Cross Section Uncertainties kickoff

Corey Adams

Ferni**LAB** **L**iquid **A**rgon **N**ear **D**etector meeting
(**FLABLAND** meeting)

Near **Cr**yogenic **O**bservatory for the **Boo**ster **N**eutrino **E**xperiment meeting
(**NecroBooNE** meeting)

Motivation

- To be able to make accurate estimations of the experimental reach of the Short Baseline program, we need to quantify the uncertainty in the normalization of the event rates.

- Flux uncertainties have been addressed, but cross section uncertainties have been ignored.

- It's expected that cross section uncertainties are highly correlated between detectors, but this needs to be show quantitatively.

Method

- Going to apply a reweighing scheme similar to the one we used to estimate flux uncertainties.

- In that analysis, we fluctuated the underlying unknown quantities (hadron production at the neutrino target) and propagated the results through the full simulation to the final event rates.

- In this exercise, we will fluctuate the interaction rates of neutrinos on argon and propagate the results to final event rates.

Reweighing cross sections

- Genie provides some interface to reweigh neutrino interactions - this is really good, because they know way more about cross sections than I do.

- Nusoft has some framework built on top of genie to access this framework from within the art framework.

- I have written all the necessary code to generate weights for interactions within our SBN monte carlo.

What remains?

- Physics:
  - I can use any of the functionalities that genie provides, but I need an expert's help deciding which interaction systematics are most important
    - You can see the complete list of possible systematics to tweak in genie in the file GSyst.h. There are a lot.
- Running:
  - Once the appropriate physics parameters are picked out, it should be a simple matter to go from there to event rate covariance matrices because we have written all of that framework for the flux studies.

Discussion or Comments

- I am open to ALL suggestions about the way to implement this study and what are the important parameters to examine.

- Much of the coding for the way I presented things (using the nusoft implementation of the genie framework) is already done.