$\mathcal{O}(a)$ improved quark mass renormalization for a non-perturbative matching of HQET to three-flavor QCD

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The use of Heavy Quark Effective Theory (HQET) on the lattice as an approach to B-physics phenomenology is based on a non-perturbative matching of HQET to QCD in finite volume. As a first step to apply the underlying strategy in the three-flavor ($N_f = 2 + 1$) theory, we determine the renormalization constant and improvement coefficients relating the renormalized current and subtracted quark mass of (quenched) valence quarks in $\mathcal{O}(a)$ improved $N_f = 3$ lattice QCD. We present our strategy and first results for the relevant parameter region towards weak couplings along a line of constant physics, which corresponds to lattice resolutions $a \leq 0.02\,\mathrm{fm}$ and fixes the physical extent of the matching volume to $L \approx 0.5\,\mathrm{fm}$.

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