

# QED radiative corrections and nuclear medium effects at GeV energies

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We consider charged-current neutrino scattering on individual nucleons. Exploiting effective field theory, we factorize neutrino-nucleon cross sections into soft, collinear, and hard contributions. We evaluate soft and collinear functions from QED, provide a model for the hard contribution with expected infrared and collinear behavior and specify corresponding uncertainties. We present results of the calculation and validate precise relation between electron and muon neutrino cross sections at GeV energy range. Moreover, we consider how the exchange of photons with nuclear medium modifies (anti)neutrino- and electron-nucleus scattering cross sections. We provide analytical expressions for the distortion of (anti)neutrino-nucleus and charged lepton-nucleus cross sections and estimate the QED-medium effects at GeV energies. We find new permille-level distortion in (anti)neutrino-nucleus scattering and permille- to percent-level corrections in electron-nucleus scattering. We discuss how the bremsstrahlung modifies these conclusions.

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