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Complex poles and spectral function of the Landau gauge gluon propagator: effects of quark flavors

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The analytic structures of propagators have kinematic information and are important to understand the color confinement; in particular, the existence of complex poles is a signal of confinement for the corresponding particle. We derive general relationships between the number of complex poles of a propagator and the spectral function under some assumptions on the asymptotic behaviors of the propagator. We apply this relation to the massive Yang-Mills model, which is an effective model of the Landau gauge Yang-Mills theory, to show that the gluon propagator in this model has two complex poles. We consider the flavor effects on the analytic structure of the gluon propagator in the massive Yang-Mills model with quarks and also discuss effects of finite temperature and chemical potential towards understanding the QCD phases in relation with the analytic structures of the propagators in the Landau gauge QCD.

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