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Kinematic description for Ridge behavior in small systems

The Ridge behavior in high-multiplicity proton-proton collisions has been debated a lot since it was first discovered. However, small systems like proton-proton collisions are not enough to provide a hot and dense medium called Quark-Gluon Plasma (QGP) in which the Ridge behavior is explained with hydrodynamic flows. In this study, we devise the pure kinematic model on interaction between jet particles and medium partons to understand the Ridge behavior; During the passage of jet particles through the medium partons, the momentum transferred from the jet particles to the medium partons causes the medium partons to align along the direction of the jet particles'motion. This alignment results in a collective motion of the medium partons, which might contribute to the observed Ridge behavior in small system collisions.
Our model requires information on the initial states to calculate cross-section, hence we employ the Parton Distribution from the hard scattering model (PDh) as a distribution function for the initial medium partons' momentum. The PDh has three free parameters: the fallout parameter, α associated with the shape of the rapidity distribution; the non-extensive parameter, β related to the fine shape of the rapidity and transverse momentum distribution; and the temperature of the system, T connected with the scales of the rapidity and transverse momentum distributions. We choose values for these free parameters by comparing PYTHIA8-string shoving simulation for proton-proton collisions at $\sqrt{s}$=13 TeV with high-multiplicity events.
Also, we set up the initial conditions for jet particles with 10 GeV entering at 0°. Then, calculate the cross-section for various jet particles' energy losses and outgoing angles, respectively. The scales of these cross-sections are inversely proportional to both the energy losses and outgoing angles, and these results affect shapes of correlations significantly. In practical scenarios, the cross-section needs to be integrated for various energy losses and outgoing angles of jet particles, employing the adopted weighting functions for each, based on the experimental results. The results show Ridge behavior, manifested as a shoulder on the near side and a flat structure on the away side. Additionally, we obtain a value of v2 ranging between 0.025 and 0.045.

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