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Formation of a transient Bose-Einstein condensate in the strong coupling regime

In relativistic heavy-ion collisions,
the initial state of the matter formed after the collision can be overpopulated due to the gluon saturation.
Recent simulations based on the kinetic theory or the classical statistical approach suggest that the Bose-Einstein condensate is created at a transient stage of the dynamics.
While these results make sense for weakly interacting systems,
the gauge coupling constant is no longer small for the realistic heavy-ion collisions.
Therefore, it is interesting to explore the dynamics of the overpopulated system in a strong coupling regime.

In this study, we investigate the far-from-equilibrium dynamics of strongly interacting systems based on the two-particle irreducible formalism.
As a first step, we consider the time evolution of the particle distribution function of the $O(N)$-symmetric scalar field theory within the next-leading order approximation of the $1/N$-expansion.

When the initial state is underpopulated, we found that the distribution function approaches toward the Bose-Einstein(BE) distribution with negative chemical potential before it converges to the BE distribution with zero chemical potential.
In contrast to the underpopulated case, overpopulated distributions lead to the condensation of soft modes on top of the Bose-Einstein distribution with positive chemical potential.

Preferred Track

Initial State Physics and Approach to Equilibrium

Collaboration

Not applicable

Primary author: TSUTSUI, Shoichiro (Kyoto University)

Presenter: TSUTSUI, Shoichiro (Kyoto University)

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