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SU(3) parity-doublet quark-hadron chiral model, lattice data, and QCD thermodynamics

The thermodynamic properties of QCD matter at high temperatures and densities
are explored within the SU(3) flavor parity-doublet quark-hadron chiral model.
The quark sector of the model is tuned to describe the lattice QCD thermodynamics at $\mu_B = 0$.
The resulting lines of constant physics as well as the structure of the baryon number susceptibilities in the temperature/chemical potential plane are studied in some detail.
The model predicts three consecutive transitions, the nuclear first-order liquid-vapor phase transition, chiral symmetry restoration, and transition to quark-dominated phase. All three transitions are of the crossover type for most of the $T - \mu_B$-plane.
The deviations from the free hadron gas baseline in the crossover temperature region at $\mu_B = 0$ are mainly attributed to the remnant of the liquid-vapor transition in nuclear matter. The chiral phase transition determines the baryon fluctuations at much higher μ_B, and at even higher baryon densities the behavior of fluctuations is controlled by the deconfinement transition.
The model is found to describe well the static properties of neutron stars as well as the neutron star merger observations.
This work presents the first effective EoS which accurately describes lattice QCD results as well as observations from physics at $T = 0$ and high densities.

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