

Methods to determine neutrino flux at low energies-Investigation of the low ν method

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We investigate the “low- ν ” method (developed by the CCFR/NUTEV collaborations) to determine the neutrino flux in a wide band neutrino beam at very low energies, a region of interest to neutrino oscillations experiments. Events with low hadronic final state energy $\nu < \nu_{\text{cut}}$ (of 1, 2 and 5 GeV) were used by the MINOS collaboration to determine the neutrino flux in their measurements of neutrino (ν_{μ}) and antineutrino ($\bar{\nu}_{\mu}$) total cross sections. The lowest ν_{μ} energy for which the method was used in MINOS is 3.5 GeV, and the lowest energy is 6 GeV. At these energies, the cross sections are dominated by inelastic processes. We investigate the application of the method to determine the neutrino flux for ν_{μ} , $\bar{\nu}_{\mu}$ energies as low as 0.7 GeV where the cross sections are dominated by quasi-elastic scattering and $\Delta(1232)$ resonance production. We find that the method can be extended to low energies by using ν -cut values of 0.25 and 0.50 GeV, which are feasible in fully active neutrino detectors such as MINERvA.

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