Contribution ID: **225** Type: **Poster**

Highly-anisotropic and strongly-dissipative hydrodynamics for early stages of relativistic heavy-ion collisions.

A new framework of highly-anisotropic hydrodynamics is introduced [1] that includes dissipation effects. Dissipation is defined by the form of the entropy source that depends on the pressure anisotropy and vanishes for the isotropic fluid. With a simple ansatz for the entropy source obeying general physical requirements, we are led to a non-linear equation describing the time evolution of the anisotropy in purely-longitudinal boost-invariant systems. Matter that is initially highly anisotropic approaches naturally the regime of the perfect fluid. Thus, the resulting evolution agrees with the expectations about the behavior of matter produced at the early stages of relativistic heavy-ion collisions.

The equilibration is identified with the processes of entropy production. For purely longitudinal, boost-invariant expansion with small anisotropy, the proposed model agrees with the Israel-Stewart theory and Martinez-strickland model [2,3,4]. However, the model is designed
to describe highly anisotropic systems where the standard dissipative hydrodynamics is not applicable.

The proposed model of isotropization may be also used to describe non-boost-invariant systems [5] and boost-invariant systems with asymmetric transverse expansion [6]. In the latter case, we find that as long as the initial energy density profile is unchanged the calculated soft hadronic observables remain practically the same. This result indicates the insensitivity of the analyzed observables to the initial pressure anisotropy and suggests that the complete thermalization of the system may be delayed to easily acceptable times of about 1 fm/c.

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Track Classification: Pre-equilibrium and initial state physics