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Anisotropic hydrodynamics for a mixture of quark and gluon fluids

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Relativistic hydrodynamics has been a fundamental tool to understand the evolution of matter in heavy-ion experiments at RICH and LHC. Despite the success of second order viscous hydrodynamics in reproducing collective behavior and particle spectra, there are still theoretical shortcomings that may question the validity of the approach in heavy-ion experiments conditions. Large gradients and fast longitudinal expansion produce very large pressure corrections, in contrast to the founding hypothesis of small deviation from local equilibrium and the perturbative treatment viscous corrections. One way to address this problem is anisotropic hydrodynamics. Most of the theoretical investigations about hydrodynamics started from a kinetic underlying substrate of a single species of particles. Unfortunately the striking agreement of anisotropic hydrodynamics with the exact solution of the Boltzmann equation was not preserved in the case of a mixtures of quarks and gluons.

We recently extended the anisotropic hydrodynamics prescription for massless particles in 1+1-dimensions to the case of mixtures of fluids, largely improving the agreement with the exact solutions compared to previous works [1-3]. We allow quarks and gluons to have different momentum scales during the evolution and a non vanishing baryon chemical potential. We take the dynamical equations from the zeroth, the first and the second moment of the Boltzmann equation [4]. We performed a test of the new formulation, comparing the results of anisotropic hydorodynamics with the exact solution of the Boltzmann equation for a mixture of fluid in the Bjorken flow limit, finding a very good agreement [5].

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