Weak interaction induced $\eta$-production off the nucleon

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Introduction

In this work we have studied the differential and total scattering cross section for the (anti-$\nu$) induced production off the nucleon at low and intermediate energies for the ongoing and future neutrino oscillation experiments. The non-resonant terms are calculated using a microscopic model based on the SU(3) chiral Lagrangians. We consider $S_{11}(1535)$ and $S_{11}(1650)$ resonances. The vector part of the N-S1 transition form factor has been obtained from the helicity amplitudes using MAID data. Dipole form is taken for the axial form factor and the FCAC relation is used for the pseudoscalar form factor.

Formalism

Charged current (anti-$\nu$) induced $\eta$-production

The expression for the differential cross section in the laboratory frame for the above process is given by,

$$d\sigma \over dq^2 = \frac{1}{2\pi} I^2 \sum \epsilon_{\eta}^2 \sum |M|^2$$

where the transition amplitude is written as

$$M = -i \epsilon_{\eta} \lambda^\mu_\nu \epsilon_{\nu} \langle \eta | j_{\mu} | p \rangle$$

and we have obtained the hadronic current for $s$-channel and $u$-channel resonant $S_{11}(1535)$ and $S_{11}(1650)$ terms.

The total width is taken as,

$$\Gamma_{\eta} = 0.621 GeV \gamma_1 + 0.461 GeV \gamma_2 - 0.121 GeV \gamma_3 + 0.106 GeV$$

We have taken the following form of $S$-wave decay width

$$\Gamma_{\eta}(0) = \frac{1}{2} (M_{\eta}^2 + M_{\pi}^2)$$

References