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Radiative corrections and effects of new physics in deep inelastic neutrino scattering

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Rapid technological advances pave the way for high-precision experiments, particularly in neutrino physics. Such enhanced precision offers new opportunities to search for new physics — physics beyond the Standard Model (BSM). In this context, neutrino scattering on matter is of particular interest, as it incorporates information regarding both the neutrino itself and the target matter.

From this perspective, deep inelastic neutrino scattering possesses a number of key advantages. The interest in neutrino scattering specifically stems from recent scientific discoveries indicating that neutrinos should have electromagnetic properties, which, in turn, explicitly point to BSM physics. However, at this level of precision, electroweak radiative corrections must also be taken into account. The present study is devoted to the theoretical analysis of high-energy neutrino-matter scattering processes, taking into account the electromagnetic and weak properties of neutrinos alongside one-loop contributions, as well as to evaluating their impact on the interpretation of experimental data.

Within the framework of quantum field theory, one-loop electroweak radiative corrections to the neutrino-matter scattering cross-section formula were calculated, incorporating the electromagnetic properties of neutrinos via the theoretical formalism of the form-factor decomposition of the vertex function. In addition, the parameterization of neutrino form factors modifying neutral currents was performed. Finally, it is demonstrated how these effects alter the differential scattering cross sections with respect to momentum transfer.

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