Using an Innovative Event Shape Selection Method to Search for the Chiral Magnetic Effect with RHIC BES-II data at STAR

for the STAR Collaboration

Abstract

The chiral magnetic effect (CME) in heavy-ion collisions probes the topological sector of quantum chromodynamics, where parity and charge-parity symmetries are locally violated. We will present the STAR results on the CME search from the BES-II data at STAR using a novel Event-Shape Selection (ESS) method [1] to suppress the flow-related background. EBE-AVFD simulations have shown that the ESS method can accurately disentangle the CME signal from the flow-related background in the measurement of charge separation observable $\Delta\gamma^{112}$. We use the spectator planes from the Zero Degree Calorimeter (ZDC) at $\sqrt{s_{NN}}$ = 200 GeV and from the Event Plane Detector (EPD) at lower beam energies to determine the magnetic field direction. The large pseudorapidity gap between the particles of interest and the EPD or ZDC helps minimize nonflow contributions. After flow-related background suppression, a non-zero charge separation signal $\Delta\gamma^{112}_{\rm ESS}$ is observed in Au+Au collisions at $\sqrt{s_{NN}}$ = 11.5, 14.6, and 19.6 GeV at 20-50% centrality, each with significance over 3σ. Below $\sqrt{s_{NN}}$ = 10 GeV and at 200 GeV, $\Delta\gamma^{112}_{\rm ESS}$ is consistent with zero. With the application of the ESS method, the background indicator $\Delta\gamma^{132}_{\rm ESS}$ yields zero.

References

[1] Z. Xu, B. Chan, G. Wang, A. Tang, H. Huang, Phys. Lett. B **848**, 138367 (2024)