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Spin-taste representation of Karsten-Wilczek fermions

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Minimally doubled fermions realize one pair of Dirac fermions on the lattice. Similarities to staggered fermions exist, namely, spin and taste degrees of freedom become intertwined, and a peculiar nonsinglet chiral symmetry and ultralocality are maintained. However, charge conjugation, some space-time reflection symmetries and isotropy are broken by the cutoff.

We address the most simple variant, Karsten-Wilczek fermions, and derive the correct spin-taste representation from first principles. The spin-taste representation on the quark level permits construction of local or extended hadron interpolating operators for any spin-taste combination, albeit with contamination by parity partners and taste-symmetry breaking. We classify hadron interpolating operators and the Noether currents. We also discuss appropriate discretizations for taste-singlet or -isovector mass or chemical potential terms.

We explain the counterterms in this spin-taste framework, and derive generic constraints on the parametric form and cutoff effects from the KW determinant and hadronic correlation functions. We derive how and why nonperturbative tuning schemes for the counterterms work, and obtain analytic, assumption-free, non-perturbative predictions for taste-symmetry breaking and other hadronic properties from first principles. In particular, we identify the origin and nature of two different types of taste-symmetry breaking cutoff effects. The few available numerical results for KW fermions validate these predictions.

Parallel Session (for talks only)

Theoretical developments and applications beyond Standard Model

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