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Chiral phase transition temperature in 3-flavor QCD.

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Establishing whether or not the famous first order corner at small quark masses exists in the Columbia plot is one of the major open issues in studies of the phase diagram of QCD. We delve into this problem and present results from our ongoing study of the chiral limit in three-flavor QCD using the Highly Improved Staggered Quark (HISQ/tree) action.

We investigate four quark masses, which in the continuum correspond to pion masses in the range 80 MeV to 140 MeV. In our simulations, the temporal lattice size, N_τ, is fixed to be equal to 8 and we explore three different aspect ratios $N_\sigma/N_\tau = 3,\ 4$ and 5.

In the pion mass range explored by us, we do not find any direct evidence of the existence of a first order phase transition. We find the quark mass and volume dependence of the chiral observables to be well-described by the universal finite size scaling functions. We obtain a quite low value for the chiral phase transition temperature that is around 100 MeV.

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