Workshop on the sign problem in QCD and beyond

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QCD deconfinement transition line up to $\mu_B = 400$˜MeV from finite volume lattice simulations

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The QCD cross-over line in the temperature (T) – baryo-chemical potential (μ_B) plane has been computed by several lattice groups by calculating the chiral order parameter and its susceptibility at finite values of μ_B. In this work we focus on the deconfinement aspect of the transition between hadronic and Quark Gluon Plasma (QGP) phases. We define the deconfinement temperature as the peak position of the static quark entropy ($S_Q(T, \mu_B)$) in T, which is based on the renormalized Polyakov loop. We extrapolate $S_Q(T, \mu_B)$ based on high statistics finite temperature ensembles on a $16^3 \times 8$ lattice to finite density by means of a Taylor expansion to eighth order in μ_B (NNNLO) along the strangeness neutral line. For the simulations the 4HEX staggered action was used with 2+1 flavors at physical quark masses. In this setup the phase diagram can be drawn up to unprecedentedly high chemical potentials. Our results for the deconfinement temperature are in rough agreement with phenomenological estimates of the freeze-out curve in relativistic heavy ion collisions. In addition, we study the width of the deconfinement crossover. We show that up to $\mu_B \approx 400$˜MeV, the deconfinement transition gets broader at higher densities, disfavoring the existence of a deconfinement critical endpoint in this range. Finally, we examine the transition line without the strangeness neutrality condition and observe a hint for the narrowing of the crossover towards large μ_B.

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