Neutrino interaction systematics for future experiments: The theory perspective

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Delivered by Jan Sobczyk
How long does it take to create a model?

• It is not trivial to create a new model and perform all necessary calculations.
  – 2p-2h excitations.
    • First publications by Delorme, Eriscon and Marteau at the end of 1990s.
    • The model develop to what now is known as the Martini’s model.
    • Over 10 years !!!
  – Spectral Function
    • Know for a few decades.
    • Sophisticated calculation my Benhar.
    • Simplified description by Ankowski helped with first implementations in the MC generators.

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• It is not trivial to create a new model and perform all necessary calculations.
  – Many other examples
    • RPA
    • Resonance productions models
    • Coherent production models
  – What all of them have in common?
    • Theoretical models existed before measurements reached precision level to test them.
    • Seems that none of the models has been refuted.
Uncertainties due to limits of the models

- Many theoretical models have intrinsic validity limits
  - Neutrino energy
  - $Q^2, W, \ldots$
  - Type of interaction (QE, RES, COH)
  - Target (nuclear effect, Spectral Functions)
- Which models can go beyond current limits?
- Does it make sense to try to expand them?
How to deal with wide-band neutrino beams

• Future long base-line experiment will use the near detector to predict rate at the far detectors
  – It is known that not all uncertainties cancel out in this procedure.
  – How to deal with the transition regions for wide-band beam (LBNE)
    • RES⇒DIS
    • How the nuclear effect depend on energy
Final state interactions and multiplicities

• New experiments will be able to measure most of the final baryons
  – What is a state of FSI calculations? What are the observables for FIS.
  – Hadronization models with heavy nuclei.