Heavy ion collisions at LHC in a multiphase transport model

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To predict what one might observe in Pb+Pb collisions at $s^{1/2}{}_{NN}$=5.5 TeV that will soon be available at the Large Hadron Colliderr (LHC), we have used a multiphase transport (AMPT) model that includes scattering in both initial partonic and final hadronic matters and the transition between these two phases of matter. Using a large parton scattering cross section of 10 mb, which is needed to describe observations in Au+Au collisions at $s^{1/2}{}_{NN}$=200 GeV at the Relativistic Heavy Ion Collider (RHIC), we have studied the rapidity distributions and transverse momentum spectra of various hadrons, the elliptic flows of both light and heavy quarks as well as resulting hadrons from coalescence of quarks and antiquarks, and the two-pion correlation functions as well as the emission source function. For rapidity distributions, the total charge multiplicity in central Pb+Pb collisions at LHC is almost a factor of three larger than in central Au+Au collisions at RHIC. This value may, however, subject to large uncertainty due to the nucleon structure functions at small *x* that is used in the model. Compared to those at RHIC, hadron transverse momentum spectra show even larger effective inverse slope parameters as a result of stronger collective transverse flow. For non-central collisions, the elliptic flows of quarks at LHC are stronger than those at RHIC. Although their values at low transverse momentum decrease with the masses of quarks, they reach similar peak values at higher transverse momenta. Using the quark coalescence model, the elliptic flows of hadrons including those consisting of heavy quarks can be related to those of quarks and thus provide the possibility to study the partonic dynamics in the collisions. From the emission function of pions in the AMPT model, two-pion correlation functions have been evaluated and are found to be smaller than those at RHIC. As at RHIC, the emission source is non-Gaussian in space and time. It shifts significantly to the direction along the pion transverse momentum and also has a strong correlation between this displacement and the emission time, leading to a radius in the direction along the pion momentum that is only somewhat larger than the radius in the direction that is perpendicular to the pion momentum and the beam direction. All radii of the emission source at LHC are, however, larger than those at RHIC. The emission function from the AMPT model also allows one to calculate the pair separation function of the source and to compare with the empirical one extracted from measured correlation function by the imaging method.

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