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Complementary Two-Particle Correlation Observables for Relativistic Nuclear Collisions

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Two-particle correlations are a widely used tool for studying relativistic nuclear collisions. Multiplicity fluctuations have been studied as a possible signal for QGP and the QCD critical point. Momentum correlations and covariances of momentum fluctuations, which arise from the same correlation function, have also been used to extract properties of the nuclear collision medium such as the shear viscosity to entropy density ratio, the shear relaxation time, and temperature fluctuations. We derive a mathematical relationship between several number and momentum density correlation observables and outline the different physics mechanisms often ascribed to each. This set of observables also contains a new multiplicity-momentum correlation. Our mathematical relation can be used as a validation tool for measurements, as a method for interpreting the relative contributions of different physics mechanisms on correlation observables, and as a test for theoretical and phenomenological models to simultaneously explain all observables. We compare an independent source model to simulated events from PYTHIA for all observables in the set.

Authors: Prof. MOSCHELLI, George (Lawrence Technological University); KOCHEROVSKY, Mark (Lawrence Technological University); GAVIN, Sean (Wayne State University); Mr MAZLOUM, Zoulfekar (Wayne State University)

Presenter: Prof. MOSCHELLI, George (Lawrence Technological University)

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