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Effect of hydrodynamic fluctuations on mixed harmonic cumulants at the LHC

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We analyze the effect of hydrodynamic fluctuations on normalized mixed harmonic cumulants ($nMHC$) [1,2] for the first time based on event-by-event simulations of high-energy heavy-ion collisions using an integrated model of an initial state model, stochastic causal fluctuating hydrodynamics, and a hadronic afterburner.

For the quantitative constraints on the transport properties of quark-gluon plasma (QGP) and the initial-state models, it is important to compare various flow correlations from dynamical models to data. Recently, $nMHC$ was shown to be useful in constraining theoretical models [3]. Meanwhile, we have shown that hydrodynamic fluctuations affect the longitudinal factorization ratio $r_n(\eta_a, \eta_b)$ [4] and can reproduce the experimental centrality dependence with initial longitudinal fluctuations [5]. However, it is non-trivial how the hydrodynamic fluctuations affect the constraints on the QGP properties through various flows and correlations.

In this talk, we investigate the effect of hydrodynamic fluctuations on $nMHC$ in $\sqrt{s_{\mathrm{NN}}}$=2.76 TeV Pb+Pb collisions. We combine the `TRENTo` initial conditions and the `UrQMD` afterburner used in Refs. [3,6] with relativistic fluctuating hydrodynamics `rfh` [6]. We first compare the results with and without hydrodynamic fluctuations and see the effect. We next consider different temperature dependencies of viscosity. We find that the hydrodynamic fluctuations tend to decrease $nMHC$, which is because they de-correlate initial correlations. In particular, $nMHC(v_2^2, v_3^2)$ is sensitive to the hydrodynamic fluctuations but almost insensitive to the viscosity. We also discuss the effect of the rapidity gap. We argue that $nMHC$ is useful for identifying the effect of hydrodynamic fluctuations and is a key to properly constraining the theoretical models.

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Category

Theory

Collaboration (if applicable)

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