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Cross sections, experimental

Mailing list: CENF-ND-Wg3 

members

Conveners

- Sara Bolognesi (CEA, Paris)
- Jonathan Asaadi (UTA)

This working group will focus on the detector effects and designs that are necessary to identify specific neutrino interactions and to measure their cross sections and thus constrain theoretical uncertainties. It will provide input to and work in collaboration with WG1 and WG4

Topics

- Target nucleus:
 - ◆ Dependence of fundamental interactions but also FSI on A (nuclear size) not well known. Two main case studies:
 - ◇ Argon: very heavy nucleus. Huge uncertainties in extrapolation from C to Ar? Need Ar ND. Problems of vertex migrations during event reconstruction in ND with multiple materials: outline an analysis strategy to address this
 - ◇ Carbon to Oxygen extrapolation: smaller uncertainties. Most up to date model is SuSav2. Precise quantification of C->O uncertainties for high statistics measurements still pending. Prospect for Oxygen cross-section measurements with ND280 update + WAGASHI?
- 'Calorimetric' energy and vertex activity measurements
 - ◆ Useful measurements to constrain not well known nuclear effects. Very poor prediction power from available model (see for instance: arXiv:1511.05944)
 - ◆ Model systematics on true energy estimation from calorimetric energy reconstruction still to be determined: especially not visible energy like binding energy, FSI energy deposits, nuclear recoil, neutrons
 - ◆ Useful measurements: energy and/or vertex activity as a function of pion and proton multiplicities. Any difference between nue and numu? (Emission of many low energy gammas?)
- Detector acceptance:
 - ◆ the angular acceptance of the detector maps into the Q2 dependence of the cross-section. Extrapolation outside acceptance (to unmeasured Q2 region) is model dependent therefore 4pi acceptance is highly desirable. [Notice: the theta->Q2 mapping is highly dependent on the energy, eg Minerva is much more forward than T2K]
 - ◆ to be evaluated similar effects due to different containment in LAr between near and far detector (probably small?)
- Critical review and analysis of all available measurements: MiniBooNE, Minerva, ND280, ... Discussed in Pittsburgh and Toronto workshops, identified issues:
 - ◆ quality of the unfolding and signal definition important to avoid biased results (avoid model dependent corrections to the data: D'Agostini unfolding, E_recoil cuts, extrapolation beyond acceptance)
 - ◆ compatibility of signal definition between different experiments is not straightforward: CC0pi vs CCQE, pi+ vs pi+/-, pion multiplicity and W cuts ...
 - ◆ NUISANCE is a great tool for this [<https://nuisance.hepforge.org/>]
- numu vs numubar and nue
 - ◆ the uncertainty in the extrapolation to different 'charge' and flavour are fully driven by uncertainties on nuclear effects (see for instance arXiv:1602.00230, arXiv:1707.01014, arXiv:1701.03628). Precise understanding of numu interactions will address the problem indirectly
 - ◆ important exception: large uncertainties on radiative corrections in nue interactions (see arXiv:1206.6745 which uses computation from Nuclear Physics B154 (1979) 394-426 to estimate 10% effect but with 100% uncertainty)
 - ◆ prospects for precision on nue cross-section? We will ever have the statistics necessary for the needed precision to constraints the numu/nue uncertainties?
 - ◆ given the 'large' 'wrong-sign' background in beams, is still important to have lepton charge identification to separate the numu and numubar interactions in cross-section measurements (eg magnetic field): nu-nubar xsec asymmetries are useful input to test/tune the models
- What is the present understanding of the Deep inelastic Region? 50% of xsec at DUNE and very poorly understood!
- Dedicated test beam measurements :
 - ◆ Proton scattering to tune FSI: eg, as a function of A

- ◆ Pion scattering to tune FSI: eg, as a function of A (look into LArAT results as well, what about a WAGASHI-like detector on pion beam?)
- How to use electron scattering measurement?
 - ◆ Need neutrino interactions models which can be extrapolated to electron scattering: eg, SuSaV2 (arXiv:1603.08396)
 - ◆ Recent comparison clearly show drawback of simplistic models used in MC (arXiv:1706.06739)
 - ◆ Pletora of measurements of Short Range Correlation but not clear how to exploit them for neutrino scattering which need instead an inclusive measurement for all ω and q^3
 - ◆ New way of looking at this: request for new (open trigger) CLAS data to compare the incoming electron beam energy with the energy measured only from the outgoing electron momentum [T2(H)K-like] and with the calorimetric energy measurement [NOVA-like, DUNE?]
[<https://meetings.triumf.ca/indico/event/6/session/19/contribution/122/material/slides/0.pdf>]

Some Documentation

- List of recent conferences and workshops on the subject
 - ◆ Workshop on Global Fits to Neutrino Scattering Data and Generator Tuning (NuTune2016) [↗](#)
 - ◆ INT Workshop: Theoretical Developments in Neutrino-Nucleus Scattering [↗](#)
 - ◆ IPPP/NuSTEC topical meeting on neutrino-nucleus scattering [↗](#)
 - ◆ EP-Nu discussion about nu-nucleus scattering [↗](#)
 - ◆ State of Nu-tion workshop (2017 NuINT premeeting) [↗](#)
 - ◆ NuInt 2017 [↗](#)

Meetings

- [15 September 2017 Agenda](#) [Minutes](#)
- [23 October 2017 Agenda](#) [Minutes](#)

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