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Gluon transport equation in the small-angle approximation and the onset of Bose-Einstein condensation

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To understand the evolution of a dense system of gluons, such as those produced in the early stages of ultra-relativistic heavy ion collisions, is an important and challenging problem. We describe the approach to thermal equilibrium using the small angle approximation for gluon scattering in a Boltzmann equation that includes the effects of Bose statistics. The role of Bose statistical factors in amplifying the rapid growth of the population of the soft modes is essential. With these factors properly taken into account, one finds that elastic scattering alone provides an efficient mechanism for populating soft modes, and in fact leads to rapid infrared local thermalization.

Furthermore recent developments suggest that high initial overpopulation plays a key role and may lead to dynamical Bose-Einstein Condensation. The kinetics of condensation is an interesting problem in itself. By solving the transport equation for initial conditions with a large enough initial phase-space density the equilibrium state contains a Bose condensate, and we present numerical evidence that such over-populated systems reach the onset of Bose-Einstein condensation in a finite time. It is also found that the approach to condensation is characterized by a scaling behavior. Finally we discuss a number of extensions of the present study.

Reference: Blaizot, Liao, McLerran, Nucl. Phys. A920(2013)58.

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