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The QCD equation of state and fluctuations of conserved charges at non-zero temperature and density

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We present results from a calculation of the QCD equation of state up to the sixth order in the baryon, strangeness and electric charge chemical potentials. As the results depend on three independent chemical potential, we consider various cases to parametrize the strangeness and electric charge chemical potentials as a function of the baryon chemical potential and temperature. Among these, the conditions met in heavy ion collision are best reproduced by enforcing strangeness neutrality and a constant baryon number to electric charge ratio. We will further discuss how cumulant rations of conserved charge fluctuations that are available in both, lattice QCD simulations and heavy ion experiments, can be used to determine freeze-out parameter of the experiment including the freeze-out curvature.

The presented 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 $24^3 \times 6$, $32^3 \times 8$, $48^3 \times 12$ and $16^3 \times 16$. The strange quark mass is tuned to its physical value and we use ratios of strange to light quark masses including $m_s/m_l = 20$ and 27, which in the continuum corresponds to a pion masses of 160 and 140 MeV.

Summary

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