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Towards a universal description of hadronic phase of QCD

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Mean-field model quantum field theories of hadrons were traditionally developed to describe cold and dense nuclear matter and are by now very well constrained from the recent neutron star merger observations. We show that when augmented with additional known hadrons and resonances but not included earlier, these mean-field models can be extended beyond its regime of applicability. Calculating some specific ratios of baryon number susceptibilities for finite temperature and moderate values of baryon densities within mean-field approximation, we show that these match consistently with the lattice QCD data available at lower densities, unlike the results obtained from a non-interacting hadron resonance gas model. We also estimate the curvature of the line of constant energy density, fixed at its corresponding value at the chiral crossover transition in QCD, in the temperature-density plane. The number density at low temperatures and high density is found to be about twice the nuclear saturation density along the line of constant energy density of $\epsilon = 348 \pm 41$ MeV/fm^3. Moreover from this line we can indirectly constrain the critical end-point of QCD to be beyond $\mu_B = 596$ MeV for temperature ~ 125 MeV.

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