Contribution ID: **767** Type: **Oral**

Thermalization and quark production in spatially homogeneous system of gluons

Wednesday 6 September 2023 15:20 (20 minutes)

We first assemble a full set of the Boltzmann Equation in Diffusion Approximation (BEDA) for studying thermalization/hydrodynamization and quark production in out of equilibrium systems. In the BEDA, the time evolution of a generic system is characterized by four space-time dependent quantities: the jet quenching parameter $\hat{q}$, the effective temperature T_* and two others that describe the conversion between gluons and quarks/antiquarks. Out of the latter two quantities, an effective baryon (net quark) chemical potential is defined, which equals the baryon chemical potential after thermal equilibration. We then study thermalization and the production of three flavors of massless quarks in spatially homogeneous systems initially filled only with gluons. A complete parametric understanding for thermalization and quark production is obtained for both initially very dense or dilute systems, which are confirmed by detailed numerical simulations. For initial distributions more relevant for heavy-ion collisions, the complete thermal equilibration is found to be significantly delayed by considering quark production due to Pauli blocking. The implications of such an observation for heavy-ion phenomenology will also be discussed.

Category

Theory

Collaboration (if applicable)

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Session Classification: Initial State

Track Classification: Initial state