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Charm production in the Parton-Hadron-String-Dynamics (PHSD) model *

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Heavy flavor is one of the important probes to investigate the properties of the hot dense nuclear matter created in relativistic heavy-ion collisions.

Since charm quark production requires high energy-momentum transfer, the number of produced charm quark pairs in relativistic heavy-ion collisions is proportional to the number of binary nucleon-nucleon collisions. Whether two nucleons collide or not in heavy-ion collisions is decided by the nucleon-nucleon inelastic cross section in geometrical method. From the binary collisions, we choose events which produce a charm quark pair by using Monte Carlo method, based on the cross section for charm quark-pair production. Furthermore, we employ Pythia event generator to generate the energy-momentum of charm quark pairs as shown in figure 1.

The produced charm quarks interact with partons in the quark-gluon plasma. We use the cross sections for the scattering of a heavy quark on the off-shell quarks and gluons (of the QGP) whose masses and widths are given by the Dynamical Quasi-Particle Model (DQPM) which reproduces the lattice QCD equation-of-state [1]. Once the local energy density is lower than a critical value (≈ 0.5 GeV/fm^3), the charm quark is hadronzied into a D meson either through fragmentation or through coalescence. The former process is favored by high-$\mathrm{p_T}$ charm quarks and the latter one by low-$\mathrm{p_T}$ charm quarks. We assume that the probability for coalescence is suppressed in Gaussian form, if the $\mathrm{p_T}$ of charm quark is larger than charm quark mass. Hadronized D mesons interact with other hadrons by using the scattering cross sections calculated in a chiral effective lagrangian model where the parameters are fitted to D meson and charmed baryon resonances.

Finally the nuclear modification factor, R_{AA}, is calculated as the number of D mesons produced in heavy-ion collisions divided by that in p+p collisions times the number of binary collisions in heavy-ion collisions as shown in figure 2 for different centralities.

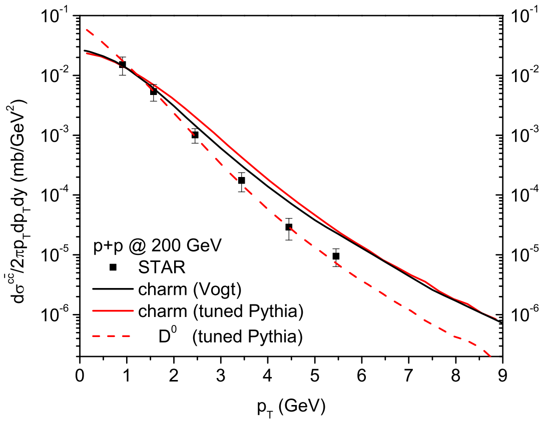

Figure 1: $\mathrm{p_T}$ spectra of charm quarks and D mesons from the tuned Pythia simulations compared with FONLL results by Vogt and that of D mesons from the STAR Collaboration.

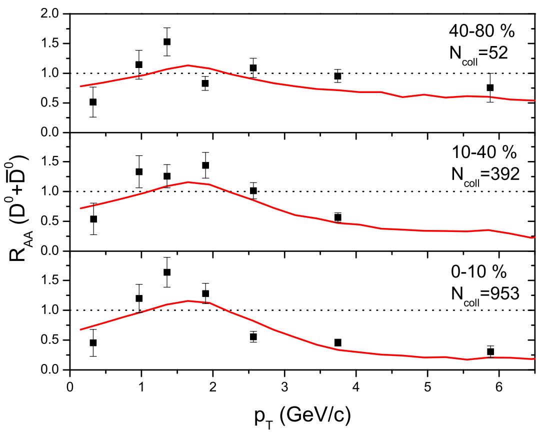

Figure 2: R_{AA} of D mesons from the PHSD simulations in comparison with the experimental data from the STAR Collaboration for Au+Au collisions at $\sqrt{s_{\mathrm{NN}}}$ =200 GeV.

References

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* Work supported by HIC4FAIR/DFG.

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DOI:10.15120/GR-2015-1-MU-THEORY-23