Straw-man DIRT model

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Motivation

- Discussion at the last DIRT meeting didn’t quite converge, but we need to pick a model

- Dan suggested a straw-man model to move things along, so here’s my attempt, along with some TODOs, etc

Starting point (+later tweaks)

- **G18_10a:** LFG + Valencia (CC) 2p2h + Berger-Sehgal RES + BY DIS + Rein-Seghal COH + AKGY + hA 2018 (see full GENIE description in the backup
- **G18_10a_02_11a:** Free nucleon cross-section model re-tune using mainly bubble chamber CCQE, CC1π, CC2π, and CC inclusive cross-section data.
- We should take GENIE's work retuning the free-nucleon model. But, previous model included some ad hoc model tuning which we should remember to stop using (e.g., 1pi DIS normalization)

Initial state model

- Generated most discussion at the last meeting: (Benhar) SF favoured because of the wider phase space
- But some critical TODOs before we settle on this:
    - Sanity check that GENIE output is sane with SF (e.g., it runs and produces events in a finite time)
    - Check SF z-exp/dipole vs LFG for QE/1pi/Npi in various kinematics
    - Andy-F pointed out that outgoing nucleon kinematic issues cropped up in QE SF validation, best tested with mono-energetic samples
- (Also general reweighting validation checks, see later)

Axial FF model

- Z-expansion as default? **Any objections?**
- Not *currently* possible to reweight from dipole → Z-expansion and then tweak the Z-expansion model
- It is possible to reweight dipole to the nominal Z-expansion parameters, but not to then apply tweaks to it
- (This is probably a simple fix, it just complains about algorithm mismatches if you try).

FSI model

- The conclusion I heard at the last meeting was that the single-step “hA” model would be easier to use than “hN”
- **Any objections?**
- HA used by default in G18_10a, so no change required
- A very naive question: does the model used for calculating FSI probabilities change to match the initial state model?

Reweighting validation

- Luke has updated nusystematics/systematicstools to work with both GENIEv2 and v3
- Also updated interface to NUISANCE to make it easy to play models over data
- Easy framework for checking that parameter variations have a sensible and consistent variation
- Also makes it easy to compare systematic error bands between versions, and investigate agreeement with external data

TODOs

- SF model validation → outstanding item, any volunteers?
  - Once validated, I think we can let production groups know what model we favour
- Work through the list of systematics from previous analysis, which are still relevant? Which need to be modified
- Validate GENIE and all relevant custom systematics in v3
- The fun stuff!

Backup

GENIE base model

G18_10a | **A theory-driven comprehensive model.**
This comprehensive model embeds the best theoretical modelling elements implemented in GENIE. It uses the Local Fermi Gas nuclear model and an implementation of the theory calculation of Nieves et al. for the simulation of CCQE and CC multi-nucleon processes. The empirical GENIE MEC model is used for the NC multi-nucleon processes since they are not included in the Nieves calculation. NCEL is simulated using an implementation of the Ahrens model, NC and CC resonance production using Berger-Sehgal, NC and CC shallow and deep inelastic scattering using Bodek-Yang, NC and CC coherent production of pions using Berger-Sehgal. Like the other G18* configurations, it adds generators for previously missing processes: Coherent production of ρ mesons is simulated using the vector meson dominance model of Kopeliovich and Marage, diffractive production of pions using the Rein model, and hyperon production using the Pais model. The hadronization model used is AGKY and it is unchanged wrt to previous versions. The intranuclear hadron transport model used is the upgraded INTRANUKE hA 2018 one. The details of the construction of this comprehensive configuration are presented in Sec. 3.3.2.3

(From the GENIEv3 manual)