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Flowing to the future: Simulating the tiniest fluids in 3+1 dimensions

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Employing a dynamical initial state model coupled to (3+1)D viscous relativistic hydrodynamics, we explore the rapidity dependence of anisotropic flow in the Relativistic Heavy-Ion Collider (RHIC) small system scan at 200 GeV center of mass energy. We demonstrate that approximately 50% of the pT-differential triangular flow difference between the measurements by the STAR and PHENIX Collaborations can be explained by the use of reference flow vectors from different rapidity regions. This emphasizes the importance of longitudinal flow decorrelation for anisotropic flow measurements in asymmetric nuclear collisions, and the need for (3+1)D simulations. We further present results for the beam energy scan of d+Au collisions and compare to PHENIX data. The same framework is used to describe p+Pb collisions and photo-nuclear events in ultra-peripheral Pb+Pb collisions at the Large Hadron Collider (LHC). We compare to experimental data on momentum anisotropies from the ATLAS Collaboration and find good agreement with the measured elliptic flow. Again, the importance of longitudinal flow decorrelations is highlighted, as they dominate the elliptic flow hierarchy between p+Pb and γ+Pb collisions. Our results imply that QCD fluids can be created at the future Electron Ion Collider, where they could be studied in great detail.

References:

3D structure of anisotropic flow in small collision systems at energies available at the BNL Relativistic Heavy Ion Collider
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Collectivity in Ultraperipheral Pb+Pb Collisions at the Large Hadron Collider
Wenbin Zhao, Chun Shen, Björn Schenke
e-Print: 2203.06094 [nucl-th] DOI: 10.1103/PhysRevLett.129.252302
Published in: Phys.Rev.Lett. 129 (2022) 25, 252302

Category

Theory

Collaboration (if applicable)

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