QUARK MATTER 2015
Sep. 27 – Oct. 3, 2015 Kobe, Japan

Contribution ID: **184** Type: **Contributed talk**

Forward-backward multiplicity fluctuation and longitudinal harmonics in high-energy nuclear collisions

Tuesday 29 September 2015 15:00 (20 minutes)

One of the largest uncertainties in the modeling of heavy-ion collision arises from present poor understanding of the early-time dynamics especially in the longitudinal direction. Forward-backward (FB) multiplicity correlation has been regarded as a power observable on the early time dynamics since it probe directly the initial state density fluctuations in pseudorapidity. Previous studies of FB multiplicity correlation were primarily based on two-bin or multi-bin correlation method in selected η ranges, whose connection to underlying dynamics is complicated by statistical smearing due to finite multiplicity and residual centrality or volume effects. In a recent paper (1506.03496), we have developed a data-driven two-particle correlation method which overcome both limitations and hence allow direct connection between the correlation function and underlying heavy-ion collision dynamics. The robustness and physics potential of the method are demonstrated using the AMPT and HIJING simulation. We found that the long-range component of the FB correlation is captured by a few longitudinal harmonics, with the first component driven by the asymmetry in the number of participating nucleons in the two colliding nuclei and the second component reflecting the EbyE fluctuation of nuclear-stopping. The higher-order longitudinal harmonics are found be strongly damped in AMPT compare to HIJING, due to weaker short-range correlations as well as the final-state effects present in the AMPT model. Two-particle pseudorapidity correlation reveals interesting charge-dependent short-range structures in AMPT model that are absent in HIJING model. The proposed method opens a new avenue to elucidate the particle production mechanism and early time dynamics in heavy-ion collisions. Future analysis directions and prospects of using the pseudorapidity correlation function to understand the centrality bias in p+p, p+A and A+A collisions are discussed.

On behalf of collaboration:

NONE

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Session Classification: Correlations and Fluctuations IV

Track Classification: Correlations and Fluctuations