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Extracting jet transport coefficient via single hadron and dihadron productions in high-energy heavy-ion collisions

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We study [1] the suppressions of high transverse momentum single hadron and dihadron productions in high-energy heavy-ion collisions based on the framework of a next-to-leading-order perturbative QCD parton model combined with the higher-twist energy loss formalism [2,3]. Our model can provide a consistent description for the nuclear modification factors of single hadron R_{AA} and dihadron I_{AA} in central and non-central nucleus-nucleus collisions at RHIC and the LHC energies.

We quantitatively extract the value of jet quenching parameter $\hat{q}$ via a global χ^2 analysis, and obtain the scaled jet quenching parameter $\hat{q}/T^3 = 4.1 \sim 4.4$ at $T = 378$ MeV for 0.2 TeV Au+Au collisions and $\hat{q}/T^3 = 2.6 \sim 3.3$ at $T = 486$ MeV for 2.76 TeV Pb+Pb collisions, which are consistent with the results from JET Collaboration [4]. We also get the $\hat{q}/T^3 = 2.5$ at $T = 516$ MeV for 5.02 TeV Pb+Pb collisions, $\hat{q}/T^3 = 3.5$ at $T = 469$ MeV for 5.44 TeV Xe+Xe collisions only via single hadron productions and provide the predictions for the dihadron I_{AA} of these two collisions. The above numerical analysis shows that $\hat{q}/T^3$ has some temperature dependence: it decreases as one increases the temperature, which can be understood as decreasing jet-medium interaction strength with increasing temperature.

Here are some other interesting results that the dihadron I_{AA} are typically larger than single hadron R_{AA} given the same nucleus-nucleus collision conditions and the values of I_{AA} also increase as one increases the trigger hadron p_T. These results can be explained by that high p_T single hadrons mainly come from surface bias emission jets, while high p_T dihadrons come from a combination of surfacial and tangential jets as well as punching-through jets [5,6]. And with increasing trigger hadron p_T, the contribution from punching-through jets increases [7]. On average in a A + A event, the total energy loss for jets in the surface bias case is larger than in the case with punching-through jets.

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