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Bayesian constraints on flavor equilibration in the quark-gluon plasma

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Most current initial condition models for ultra-relativistic heavy-ion collisions assume an initial state based on gluon saturation, such as IP-Glasma and EKRT. However, conventional hydrodynamics models rely on an assumption of chemical equilibrium between quarks and gluons, even though the timescales of equilibration remain an open question. Here we test this equilibrium assumption, using Bayesian parameter estimation to quantitatively extract the timescales of light and strange flavor production from experimental data produced at RHIC and the LHC.

In our model, we initialize the QCD medium in a gluon dominated state, with the light and strange quark fugacities at hydrodynamization left as free parameters. Local quark production during the hydrodynamic phase is simulated through the evolution of these time-dependent fugacities for each quark flavor, which dynamically modify the equation of state according to the medium's flavor composition. Using this framework, we present here the first Bayesian analysis that simultaneously constrains the light and strange fugacities at hydrodynamization, their equilibration timescales, and the transport coefficients of the QGP.

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