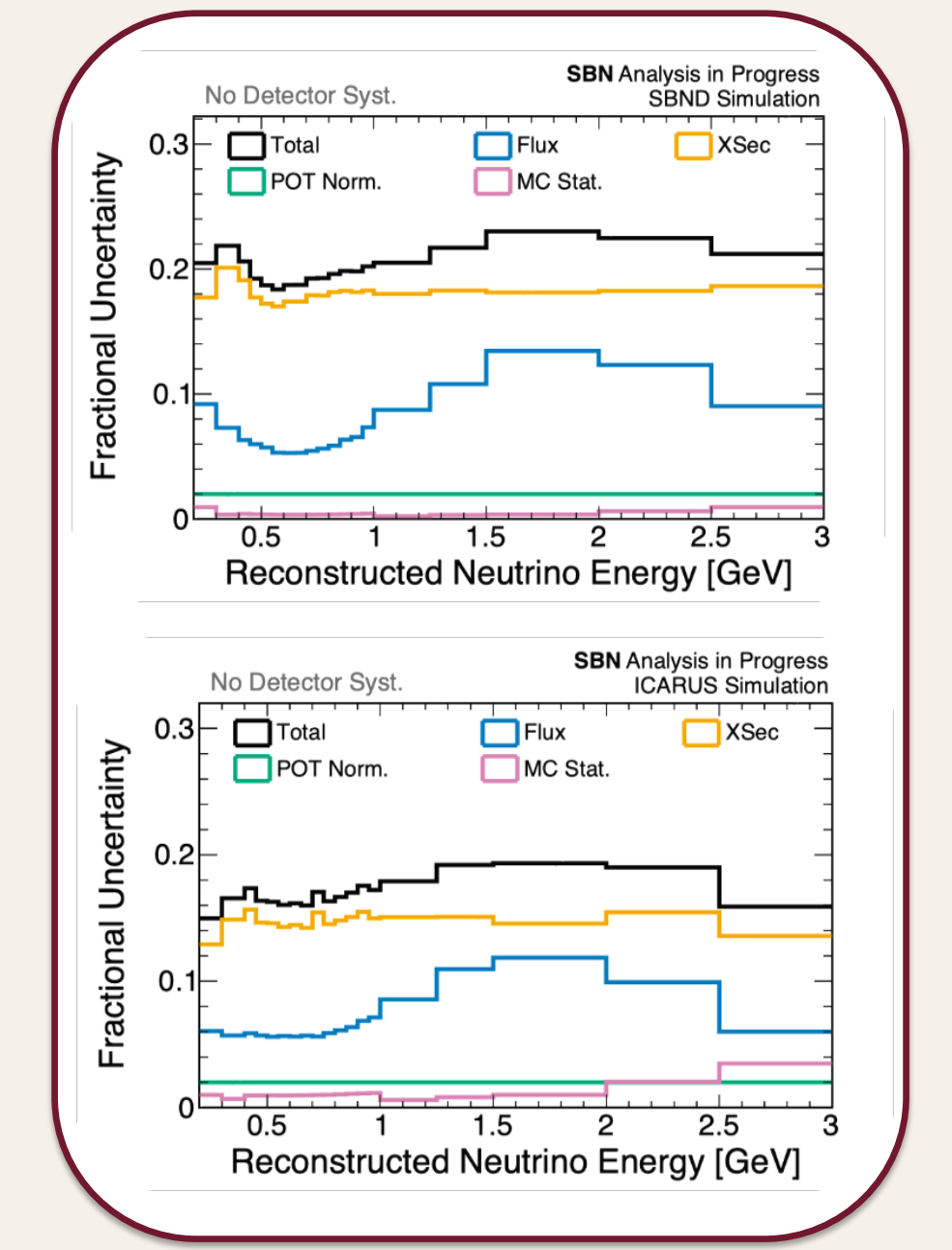
- Event selection : Cosmic rejection + Hadronic system containment + Muon Momentum threshold + Muon PID
- This sample is splitted in exclusive topologies

Detector	Efficiency [%]	Purity [%]
SBND	58.5	92.0
ICARUS	47.9	80.0

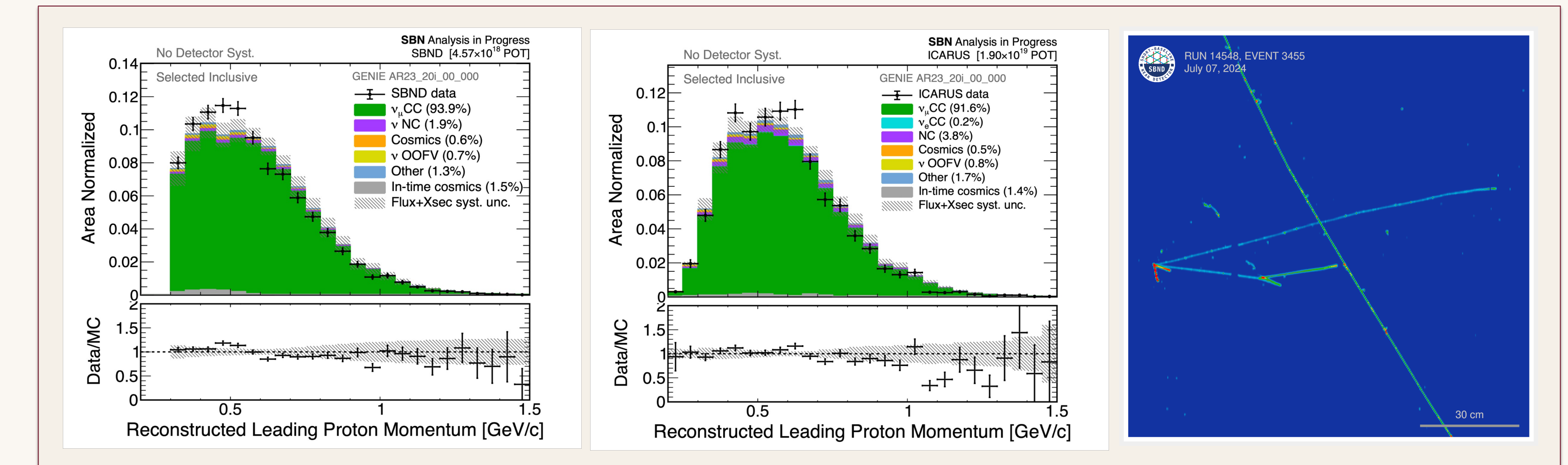
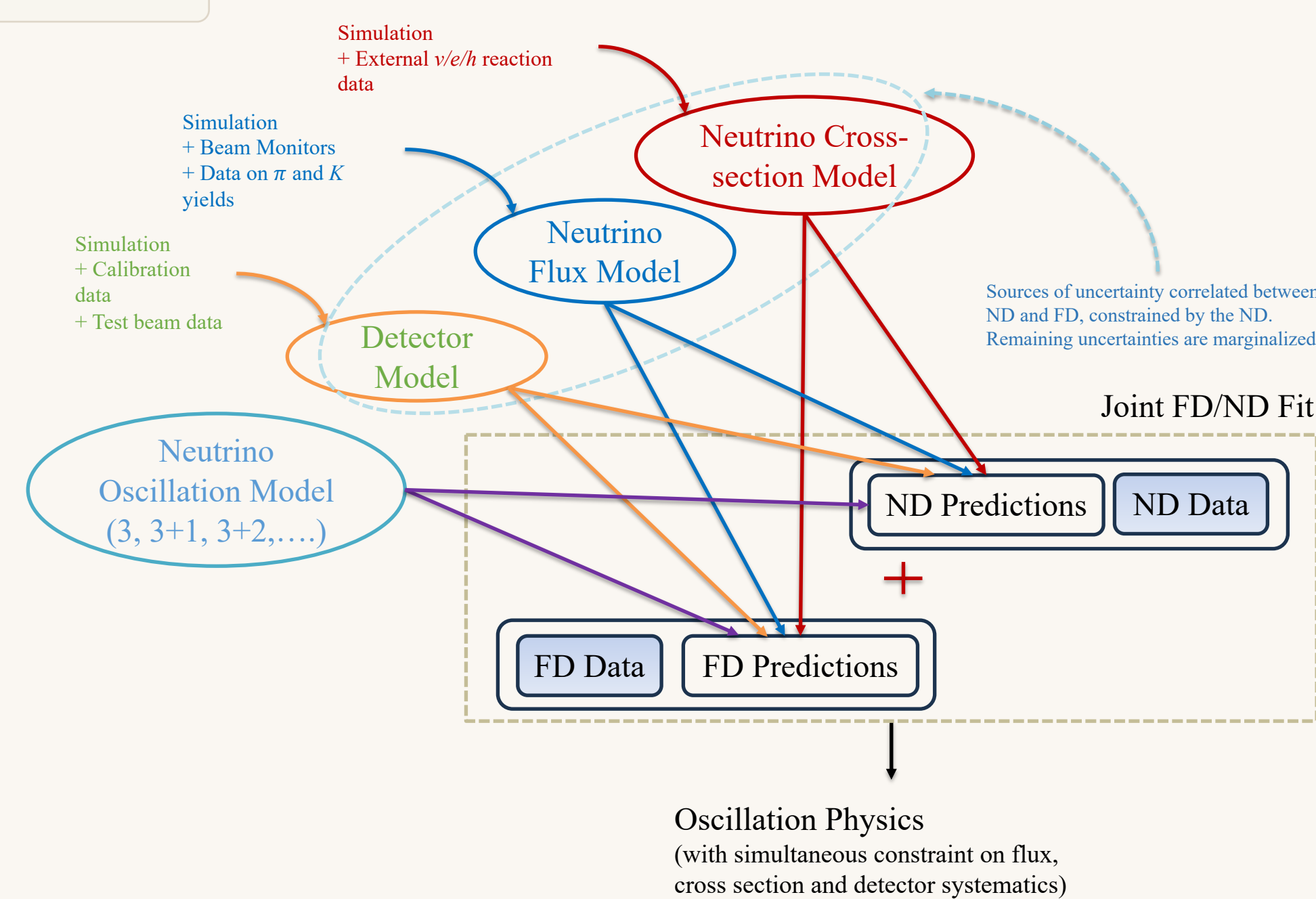


Pre-fit uncertainty size on the fit variable

- Post-fit uncertainties are expected to be constrained to a few-percent level
- Simultaneous fit of exclusive topologies improves systematic parameter constraints

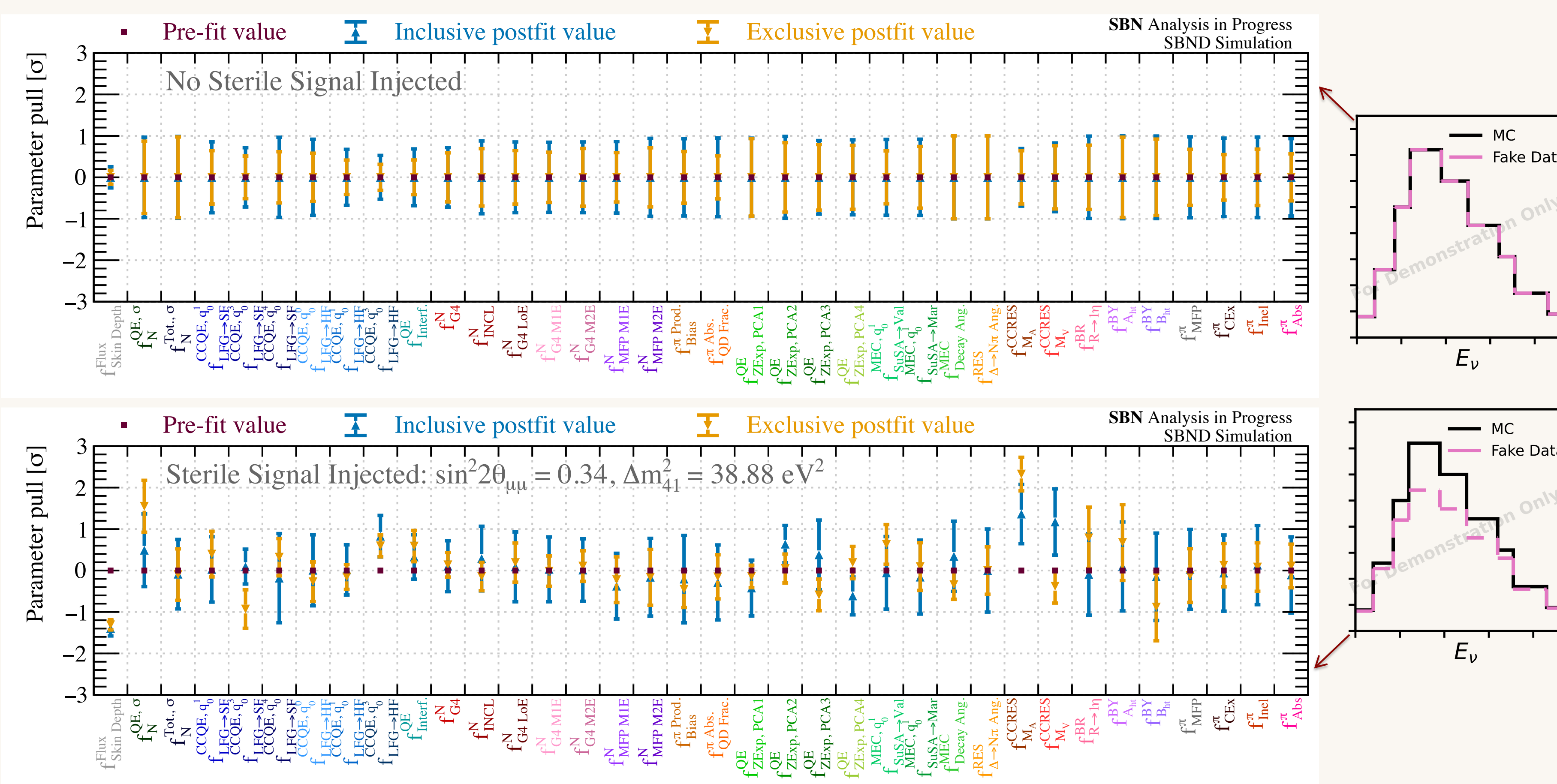


4 The SBN Data



5 Conclusion

Post-fit systematic parameter constraints comparing Inclusive and Exclusives fit



Take-home-message:

- The post-fit uncertainties of 36 parameters, comprising flux and cross-section systematics, show that the multi-topology fit improves systematic constraints and hence enhances ν_μ -disappearance sterile-search sensitivity
- Selected parameter post-fit values:

Parameter	Post-fit value [σ]
f_{CCRES}^{MA}	2.326 ± 0.405
f_{PCAL}^{ZExp}	-0.143 ± 0.271
$f_{MEC}^{Decay Ang.}$	-0.342 ± 0.353

References : [1] The LSND Collaboration, "Evidence for Neutrino Oscillations from the Observation of Electron Anti-neutrinos in a Muon Anti-Neutrino Beam", Phys.Rev.D64:112007, 2001.
 [2] The MiniBooNE Collaboration, "Unexplained Excess of Electron-Like Events From a 1-GeV Neutrino Beam", Phys.Rev.Lett.102:101802, 2009.
 [3] Andreopoulos C., et. al., "VALOR | A Cutting-Edge Analysis Framework", <https://valor-fit.github.io>