Neutrino interaction systematics for future experiments: The theory perspective

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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 bye 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.

How long does it take to create a model?

- 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, …
  - 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.