Contribution ID: **367** Type: **Poster**

Understanding Ridge behavior via kinematics between jets and medium

Tuesday 5 September 2023 17:30 (2h 10m)

The Ridge behavior in high-multiplicity proton-proton collisions has been discussed a lot since it was first reported. However, small systems like proton-proton collisions are not enough to generate a medium called Quark-Gluon Plasma (QGP) in which the Ridge behavior is explained with high-order flows. In this work, we suggest the pure kinematic mechanism between jets and medium partons as tools for understanding the Ridge behavior; during jets passing through the medium, the momentum transferred from jets to medium partons makes the medium partons aligned along the direction of jets'motion. It produces a collective motion of the medium, which is in charge of the Ridge behavior in small system collisions.

We adopt Parton Distribution from the hard scattering model (PDh) as a distribution function for initial medium partons'momentum. The PDh is parameterized by a fallout parameter, a, a non-extensive parameter, q, and the temperature of the system, T; a decides the shape of rapidity distribution and q affects rapidity and transverse momentum distribution. And T is related to scales of rapidity and transverse momentum distributions. We choose values of these free parameters by comparing PYTHIA8-string shoving simulation for pp collisions at $\sqrt{s} = 13\mathrm{TeV}$ with high-multiplicity.

We set the initial conditions that jet particles with $10\mathrm{GeV}$ lose their energy by $1\mathrm{GeV}$ while interacting with medium partons through bremsstrahlung. Then, we calculate the cross-section with various outgoing angles of jet particles using PDh and derive the two-particle angular correlation from this. We find out that the Ridge like behaviors appear when the outgoing jets'angle gets smaller. To integrate over the scattering angles, we calculate the cross-sections for several angles within the jet radius of 0.4 and sum them over with the weights, which are from the experimental data. We calculate the correlation and find that Ridge like behaviors exist in pp collision, compared to the experimental data. We also find v_2 within 0.025 ~ 0.045, consistent with the experimental result.

Category

Theory

Collaboration (if applicable)

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Session Classification: Poster Session

Track Classification: Collective Dynamics