

## Abstract

Neutrino-nucleon interactions that produce a single pion in the final-state are of critical importance to accelerator based neutrino experiments. These Single Pion Production (SPP) channels make up the largest fraction of the inclusive neutrino-nucleus cross section in the 1 – 3 GeV range, a region covered by most accelerator based neutrino beams.

Models of SPP cross section processes are required to accurately predict the number and topology of observed charged-current (CC) neutrino interactions, and to estimate the dominant source of neutral-current (NC) backgrounds, where a charged (neutral) pion is confused for a final-state muon (electron). These experiments make use of nuclear targets, however, the foundation of neutrino-nucleus interaction models are neutrino-nucleon reaction processes like the one described in this paper.

This work represents an extension of the single pion production model proposed by D.Rein [9]. The model consists of resonant pion production and nonresonant background contributions coming from three Born diagrams in the helicity basis. The new work includes lepton mass effects, and nonresonance interaction is described by five diagrams as it is proposed in [10]. The main challenge of the recent work is to calculate them in helicity basis in order to study the interference effect of resonance and non-resonance interactions. The interference contribution has a visible effects on cross-section especially on pion angular distributions.

The resonant interaction is Rein-Sehgal model [7] with one exception on the sign of resonances. We choose different signs for few resonances, to get the best description of data.

The full model has very good agreement with all available data and it is implemented in NEUT to be used for the future T2K analysis.