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Global Extraction of the C-12, Ca-40, and Fe-56 Nuclear Electromagnetic Response Functions and Comparisons to Nuclear Theory and Neutrino/Electron Monte Carlo Generators

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We report on global extractions of the ^{12}C, ^{40}Ca and ^{56}Fe longitudinal ($calR_L$) and transverse ($calR_T$) nuclear electromagnetic response functions from an analysis of all available electron scattering and photoprodution data on these nuclei. The response functions are extracted for energy transfer ν, spanning the nuclear excitation, quasielastic (QE) scattering with one nucleon (1p1h) and two nucleon (2p2h) final states, and the resonance and inelastic continuum. We extract $calR_L$ and $calR_T$ as functions of ν for both fixed values of Q^2 and also for fixed values of 3-momentum transfer **q**. Given the nuclear physics common to both electron and neutrino scattering from nuclei, extracted response functions from electron scattering spanning a large range of Q^2 and ν also provide a powerful tool for validation and tuning of neutrino Monte Carlo (MC) generators. In this paper we present comparisons of our previous measurements of ^{12}C and new measurements of ^{40}Ca and ^{56}Fe nuclear response functions to the predictions of the "Energy Dependent-Relativistic Mean Field" (ED-RMF) calculation, and the predictions of an improved superscaling model (SuSAv2) over the entire kinematic range.

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