

Neutrino-nucleus interaction simulation program libraries

Personal view and thoughts

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Implemented models

Current status in short

- Local Fermi-gas & spectral function CC quasi-elastic scattering are becoming the `standards`.
- Short range and long range correlation effects are taken into account.
- Multi-nucleon interactions have been implemented.
- For single pion production, not only the traditional Rein-Sehgal model but the other models are available (already or soon).
- Similar idea to treat the transition region (resonance region to DIS region) but outputs are quite different.
(Discussed in the last week: Summarized by C. Bronner-san.)

Necessary work

for the current and coming experiments

- Consistent implementations of
CCQE & Multi-nucleon interactions.
- Improve the models of interactions from 1 to 10 GeV.
Single pion production, transition region and DIS.
Treatments of nucleons from both
primary neutrino interactions and
final state interactions.
- Justifications of the implemented models
with the electron/photon/hadron scattering data sets.

How to and/or what is the best way to evaluate the models in the small q^2 and ω region using electron scattering data?

All the 5 software libraries have quite different attitudes toward their developments.

- GENIE
To be a “good generator” for various experiments.
- NEUT
Useful in the specific experiments.
- NuWro
To be used as the ‘systematic evaluator’
- GIBUU
(nearly) consistent theory and code framework
and expected to be used out of the box
- FLUKA
Support various interactions other than neutrino scatterings.
Sophisticated treatments in hadron-nucleus interactions.
Still some of the neutrino-nucleus interactions are missing.

Discussion points

Selections of the models

Determinations of the parameters

Optimizations & tunings

Who decides?

How they are decided (selected)?

GENIE: Authors decided to provide “several choices”.
Users select the appropriate one for them.

NEUT: Experiments decide what they want and use.
(Authors are the collaborators of the experiment.)

NuWro: Authors define official version for a reference.
Parameters are tunable by the users.

GIBUU: Authors select the best ones.
This may be one of the simplest and clearest way.

Inter-operability or “easy way” to compare each other

NUISANCE provided a framework.

It may be a time to make their work easier.

First step: define common output data format

Simple : just kinematics of the particles

PIDs + 4-momenta

Complex : History of the interactions

Particle stacks

Primary interaction

Final state interactions