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An EEC Way to See the Interplay Between Elastic Scatterings and Jet Wakes

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Quark gluon plasma (QGP), when viewed at length scales of order the inverse of its temperature, behaves as a strongly coupled liquid. However, when it is probed at shorter length scales or with sufficiently high momentum transfer, asymptotic freedom mandates the presence of quark-like and gluon-like quasi-particles. High energy partons within jets can trigger these high-momentum exchanges, making jets valuable probes for revealing the presence of such quasi-particles. In this talk, we describe an implementation of such elastic scatterings within the hybrid strong/weak coupling model. High-energy partons in jets undergo elastic Molière scatterings with quasi-particles in the medium. A jet parton that scatters is deflected, kicking a medium parton, which recoils. Subsequently, as both of these partons propagate further through the medium they each lose energy and momentum to the medium, producing hydrodynamic wakes in the droplet of QGP. That is, elastic scattering results in modifications to both the parton shower and to the wake that the shower excites in the droplet of QGP.

Energy-energy-correlators (EECs) characterize the substructure of the energy flow within jets. Using two-point and three-point EEC observables we are able to reveal the relevant angular regions at which (modified) parton showers and wakes in the QGP each dominate, offering a new way with which to visualize and constrain the corresponding dynamics. We compare our calculations to recent CMS measurements of two-point EECs of charged-particle tracks in anti-k_t $R = 0.4$ jets. We show that our calculations agree with the CMS measurements only when elastic scattering is included and when the elastically scattered recoil-partons produce their own wakes.

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