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The QCD Equation of State in Small Systems

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Multiparticle correlations measurements in even the smallest collision systems are consistent with predictions from viscous relativistic hydrodynamics calculations. However, these hydrodynamics calculations use a continuum extrapolated—i.e. infinite volume—equation of state. For the modest temperature probed in these small collisions, the controlling dimensionless product of the temperature and system size T*L ˜ 400 MeV * 2 fm / 197 MeV fm ˜ 4 is not particularly large. One should therefore investigate the small system size corrections to the equilibrium QCD equation of state used in modern viscous hydrodynamics simulations.

We present first results on just such finite system size corrections to the equation of state, trace anomaly, and speed of sound for two model systems: 1) free, massless scalar theory and 2) quenched QCD with periodic boundary conditions (PBC). We further present work-in-progress results for quenched QCD with Dirichlet boundary conditions.

We show that free, massless scalar fields, which are maximally sensitive to the finite size box, deviate enormously from their infinite volume conformal limit. Quenched QCD with PBC show corrections of ˜20% for the trace anomaly near the phase transition. These corrections are more modest, but will have a meaningful, quantitative impact on the extracted bulk and shear viscosities in these small systems.

This presentation is based on
Mogliacci et al., Phys.Rev.D 102 (2020) 11, 116017 [arXiv:1807.07871]
Kitazawa et al., Phys.Rev.D 99 (2019) 9, 094507 [arXiv:1904.00241]
Horowitz and Rothkopf, in progress

Apply to be considered for a student ; award (Yes / No)?

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