



XXIV QUARK MATTER DARMSTADT 2014

Contribution ID: 399

Type: **Contributed Talk**

Signatures of collective behavior in small systems

Wednesday 21 May 2014 09:20 (20 minutes)

We perform 3+1D viscous hydrodynamic calculations of proton-nucleus and nucleus-nucleus collisions. The goal is to ascertain the nature of the striking correlations seen in recent proton-nucleus collisions. In particular, one would like to know: is the observed ridge a signature of collective behavior? Can the highest multiplicity collision systems be accurately described as a relativistic fluid? If so, at what point does hydrodynamics fail to describe the bulk evolution?

To this end, we propose to measure the detailed transverse momentum structure of two-particle correlations. They must satisfy rigid inequality relations in any hydrodynamic system, and within those bounds we show that they should have a particular dependence on multiplicity over the entire measured centrality range. Any deviation from this behavior would signal a breakdown of a hydrodynamic description. We also show how a simultaneous description of Pb-Pb and p-Pb data can put a significant constraint on theoretical models.

Finally, we compare our calculations to the full set of existing measurements, demonstrating what parameters are required for a good fit to data and commenting on what can be learned.

On behalf of collaboration:

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Session Classification: Correlations and fluctuations

Track Classification: Correlations and Fluctuations