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Measurement of Longitudinal Decorrelation of Anisotropic Flow v_2 and v_3 in 54 and 200 GeV Au+Au Collisions at STAR

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The measurement of the decorrelation of flow harmonics, v_n, and event plane angles, Ψ_n, (or flow vector, $V_n \equiv v_n e^{in\Psi_n}$) in the longitudinal direction explores the non-boost-invariant nature of the initial collision geometry and final state collective dynamics. The decorrelations were first observed at the LHC, but are predicted by several (3+1)D hydrodynamic models to be stronger for lower $\sqrt{s_{NN}}$ at RHIC due to the smaller number of initial partons and shorter string length at lower $\sqrt{s_{NN}}$. We report the results from large minimum-bias Au+Au datasets at $\sqrt{s_{NN}} = 200$ GeV (1.2 billion events) and 54 GeV (1 billion events) with the STAR detector. The factorization ratio, $r_n(\eta) = 3D\langle V_n(-\eta)V_n^*(\eta_{\rm ref})\rangle/\langle V_n(\eta)V_n^*(\eta_{\rm ref})\rangle$, is used to measure the decorrelation between η and $-\eta$ relative to a common reference $\eta_{\rm ref}$. Non-flow correlations are suppressed by a large rapidity gap between η from the TPC ($|\eta| < 1$) and the $\eta_{\rm ref}$ from the Forward Meson Spectrometer ($2.5 < \eta_{\rm ref} < 4$). The results are obtained for v_2 and v_3 as a function of transverse momentum and centrality for the two collision energies. They are compared with results from the LHC and calculations from different models. The decorrelations do not scale trivially with the beam rapidity y_{beam}, i.e. $r_n(\eta/y_{beam})$ from different beam energies do not overlap. Hydrodynamic models tuned to the Pb+Pb data at 2760 GeV fail to describe the strength of the decorrelation at 54 and 200 GeV. These results will help to constrain the initial condition along longitudinal direction and help to understand the longitudinal evolution of the fireball.

Content type

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