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Effective Potential and Phase Diagram in the Strong-Coupling Lattice QCD with Next-to-Next-to-Leading Order and Polyakov Loop Effects

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Strong Coupling Lattice QCD (SC-LQCD) is a method directly based on QCD, and has been applied to investigate the properties of the QCD phase diagram in the finite chemical potential region. The previous studies in next-to-leading order (NLO) evaluation assert that the effect of NLO in the effective potential are renormalized in modification of the quark mass and chemical potential in the strong coupling limit (SCL), and two order parameters (the chiral condensate and density) are found to appear. These studies indicate the possibility of the partially chiral restored phase as well.

In this study, we evaluate the effective potential in the strong-coupling lattice QCD including next-to-next-to-leading order and Polyakov loop effects. We also discuss the properties of the QCD phase diagram by using the effective potential, including the critical temperature and the position of the critical point. We find that the critical point is sensitive to the NNLO effects. We also find that the critical temperature of the chiral phase transition is close to Monte Carlo results due to Polyakov loop effects at $\beta = 2N_c / g^2 \sim 4$ and the critical temperature of the chiral and deconfinement phase transition have almost the same values.

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talk

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