



Contribution ID: 160

Type: Oral presentation

Heavy quark diffusion in an overoccupied gluon plasma

Friday 30 July 2021 06:00 (15 minutes)

We extract the heavy quark diffusion coefficient κ and the resulting momentum broadening $\langle p^2 \rangle$ of a heavy quark embedded in a far-from-equilibrium gluon plasma using classical-statistical lattice simulations. We find several features in the time dependence of the momentum broadening: a short initial rapid growth of $\langle p^2 \rangle$, followed by linear growth with time due to Langevin-type dynamics and damped oscillations around this growth at the plasmon frequency. We show that these novel oscillations are not easily explained using perturbative techniques but result from an excess of gluons at low momenta. These oscillations are therefore a gauge invariant confirmation of the infrared enhancement we had previously observed in gauge-fixed correlation functions. We argue that the kinetic theory description of such systems becomes less reliable in the presence of this IR enhancement.

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Session Classification: QCD at nonzero Temperature and Density

Track Classification: QCD at nonzero Temperature and Density