HAW14-2014-000485

Abstract for an Invited Paper
for the HAW14 Meeting of
the American Physical Society

Non-perturbative reorganization of viscous hydrodynamics[1]

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The quark-gluon plasma created in relativistic heavy ion collisions is not momentum-space isotropic in the local rest frame due to the rapid longitudinal expansion of the system. As a result, the system's pressure transverse to the beam line can be significantly different than the pressure along the beamline. Such large pressure anisotropies (related to large shear corrections) can cause severe problems for traditional viscous hydrodynamics approaches and result in e.g. negative one-particle distribution functions, negative particle pressures, etc. In this talk, I will review a recently developed framework that builds in such momentum-space anisotropies non-perturbatively at leading order and then treats deviations perturbatively. The resulting framework has been dubbed anisotropic hydrodynamics (aHydro). The aHydro framework has many nice features, e.g. (i) it has been shown that aHydro agrees with traditional viscous hydrodynamics in the limit of small anisotropies (near equilibrium), (ii) it can be used to describe the large viscosity limit in which the system is free streaming and far-from-equilibrium, (iii) it is guaranteed that the leading-order one-particle distribution and longitudinal pressure are positive, both at small and large anisotropy.

[1]DOE Grant No. DE SC0004104