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Gauge cooling for the singular-drift problem in the complex Langevin method - an application to finite density QCD

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The complex Langevin method is a promising approach
to complex action systems, which suffer from the sign problem.
In particular, the use of gauge cooling enabled the studies of finite
density QCD either in the deconfined phase or in the heavy dense limit.
In the confined phase with light quarks, however, the method does not
work as it is due to the singularities in the fermion drift term
caused by small eigenvalues of the Dirac operator with the quark mass.
In a previous paper, we proposed that this singular-drift problem
can be overcome by the gauge cooling with different criteria for choosing
the complexified gauge transformation, and showed that
the method works in chiral Random Matrix Theory even at small quark mass.
Here, we apply the same idea to QCD at finite density with light quarks
and present some preliminary results.

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