Abstract

Fluctuations in the multiplicity of particles produced in relativistic nuclear collisions influence many multi-particle correlation measurements. In each nuclear collision, the number of produced particles fluctuates because the number of particle sources fluctuates, and the number of particles emerging from each source also fluctuates. Further, we expect that jet and thermal source models of particle production should produce different fluctuation patterns. We search for a method to categorize collision events by the regions of phase space that provide the largest contribution to multiplicity fluctuations. In particular, we seek to develop a method for comparison of different collision systems including proton-proton, proton-nucleus, and nucleus-nucleus collisions.

Two-Particle Correlations

The Two-Particle Correlation Function

\[ r(p_1, p_2) = \frac{\rho_1^2 - \rho_1 \rho_2}{\langle N \rangle} \]

Multiplicty Fluctuations

\[ \mathcal{R} = \frac{\langle N(N-1) \rangle - \langle N \rangle^2}{\langle N \rangle^2} \]

Related Two-Particle Correlations

See poster 313 by Brendan Koch about two-particle correlations and partial thermalization.

Transverse Momentum Correlations

\[ C = \frac{1}{\langle N \rangle^2} \int p_1 p_2 r(p_1, p_2) d^3 p_1 d^3 p_2 \]

Can be used to extract estimates of shear viscosity and shear relaxation time.

Gavin, Moschelli, Zin, Phys. Rev. C 95 (2017) no. 6, 064901

Correlations of Transverse Momentum Fluctuations

\[ \delta p_{T1} \delta p_{T2} = \frac{1}{(N-1)} \int p_1 p_2 \rho_1(p_1, p_2) d^3 p_1 d^3 p_2 \]

\[ \delta p_{T1} = \rho_{T1} - \langle \rho_T \rangle \]

Can be used to test thermal equilibrium.

Gavin, Moschelli, Zin, Phys. Rev. C 95 (2017) no. 6, 064901

Momentum-Multiplicity Correlations

\[ D = \frac{1}{\langle N \rangle^2} \int p_1 p_2 \rho_1(p_1, p_2) d^3 p_1 d^3 p_2 \]

\[ \langle p_T \rangle = \frac{\langle N \rangle \rho_1}{(N)} \]

\[ \langle p_T \rangle = \frac{\rho_1}{(N)} \frac{1}{p_T} \int p_1 p_2 \rho_1(p_1, p_2) d^3 p_1 d^3 p_2 \]


See poster 312 by Mark Kocherovsky about the influence of jets on C.

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