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Short-Range Correlations and Meson-Exchage Currents in neutrino and electron scattering

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We compute the contribution of meson-exchange currents (MEC) to the one-particle emission transverse response of nuclear matter, including short-range correlations (SRC) within the independent pair approximation. Our results show a significant enhancement of the transverse response in electron scattering, in contrast to independent-particle models that neglect SRC [1]. SRC are incorporated by solving the Bethe-Goldstone (BG) equation in the nuclear medium [2] using the Granada-2013 NN potential. This realistic interaction, fitted to the world database of NN scattering [3], allows the BG equation to be reduced to a system of linear equations, which can be solved exactly. The nucleon-pair wave function acquires high-momentum components, as Pauli blocking prevents low-momentum scattering in the nuclear medium. In one-particle emission reactions, the MEC 1p1h matrix element interferes with the one-body current contribution, modifying the response function. When the MEC operator acts on the high-momentum components of the correlated wave function, it generates an additional contribution that enhances the response beyond the uncorrelated Fermi gas. This enhancement is consistent with Fabrocini's results [4], within correlated basis function perturbation theory and provides a step toward explaining experimental data on the transverse response.
We extend the formalism to the weak sector relevant for quasielastic neutrino scattering, which is of particular interest in neutrino oscillation experiments. The MEC–one-body interference response in nuclear matter includes a contribution from the pure Fermi gas and another from the coupling to high-momentum components generated by short-range correlations between nucleon pairs. These results are presented here for the first time in the case of neutrino-induced reactions where the differents contributions to the response functions are analyzed in detailed for different kinematics.

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