Contribution ID: **344** Type: **Poster**

Charge Asymmetry Measurements in Au+Au collisions by STAR in Search of the Chiral Magnetic Effect

Metastable domains of topological charges in QCD can cause chirality imbalance and, under the strong magnetic field present in heavy-ion collisions, result in charge separation along the magnetic field, a phenomenon called the Chiral Magnetic Effect (CME) [1]. Charge separation can also be caused by intrinsic particle correlations coupled with elliptic flow anisotropy, a major background for the CME search. In this talk, we report results by two analysis methods designed to reduce or eliminate, model-independently, background contributions.

In the first method [2], a correlator Cp is constructed as the ratio of real-event to shuffled-event differences between positive and negative charge distributions of a correlation variable with respect to the event plane. A second correlator Cp_perp is similarly constructed using the particles perpendicular to the event plane. The shape of the double-ratio $C_p/C_{p_{perp}}$ is concave for a CME-associated charge asymmetry and flat or convex for all non-CME associated effects. The observation of a concave shape for $C_p/C_{p_{perp}}$ in the data confirms the presence of a CME associated charge asymmetry. Quantification of this signal is obtained via comparisons with data driven simulations.

In the second method [3], correlators are constructed from multiplicity asymmetries of positive and negative particles across the event plane. The same- and opposite-sign difference is studied as a function of the event-by-event anisotropy of the measured particles. A linear dependence is observed in both real and mixed-events. The intercept or the difference between real- and mixed-events measures the charge separation with reduced flow background.

We present the results obtained via these two methods for Au+Au collisions at several collision centralities and beam energies at RHIC. We discuss our results in terms of the CME search.

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[2] N. N. Ajitanand, R. A. Lacey, A. Taranenko, and J. M.Alexander, Phys. Rev. C 83, 011901(R) (2011).
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Preferred Track

Collective Dynamics

Collaboration

STAR

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Session Classification: Poster Session