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QED radiative corrections for accelerator neutrinos

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Abstract

As neutrino physics has entered the precision era, improvements in scattering cross sections and flux predictions are of increasing importance. In particular, charged-current quasielastic neutrino scattering is the signal process in oscillation experiments and requires precise theoretical prediction for the analysis of modern and future experimental data. We formulate radiative corrections in a soft-collinear effective field theory framework and validate the precise relation between electron and muon neutrino cross sections for the experimental setup of modern and future accelerator-based neutrino oscillation experiments. The exchange of photons with nuclear medium modifies (anti)neutrino and electron scattering cross sections. Evaluating these QED-medium effects, we find new permille-to-percent level effects, which were never accounted for in either (anti)neutrino-nucleus or electron-nucleus scattering.