Contribution ID: **134** Type: **Oral**

Quantum to classical parton evolution in the QGP

Tuesday 5 September 2023 12:40 (20 minutes)

We study the time evolution of the density matrix of a high energy quark in the presence of a dense QCD background that is modeled as a stochastic Gaussian color field. At late times, we find that only the color singlet component of the quark's reduced density matrix survives the in-medium evolution and that the density matrix becomes asymptotically diagonal in both transverse position and momentum spaces. In addition, we observe an accelerated entropy growth due to the larger phase space being explored by the quark and that the quantum and classical quark entropies converge at late times. We further observe that the quark state loses all memory of the initial condition. Combined with the fact that the reduced density matrix satisfies Boltzmann-diffusion transport, we conclude that the quark reduced density matrix can be interpreted as a classical phase space distribution. Finally, we comment on how this approach can offer a generic way to study parton evolution in the QGP and establish a strong connection to initial stage physics.

Category

Theory

Collaboration (if applicable)

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Session Classification: Jets

Track Classification: Jets