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Non-perturbative renormalization of quark and gluon operators using a gauge-invariant scheme

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We present preliminary results of the renormalization functions (RFs) for a number of quark and gluon operators studied in lattice QCD using a gauge-invariant renormalization scheme (GIRS). GIRS is a variant of the coordinate-space renormalization prescription, in which Green's functions of gauge-invariant operators are calculated in position space. A novel aspect is that summations over different time slices of the operators' positions are employed in order to reduce the statistical noise in lattice simulations. We test the reliability of this scheme by calculating RFs for the vector one-derivative quark bilinear operator, which enters the average momentum fraction of the nucleon. We use $N_f = 4$ degenerate twisted mass/clover fermion ensembles of different volumes and lattice spacings. We also present first results of applying GIRS when operator mixing occurs: the mixing coefficients of the gluon and quark singlet energy-momentum tensor operators are evaluated by imposing appropriate renormalization conditions on the lattice.

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