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Exploring different high-$p_\perp$ parton energy loss scenarios in pre-equilibrium QCD matter

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The pre-equilibrium stage of quark-gluon plasma remains one of the major sources of uncertainty in studies of heavy ion collisions, which became a prominent research problem in heavy ion community. Major efforts regarding this problem are made in low-$p_\perp$ sector. We here instead propose [1] to utilize high-$p_\perp$ particles energy loss, as a complementary tool, to elucidate these early stages.

To this end, we employ our recently developed DREENA-B framework, which is based on our sophisticated dynamical energy loss formalism, where temperature is an intrinsic input/parameter. It also considers a simple Bjorken medium evolution, which is highly suitable for analytically exploring different energy loss scenarios. Within this, we test four distinct cases, ranging from none to infinitely large energy loss in pre-equilibrium stage. In particular, we test: 1) free-streaming case; 2) linear case, corresponding to linearly increasing temperature with time; 3) constant case, with constant pre-equilibrium temperature; and 4) divergent case, corresponding to Bjorken expansion from the beginning. Thus obtained high-$p_\perp$ R_{AA} and v_2 predictions for $h^\pm$, D and B mesons are compared with 5.02 TeV LHC data. Contrary to common expectations, we obtain that high-$p_\perp$ v_2 is unable to distinguish between diverse scenarios, being insensitive to the early stages of medium evolution. R_{AA} is however sensitive to these different cases, and could provide an insight in the early stages' dynamics. However, higher-precision measurements of high-$p_\perp$ R_{AA} are required to allow for more reliable conclusions through this observable.

[1] D. Zigic, B. Ilic, M. Djordjevic and M. Djordjevic, Phys. Rev. C 101, 064909 (2020).

Preferred track

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