Longitudinal flow-plane decorrelation from multiple-plane cumulants with STAR

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The systematic variations (monotonic rotation, random walk, etc.) of anisotropic flow planes (Ψ_n) as a function of rapidity, commonly known as flow plane decorrelations, has been studied by measuring the correlations of the four local flow-plane angles from backward, mid, and forward rapidity regions in Au+Au and isobar (Ru+Ru/Zr+Zr) collisions at $\sqrt{s_{_{NN}}} = 200$ GeV. A new cumulant observable $\mathrm{T}^{\Delta\Psi_n^{a\to b}*\Delta\Psi_n^{c\to d}} = \langle\langle \sin[n(\Psi_n^b - \Psi_n^a)]\sin[n(\Psi_n^d - \Psi_n^c)]\rangle\rangle$ proposed by Zhiwan Xu *et al.* in Ref. [1] to probe the genuine longitudinal flow-plane (de)correlation has been measured for the first time using STAR data for the elliptic and triangular anisotropic flow planes (i.e. $n = 2$ and 3). These results provide essential information for establishing the decorrelation pattern presented in the experimental data and a quantitative estimate of the possible systematic of the flow angles between forward and backward rapidity regions.

Such study on the longitudinal flow-plane decorrelations provide new insights in understanding the initial condition of the system and development of anisotropic flow in heavy-ion collisions, opening new possibilities for the detailed exploration of the quark-gluon plasma.

[1] Zhiwan Xu, Xiatong Wu, Caleb Sword, Gang Wang, Sergei A. Voloshin, and Huan Zhong Huang. Flow-plane decorrelations in heavy-ion collisions with multiple-plane cumulants. *Phys. Rev. C*, 105:024902, Feb 2022.