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Light and strange quark chemical equilibration of the quark-gluon plasma

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The early stage of a heavy-ion collision is marked by rapid entropy production and the transition from a gluon saturated initial condition to a plasma of quarks and gluons. Even in the early times of the hydrodynamic evolution, the chemical composition of the QCD medium is still largely unknown. Here we study the effects of quark chemical equilibration on the (Q)GP using a novel model of viscous hydrodynamic evolution in partial chemical equilibrium. In this model, we initialize the QCD medium as a completely gluon dominated state, as motivated by the success of gluon saturated initial condition models. Local light and strange quark production during the hydrodynamic phase is simulated through the evolution of time-dependent fugacities for each quark flavor, with the timescales set as free parameters to compare different rates of equilibration. This impacts the system through the equation of state, which we have constructed to depend on the quark flavor content throughout the medium evolution.

In this contribution, we present for the first time the results of complete heavy ion collision simulations using this partial chemical equilibrium model. We find that hadronic and electromagnetic observables are sensitive to the quark equilibration times, and discuss the observed effects. We also examine the impact of quark chemical equilibration on the transport properties of the QGP, and present the framework for a Bayesian model-to-data comparison that will simultaneously constrain the equilibration times and transport coefficients of the QGP.

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