SURVEY SUMMARY/DISCUSSION

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What new electron scattering measurements do you think are important for neutrino experiments, and why?

- Exclusive samples with protons in the final state for tuning final state interactions models especially at low energy regions where the data is scarce.
- Semi-inclusive (e,e') measurements and extractions of objects that can be ported over to the neutrino program (e.g. spectral function)
- New measurements of proton magnetic form factor with improved systematics are needed for robust extractions of the axial form factor from the neutrino scattering data. Additional data on deuteron target will also help.
- High-precision unfolded with radiative corrections parity-violating electron-scattering data for weak form factor is necessary for better predictions of the coherent cross sections.
- Exclusive measurements. because we have none.
- Angular correlations of two-hadron final states.
- Inclusive and (e,e'p) measurements on argon. Electron induced pion production on nucleus (with pion detected in coincidence with the electron).
- Exclusive or semi-inclusive hadron states measurements. Nuclear models are developed to describe inclusive cross-section (lepton final states). We have very little ideas how to model hadron final states, and I think electron scattering data will be useful for that.

What new theoretical developments are needed to benefit from the new electron scattering programs?

- Tuning the final state interactions models for neutrino generators.
- Radiative corrections, coulomb corrections, factorization theorems.
- Connection from electron scattering to neutrino scattering at percent level of accuracy for 300 MeV-GeV energy range is absent.
- More highly precise quantum Monte Carlo inputs for generators, especially utilizing tools amenable to higher A nuclei.
- Shell model calculations.
- Semi-exclusive approaches (some hadrons detected in coincidence with the electron) for the different reaction channels: from QE to the shallow region.
- Transport theory for (e,A) reactions.
- Relationship between vector and axial components of resonances SIS and DIS structure functions and final state interaction of hadrons with the nucleus.
- Oscillation analyses use event generators. To be useful we need these generators to have e scattering modes that share as many modules as possible with the ν mode. Anything on final state interactions, etc. that is tuned by electrons should impact neutrinos otherwise its an academic exercise that will have limited impact.
- Prediction of kinematics and multiplicity of hadron final states from nuclear target.

Are there any older data or theoretical approaches which are worth revisiting?

- e-Ar at JLab
- Mainz data for Gm should be remeasured.
- CLAS inclusive data of 20 years.
- Pion electro-production and associated strangeness electro-production
- Longitudinal and transverse inclusive responses data.
- Hadronization experiments JLAB@5GeV (Will Brooks et al), HERMES hadronization
- There exists sufficient data and with the new Jlab data (JUPITER) coming out this month to peg down the vector inclusive cross sections. The comparison between longitudinal and transverse structure functions in the nucleus will come out in December from the JUPITER program. There is now a fit to all of the world's QE, resonance and inelastic cross sections on nucleons and nuclei.
- We're analyzing some CLAS6 data. There are additional data sets existing but I'm not sure re-analyzing them is simpler then doing new measurements.
- Nuclear PDFs at large x - need to look at target mass in nuclei, x>1, etc.

We recognize there has been a significant barriers to programs which cross HEP/NP funding divides and wish to comment on it in our Snowmass report. If applicable, have you encountered these issues and do you wish to share any solutions and/or raise concerns for our report?

- YES. Did not solve it yet. I'm funded by Medium Energy NP at DOE. They literally "don't want to see the word 'neutrino' in the proposal". NSF won't help because we're a DOE group with good funding so the hope is that DOE-HEP will step up. This is a major issue that will eventually kill our effort if they won't agree to fund us in the coming cycle.
- I share the concern!
- An additional issue is that programs with international collaboration face funding problems, Fermilab must find ways to directly support international theory work.

If applicable, what experiment are you affiliated with?

- DUNE
- e4nu
- GENIE
- Jlab hall C experiments JUPITER collaborationm,
- MicroBooNE
- Jefferson Lab, CTEQ