NOvA Cross Section Priorities
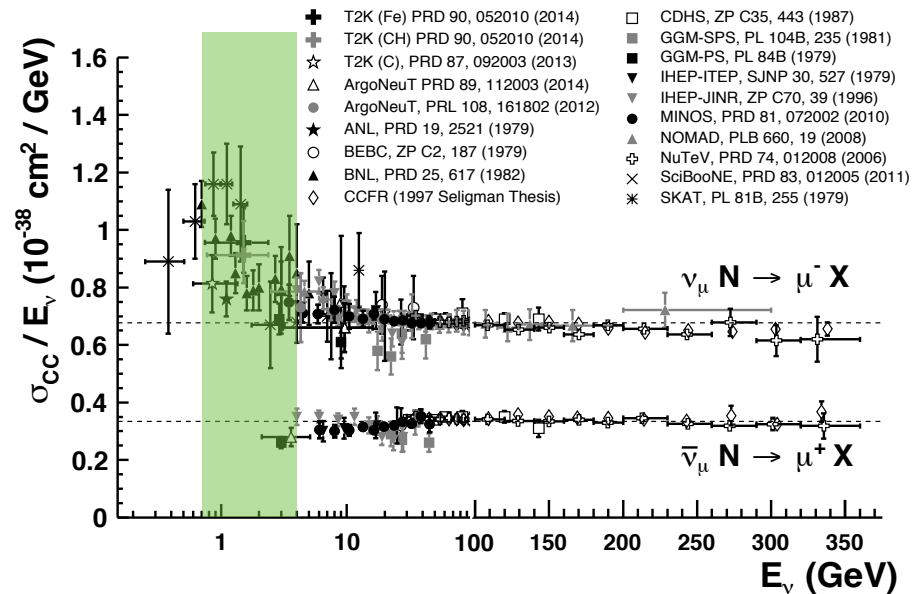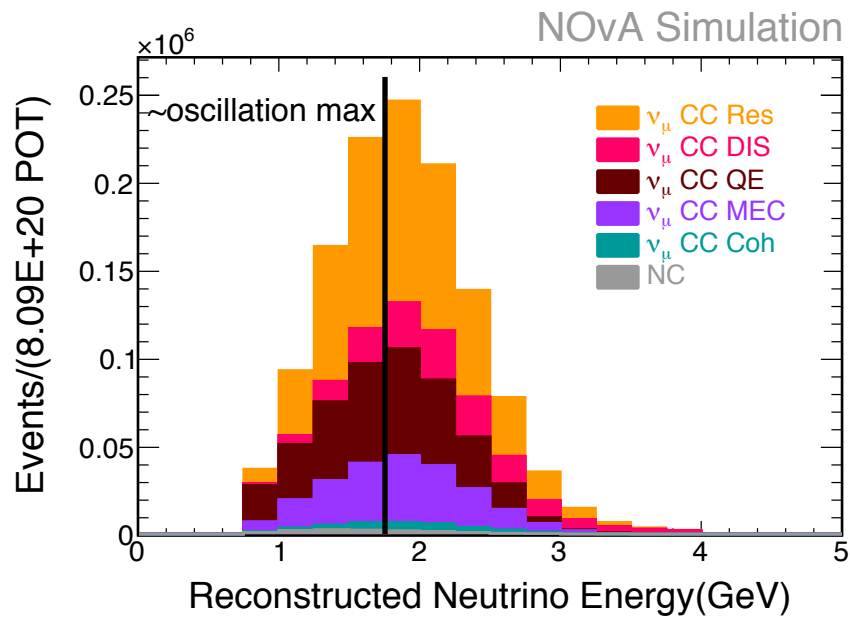
(note: these are some quick initial thoughts, and I am not officially representing NOvA here)

Jonathan Paley

NuSTEC Board Meeting

December 10, 2018

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A Reminder of the Beam at NOvA

- Even with a "narrow band beam", NOvA is still sensitive to many different nu+A interaction channels. There is also a long high-energy tail.
- Selected events dominated by the Resonance and QE-like interactions, with small contributions from DIS.
- Note: the oscillation analyses rely on MC to relate observed calorimetric energy to the "true" hadronic energy. Getting the relative rates of pion production vs. nucleons knocked-out is important.

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Needs for the NOvA analyses

- For all of our analyses, it is equally as important to have both good models and good uncertainties on the models.

- GENIE is our primary event generator. The fastest way for "NOvA to use model X" is for it to be implemented in GENIE. We are working on methods to implement other generators, but even if we do get that working, I don't see anything replacing GENIE for our official analyses.

- Specifically:

  - We benefit most from having better MEC and Resonance models

  - Although significant progress has been made on the MEC front, more needs to be done.

  - **IMO, we need to focus a great deal more on Resonance: relative rates of each resonance and final state particle kinematics.**

- Selection efficiency depends on event topology. We need "knobs" (guidance) on how to vary the final state particle kinematics for all interaction modes.

- For the xsec analyses, we always appreciate guidance on what "interesting" measurements we can make.

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Other concerns

- $\sigma(\nu_e)/\sigma(\nu_\mu)$ ratios + uncertainties

- $\sigma(\nu\text{-bar})/\sigma(\nu)$ ratios + uncertainties

- A-dependence of FSI: NOvA detectors are 67% carbon, 16% chlorine, 10% hydrogen, and few percent titanium, few percent oxygen.

- DIS uncertainties in GENIE are unreliable… not sure if this can even be fixed?

- Neutrons, neutrons, neutrons…

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