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Perturbative and non-perturbative renormalization results of the Chromomagnetic Operator on the Lattice

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The chromomagnetic operator mixes with a large number of operators under renormalization. We identify which operators can mix with the chromomagnetic operator, at the quantum level. Even in dimensional regularization (DR), which has the simplest mixing pattern, the chromomagnetic operator mixes with a total of 9 other operators,forming a basis of dimension-five (d=5), Lorentz scalar operators with the same flavor content as the chromomagnetic operator. Among them, there are also gauge noninvariant operators; these are BRST invariant and vanish by the equations of motion, as required by renormalization theory. On the other hand using a lattice regularization further operators with equal or lower dimensionality will mix; choosing the lattice action in a manner as to preserve certain discrete symmetries, a minimul set of 3 additional operators (all with d<5) will appear. In order to compute all relevant mixing coefficients, we calculate the quark-antiquark (2-pt) and the quark-antiquark-gluon (3-pt) Green's functions of the chromomagnetic operator at nonzero quark masses. These calculations were performed in the continuum (dimensional regularization) and on the lattice using the maximally twisted mass fermion action and the Symanzik improved gluon action. In parallel, non-perturbative measurements of the K-π matrix element are being performed in simulations with 4 dynamical (N_f = 2+1+1) twisted mass fermions and the Iwasaki improved gluon action.

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