Contribution ID: **284** Type: **Poster**

Adiabatic hydrodynamization in the bottom-up thermalization scenario

Tuesday 5 September 2023 17:30 (2h 10m)

We demonstrate that the early stages of the bottom-up thermalization scenario [1] are well described by the adiabatic hydrodynamization framework, thus providing novel analytic results on the thermalization process of QCD in a heavy ion collision. These results provide an intuitive explanation of why a gas of quarks and gluons can relax so quickly towards equilibrium, and provide a starting point for a systematic exploration of pre-hydrodynamic attractors in QCD. All of the qualitative features exhibited in QCD effective kinetic theory (EKT) simulations at weak coupling [2] are captured by the emergence of an effective low-energy instantaneous ground state for the 1-particle gluon distribution function, which defines the early-time kinetic theory attractor. This ground state may be pulled back to arbitrarily early times, where it represents a free-streaming solution, and at later times it integrally describes the BMSS fixed point, including the recently observed deviations from the original predictions for the scaling exponents [2].

To find this instantaneous ground state it is necessary to elucidate the deep connections between scaling and adiabaticity in expanding gluon plasmas [3]. We first solve the Boltzmann equation for gluons in the small-angle scattering approximation numerically and find that it features time-dependent scaling, reproducing the QCD EKT scaling of hard gluons [2]. By studying this equation analytically, we find that an appropriate momentum rescaling allows the scaling distribution to be identified as the instantaneous ground state of the operator describing the evolution of the distribution function, and the approach to the scaling function is described by the decay of the excited states. That is to say, the system evolves adiabatically, and the instantaneous ground state describes the early-time kinetic theory attractor. We obtain this ground state analytically. Corrections to the BMSS fixed point exponents agree quantitatively with those found previously in QCD EKT.

---

[1] Baier, Mueller, Schiff, Son, arXiv:hep-ph/0009237
[2] Mazeliauskas, Berges, arXiv:1810.10554
[3] Brewer, Scheihing-Hitschfeld, Yin, arXiv:2203.02427

Category

Theory

Collaboration (if applicable)

Authors: SCHEIHING HITSCHFELD, Bruno Sebastian (Massachusetts Institute of Technology); BREWER, Jasmine Therese (CERN); Dr YIN, Yi (Institute of modern physics, Chinese Academy of Sciencessti)

Presenter: SCHEIHING HITSCHFELD, Bruno Sebastian (Massachusetts Institute of Technology)

Session Classification: Poster Session

Track Classification: Initial state