Contribution ID: **799** Type: **Parallel Talk**

Transits of the QCD Critical Point

Wednesday 16 May 2018 15:40 (20 minutes)

Building on an analysis of hydrodynamic long time tails for a Bjorken expansion (Akamatsu 2017, Akamatsu 2017), we discuss the hydrodynamic scales associated with transiting the critical point. First, we consider the case where the nuclear medium passes directly through the critical point. In this case, the modes with wave-number of order the inverse Kibble-Zurek length and smaller fall out of equilibrium during the transit, and limit the growth of critical fluctuations in a characteristic way which depends on the wave-numbers involved. This Kibble-Zurek wavenumber will be contrasted to wave numbers of order $k \sim \sqrt{(e+p)/\eta\tau}$ which are always out of equilibrium, even away from the critical point (Akamatsu 2016). Subsequently we generalize to the situation when the system misses the critical point by a an amount, $\Delta = n_c/s_c\delta(s/n)$. In this case there is an additional scale, and Kibble-Zurek scaling is only relevant if Δ is sufficiently small. We will define "sufficiently small" in the talk and analyze the intermediate case. The scales introduced in this analysis give a qualitative picture of the QCD critical point in heavy ion collisions, which can inform all experimental searches.

References:

Y. Akamatsu, A. Mazeliauskas and D. Teaney, "A kinetic regime of hydrodynamic fluctuations and long time tails for a Bjorken expansion," Phys. Rev. C95, no. 1, 014909 (2017) [arXiv:1606.07742 [nucl-th]].

Y.˜Akamatsu, A.˜Mazeliauskas and D.˜Teaney,"Bulk viscosity from hydrodynamic fluctuations with relativistic hydro-kinetic theory," arXiv:1708.05657 [nucl-th].

Content type

Theory

Collaboration

Centralised submission by Collaboration

Presenter name already specified

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Session Classification: Phase diagram and search for the critical point

Track Classification: Phase diagram and search for the critical point