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Heavy flavour momentum correlations and suppression at RHIC and LHC via AdS/CFT

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We derive a diffusion coefficient for heavy quarks in a strongly-coupled plasma using the AdS/CFT correspondence. Crucially, unlike some prior calculations, our novel diffusion coefficient does not increase with heavy quark velocity: instead, we find that the effect of momentum fluctuations smoothly interpolates between light and heavy flavours. Taking our diffusion coefficient derivation as fundamental, we use the fluctuation-dissipation theorem to predict a strong-coupling heavy quark drag that differs slightly from the original calculations of Gubser and Herzog et al.
We then show numerical work that supports the key assumptions made in our analytic derivation. Incorporating our heavy flavour drag and diffusion into an energy loss model, we compare with pQCD predictions of Nahrgang et al. at the partonic level, and with suppression data from LHC for heavy flavour observables.
The partonic momentum correlations exhibit an order of magnitude difference in low momentum correlations to the pQCD calculations. We thus propose heavy flavour momentum correlations as a distinguishing observable of weakly- and strongly-coupled energy loss mechanisms.
For the LHC predictions, our numerical framework interfaces with FONLL for LO production, and Herwig++ and Pythia8 for NLO production. Our LHC suppression predictions are in good agreement with data from both ALICE and CMS, when accounting for the physics missing in each particular framework combination.

Collaboration name

Track

Heavy Flavour

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