Search for the Chiral Magnetic Effect and Chiral Vortical Effect with BES-II data from STAR

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Abstract

Quantum Chromodynamics allows for the formation of parity-odd domains inside the Quark-Gluon Plasma produced in heavy-ion collisions. The Chiral Magnetic Effect (CME) and Chiral Vortical Effect (CVE) are predicted to cause electric-charge and baryonic-charge separation, respectively, along the direction of the magnetic field or vorticity. To investigate the CME and CVE predictions, we will present the STAR measurements of h-h, π-π, and Λ-p reaction plane dependent $\Delta\gamma$ correlations from Beam Energy Scan phase II Au+Au collisions data, where the non-flow related background is expected to be significantly reduced. Specifically, the $\gamma_{112} \equiv \langle\cos(\phi_1 + \phi_2 - 2\Psi_{\rm RP})\rangle$ correlator is used to measure the electric and baryonic charge separations from possible CME and CVE, while the $\gamma_{132} \equiv \langle\cos(\phi_1 - 3\phi_2 + 2\Psi_{\rm RP})\rangle$ correlator is used to evaluate the background. We also apply the event-shape selection analyses by computing the γ_{112} and γ_{132} correlators for selected event classes where the elliptic flow of particles of interest is near zero. The STAR's capability for the event-shape selection analyses has been significantly enhanced with the Event Plane Detector, which can determine the event plane angles at forward/backward rapidity for low energy Au+Au collisions. Recent simulations [1] showed that such event-shape selection procedure can effectively suppress the flow-related background. With the sensitivity for the CME and CVE search enhanced by this method, we are able to see significant difference between γ_{112} and γ_{132} for Λ-p results in Au+Au collisions at $\sqrt{s_{\rm NN}} = 27$ GeV, and for h-h and π-π results at 27, 19.6, and 14.6 GeV.

References

[1] Ryan Milton et al. *Utilization of Event Shape in Search of the Chiral Magnetic Effect in Heavy-ion Collisions*. 2021. arXiv: `2110.01435 [nucl-th]`.