ID de Contribution: **268** Type: **Talk**

Equilibrium expectations for non-Gaussian fluctuations near a QCD critical point

mardi 4 juin 2024 09:10 (20 minutes)

With the highly anticipated results from the Beam Energy Scan II program at RHIC coming soon, an understanding of particle-number fluctuations and their significance as a potential signature of a possible QCD critical point is crucial. Early works that embarked on this endeavor sought to estimate the fluctuations due to the presence of a critical point assuming they stay in equilibrium [1,2]. From these results came the proposal to focus efforts on higher, non-Gaussian, moments of the event-by-event distributions, in particular of the number of protons. These non-Gaussian moments are especially sensitive to critical fluctuations, as their magnitudes are proportional to high powers of the critical correlation length. As the equation of state provides key input for hydrodynamical simulations of heavy-ion collisions, we estimate equilibrium fluctuations from the BEST equation of state (EoS) that includes critical features from the 3D Ising Model [3,4,5]. In particular, the net-baryon kurtosis and its dependence on non-universal mapping parameters is investigated within the BEST EoS [6]. Furthermore, the correlation length, as a central quantity for the assessment of fluctuations in the vicinity of a critical point, is also calculated in a consistent manner with the scaling equation of state. We propose a new parameterization of the critical correlation length in terms of the same parametric variables (R, θ) used for the BEST EoS, consistent with the ⊠-expansion. Additionally, we study how these parametrizations of the correlation length could be used to calculate critical cumulants, updating the early work of [1]. These will be useful for further comparison to estimates of out-of-equilibrium fluctuations in order to determine the magnitude of the observable fluctuations to be expected in heavy-ion collision experiments, in which the time spent near a critical point is short.

1. C. Athanasiou, K. Rajagopal, M. Stephanov, "Using Higher Moments of Fluctuations and their Ratios in the Search for the QCD Critical Point,"Phys. Rev. D 82 (2010), 074008.
2. M. Stephanov, "On the sign of kurtosis near the QCD critical point,"Phys. Rev. Lett. 107 (2011), 052301.
3. P. Parotto, M. Bluhm, D. Mroczek, M. Nahrgang, J. Noronha-Hostler, K. Rajagopal, C. Ratti, T. Schaefer, and M. Stephanov, "QCD equation of state matched to lattice data and exhibiting a critical point singularity,"Phys. Rev. C 101 (2020), 034901.
4. J.M. Karthein, D. Mroczek, A.R. Nava Acuna, J. Noronha-Hostler, P. Parotto et al., "Strangeness-neutral equation of state for QCD with a critical point,"Eur. Phys. J. Plus 136 (2021) 6, 621.
5. D. Mroczek, A.R. Nava Acuna, J. Noronha-Hostler, P. Parotto, C. Ratti et al., "Quartic cumulant of baryon number in the presence of a QCD critical point,"Phys. Rev. C 103 (2021) 3, 034901.
6. T. Dore, J.M. Karthein, I. Long, D. Mroczek, J. Noronha-Hostler et al., "Critical lensing and kurtosis near a critical point in the QCD phase diagram in and out-of-equilibrium,"arXiv:2207.04086.

Auteurs principaux: KARTHEIN, Jamie (Massachusetts Institute of Technology); RAJAGOPAL, Krishna (MIT); PRADEEP, Maneesha (University of Maryland); STEPHANOV, Mikhail (University of Illinois at Chicago); YIN, Yi (Institute for Modern Physics, Lanzhou)

Orateur: KARTHEIN, Jamie (Massachusetts Institute of Technology)

Classification de Session: Track4-Bulk&Phase

Classification de thématique: Bulk matter phenomena, QCD phase diagram and Critical point