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Systematics of higher order net-baryon number fluctuations at small values of the baryon chemical potential

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We analyze cumulant ratios of net-baryon number fluctuations calculated in (2+1)-flavor QCD in next-to-leading order (NLO) Taylor expansions in terms of temperature and the conserved charge chemical potentials for baryon number, strangeness and electric charge. We approximate the conditions met in heavy ion collision by enforcing strangeness neutrality and a constant baryon number to electric charge ratio. We show that fourth-order results are sufficient to model dense matter created in heavy ion collisions with center-of-mass energies down to $s_{NN}^{1/2} \sim 20GeV$ and use Sixth-order results to estimate truncation errors. We discuss to what extent the pattern seen in the RHIC beam energy scan of up to 4th order cumulants of electric charge and proton (baryon) number fluctuations can be understood in terms of QCD equilibrium thermodynamics.

The results are based on lattice calculations performed with the Highly Improved Staggered Quark action (HISQ) in the temperature range 140 MeV < T < 330 MeV, with lattice sizes 24ˆ3 \times 6, 32ˆ3 \times 8 and 48ˆ3 \times 12. The strange quark mass is tuned to its physical value and we use a strange to light quark mass ratio m_s/m_l = 20, which in the continuum limit corresponds to a pion mass of about 160 MeV.

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