



Contribution ID: 81

Type: **Oral contribution**

Improved RDWIA CCQE Interaction Modelling with the ED-RMF Nuclear Potential in NEUT

Neutrino oscillation experiments, such as the Tokai-to-Kamioka (T2K) and Hyper-Kamiokande (HK) experiments, are increasingly limited by uncertainties in neutrino-nucleus interaction modelling. For HK, this issue will become increasingly prominent as the greatly increased statistics will result in systematic uncertainties being a dominant limitation on the experiment's physics scope, with neutrino interaction uncertainties among the largest contributions.

In recent years, significant progress has been made in neutrino interaction event generators through the implementation of more sophisticated neutrino-nucleus interaction models. Notably, a fully exclusive relativistic distorted wave impulse approximation (RDWIA) model using the energy-dependent relativistic mean field (ED-RMF) nuclear potential has been implemented in the NEUT event generator [J. McKean et al., Phys. Rev. D 112, 032009, R. González-Jiménez et al., Phys. Rev. C 101, 015503]. The model provides a fully exclusive and unfactorised calculation of the differential cross section, allowing more accurate modelling of lepton-nucleon correlations and elastic final-state interactions that were not previously described by the NEUT intranuclear cascade model.

At the same time, recent developments in lattice quantum chromodynamics (LQCD) have motivated renewed scrutiny of the axial form factor used in neutrino-nucleus interactions. While most generators employ a dipole parameterisation governed by a single axial mass parameter, LQCD calculations provide alternative parameterisations based on the z -expansion formalism. Incorporating this additional flexibility is therefore important for assessing the model dependence of neutrino-nucleus cross-section predictions.

In this talk, I will present recent improvements to the RDWIA model within the NEUT event generator that address these concerns. These include the addition of two-body current contributions to one-particle one-hole final states as well as the ability to vary the axial form factor, which was not available in the previous implementation of the model. I will discuss the impact of these changes on comparisons to inclusive and semi-inclusive cross-section data, showing how the combined effects of axial form factor variations and two-body current contributions can introduce tension with existing measurements depending on the kinematic region. In addition, I will present a detailed study of NEUT nuclear models using the JSNS² kaon decay-at-rest measurement of the missing-energy differential cross section at a single neutrino energy. Together, these studies highlight the need for continued improvements to the nuclear models used alongside interaction models in current and future oscillation analyses.

Primary author: MCKEAN, Jake (Kyoto University)

Co-authors: Dr MUNTEANU, Laura (CERN); ABE, Seisho (University of Tokyo); Dr FRANCO-MUÑOZ, Tania (Ghent University)

Presenter: MCKEAN, Jake (Kyoto University)

Track Classification: WG2: Neutrino Scattering Physics