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Quark production far from equilibrium

We show that quantum effects dramatically enhance the production of quarks during nonequilibrium bosonic instabilities. Standard semi-classical descriptions based on the Dirac equation with a homogeneous background field fail to describe nonequilibrium fermion production in presence of non-perturbatively high boson occupation numbers. Our analysis goes beyond this approximation by taking into account quantum corrections including scattering and decay processes, as well as off-shell and memory effects. This is done in a quark-meson model by using two-particle irreducible (2PI)
effective action techniques, which we compare to results from real-time lattice simulations. As a consequence fermions rapidly approach a quasi-stationary distribution with a thermal occupancy in the infrared, while bosons enter a turbulent scaling regime. We also illustrate the transition between a quasi-particle like excitation spectrum towards a strongly correlated medium.

Primary authors: GELFAND, Daniil (TU Darmstadt); Dr PRUSCHKE, Jens (TU Darmstadt); Prof. BERGES, Jürgen (TU Darmstadt)

Presenter: GELFAND, Daniil (TU Darmstadt)

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