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Conserved charge fluctuations at vanishing and non-vanishing baryon chemical potential from lattice QCD

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Up to 6th order cumulants of fluctuations of net baryon-number, net electric charge and net strangeness as well as correlations among these conserved charge fluctuations are now being calculated in lattice QCD. These cumulants provide a wealth of information on the properties of strong-interaction matter in the transition region from the low temperature hadronic phase to the quark-gluon plasma phase.

We use results from our 6th order Taylor expansion of the QCD equation of state to construct expansions for second and fourth order cumulants of conserved charges and their correlations, e.g. the second order cumulants can be calculated up to $calO(\mu_B^4)$ in the baryon chemical potential. We show that these low order cumulants strongly constrain the applicability range of hadron resonance gas model calculations. We point out that the latter is inappropriate to describe equilibrium properties of cumulants at finite μ_B already at $T \sim 155$ MeV.

For vanishingly small baryon chemical potential, we show that fourth order cumulant ratios calculated in QCD start to deviate from hadron resonance gas model calculations already at about 155 MeV, and the sixth order cumulants differ from HRG model calculations even earlier. Even some second order cumulants like the correlations between net-baryon number and net strangeness or net electric charge differ significantly at temperatures above 155 MeV in QCD and HRG model calculations. Since these cumulants are calculated at vanishing chemical potential they can be compared to measurements at the LHC.

Preferred Track

Correlations and Fluctuations

Collaboration

Other

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