

# A Comprehensive Effective Field Theory Framework for Coherent Elastic Neutrino-Nucleus Scattering

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Coherent elastic neutrino-nucleus scattering (CEvNS) is critical for testing the Standard Model electroweak sector, exploring neutrino properties, and searching for new physics (NP), with recent experiments (e.g., COHERENT, CONUS+, PandaX-4T, XENONnT) highlighting the need for a systematic theoretical framework. We have constructed a comprehensive end-to-end effective field theory (EFT) framework for CEvNS, covering the full energy scale hierarchy from the ultraviolet (UV) to the nuclear sector. It includes low-energy EFT (LEFT) operators up to dimension 8 (with QCD renormalization group running), spurion-method matching to the chiral Lagrangian, full power counting analysis for nuclear response functions (accounting for nucleon number enhancement), and matching of relevant LEFT operators to Standard Model EFT operators (with tree-level UV completions). Using CEvNS experimental data, this framework enables combined analysis to constrain EFT operator scales and neutrino non-standard interaction parameters.

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