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# Study of transverse momentum spectra and nuclear modification factors of Heavy Hadrons in Au+Au collision at centre-of-mass energy of 200 GeV.

In ultrarelativistic heavy-ion collisions, a hot and dense state of deconfined color-conducting matter, known as Quark-Gluon Plasma, is produced at extremely high temperature and density. This state allows the exploration of Quantum Chromodynamics properties. In particular, Heavy quarks are primarily produced in the initial hard scattering and traverse the QGP throughout its evolution. As a result, heavy quarks serve as essential probes for examining the pre-equilibrium phase and the transport properties of dense nuclear matter, using perturbative calculations of their production cross-sections. Some key observables for studying the QGP medium include the transverse momentum ($p_T$) distributions and nuclear modification factors ($R_{AA}$ and $R_{CP}$) of final-state hadrons. In this study, we employed the Monte Carlo based HYDJET++ event generator to simulate the production of heavy hadrons ($D^0$, $\bar{D}^0$, $\Lambda_c$, $D^+$, and $D^-$ ) in Au+Au collision at $\sqrt{s_{NN}}$ = 200 GeV. We analyzed $p_T$ spectra and observed that the slope of the $p_T$ spectra decreases from the peripheral collisions to central collisions, indicating a higher temperature in central collisions, which is consistent with STAR experimental data. The HYDJET++ model reproduces experimental results well at low and intermediate $p_T$; however, at high $p_T$, it overestimates the data. Further insights are gained by analyzing the nuclear modification factors. The observed suppression in $R_{AA}$ at high $p_T$ is attributed to radiative energy loss within the QGP, and this suppression weakens in peripheral collisions due to the smaller overlap region of the colliding nuclei. At low $p_T$ , a slight suppression is observed, likely due to the coalescence of heavy quarks with in-medium constituents. Similarly, $R_{CP}$ reflects the centrality dependence of energy loss effects. This behaviour of $R_{AA}$ and $R_{CP}$ matches the experimental data well. Overall, this study highlights the capability of the HYDJET++ model in describing charm hadron production, the centrality dependence of momentum distributions, and the energy loss effects in heavy-ion collisions.

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