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Weak Interaction Induced Eta Production from Nucleon and Nuclear Targets

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We study neutrino and antineutrino induced eta production from the free nucleon and nuclear targets. The hadronic current receives contribution from the background terms as well as from the nucleon and delta resonance excitations. We have considered only those nucleon/delta resonances which are present in the PDG having spin ≤ 3/2 and mass in the range < 2 GeV with significant branching ratio in any particular meson decay mode. In the neutrino induced processes, the weak hadronic current contains the vector as well as the axial vector current. The vector current of the weak interaction is related to the electromagnetic current through the conserved vector current (CVC) hypothesis and for the axial vector current, PCAC and the Goldberger-Treiman relation are used. The Q^2 dependent form factors from the electroproduction are used to determine the weak vector form factors in the vector current and for the axial vector current, generally a dipole form factor is assumed. The couplings at the strong $g_{NN\eta}$ and $g_{RN\eta}$ vertices determined in the case of meson photoproduction, would be used for the strong couplings of the neutrino induced meson production. Thus, in the neutrino induced meson production, the couplings and the form factors from the photoproduction and electroproduction, respectively, will be used as inputs.

Moreover, when the production of eta mesons takes place from the nuclear targets, the nuclear medium effects comes into picture. In our numerical calculations, we have taken into account the effect the Fermi motion and Pauli blocking as well as the effect of width broadening of the $S_{11}(1535)$ resonance. The produced eta meson while travelling through the nuclear medium may interact with the residual nucleus and gets absorbed inside the nuclear medium, therefore, we have also taken into account the final state interaction effects on the produced eta mesons. We shall present the results for the total and differential scattering cross sections for the production of eta mesons from the free nucleons as well as from the nucleon bounds inside the nuclear medium relevant for MicroBooNE and DUNE experiments. This talk will be based on our recent publications Phys. Rev. D 108, 053009 (2023) and Phys. Rev. D 107, 033002 (2023).

Working Group

WG 2: Neutrino Scattering Physics

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