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Two- and three-particle nonflow effects on the CME measurements in Au+Au and isobar collisions at RHIC

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QCD vacuum fluctuations can lead to chirality anomaly and parity violation in metastable local domains. This would result in a charge separation along the strong magnetic field produced in off-center relativistic heavy-ion collisons, a phenomenon called the chiral magnetic effect (CME). A widely used observable to search for the CME is the charge-dependent three-point correlator, $\Delta\gamma \equiv \langle\cos(\phi_\alpha + \phi_\beta - 2\Psi_{\rm RP})\rangle$, measured by the azimuthal angles of two particles relative to the reaction plane ($\Psi_{\rm RP}$) or a third particle. The observable is, however, contaminated by a major elliptic flow (v_2) induced background. Recent measurements in Au+Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV with respect to the spectator and participant planes, where the flow-induced background is eliminated, indicate a postive CME signal ($f_{\rm CME}$) with a $\sim 2\sigma$ significance [1]. The newly released isobar results by STAR, properly normalized by the observed multiplicity difference, are systematically above the naive baseline expectation of unity [2].

Nonflow contaminations in v_2 and three-particle correlations, however, can still affect the $f_{\rm CME}$ measurements in Au+Au collisions and the isobar baseline to deviate from unity. In this talk, we estimate the effects of nonflow correlations on $f_{\rm CME}$ [3] by using a multiphase transport (AMPT) and heavy ion jet interaction generator (HIJING) together with available experimental data on nonflow. It is found that the nonflow correlations can introduce a small (even possibly negative) contribution to $f_{\rm CME}$, insufficient to explain the positive measurements by STAR. We further investigate the effects of nonflow correlations on the background baseline of the isobar data, and discuss the implication of our results to the CME search in isobar collisions.

[1] M. Abdallah et al. (STAR Collaboration), [arXiv:2106.09243 [nucl-ex]].
[2] M. Abdallah et al. (STAR Collaboration), [arXiv:2109.00131 [nucl-ex]].
[3] Y. Feng, J. Zhao, H. Li, H. j. Xu and F. Wang, [arXiv:2106.15595 [nucl-ex]].

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