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(G*) Applications of ab initio nuclear theory to tests of fundamental symmetries

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Recent global analysis of Fermi decays, and the corresponding V_{ud} determination, reveal a statistical discrepancy with the well-established SM expectation for Cabibbo-Kobayashi-Maskawa (CKM) matrix unitarity. Theoretical confirmation of the discrepancy would point to a deficiency within the SM weak sector. Necessary for extracting V_{ud} from experiment is calculation of several theoretical corrections to the Fermi transition values. In fact, the development of the novel dispersion relation framework (DRF) for evaluating the nucleon γW-box contribution to the electro-weak radiative corrections (EWRC) is at the centre of the recent tension with unitarity. Thus, what remains is to calculate the two nuclear structure dependent corrections: (i) δ_C, the isospin symmetry breaking correction (ii) δ_{NS}, the EWRC representing evaluation of the γW−box on a nucleus. These corrections are calculable within the ab initio no-core shell model (NCSM), which describes nuclei as systems of nucleons experiencing inter-nucleonic forces derived from the underlying symmetries of Quantum Chromo-Dynamics (QCD). As we have explored calculations of δ_C in the past, it is a natural next step to calculate δ_{NS} in the same approach, providing a consistent evaluation of both nuclear structure dependent corrections to Fermi transitions. Preliminary evaluations of δ_{NS} have already been made using the DRF, however, while one can capture various contributions to δ_{NS} in the DRF, the approach cannot include effects from low-lying nuclear states. These contributions require a true many-body treatment and can be directly computed in the NCSM using the Lanczos continued fractions method. Hence, by studying Fermi transitions in light-nuclei, e.g. the ^{10}C $\rightarrow$ ^{10}B and ^{14}O $\rightarrow$ ^{14}N beta transitions, we may perform a hybrid calculation of δ_{NS} utilizing the ab initio NCSM and the novel DRF. We aim to present a preliminary calculation of δ_{NS} for the ^{10}C $\rightarrow$ ^{10}B transition.

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