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Title:
Neutrino nucleus Quasi-Elastic and resonant Neutral Current scatterings with Non-Standard Interactions.

Abstract:
As is well known, the cross sections of the resonance and Quasi-Elastic (QE) scattering off nucleons depend on quantities known as form factors that describe the nucleon structure. There are alternative approaches to determine the values of these non-perturbative quantities, some of them relying on the Neutral Current (NC) scattering of neutrinos off nucleons. In the presence of NC Non-Standard Interactions (NSI), such derivations must be revisited. In this paper, we discuss how information on NSI can be extracted by combining alternative approaches for deriving the form factors. We discuss how the KamLAND atmospheric neutrino data with $E_\nu < GeV$ (used to determine the axial strange form factor g_s^A) can already constrain the axial NSI of ν_τ with nucleons. We also argue that if the precision measurement of ν_μ NC QE scattering establishes an unexpectedly large vector strange form factor (e.g., $F_1^s(Q^2) \sim 0.01$), it will be an indication for nonzero NSI coupling with u and d quarks ($\epsilon_{\mu\mu}^{Au/d} \sim 0.01$). We study the QE and resonance scattering cross sections of ν_τ and ν_e off Argon and show that if their axial NSI is of the order of (but of course below) the present bounds, the deviation of QE cross sections from the SM prediction will be sizable and distinct from the uncertainties induced by the form factors.