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Thermalization and Hydrodynamization in Small and Large Systems

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The early time dynamic which connects the far-from-equilibrium matter created after the high energy collision toward the hydrodynamic regime is still a poorly understood process. We constructed a parton cascade model based on the hadronic transport model SMASH in order to explore this phase since SMASH has been shown to be able to correctly simulate multiparticle interaction in the hadronic case. We included 2-to-3 partonic interactions as the main source of particle and entropy production which are important for thermal and chemical equilibration. The initial condition for large and small collision systems are prepared using mini-jet model. Focusing on the mid-rapidity region $|\eta| < 0.5$ and up until time = 5 fm, we assume that perturbation QCD is still valid at a relatively lower energy region even at a later time and fixed the QCD coupling constant to a small value. Chemical and thermal equilibrium is assumed when the ensemble follows the Maxwell-Boltzmann distribution. In our model, hydrodynamization is measured by Knudsen number with the characteristic length of the medium calculated using a clustering algorithm based on the spatial information of the particles. We use the time evolution of these values in high energy Pb-Pb collision systems to establish a benchmark and compare it with p-p at 13 TeV to predict whether hydrodynamization and thermalization occur and identify the timescale of each process.

Category

Theory

Collaboration

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