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Exploring transverse momentum fluctuations via study of $v_0(p_T)$ in the AMPT and PYTHIA model

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Transverse momentum fluctuations serve as a powerful tool for probing the properties and evolution dynamics of the system formed in high energy heavy-ion collisions. Momentum fluctuations are sensitive to the equation of state as well as to the bulk-viscosity of the QCD system. An observable known as $v_0(p_T)$ which quantifies the momentum fluctuations has been suggested to measure in experiments as it is strongly correlated with the fluctuations in the entropy per area, thereby providing a new handle on one of the most important initial state parameters. Hydrodynamic simulations with the hybrid models predict that $v_0(p_T)$ shows a discernible mass hierarchy for pions, kaons, and protons. Recent studies also suggest that measurement of $v_0(p_T)$ could serve as a valuable tool for refining our understanding of the bulk viscosity of the system and the speed of the sound in the medium formed in heavy-ion collisions.

In this work, we study the observable $v_0(p_T)$ in p+p and Au+Au collisions at centre-of-mass energy 200 GeV using the PYTHIA8 and AMPT model, respectively. This study is performed in the kinematic acceptance range of p_T from 0.2 to 5 GeV/c for inclusive charged hadrons and for identified particle species such as pion, kaon, and proton. The observable is calculated in a similar way as the harmonic flow $v_2(p_T)$, using a gap in pseudo-rapidity to reduce non-flow effects. The effect of different hadronisation mechanisms in the models will be investigated. These model results would be useful for the future measurements in heavy-ion collision experiments.

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