Universität Bielefeld Fakultät für Physik

Seminar

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Chiral phase transition in (2 + 1)-flavor QCD

The chiral phase transition temperature T_c^0 is a fundamental quantity of QCD. To determine this quantity, we have performed simulations of (2 + 1)-flavor QCD using the Highly Improved Staggered Quarks (HISQ) action on $N_\tau = 6, 8, 12$ lattices and aspect ratios N_σ/N_τ ranging from 4 to 7. In our simulations, we fix the strange quark mass value to its physical value $m_s^{\rm phy}$, and the values of two degenerate light quark masses m_l are varied from $m_s^{\rm phy}/160$ to $m_s^{\rm phy}/20$ which correspond to a Goldstone pion mass m_π ranging from 55 MeV to 160 MeV in the continuum limit. By investigating the light quark mass dependence and volume dependence of various chiral observables, e.g. chiral susceptibilities and Binder cumulants, we didn't find any evidence for a first order phase transition in our current quark mass window. To extract the chiral phase transition temperature T_c^0 in the chiral & continuum limit, we proposed two novel estimators $T_{60\%}^-$ and T_δ. The uncertainty in the determination of T_c^0 is also discussed. We also discuss the nature of the chiral phase transition in the chiral limit.

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