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First order transition region of an equation of state for QCD with a critical point

In addition to signals for the critical point, evidence for a first order phase transition would indicate a nontrivial structure within the QCD phase diagram. Moreover, while not a direct measurement of the critical point, the presence of a first order transition would imply its existence. This motivates the need to understand signatures of this first order transition in addition to directly studying the effect of a critical point. To this effect, we map the mean-field Ising model equation of state onto the QCD phase diagram, and reconstruct the full coexistence region in the case of a first order phase transition [1]. Beyond the coexistence line, we maintain access to the spinodal region in the phase diagram, thus providing a description of metastable and unstable phases of matter. Thus, we describe the super-heated hadronic phase and the super-cooled quark-gluon plasma, which is useful for hydrodynamic simulations of the fireball created in a heavy-ion collision at low collision energy, where a first order phase transition is expected. We discuss the features of the pressure and other thermodynamic observables as functions of temperature and baryonic chemical potential, in particular their behavior in the coexistence region. Finally, we compare our equation of state to 3D Ising model ones available in the literature.

1. J.M. Karthein, V. Koch, C. Ratti, arXiv:2409.13961, PRD (under review)

Category

Theory

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