Thermal charm production in quark-gluon plasma at LHC

B. W. Zhang,[1] C. M. Ko, and W. Liu
[1]*Institute of Particle Physics, Central China Normal University, Wuhan 430079, China*

Modeling central heavy ion collisions at the Large Hadron Collider (LHC) at CERN by a schematic longitudinally boost invariant and transversely expanding fire-cylinder of quark-gluon plasma, we have evaluated the number of thermally produced charm quark pairs at next-to-leading-order in QCD. With an initial temperature of 700 MeV for an equilibrated quark-gluon plasma at an initial proper time of 0.2 fm/c and a charm quark mass of 1.3 GeV, we have obtained about 30% enhancement in the production of charm quarks than that produced directly from initial hard collisions, which is taken to be 20 pairs at midrapidity, as shown in Fig. 1. About equal contributions are obtained from the leading order and the next-leading order processes. This result is, however, sensitive to the initial conditions for the produced quark-gluon plasma and the charm quark mass. The enhancement is increased to about 80% if the initial temperature is increased to 750 MeV, but it is reduced to about 10% if the initial temperature is 630 MeV. Delaying the proper time at which a thermalized quark-gluon plasma is formed does not affect much thermal charm quark production as the effect due to decreased initial temperature is compensated by that from the increased volume of the quark-gluon plasma. With a larger charm quark mass of m_c = 1.5 GeV, thermal charm quark production from the quark-gluon plasma becomes unimportant.

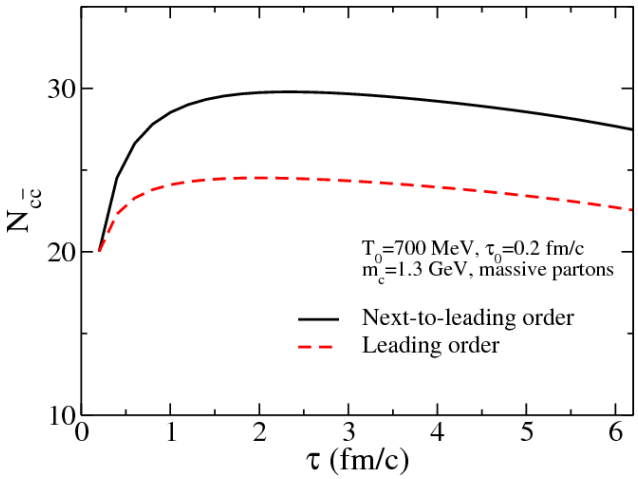

Figure 1. Number of charm pairs as a function of proper time in central Pb+Pb collisions at $s^{½}_{NN}$=5.5 TeV in the leading order (dashed line) and the next-to-leading order (solid line) in QCD.

[1] B. W. Zhang, C. M. Ko, and W. Liu, Phys. Rev. C **77**, 024901 (2008).