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Probing the initial conditions of ultra-relativistic nuclear collisions at the LHC with multi-particle cumulants of transverse momentum

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The primary goal of the ultrarelativistic heavy-ion collision program at the LHC is to recreate the quark-gluon plasma (QGP) and study its properties. However, the lack of knowledge on the initial conditions of heavy-ion collision results in a significant uncertainty of the extraction of the transport properties of QGP. Recently, it has been realized that the generation of transverse momentum is sensitive to the initial conditions, including the size and the initial shape, in terms of the deformation parameter of the colliding nucleus. In this contribution, we propose that multi-particle cumulant of mean transverse momentum p_{T} as a powerful probe of initial conditions in relativistic nuclear collisions. This study is based on establishing a whole new generic algorithm of multi-particle cumulants of mean transverse momentum. It significantly extends the current study to very higher-order cumulants that have never been investigated before. We will present the first Monte Carlo calculations using AMPT transport model to illustrate the implications of this new tool to probe the initial conditions. In addition, based on PYTHIA model simulations, we will show how to eliminate the trivial few-particle transverse momentum correlations that will potentially bias future experimental measurements at the LHC.

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