What is the path forward for our precision neutrino oscillation needs?

Mitch Soderberg

NuINT 14

Surrey, UK

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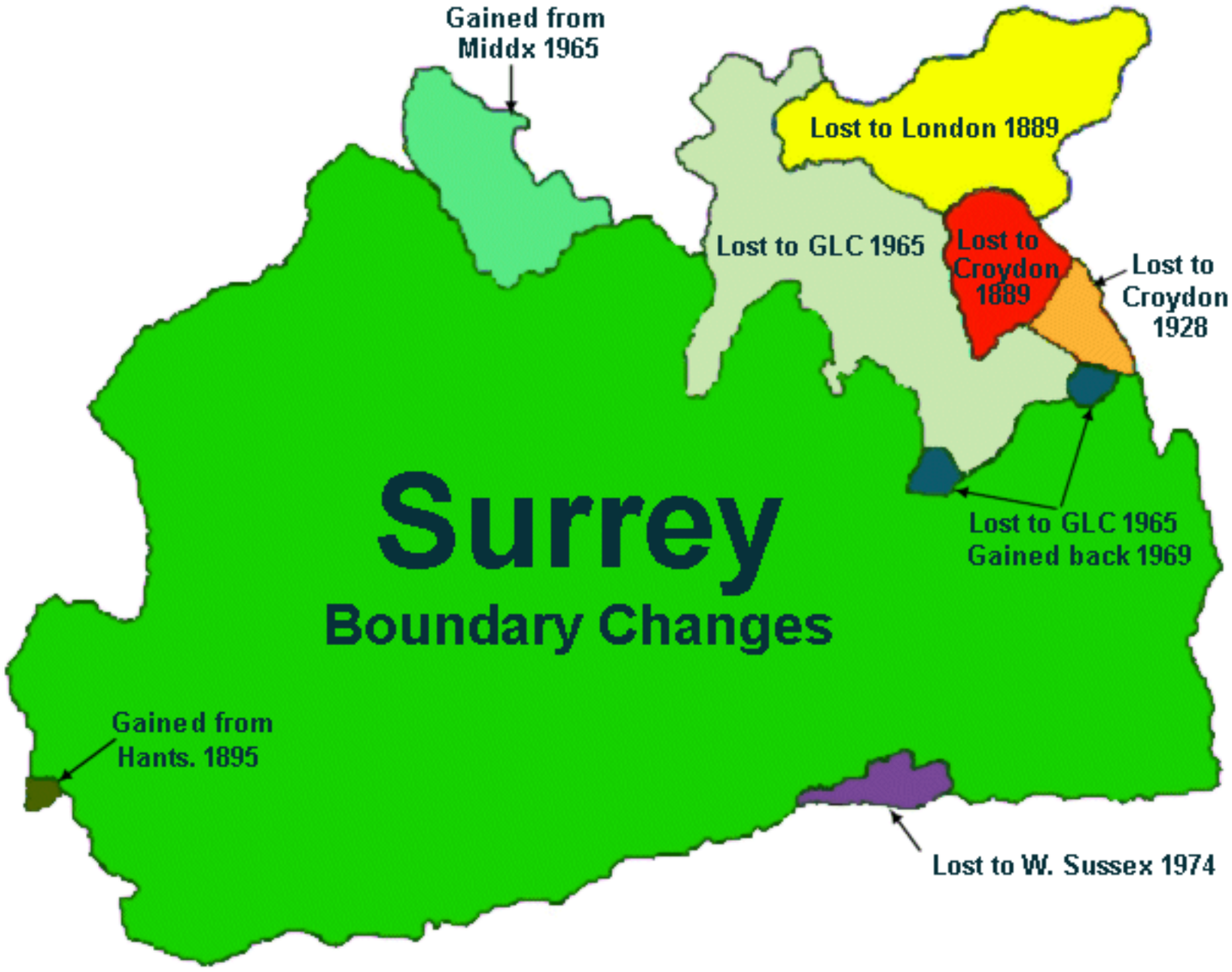

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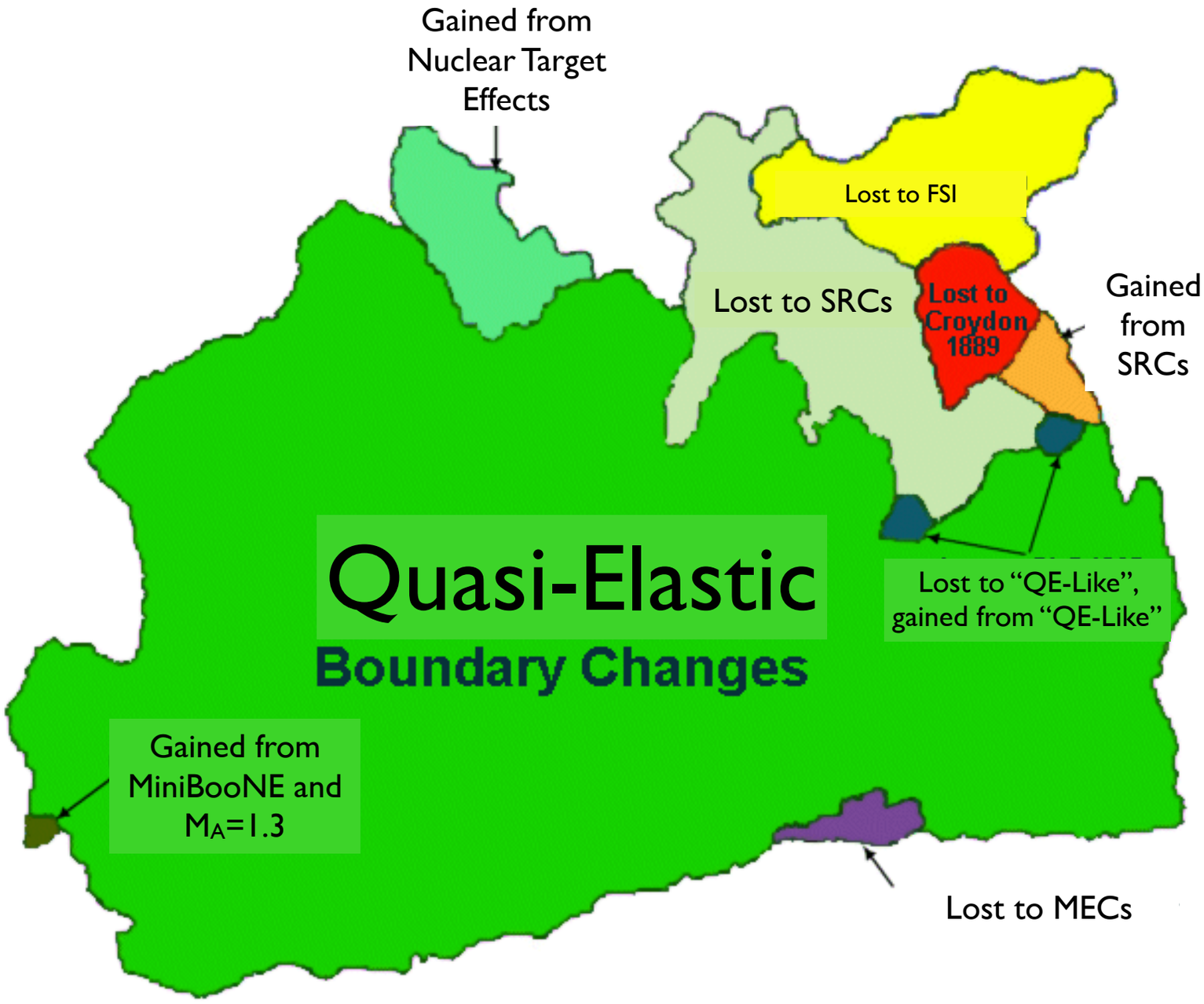
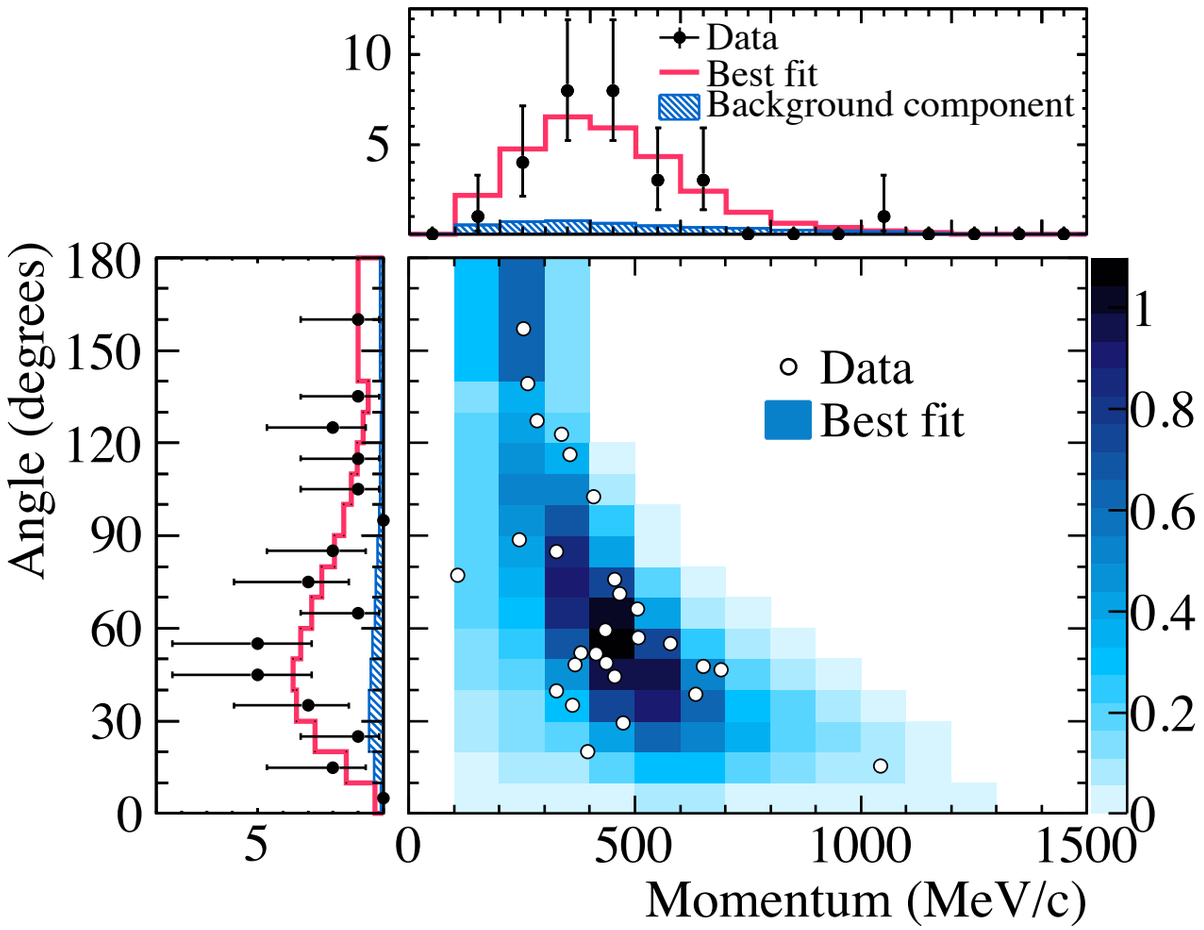


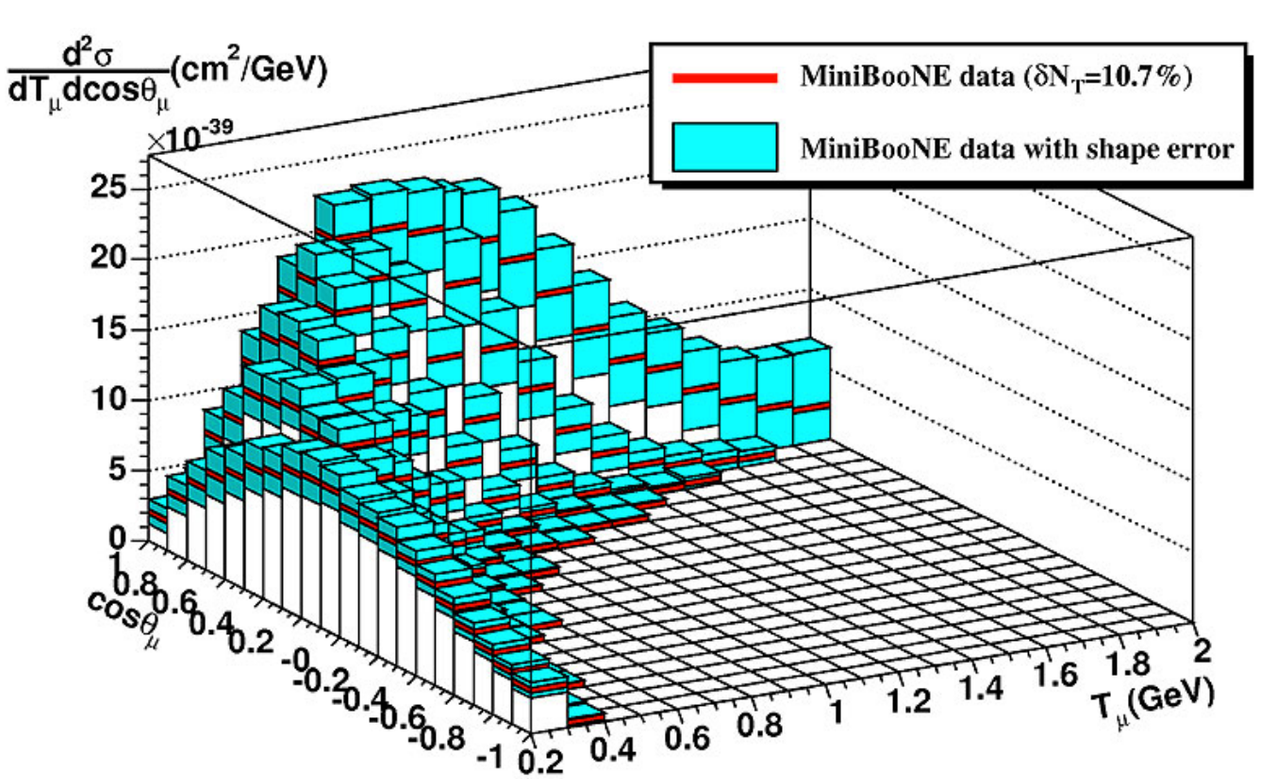
After numerous NuINTs, we know even something as "simple" as Quasi-elastic neutrino scattering can be complicated to define and measure in an experiment.

Defining What We Measure

- Since definitions such as "quasi-elastic" can be open to interpretation, experimenters should (and usually do) report specifically what is measured in an experiment, and what assumptions/models are utilized.
- Previous NuINTs have emphasized this, and it seems to have permeated the community, but it's worth repeating.

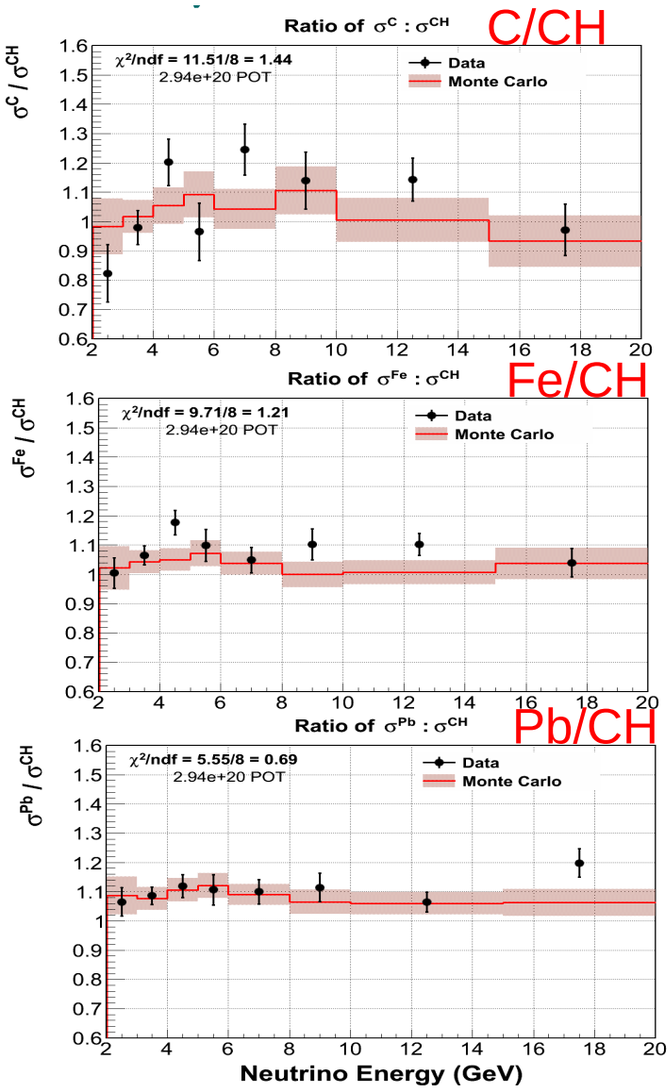


T2K

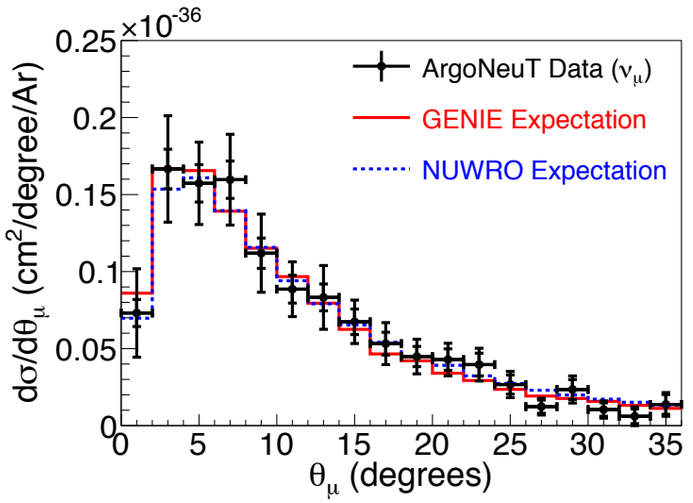


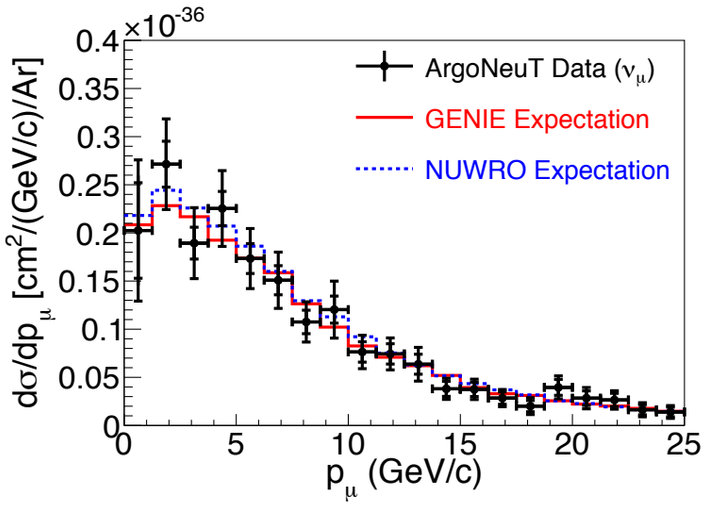
MiniBooNE

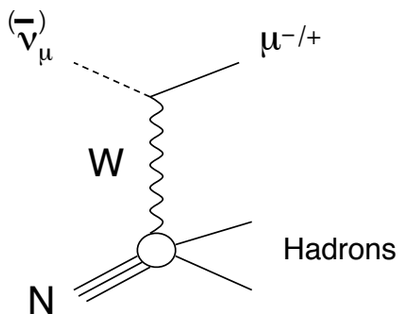
Comparisons Amongst Experiments

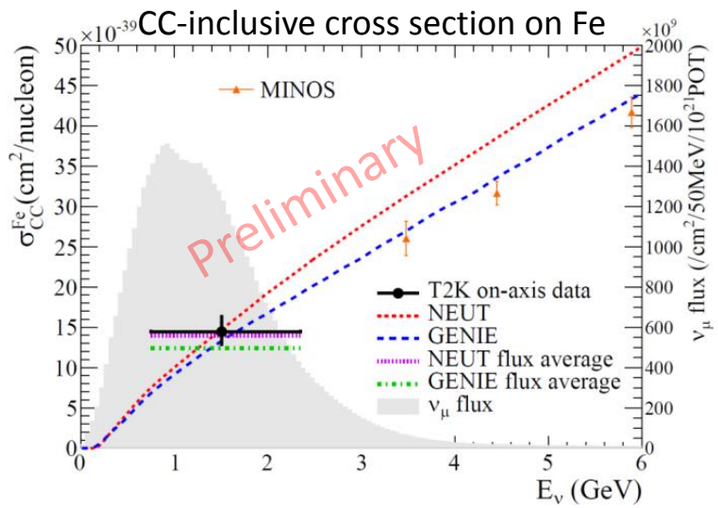


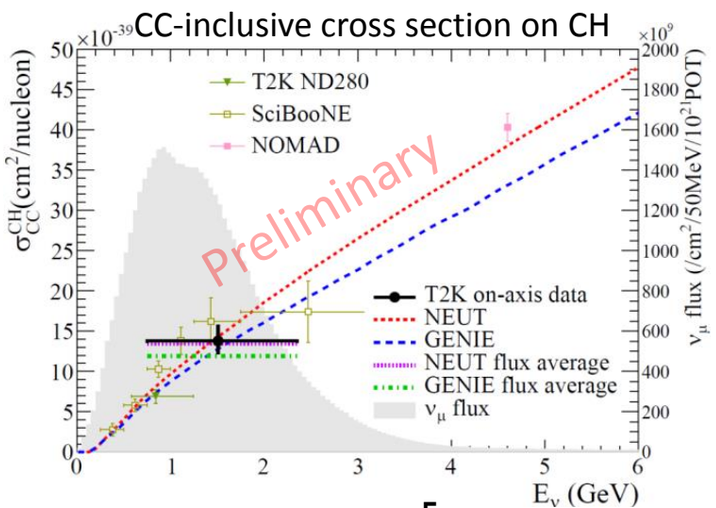
- We saw several new CC-inclusive results this week.
- Is it useful to compare things like lepton kinematics among experiments?
- Most experiments say that these results can be used to "tune generators". Are they?

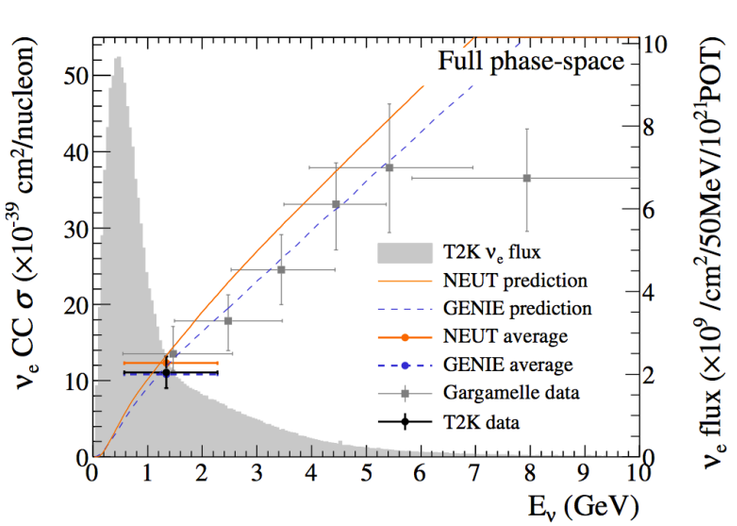












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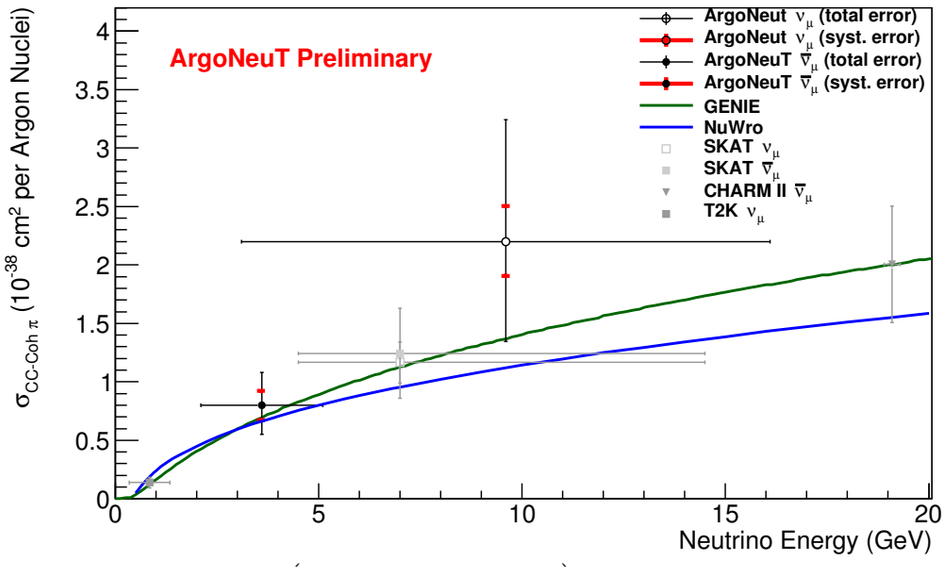
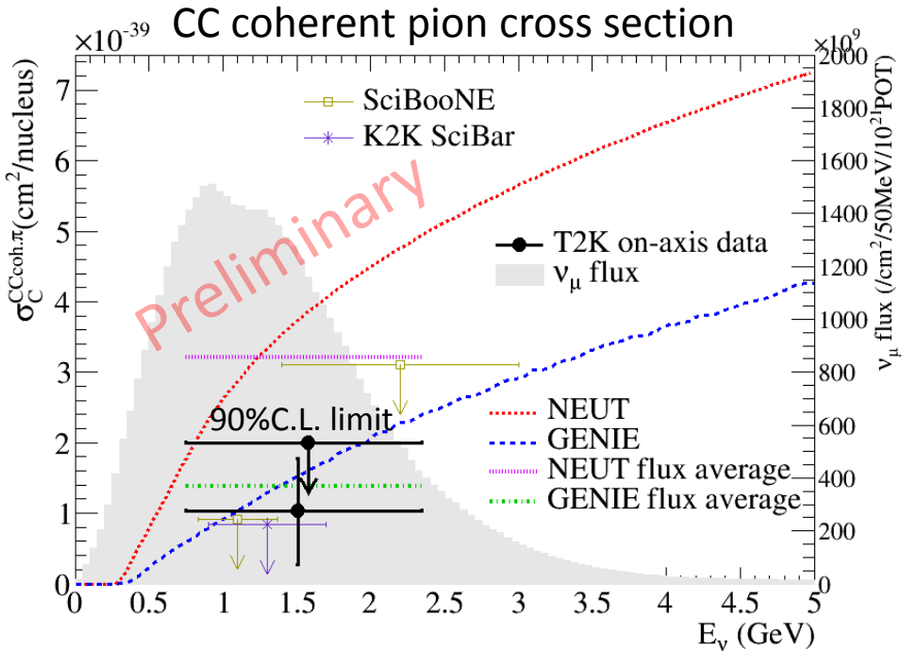
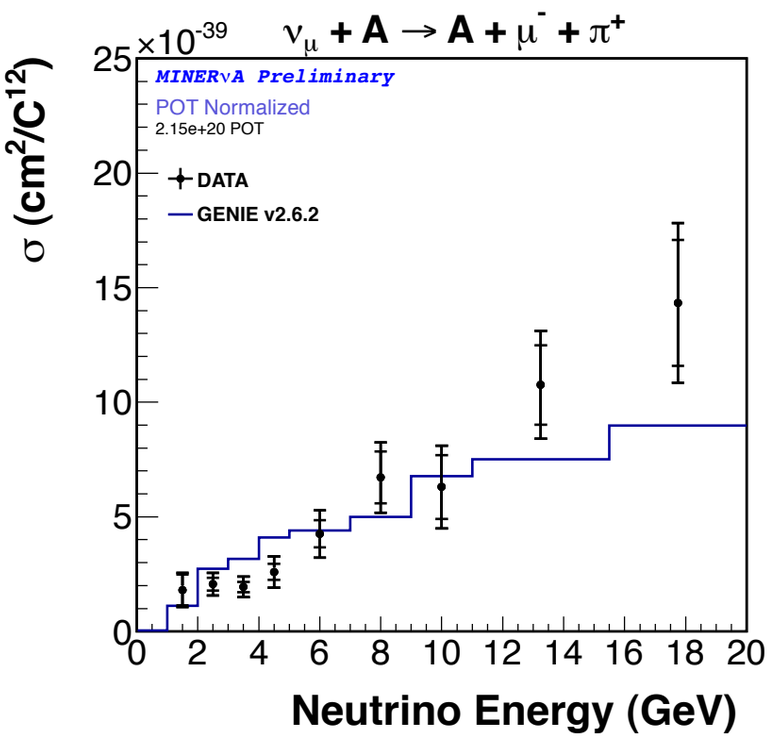
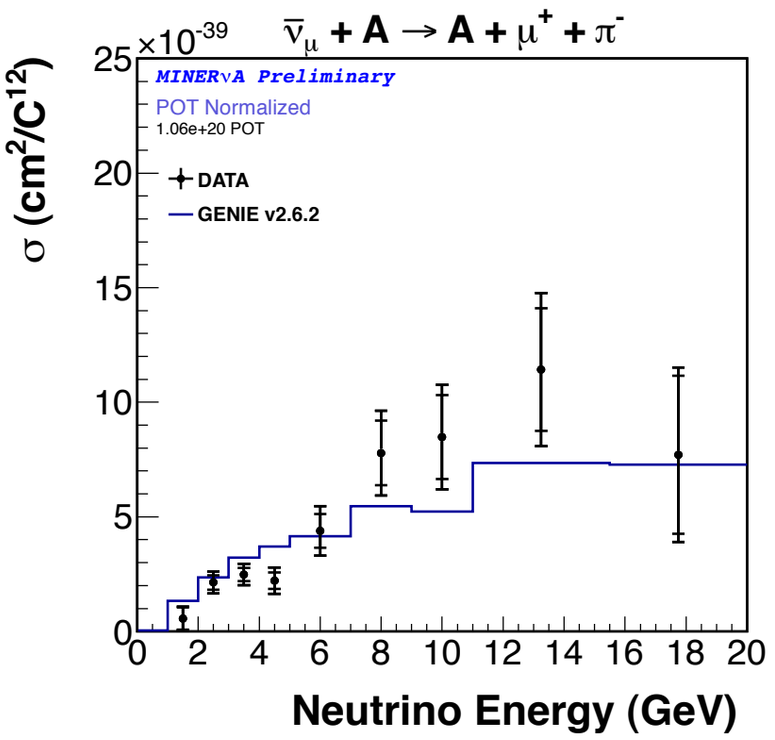


- We saw several new CC coherent results this week.
- Look forward to more data, and comparisons to more sophisticated models.







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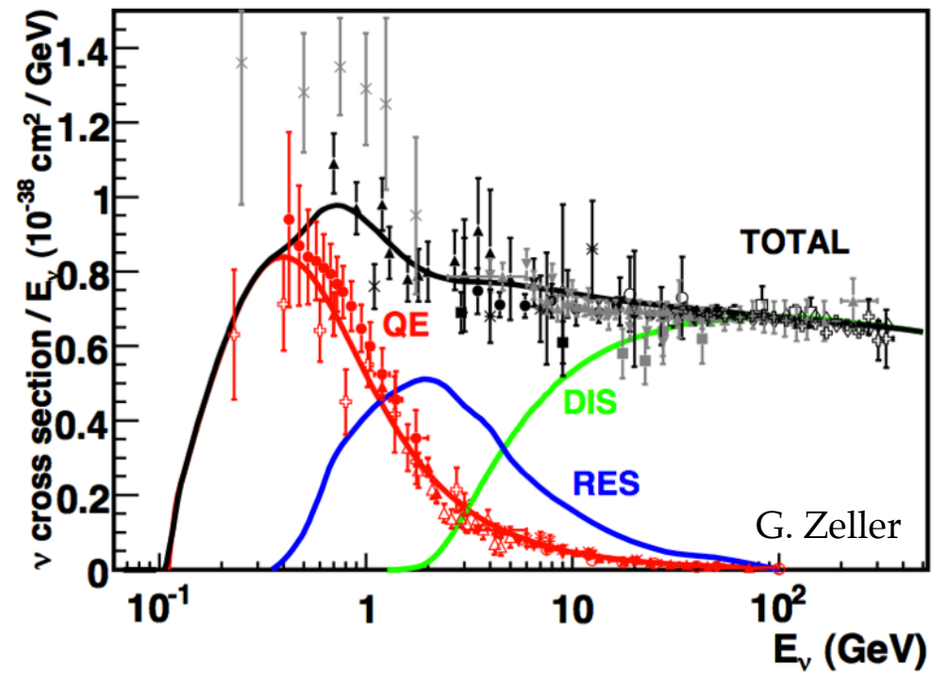
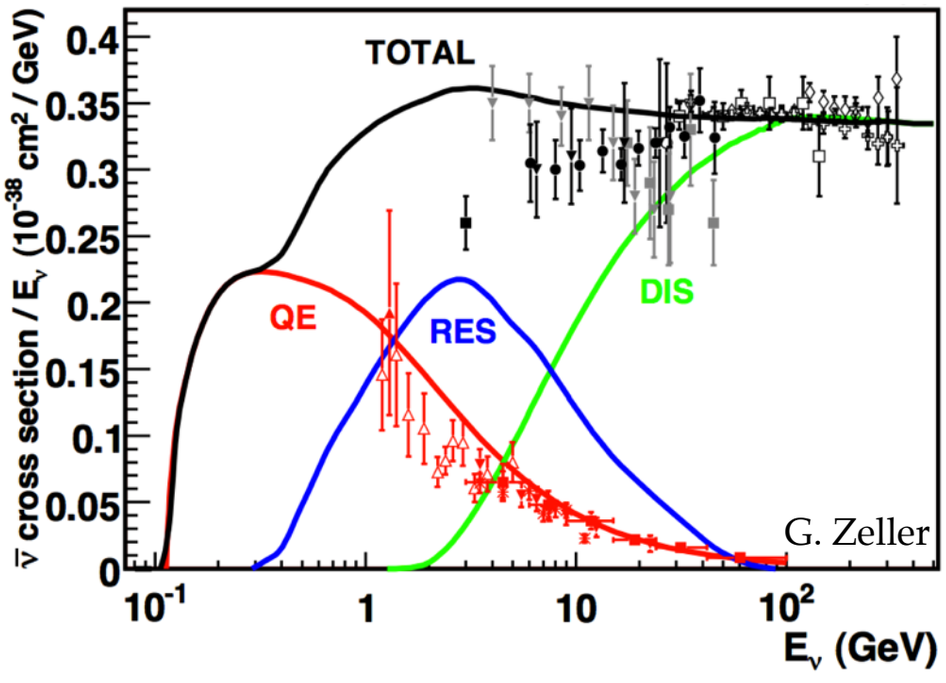


G. Zeller



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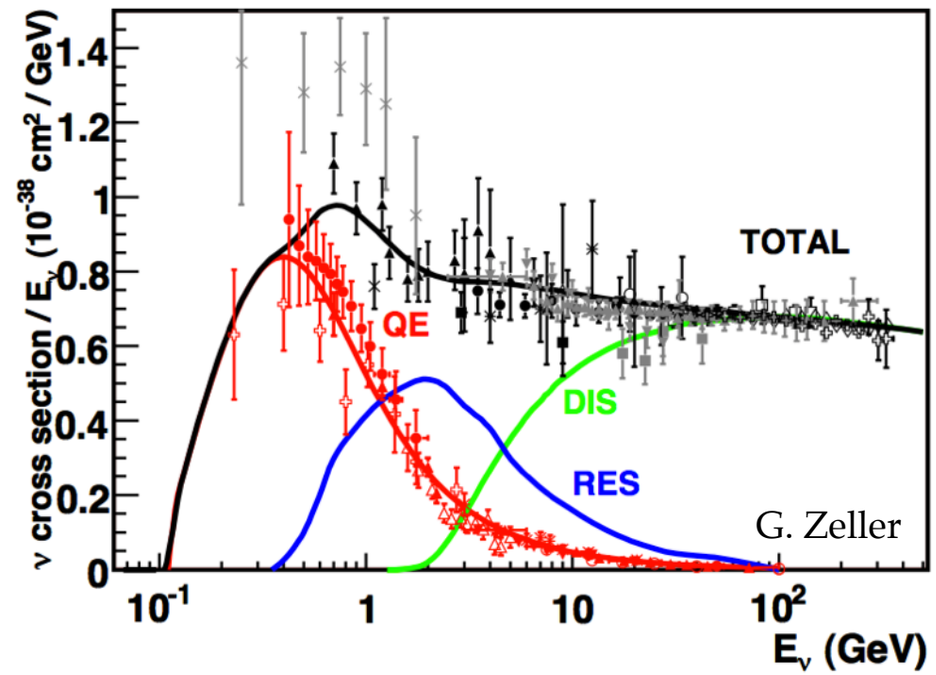

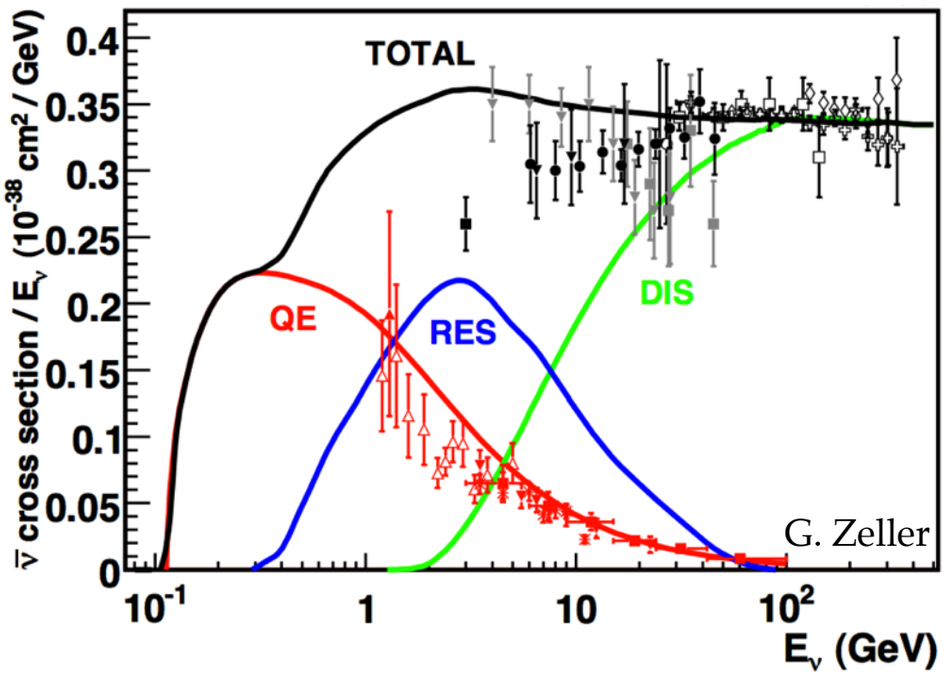

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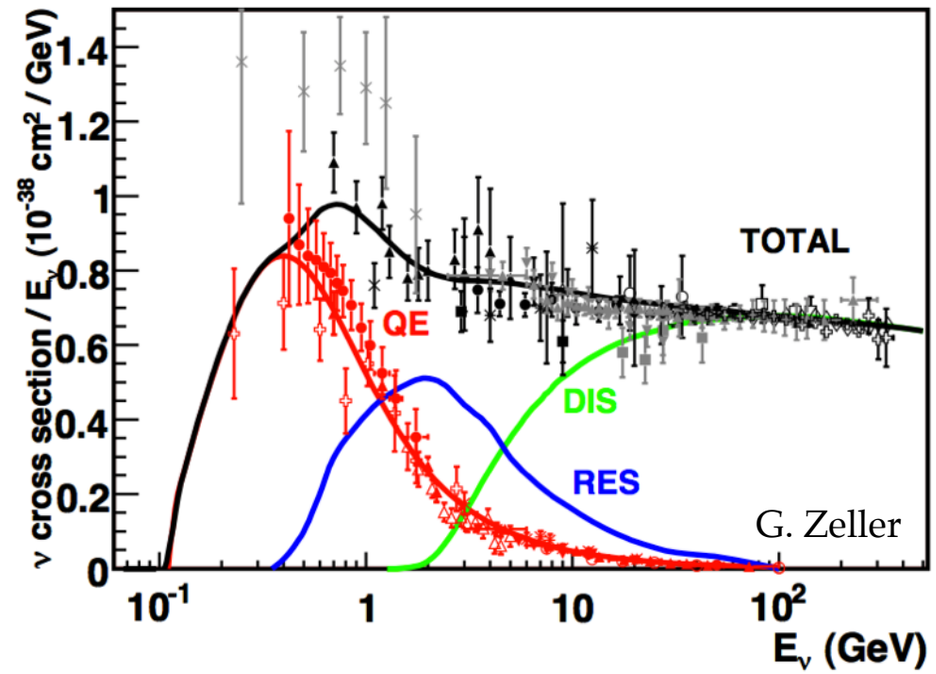

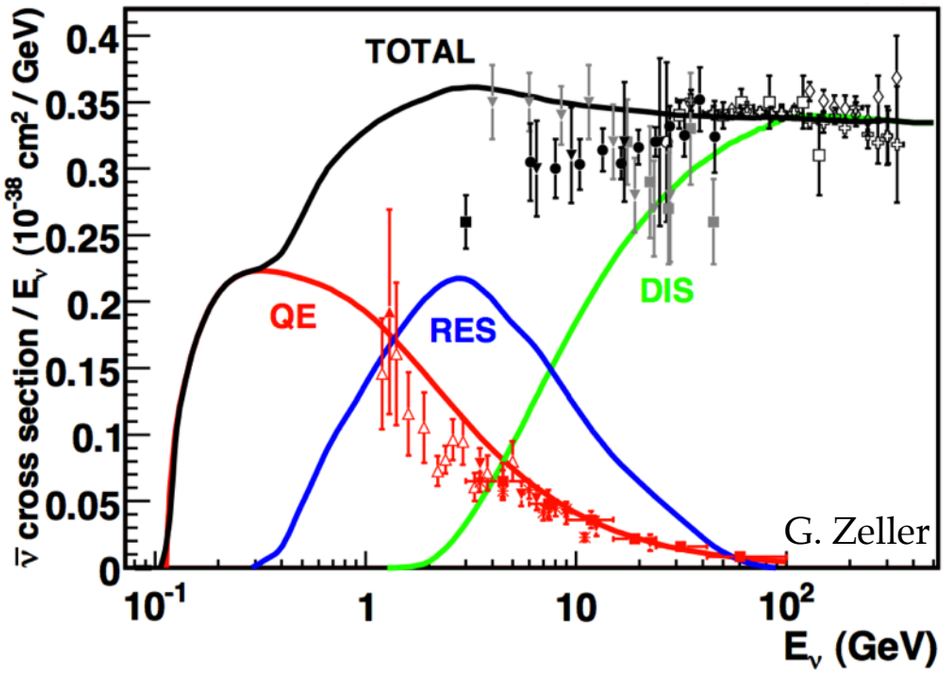

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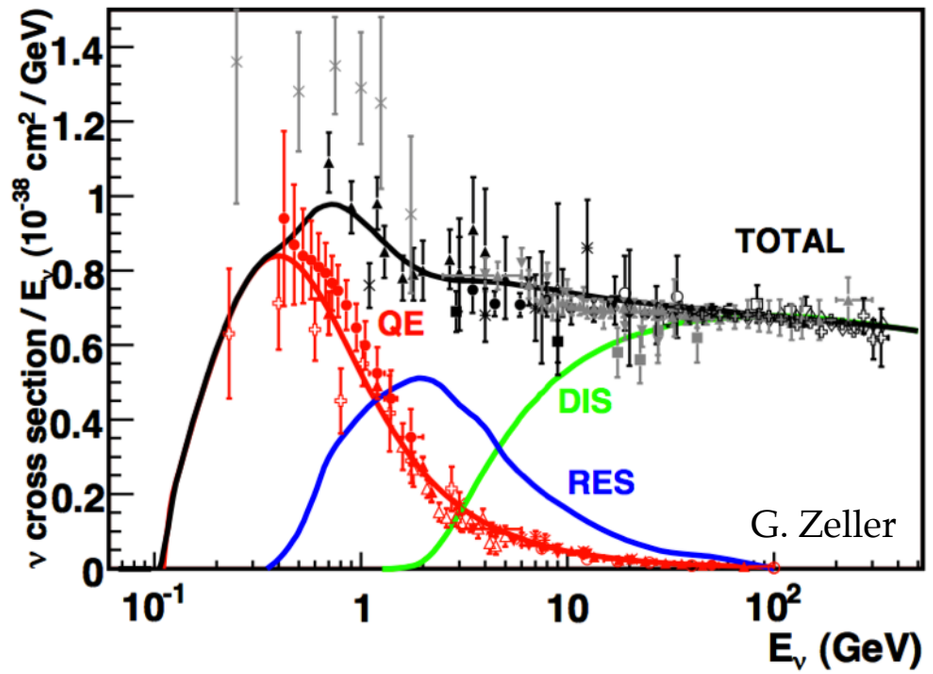
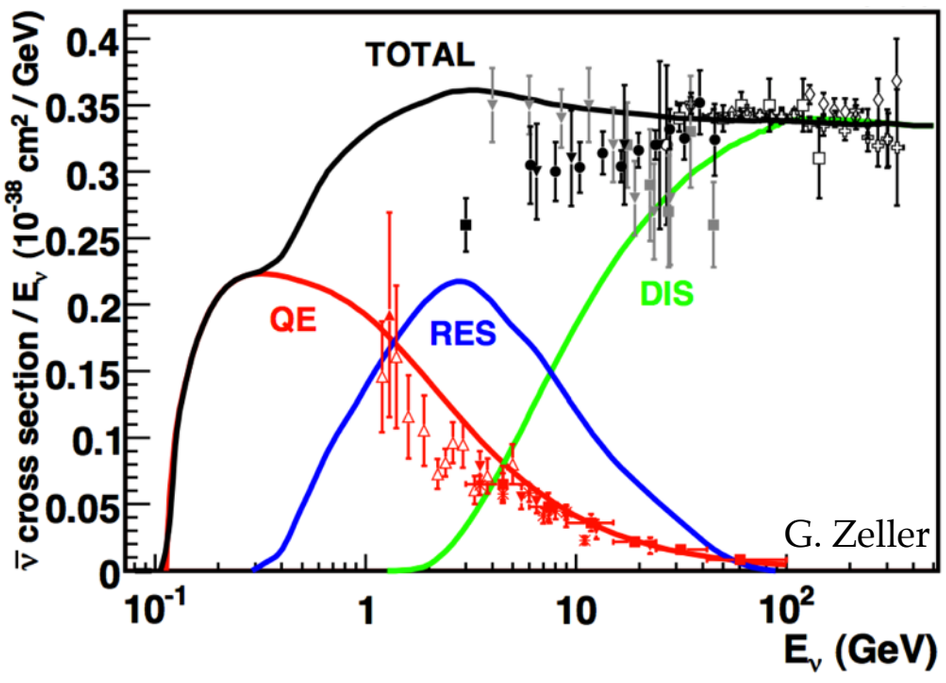
- Perhaps a role for NuSTEC is to compile the various cross-section results/plots each year? Also make the data available in some format for experiments/theorists to utilize? (Such an idea came from NuINT04, but I'm not sure it's maintained: http://hepdata.cedar.ac.uk/review/neutrino/)





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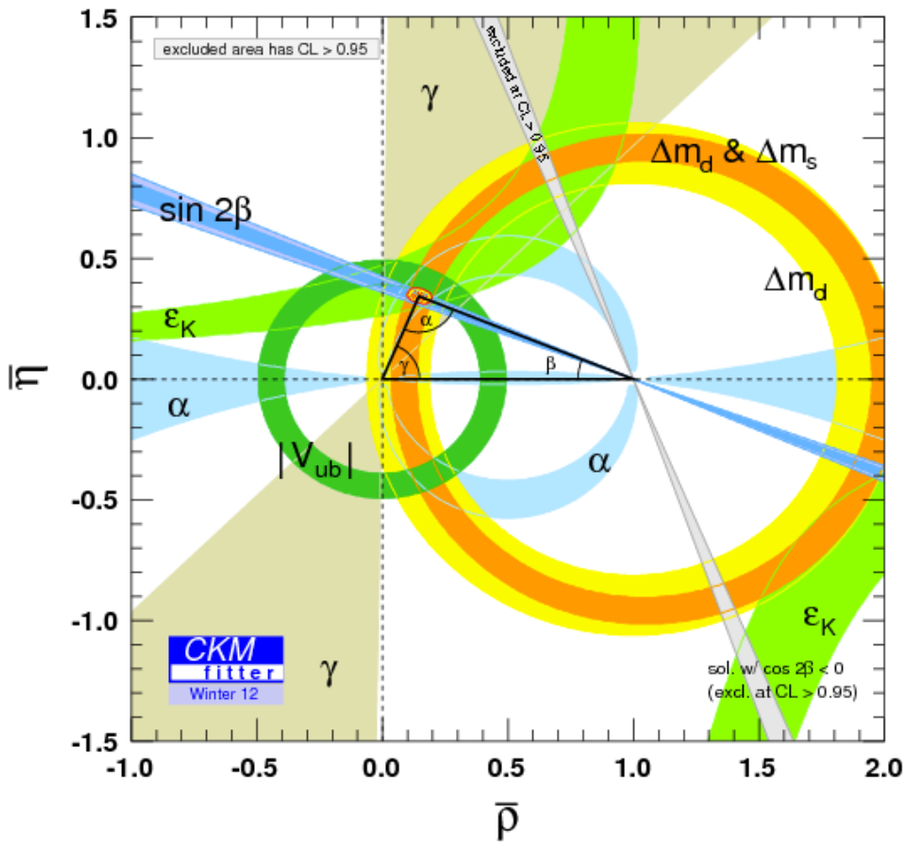

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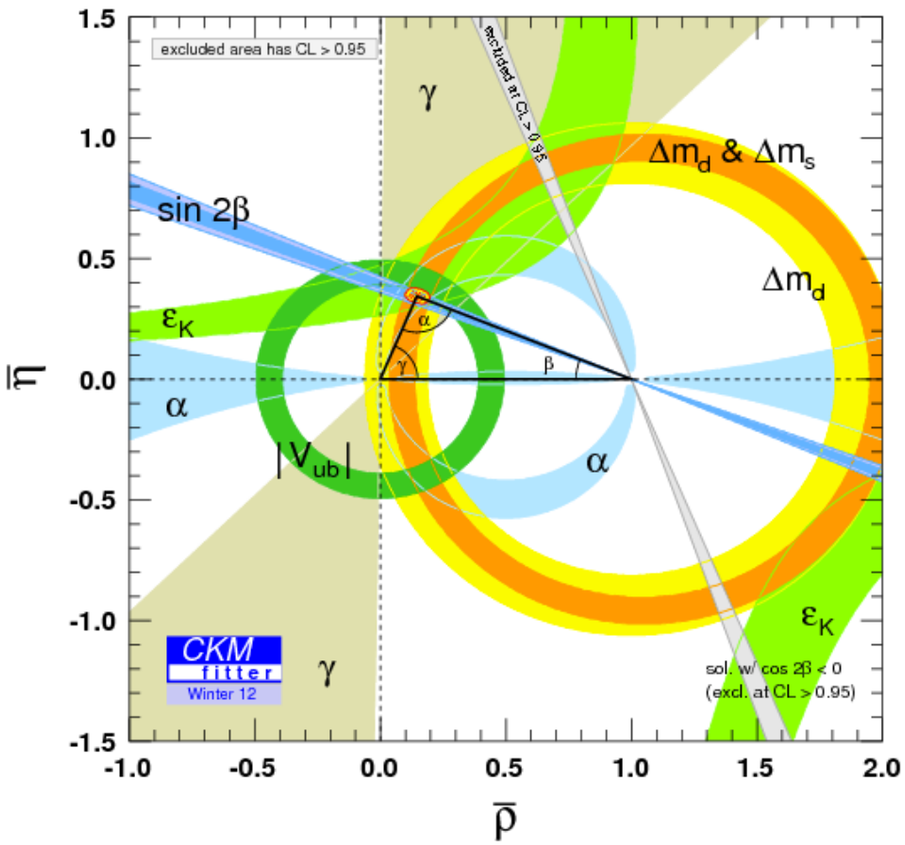

"The LBNE Exploring Fundamental Symmetries of the Universe"

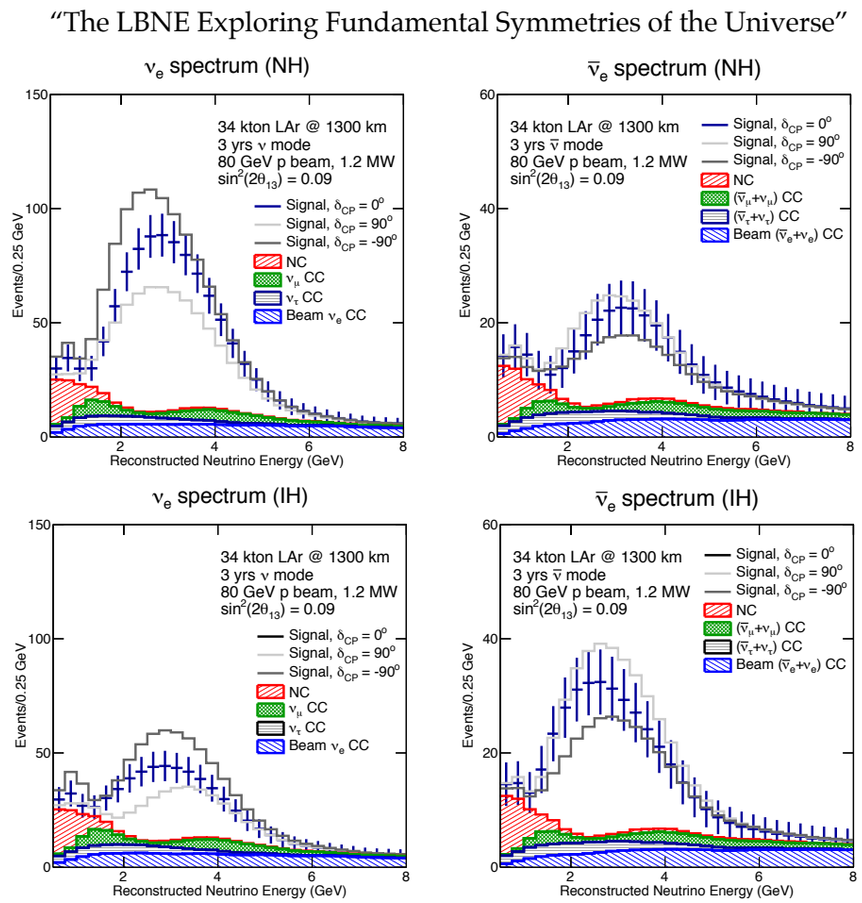

Figure 4.3: The expected reconstructed neutrino energy spectrum of ν_e or $\overline{\nu}_e$ oscillation events in a 34-kt LArTPC for three years of neutrino (left) and antineutrino (right) running with a 1.2-MW, 80-GeV beam assuming $\sin^2(2\theta_{13}) = 0.09$. The plots on the top are for normal hierarchy and the plots on the bottom are for inverted hierarchy.

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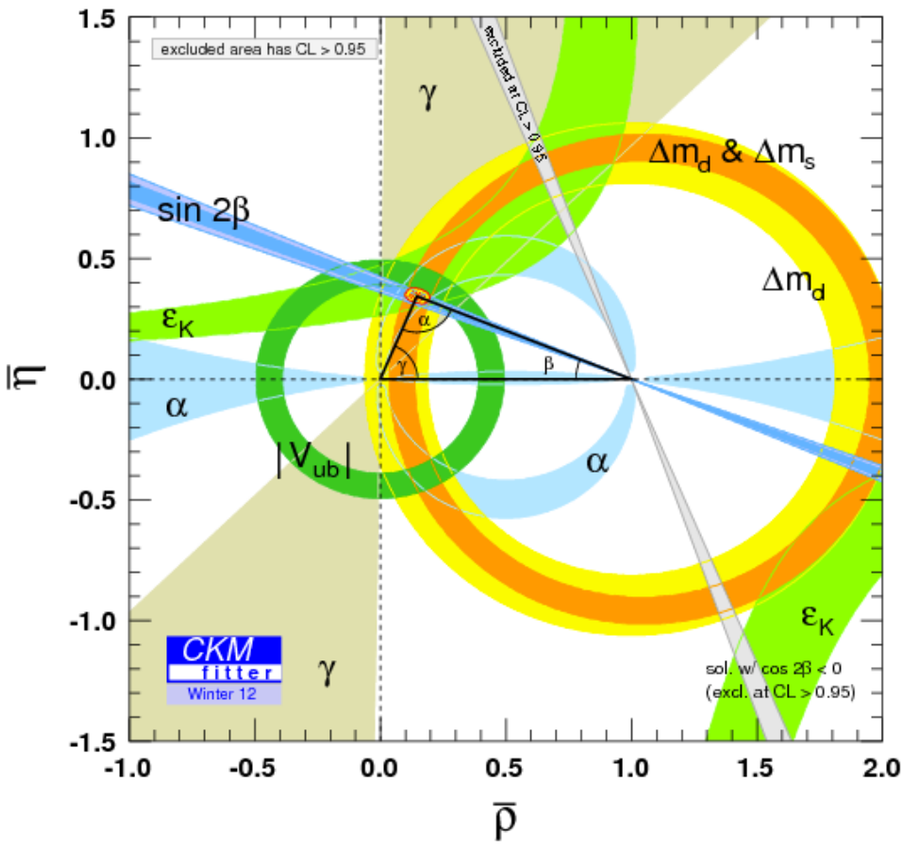
- A large part of what we mean is having the capability to do discovery level mass-hierarchy/CP-violation physics at a desired sensitivity.
- Our collider friends set specific target goals for things like top-quark mass precision. Situation is certainly not directly comparable, but would we do better to get specific about what precision we seek for various cross-section measurements?



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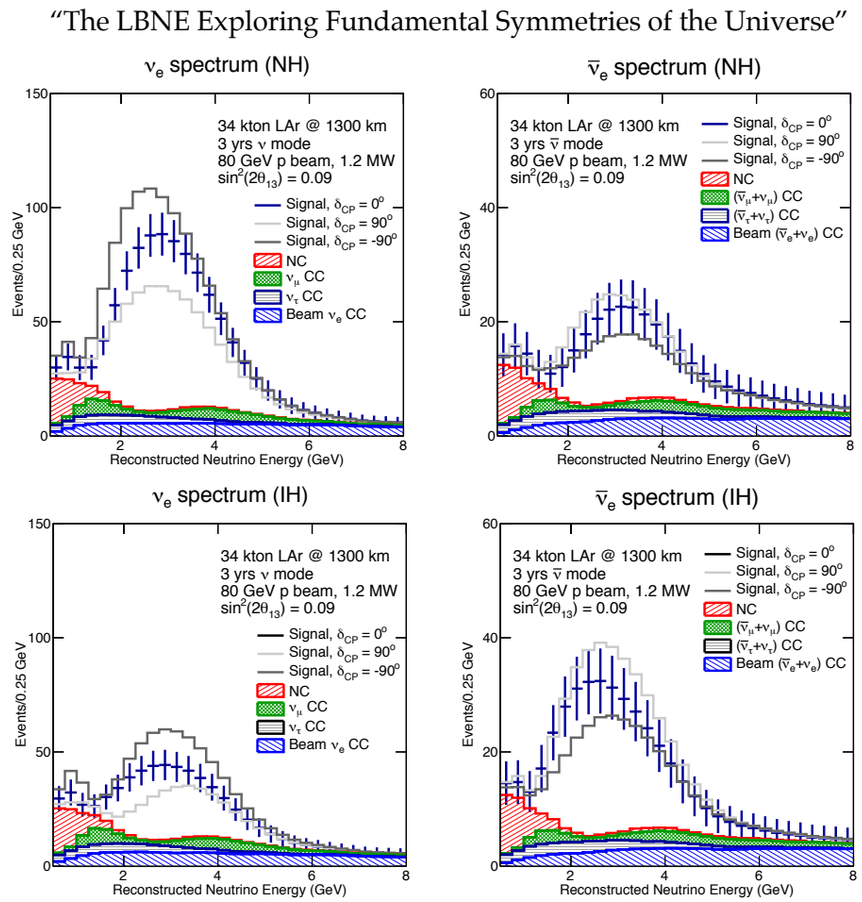

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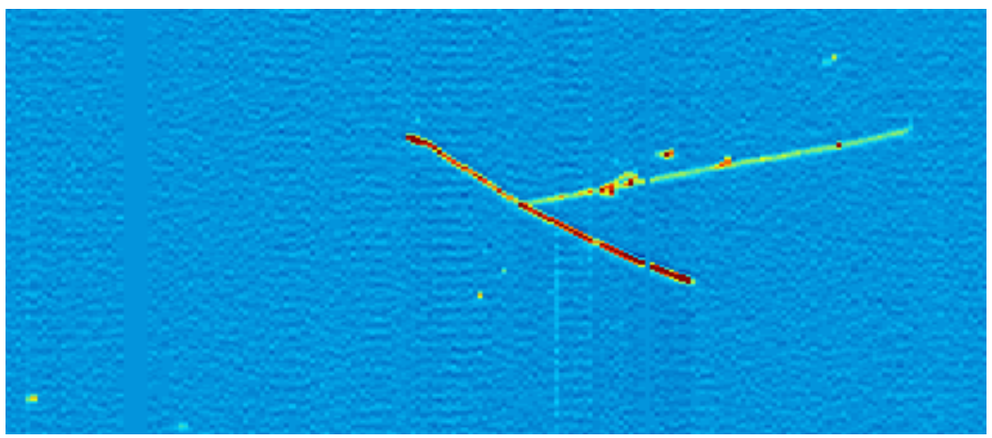
  - creating new analysis techniques.
- In the near-term, can we do "precision" things like measure the kinematics of final-state nucleons in 2p-2h like events and really test the theory?
  - ArgoNeuT has attempted this, and while the statistics are too low to make any definitive claims, the results and approach seem promising.
  - MicroBooNE will have statistics, and even better resolution, in the not-so-far future. Maybe early looks by NuINT15?



Conclusions

- DATA is the great motivator for experimentalists, and with numerous experiments running (or about to start running), we should have no shortage of motivation for years to come.

- Two final personal opinions:

  - NuSTEC idea seems like an excellent way to coordinate our efforts and train younger people just entering the field. As a former CTEQ student, I can vouch for the utility of such training (though please don't ask me to do pQCD right now).

  - I personally think the Cross-Section newsletter that Teppei has created is a fantastic venue for exchange of ideas and keeping up on latests results. I hope everyone is signed up (should come "free" with registration to NuINT).

Thank You!


DAMN THE TORPEDOES, FULL SPEED AHEAD!!
Neutrino
Detector Systematics
MECs
SRCs
Beam Systematics
FSI