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Quark mass dependence of finite temperature phase transitions in QCD with many flavors of Wilson fermions

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We investigate the phase transitions of $(2+N_f)$ -flavor QCD, where two light flavors and N_f massive flavors exist, to discuss the electroweak baryogenesis in realistic technicolor scenario. Because an appearance of a first order phase transition at finite temperature is a necessary condition for the baryogenesis, it is important to study the nature of phase transition in the case of massless 2 flavors. Performing simulations of 2-flavor QCD with Wilson fermions and using the reweighting method, we calculate probability distribution functions of the many-flavor QCD. Through the shape of the distribution function, we determine the boundary of the first order region in the parameter space of the light quark mass and heavy quark mass. It is found that the light quark mass dependence of the critical mass of heavy quarks is very small in the region we investigated. From the light quark mass dependence, it is even possible to extract the nature of the transition of massless 2-flavor QCD. Our current result of small dependence suggests that the critical mass of heavy quark remains finite in the chiral limit of 2-flavors and there exists a second order transition region on the line of the 2-flavor massless limit.

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