NIUWG/DIRT2 discussion on pion-prod/SIS/DIS uncertainties

DUNE Collaboration Meeting, Santa Marta, Colombia
28 September 2023

State of the NIUWG-tion*

*inspired by Luke Pickering

Ground state validations+integration in GENIE complete, available for production

Fairly good progress on GS, QE and 2p2h dials

Dials in development/validation

- GS dials: Emiss shape, Emiss linear modification, tail strength (all done by Tom)
- QE dials: Z-exp dials (need validation), low-w dials (in progress), Pauli Blocking (not started)
- 2p2h dials: 2p2h norm, SuSA-to-altModel, delta-not delta shape, energy dependence, pair fraction, angular distribution (all in progress by Lars)

Unless you have a fantastic idea, we are mostly covered for QE/0pi dials!

Did we forget anything?

Higher energy uncertainties

Goals:

- Advanced nucleon-level uncertainties for Delta and higher resonances
- Dials targeting charged pion fractions and multiplicity
  - Important for Phase-II/ND-GAr
- Energy fraction to neutrons
- Nightmare studies/fake data tests?

Dial plans

- Rvn1pi, Rvp1pi, AGKY, BY (split by vector/axial part?) - all in GENIEReWeight, just need validation/porting into nusystematics - **EASY beginner task**
- Changing strength and form factor for Delta vs non-Delta resonances
- AMU/SuSAv2 inelastic model reweight - template reweight. Anne Norrick is implementing the AMU reweight.
- FSI dials: hA2018 dials from GENIEReWeight. Implemented in nusystematics, checked by Richie+Yinrui.
    - Other dials: FSI model reweight as a function of neutrino energy bias - Yinrui Liu leading the effort, templates produced. Will implement in nusystematics
    - ML-based reweighting (Radi, Stephen, Laura) to reweight between generator predictions in high dimensions

Dial plans

- Location and width of Delta-resonance in a Bodek Cai way. Consider energy dependence of the shift?
- Low-q0 nuclear effects in pi-prod region (e.g. take the same ones from QE? Discuss!)
- Change FSI strength for Delta vs non-Delta resonances
- Hadronization multiplicities
  - Granulate+smoothen? [a la low-w dials]
    - A-dep, Energy dependence, x/y dependence
- Nuclear effects in DIS (e.g. EMC effect?)

Discuss - suggestions for other dials/implementation schemes/person power

Interfacing (non-exhaustive)

- 2x2
  - Multiplicity analysis (FSI+DIS/SIS) [Richie Diurba looking at FSI multiplicities between models], 0-meson analysis
  - Effort ramping up, not at critical point for xsec systematics yet
- NDGAr
  - Lots of interest in resonance models, especially involving pion multiplicities. Created a slack channel #hptpc-niuwg - started reaching out to discuss priorities.
- ICARUS/T2K
  - Jaesung working on hadron-tensor based reweighting framework in nusystematics, will be useful for all sorts of dials
  - Tom Holvey working on low-w dials on both DUNE and T2K (same dials and philosophy) but using T2K framework
- NOvA