Contribution ID: **677** Type: **Poster Presentation**

Smallest QCD Droplet for Hydrodynamic Response via Gubser Flow

Monday 4 November 2019 17:40 (20 minutes)

Over the past years, the observed features in the collisions of small systems which resemble collective flow patterns, are under intense debates. A relevant question is to what extent these observations are related to the real collective evolution of the medium, and if this is the case, the related question is what is the smallest system size which can still accommodate collective behaviour. The present talk attempts to shed new light on these non-trivial questions. Specifically, we address the following problem: what is the smallest system consistent with hydrodynamic equations and with hydrodynamization time $\tau_{\rm hyd}\, T \sim 1$? In order to solve, we employ the Gubser solution as a toy model to perceive the consistency between the hydrodynamization time and the system size. We show that, up to a factor of the order of unity, the rms radius of the system, $\sigma_{\rm rms}$, cannot be smaller than the inverse of the square root of the total energy in the transverse plane, $\epsilon_{\rm tot}^{1/2}$. According to our simple model, we find that hydrodynamic is applicable for the core of the systems with size $\sigma_{\rm rms} \sim 0.5$ fm corresponds to the multiplicity around two particles per unit rapidity. However, a large fraction of particles are emitted from the corona part (hadron gas at the tail of the fireball) for such system. On the other hand, for a system with the same size, the events with multiplicity per unit rapidity above 20 are dominated with particles from the core with strong flow signal. Using perturbation on top of Gubser flow, we discuss about the hydrodynamic response of an elliptic initial energy density in small systems.

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Session Classification: Poster Session

Track Classification: Small systems