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Schwinger-Keldysh formalism for Lattice Gauge Theories

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It is important to compute transport coefficients in QCD at finite temperature and density. When the imaginary-time formalism of Lattice QCD is used, the spectral functions have to be reconstructed by supplementing certain Ansatze for correlation functions on the lattice. On the other hand, real-time Green's functions can be obtained directly in the Schwinger-Keldysh (SK) formalism. But the SK formalism has not been constructed so far for QCD non-perturbatively. In this work we formulate the SK formalism for Lattice QCD by constructing the transfer matrix in the direction of real time for gauge link field and Wilson fermion. We examine the spectral functions and other real-time Green's functions in weak gauge-coupling limit. We also obtain the Kubo formulae in this framework as a summation of the real-time Green's functions on the closed time path.

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