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TALK: Charged-current (anti)neutrino-nucle on Scattering and QED Nuclear Medium

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Charged-current quasielastic neutrino scattering is the signal process in neutrino oscillation experiments and requires precise theoretical prediction for the analysis of modern and future experimental data, starting with the nucleon axial-vector form factor. In this talk, I compare a new MINERvA measurement of this form factor with lattice-QCD calculations and deuterium bubble- chamber data, provide uncertainty projections for future extractions, present recent calculations of radiative corrections to charged-current processes, and investigate the potential of neutrino scattering data on constraining nucleon- and quark-level interactions beyond the Standard Model. The exchange of photons with nuclear medium modifies (anti)neutrino and electron scattering cross sections. We study the distortion of (anti)neutrino-nucleus and charged lepton-nucleus cross sections, medium-induced bremsstrahlung, and estimate the QED-medium effects on the final- state kinematics and scattering cross sections. We find new permille-to-percent level effects, which were never accounted for in either (anti)neutrino-nucleus or electron-nucleus scattering. We quantitatively compute the effects of Glauber photon-mediated multiple re-scattering within the nuclear medium and find that the relativistic charged lepton acquires a momentum of order 10 MeV transverse to its direction of propagation inside the nucleus. This broadening sizably deflects expected electron and muon tracks and suppresses scattering cross sections. Precise extraction of the nucleon and nuclear structure by electron and muon probes should, thus, take the QED nuclear medium angular redistribution of particles into account.

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