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Search for the Chiral Magnetic Effect by Event Shape Engineering as a Function of Invariant Mass in Au+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV from STAR

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Chiral Magnetic Effect (CME) is a phenomenon in which electric charge is separated by a strong magnetic field from local domains of chirality imbalance and parity violation in quantum chromodynamics (QCD). The CME-sensitive observable, charge-dependent three-point azimuthal correlator $\Delta\gamma$, is contaminated by a major physics background proportional to the particle elliptic anisotropy (v_2). In this contribution, we report a fresh investigation of charge separation in Au+Au collisions at $\sqrt{s_{\mathrm{NN}}} = 200$ GeV with the STAR detector using the Event Shape Engineering (ESE) approach [1]. Our approach has several novel aspects, such as using three subevents to identify dynamical fluctuations of v_2 by using subevent different from particles of interest for the ESE selection. Since the CME is a low-p_{T} phenomenon, we further apply the ESE differentially to the $\Delta\gamma$ as a function of the pair invariant mass (m_{inv}), particularly at lower m_{inv}, which is dominated by a larger fraction of low-p_{T} pions. We extract the signal as the intercept by projecting $\Delta\gamma$ to zero v_2, both integrated over inclusive mass and at low mass. Our results suggest non-zero intercept with an approximately 2σ significance, which we compare to the published results from the spectator/participant measurement [2]. The extracted signals, highly sensitive to the CME, may still be contaminated by residual flow as well as nonflow contributions

in the v_2 measurement and in the three-particle correlator [3]. We investigate these contaminations in the ESE measurement, and also report measurement using the zero-degree calorimeter (ZDC) that largely supresses the nonflow contamination. We discuss the implications of our results and perspectives with the expected 10-fold increase in statistics from the RHIC runs in the years 2023 and 2025.

[1] J. Schukraft, A. Timmins, and S.A. Voloshin, Phys. Lett. B719 (2013) 394.
[2] M.S. Abdallah et al. (STAR Collaboration), Phys. Rev. Lett. 128, 092301.
[3] Y. Feng, J. Zhao, H. Li, H.-j. Xu, and F. Wang, Phys. Rev. C105 (2022) 024913.

Category

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