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Exploring the QCD Phase Structure at Finite T, μB, and μI within the NJL Model

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Recent developments in lattice calculations of thermodynamical properties of the QCD equation of state along the isospin axis at finite temperature and low baryon chemical potential have been successfully implemented (B. B. Brandt, F. Cuteri and G. Endrődi, JHEP 07 (2023) 055 [2212.14016]). Lattice calculations provide reliable physical data on the thermodynamics of gauge theories such as QCD, though the sign problem restricts this approach to low baryonic densities at high temperatures.

Effective models are valuable tools for exploring the QCD equation of state in the non-perturbative regime. These models extend our understanding beyond the regions currently accessible through lattice QCD calculations. The Nambu—Jona-Lasinio (NJL) model for quarks has been widely used due to its ability to qualitatively reproduce dynamical chiral symmetry breaking and restoration properties. As a non-renormalizable model, the NJL model requires careful consideration of regularization procedures, which play a crucial role in determining the qualitative behavior of its results.

In this work, we explore the QCD phase structure and properties using the SU(3) flavor version of the NJL model at finite temperature, baryon chemical potential, and isospin chemical potential. We pay special attention to medium-dependent terms in two different regularization procedures.

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