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Fluid dynamics of out of equilibrium boost invariant plasmas

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We establish a set of equations for moments of the distribution function. On the one hand, these equations generalize the fluid dynamics to the out-of-equilibrium evolution of boost invariant plasmas. On the other hand, they systematically generalize the theoretical framework of viscous hydrodynamics to arbitrary orders. These moments quantify details of the momentum anisotropies of out-of-eqilibrium phase space distributions. The evolution of these moments measures the evolution of systems towards thermalization to a finer level, beyond the commonly used ratio of longitudinal to transverse pressures. In the hydrodynamical regime, these moments are found to correspond to viscous corrections. In the relaxation time approximations, these moments obey a coupled set of equations that can be truncated order-by-order. Truncations at the lowest orders give rise to the exact form of the second order and third order viscous hydrodynamic equations of motion for the Bjorken flow. Solving the equations of the moments, we are able to identify an attractor solution that controls a transition from a free streaming fixed point to a hydrodynamic fixed point. In particular, this attractor solution provides a renormalization of the effective value of the shear viscosity to entropy density ratio, η/s, taking into account off-equilibrium effects.

[1] Jean-Paul Blaizot, Li Yan, JHEP 1711(2017) 161, arXiv:1703.10694
[2] Jean-Paul Blaizot, Li Yan, arXiv:1712.03856

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