Contribution ID: **90** Type: **Contributed talk**

Elliptic Anisotropy v_2 May Be Dominated by Particle Escape instead of Hydrodynamic Flow

Wednesday 30 September 2015 12:10 (20 minutes)

It is commonly believed that azimuthal anisotropies in relativistic heavy ion collisions are generated by hydrodynamic evolution of the strongly interacting quark-gluon plasma. Recently, apparent anisotropy signals have been observed in small systems of proton- and deuteron-nucleus collisions, and the signals can again be described by hydrodynamics. A natural question is why hydrodynamics still seems to be applicable to such small systems. Since A Multi-Phase Transport (AMPT), like hydrodynamics, has been quite successful in describing a large amount of experimental data, we investigate the generation of anisotropies in AMPT by analyzing the complete parton collision history. We also use another transport model, the MPC/Cascade, to check the model dependence of our results.

To our surprise, we find [1] that the majority of v_2 comes from the anisotropic escape of partons, not from the parton collective flow, for semi-central Au+Au collisions at 200A GeV. Hydrodynamic-type collective flow will eventually dominate over the escape mechanism at unrealistically large parton cross sections. However, even at the parton cross section of 40 mb, the escape mechanism still contributes to about one-third of the final parton v_2. The picture is qualitatively the same from both transport models, and for the smaller d+Au system the escape mechanism is more dominant as expected. Our results thus show that elliptic anisotropy v_2 is dominated by particle escape instead of hydrodynamic flow in transport models. If confirmed, our finding could change the paradigm of anisotropic flow. Our results also suggest the need for hydrodynamics to include the escape mechanism, without which the extracted viscosity to entropy density (η/s) ratio would be severely underestimated.

[1] L. He, T. Edmonds, Z.W. Lin, F. Liu, D. Molnar, F.Q. Wang. ArXiv:1502.05572 [nucl-th].

On behalf of collaboration:

NONE

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Session Classification: Collective Dynamics IV

Track Classification: Collective Dynamics