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Gradient Jet Tomography in heavy-ion collisions

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Transverse momentum broadening and energy loss of a propagating parton are dictated by the space-time profile of the jet transport coefficient $\hat{q}$ in a dense QCD medium. The spatial gradient of $\hat{q}$ perpendicular to the propagation direction can lead to a drift and asymmetry in parton transverse momentum distribution. Such an asymmetry depends on both the spatial position along the transverse gradient of the dense matter and path length of a propagating parton as shown by numerical solutions of the Boltzmann transport in the simplified form of a drift-diffusion equation. In high-energy heavy-ion collisions, this asymmetry with respect to a plane defined by the beam and trigger particle (photon, hadron, or jet) with a given orientation relative to the event plane is shown to be closely related to the transverse position of the initial jet production in full event-by-event simulations within the linear Boltzmann transport model. Such a gradient tomography can be used to localize the initial jet production position for a more detailed study of jet quenching and properties of the quark-gluon plasma along a given propagation path in heavy-ion collisions.

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