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Kinetic equations and anisotropic hydrodynamics for quark and gluon fluids

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Relativistic hydrodynamics is one of the fundamental tools used to interpret the data measured in heavy-ion collision experiments at RHIC and the LHC. Despite the success of second order viscous hydrodynamics in reproducing physical observables, there exist still theoretical problems that may question validity of this approach for description of heavy-ion collisions. The main source of the problems are large gradients and fast longitudinal expansion which produce very large anisotropic pressure corrections to local equilibrium. One way to avoid this problem is the use of anisotropic hydrodynamics, a framework where large pressure corrections are taken into accound already in the leading order of the hydrodynamic expansion [1-4].

We have recently extended the anisotropic hydrodynamics description to the case of a non-conformal mixture of quark and gluon fluids studied in a one-dimensional and boost-invariant setup with quantum statistics effects included. We compared the predictions of the coupled kinetic equations treated in the relaxation time approximation with anisotropic hydrodynamics results, founding a very good agreement [5].

Our numerical results also illustrate how a non-equlibrium mixture approaches hydrodynamic regime described by the Navier-Stokes equations with appropriate forms of the kinetic coefficients. The numerical studies of the ratio of the longitudinal and transverse pressures show, to a good approximation, that it depends on the ratio of the relaxation and proper times only. This behaviour is connected with the existence of an attractor for conformal systems [6].

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