

Renormalization-group analysis of the validity of staggered-fermion QCD with the fourth-root recipe

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Abstract: I develop a renormalization-group blocking framework for lattice QCD with staggered fermions. Using it, I argue that the fourth-root recipe used in numerical simulations is valid in the continuum limit. The taste-symmetry violating terms, that give rise to non-local effects in the fourth-root theory when the lattice spacing is non-zero, vanish in the continuum limit. The claim rests on the following ingredients:

1. power-counting renormalizability,
2. locality of the effective action that the integration over ultra-violet modes generates at each blocking step for the remaining degrees of freedom, and
3. the hypothesis that scaling laws of irrelevant operators can be trusted in any local renormalizable theory.

A key role is played by re-weighted theories that are local and renormalizable on the one hand, and that approximate the fourth-root theory better and better as the continuum limit is approached on the other hand.