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Mott-Hagedorn resonance gas and lattice QCD thermodynamics

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We construct a combined effective model reproducing the equation of state of strongly interacting matter as obtained in recent lattice QCD simulations. The model reproduces basic physical characteristics of the hadronic resonance gas at low temperatures and embodies the crucial effect of hadron dissociation. The quark and gluon degrees of freedom are described within an effective mean-field theory, the Polyakov-loop improved Nambu, Jona-Lasinio (PNJL) model. The hadron dissociation is obtained by the Mott effect within a generalized Beth-Uhlenbeck approach. The lowering of the thresholds for the two- and three-quark scattering state continuous spectrum triggers the transformation of hadronic bound states to resonances in the scattering continuum. We postulate a generic temperature dependent behavior of the scattering phase shifts in these channels. The in-medium phase shift model is in accordance with the Levinson theorem. This results in the vanishing of hadronic contributions to the thermodynamics at high temperatures. The crucial in-medium effect responsible for the hadron-to-quark matter phase transition is the lowering of the quark masses in the chiral restoration transition which itself is a result of the behavior of the chiral condensate. We aim at a selfconsistent solution of the model. The used PNJL model is improved over its standard versions by adding perturbative corrections in $0(\alpha_s)$ for the high-momentum region above the three-momentum cutoff. This leads to the broadening of the quarks, while the quark selfenergy is calculated from the same kind of diagrams as hadronic selfenergy.

This is an extension of former results obtained in arxiv:1501.00485 (Phys. Part. Nucl. 46 (2015) in press)

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