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Nonperturbative Particle Production in Boost-Invariantly Expanding Electric Fields and Two-Particle Correlations

Nonperturbative particle production via the Schwinger mechanism has been studied as a mechanism of matter formation in the context of heavy-ion collisions. In the color flux model, the generation of longitudinal color-electric fields between two Lorentz-contracted nuclei receding from each other has been assumed. These electric fields polarize the vacuum and produce quarks and gluons. Also in the framework of the color glass condensate, the formation of longitudinal electric fields and longitudinal magnetic fields as well has been predicted. One of characteristics of these electric fields is its boost-invariance in the longitudinal beam direction. In an ideal situation where two nuclei run at exactly the speed of light, the electric fields span only inside the forward light cone and their configuration is symmetric under the longitudinal boost transformation.

We study the dynamics of nonperturbative particle pair creation in such boost-invariantly expanding electric fields. The proper-time evolution of momentum distributions of created particles, which preserve the boost invariance of the background field, will be presented. The particles have the same velocity distributions as the flow velocity of the Bjorken flow from the first instance they are created.

We will also present the results on the calculation of the two-particle correlation between particles produced in the boost-invariant field. The correlation is short-range with respect to the transverse momentum, which originates in the Bose-Einstein correlation, and is long-range with respect to the longitudinal rapidity. This long-range rapidity correlation arises because the particles are created not as an eigenstate of a longitudinal momentum, which violates the boost-symmetry, but as a superposition of several momentum modes preserving the boost-symmetry.

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