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Implications of SMEFT for semileptonic processes

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The $SU(2)_L \times U(1)_Y$ invariance of the Standard Model Effective Field Theory (SMEFT) predicts multiple restrictions in the space of Wilson coefficients of $U(1)_{em}$ invariant effective lagrangians such as the Low-energy Effective Field Theory (LEFT), used for low-energy flavor-physics observables, or the Higgs Effective Field Theory (HEFT) in unitary gauge, appropriate for weak-scale observables. In this work, we derive and enumerate all such predictions for semileptonic operators up to dimension 6. We find that these predictions can be expressed as 2223 linear relations among the HEFT/LEFT Wilson coefficients, that are completely independent of any assumptions about the alignment of the mass and flavor bases. These relations connect semileptonic B meson decays to a wide array of experimental searches, including high-p_T dilepton searches, top decays, Z-pole observables, charged lepton flavor violating observables, non-standard neutrino interaction searches and semileptonic decays of K and D mesons. We illustrate how these relations can be utilized to impose stringent indirect constraints on several Wilson coefficients that are currently weakly constrained or entirely unconstrained by direct experiments. Moreover, these relations imply that any evidence of new physics in a specific search channel must generally be accompanied by correlated anomalies in other channels.

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