Contribution ID: **1**

Type: **not specified**

Initial energy density in pp collisions and AA collisions

A previously known class of analytic, exact solutions of prefect relativistic hydrodynamics is utilized to fit the new results on the pseudorapidity distributions with an acceleration parameter λ. Those results include a broad centrality range for Cu+Cu, Au+Au, Pb+Pb at RHIC and LHC. Based on hydrodynamic description of the pseudo-rapidity distribution with acceleration effects taken into account, the energy density is estimated, and the ratio between the newly estimated energy density and the Bjorken estimate is found to depend on the pressure gradients and volume expanding in the hydrodynamical evolution.

Summary

New results are shown in this paper on the pseudorapidity distributions and initial energy density estimate from the previous known exact solutions of accelerating hydrodynamic and Buda-Lund hydrodynamic model. We have extracted a series of acceleration parameter λ for different systems at RHIC and LHC energies. Taking the acceleration effect into account and refining the typical Bjorken model, we got a general class of initial energy density ε_{corr} for central collisions, which was found significantly lager based on the latest PHENIX and LHC transverse energy spectra.

An improved estimate for initial energy density is also discussed for the semi-central collisions. For peripheral collisions the estimate for the initial energy density is difficult based on the Bjorken model. Here we are able to find the approximation based on the MC-Glauber model and the initial accelerating time period. For the peripheral case there exist various qualitative and quantitative analyses, and the thermalization time, freeze-out time, transverse overlap, and volume expansion deserve more attention discussing the QGP medium initial energy density. The more detailed testing of QGP medium numerical solutions of peripheral collision will be done in the future.

It should be emphasized that in this paper our purpose is to discuss inhomogeneous flow from exact solution of relativistic hydrodynamics, and that the relativistic hydrodynamic Buda-Lund model can describe the experimental data stable and causally. Either analytically or numerically, the accelerating hydrodynamical description makes a difference on both the rapidity distribution and the energy density estimation.

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