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Latest developments in anisotropic hydrodynamics

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In ultrarelativistic heavy-ion collisions nuclear matter is heated to a temperature exceeding that necessary to create a quark-gluon plasma (QGP). Traditionally, second order viscous hydrodynamics has been used to reproduce the soft collective flow of the QGP and hadronic spectra; however, due to rapid longitudinal expansion in the early stages of evolution, the system may possess substantial pressure anisotropies which are a consequence of large viscous corrections.

These large corrections violate the viscous hydrodynamics assumption of small deviation from local equilibrium. They may lead to unphysical results, and, comparing to the exact 0+1 solutions of the Boltzmann equation, they often badly reproduce the longitudinal pressure (especially for initial stages) and provide the wrong asymptotic behavior.

In order to more accurately treat systems possessing large pressure anisotropies, a new approach called anisotropic hydrodynamics was recently developed. In this approach, the pressure anisotropy is treated non-perturbatively at leading order in the hydrodynamic expansion. This allows one to match with second order viscous hydrodynamics in the close to equilibrium limit and to also have a striking agreement with the exact solution for large anisotropies. I am presenting the latest formulation of leading-order anisotropic hydrodynamics which uses (1) an ellipsoidal ansatz for the underlying distribution function, allowing non trivial transverse dynamics; and (2), dynamical equations resulting from the second moment of the Boltzmann equation.

References

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