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The QCD equation of state and fluctuations of conserved charges at non-vanishing 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 number, strangeness and electric charge chemical potentials. We consider various cases to express strangeness and electric charge chemical potentials as function of the baryon chemical potential and temperature. Among those, 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 parameters including the freeze-out curvature of the experiment.

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 correspond to pion masses of 160 and 140 MeV.

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