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AdS/CFT predictions for azimuthal and momentum correlations of bbbar pairs in heavy ion collisions

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In arxiv:1305.3823v2, the azimuthal correlations of heavy $q\bar{q}$ pairs in a weakly coupled plasma in Pb+Pb collisions ($\sqrt{s} = 2.76$TeV) were studied, both for a model involving purely collisional energy loss and one additionally incorporating radiative corrections.
These weak coupling based azimuthal correlations provide a secondary indicator for the momentum correlations and we compare them with computations from an AdS/CFT correspondence exploiting energy loss model sensitive to thermal fluctuations, the latter already having been introduced in arxiv:1501.04693.
As in arxiv:1501.04693, we probe the spectrum of reasonable AdS/CFT based energy loss models with two plausible 't Hooft coupling constants ($\lambda_1 = 5.5$ & $\lambda_2 = 12\pi\alpha_s \approx 11.3$ with $\alpha_s = 0.3$) with the additional requirements that, for the former, temperature and the Yang-Mills coupling are equated, while in the latter case, energy density and the coupling are equated.
The calculations are performed for the same transverse momentum classes as in arxiv:1305.3823v2 and also both with leading order and next-to-leading order production processes used for the initialisation.
Additionally, we consider momentum correlations that take initial momentum correlations into account.

When restricted to leading order production processes, we find that the strongly coupled correlations of high transverse momentum pairs (> 4GeV) are broadened less efficiently than the corresponding weak coupling based correlations, while low transverse momentum pairs (1-4GeV) are broaded with similar efficiency, but with an order of magnitude more particles ending up in this momentum class. The strong coupling momentum correlations we compute account for initial correlations and reveal that the particle pairs suppressed from intially high momenta to the low momentum domain do not suffice to explain the stark difference to the weak coupling results in momentum correlations for 1-4GeV.
From this, we conclude that heavy quark pairs are more likely to stay correlated in momentum when propagating through a strongly coupled plasma than a weakly coupled one.

The next-to-leading order initialisation is performed using the aMC@NLO framework with Herwig++ as the event generator. Compared with the leading order initialisation, we observe significant broadening of the azimuthal correlations, and they are almost entirely washed out for low momentum pairs (1-4GeV).

Summary

A key step in understanding the quark gluon plasma is identifying its relevant coupling strength. Finding observables that can distinguish between weakly and strongly coupled plasmas is thus very desirable. In this light, we compare the azimuthal and momentum correlations of $b\bar{b}$ pairs in Pb+Pb collisions ($\sqrt{s} = 2.76$TeV) of pQCD calculations and an AdS/CFT based energy loss model sensitive to thermal fluctuations. By accounting for initial momentum correlations as well, we gain further insight into the inherent differences in dynamics between the models.
Finally, we demonstrate that low momentum correlations (1-4GeV) serve as a potential distinguishing observable between weakly and strongly coupled plasmas.

Presentation type

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