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Dynamical critical fluctuations near the QCD critical point

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The recent BES data of the energy dependent κσˆ2 for net protons in Au+Au collisions presented large deviations from the statistical baselines at lower collision energies, and non-monotonic behavior at around 20 GeV, which indicates possible signals for the existence of the QCD critical point [1].

In our recent paper [2], we introduce a freeze-out scheme to the dynamical models near the QCD critical point. Our model calculations for the static critical fluctuations on the freeze-out surface shows that the C_4 and κσˆ2 data of net protons can be roughly described. However, C_2 and C_3 are always over-predicted due to the positive static critical fluctuations. After solving the time evolution equations of the various cumulants of the sigma field, the BNL group found the Skewness and Kurtosis could change their sign after the evolution, which indicates that dynamical critical fluctuations could solve the sign problem of C_3 [3]. However, such BNL approach can not be easily combined with our freeze-out scheme to compared with the experimental data since only the zero mode of sigma field are considered there, which already erase the needed spatial information.

Within the framework of Langevin dynamics, we simulate the dynamical evolution of the fluctuating sigma field in position space and calculate the cumulants of the sigma field in the critical regime[4]. Our numerical simulations show that C_2 automatically increases as the system evolves in the critical regime, which represents the spontaneous increase of the chiral field's correlation. Besides, for both C_3 and C_4, the sign in the earlier times can be remembered during the dynamical evolution due to the memory effects near the critical point[4]. Combined with the freeze-out scheme developed in [2], our calculation provides a possible way to qualitatively describe the different cumulants data of net protons.

[1] Xiaofeng Luo (for the STAR collaboration), PoS CPOD2014 (2014) 019. ArXiv:1503.02558v1.

[2] Lijia Jiang, Pengfei Li, Huichao Song, Phys. Rev. C 94, 024918 (2016).

[3] S. Mukherjee, R. Venugopalan and Y. Yin, Phys. Rev. C 92, 034912 (2015).

[4] Lijia Jiang and Huichao Song, in preparation.

Preferred Track

Correlations and Fluctuations

Collaboration

Not applicable

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