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Nonperturbative excitations in overoccupied gluon plasmas

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Motivated by the early-time dynamics of the quark-gluon plasma in high-energy heavy-ion collisions, we extract gluonic spectral functions of overoccupied gauge theories far from equilibrium using classical-statistical lattice simulations. In 3+1 dimensions we find that the spectral function exhibits quasiparticle excitations at all momenta that are mostly consistent with perturbative hard-thermal loop predictions, while partially showing nonperturbative deviations. In contrast, the structure of excitations in 2+1 dimensions is nontrivial and nonperturbative. These nonperturbative interactions lead to broad excitation peaks in the spectral function, demonstrating the absence of soft quasiparticles in these theories.

Primary authors: BOGUSLAVSKI, Kirill (Vienna University of Technology (AT)); KURKELA, Eero Aleks (University of Stavanger (NO)); LAPPI, Tuomas (University of Jyvaskyla); PEURON, Jarkko (Lund University)

Presenter: BOGUSLAVSKI, Kirill (Vienna University of Technology (AT))

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