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Single Pion Production in Neutrino-Nucleon Reactions

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This work represents an extension of the single pion production model proposed by D. Rein. The model consists of resonant pion production (Rein-Sehgal model and based on helicity amplitudes) and non-resonant background contributions coming from three born diagrams in the helicity basis.

The new work includes **lepton mass effects**, and non-resonance interaction is described by **five diagrams** as it is proposed in HNV paper. The main challenge of this work has been to calculate them in the helicity basis in order to evaluate the **interference effect** of resonant and non-resonant interactions.

The present model can describe single pion production in neutrino and anti-neutrino induced charged current interactions, i.e.
\begin{equation}
\nu_{\mu} + p \longrightarrow \mu^{-} p \pi^{+}~~~, ~~~~~~~~ \bar\nu_{\mu} + p \longrightarrow \mu^{+} p \pi^{-}
\end{equation}
\begin{equation}
\nu_{\mu} + n \longrightarrow \mu^{-} n \pi^{+}~~~, ~~~~~~~~\bar\nu_{\mu} + n \longrightarrow \mu^{+} n \pi^{-}
\end{equation}
\begin{equation}
\nu_{\mu} + n \longrightarrow \mu^{-} p \pi^{0}~~~, ~~~~~~~~\bar\nu_{\mu} + p \longrightarrow \mu^{+} n \pi^{0}
\end{equation}
The model prediction is in good agreement with all existing bubble chamber neutrino and anti-neutrino data with **W<2 GeV** cut. The comparisons are performed for angular and W distributions, Q^2-differential cross-section and integrated cross-section for different channels.

A model that has better agreements with data can reduce the uncertainties in neutrino oscillation measurements which is the main goal of neutrino experiments.

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