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The QCD Equation of State and critical end-point estimates at 6^{th} order in chemical potentials

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The QCD Equation of State (EoS) is fundamental for our understanding of the properties of strong-interaction matter at non-zero temperature and density. In view of the upcoming Beam Energy Scan II program at RHIC, it is important to gain control over the EoS in the entire range of chemical potentials (μ_B) accessible at RHIC, $0 \leq \mu_B/T \leq 3$. This will provide crucial input for the hydrodynamic modeling of hot and dense matter and will allow to clarify whether or not a critical end-point exists in this parameter range.

We present results for the QCD Equation of State at non-zero chemical potentials corresponding to the conserved charges in QCD using Taylor expansion upto 6^{th} order in the baryon number, electric charge and strangeness chemical potentials. The latter two are constrained by strangeness neutrality and a fixed electric charge to baryon number ratio. In our calculations, we use the Highly Improved Staggered Quarks (HISQ) discretization scheme at different values of the lattice spacings to control lattice cut-off effects. The light and strange quark masses are adjusted to reproduce physical values of pion and kaon masses. Furthermore we calculate the pressure along lines of constant energy density, which serve as proxies for the freeze-out conditions and discuss their dependence on μ_B, which is necessary for hydrodynamic modeling near freezeout.

We also provide an estimate of the radius of convergence of the Taylor series from the 6th order coefficients which gives a new constraint on the location of the critical end-point in the T-μ_B plane of the QCD phase diagram.

Preferred Track

QCD at High Temperature

Collaboration

Other

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