Simulations for Neutrinos

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Overview

- GENIE Status
- Geant4 Status (K. Genser)
- (GENIE) Working Group Plans

Special Announcement: Our Next Meeting

- We will probably not have a meeting in August. Instead, we will have a special seminar.
  - Jan Sobczyk: "Current Issues in Neutrino Event Generators"
    - August 26 at 1 PM in the Hornet's Nest.
    - The seminar will be broadly publicized but it is aimed at "this group" – people actively working on and thinking about simulations.
- We will look to schedule our next regular meeting in early September.

GENIE Status

- Reviewing release candidate 2.8.2.
- Bugfix release – no changes to (intended/ correct) model behavior and no change to the global tune.
- All the code is committed and we are working on validation now.
- We plan to release it very soon! (Before the end of August.)

GENIE 2.8.2

(We'll call out contributing experiments/collaborations when they aren't GENIE core members.)

- Bug fix in the event generation driver (J. Koskinen, IceCube).
- Bug fix in the beamline flux driver (T. Dealtry, T2K).
- Re-weighting initialization performance improvement (C. Backhouse, NOvA).
- Intranuke: new validation data sets and programs (S. Dytman and T. Golan)
- Make: stop the build on an error (P. Rodrigues, MINERvA)

GENIE 2.8.2

- Coherent pion model energy indexing bug fix (D. Cherdack, T2K/LBNE).
- Intranuke: strangeness conservation violation, nomenclature, problem with high energy protons (S. Dytman).
- PDF confusion with cernlib (H. Gallagher and B. Tice, MINERvA/SeaQuest).
- Nuclear modification to structure functions is f(x), not f(rescaled x) (B. Tice, MINERvA/ SeaQuest).
- Formation zone in nucleons bugfix (H. Gallagher).

Geant4 Status...

(see talk by K. Genser)

Working Group

- Consider the GENIE-focused side of things for the moment.
- What were the main concerns expressed by the experiments at the lab?
  - Release schedule
  - Understanding changes from one release to the next
  - Understanding the physics performance

Attack Head-on

- We should produce a set of fully-featured physics performance comparisons to modern published data.
- We should leverage local expertise and knowledge about Fermilab experiments.
- We should build a mini-framework that contains:
  - tools to simplify running the simulation (esp. for Fermilab configurations),
  - tools for making quantitative comparisons and computing systematic uncertainties,
  - a way of documenting the exact configuration of GENIE for easy reproducibility, along with mechanisms to make the configuration more accessible to non-experts.

From the Experiments

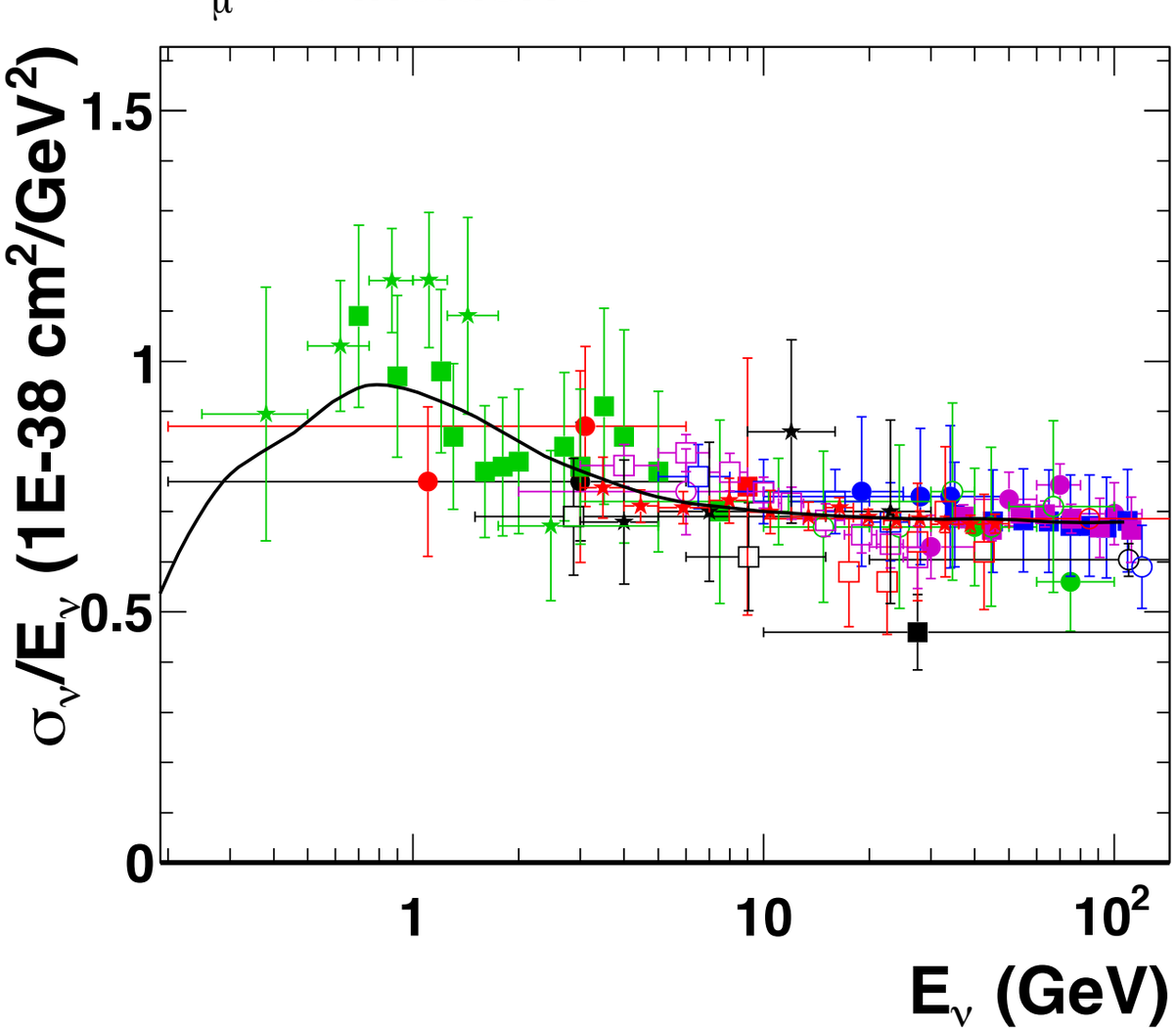
- Complete understanding of background subtraction procedures.
- Complete correlated systematic uncertainty matrix.
- Complete understanding of the acceptance.
- Fermilab experiments:
  - Proper treatment of correlated uncertainties between experiments in the same beamline! We should not compare Booster or NuMI experiments to GENIE in isolation.

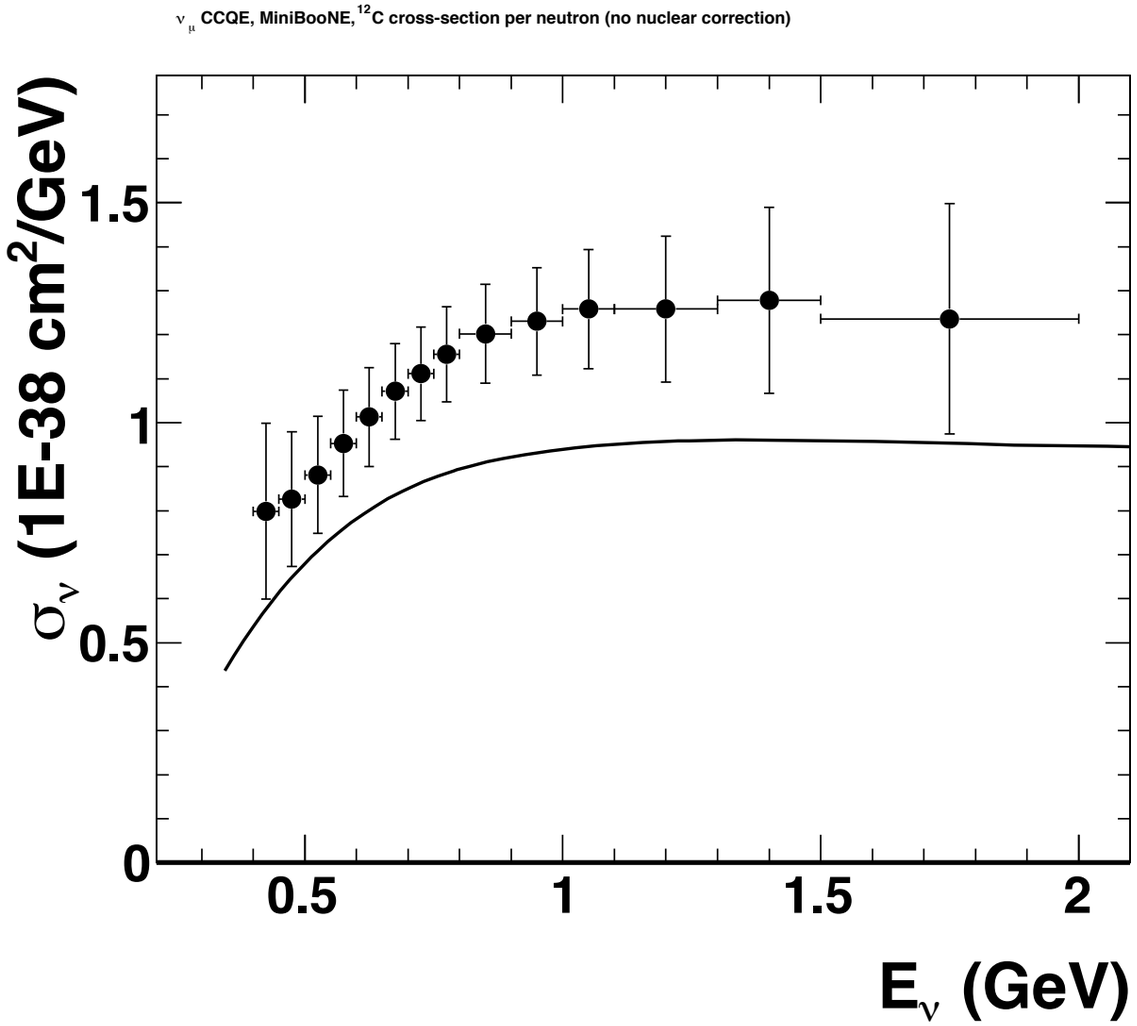
What we have now...

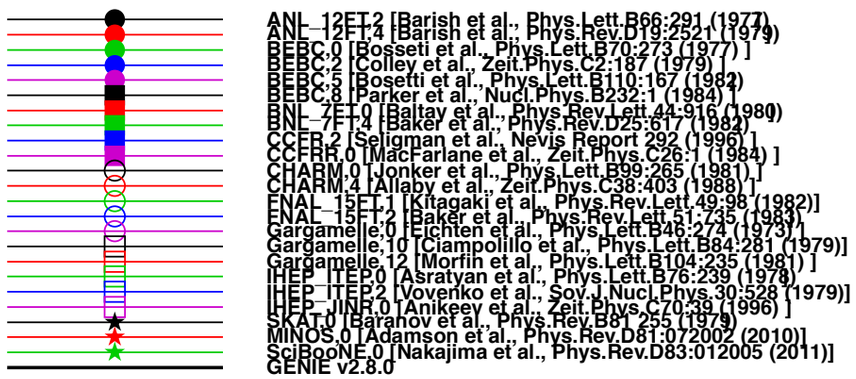
- Great base to work from.
- GENIE is probably the most carefully validated event generator on the market.
- Inclusive and exclusive distributions, electron and hadron scattering data, hadronization, etc.
- MANY pre-existing classes and tools for making comparisons.
- See, e.g.
  - http://projects-docdb.fnal.gov/cgi-bin/ShowDocument?docid=2927
  - This is a very comprehensive look at validation and includes a number of topics that are outside the scope of this group.

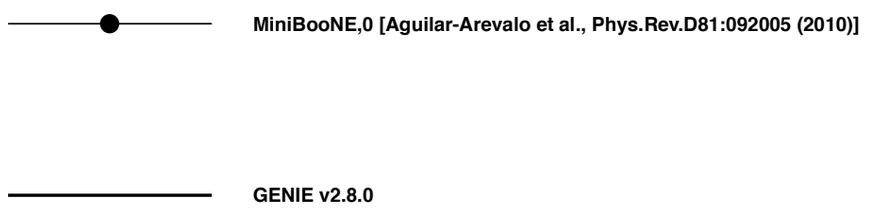
What we have now... many plots!

https://users.hepforge.org/~candreop/outbox/genie/tuning/2012a/data_mc/latest/









The Goal

- Comparison applications that produce quantitative physics performance metrics, with a focus on Fermilab experiments and datasets that are critical to Fermilab experiments.

- We want the comparison applications to be permanent additions to GENIE that are run with every validation of the code.

  - Compare model X to dataset Y – what is the chi-squared?

  - This group has a chance to directly influence the discussion about properly making and quantifying these comparisons.

  - This is the first step in producing new global tunes.

The Goal

- The applications would consume ASCII formatted experimental data and produce ROOT objects. They would also consume generator output and take advantage of GENIE's re-weighting machinery for handling uncertainties on the prediction.
  - Format will make it easy for anyone to consume / use the data.
  - It will be much simpler to track changes in the physics performance over time and to study the impact of changes on the datasets most important for a given experiment.

The Workplan

- We have a start for the plotting & systematics framework:
  - https://github.com/ManyUniverseAna/RooMUHistos
    - (This is an experiment-neutral version of the MINERvA plotting and systematics framework.)
- We also have on-going work at the lab on an automated framework to organize running the whole collection of physics performance applications.
- We also have a significant number of comparison applications and supporting classes to build on top of.

The Workplan

- The first step will be to form a group and choose a set of initial measurements.
- Then we start coding the application and report to this group and to the GENIE systematics and tuning working group.

Why get involved?

- Experiments will be able to use these tools privately to help compare their data to GENIE (using multiple models / configurations).

- When ready to publish, experiments can provide the applications and datasets for inclusion in GENIE as part of the permanent record.

- We will publish GENIE papers on the methods, tunes, and technologies.