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Equation of state and baryon kurtosis in the presence of a critical point

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We construct a family of equations of state for QCD, which reproduce the lattice results at small chemical potential and include a critical point in the 3D Ising model universality class. These equations of state, based on the original formulation developed in [1], include the constraint of strangeness neutrality, which is phenomenologically relevant for heavy-ion collisions [2]. We then use our parametrization to study the quartic cumulant of the baryon number χ_4^B, which can be accessed experimentally via net-proton fluctuation kurtosis measurements. It was originally predicted, through universality arguments based on the leading singular contribution, that χ_4^B should show a specific nonmonotonic behavior due to the critical point. In particular, when following the freeze-out curve on the phase diagram by decreasing beam energy, the kurtosis is expected to dip, and then peak, when the beam energy scan passes close to the critical point. We find that, while the peak remains a solid feature, the presence of the critical point does not necessarily cause a dip in χ_4^B on the freeze-out line below the transition temperature [3].

References
[1] P. Parotto et al., Phys. Rev. C101 (2020) 3, 034901.
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[3] D. Mroczek et al., Phys. Rev. C103 (2021) 3, 034901.

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