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Constraining mechanisms of jet-medium interaction via simultaneous studies of energy loss and angular broadening effects

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Energetic heavy quarks passing through the hot and dense medium of a quark-gluon plasma (QGP), represented by the resulting mesons, are viewed as a suitable probe for the interactions inside of the QGP, in particular the mechanisms of energy loss, as they are less likely to thermalize within the medium and are mostly created at early stages of the medium evolution.
However, models of both, purely collisional energy loss as well as combinations of collisional and radiative energy loss are equally successful for reproducing the nuclear modification factor R_{AA} and the elliptic flow v_2 [1]. To make progress for identifying the reaction mechanism, an alternative observable, the angular correlations between two mesons were investigated, in an attempt to discriminate between the two different mechanisms. Azimuthal correlations between pairs of heavy mesons, like D-$\bar{D}$ pairs, allow for distinguishing the energy-loss scenarios [2].

We continue these studies by investigating the angular correlations between pairs of heavy and light mesons (D and π), originating from a heavy quark jet. This is motivated
by the fact that the emitted gluon in radiative collisions hadronizes and these hadrons are correlated to the emitting heavy quark.
For this study we created a Monte-Carlo code for the parton splitting in the vacuum together with an effective medium model.
This program represents a consistent framework to study the influences of either collisional or radiative processes (as well as combinations thereof) on parton propagation, and, thus, on the correlations between the final mesons.
In particular, we focused on the angular broadening effects that result from the different types of jet-medium interaction – effects that are reflected by corresponding jet-observables as well: As new data for jet-shapes became available [3] this allowed for comparisons of the different effective models of in-medium energy loss with the experiment.

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[2] M. Nahrgang, J. Aichelin, P. B. Gossiaux and K. Werner,
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[arXiv:1310.2218 [hep-ph]].

[3] CMS Collaboration, CMS-PAS-HIN-16-020.

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