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An event-shape-engineering method to study charge separation in heavy-ion collisions

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Recent measurements of charge-dependent azimuthal correlations in high-energy heavy-ion collisions at RHIC and the LHC have indicated charge-separation signals perpendicular to the reaction plane, and have been related to the chiral magnetic effect (CME) (see a review in Ref [1]). The discovery of this phenomenon in heavy-ion collisions will signify simultaneously three important physics ingredients: the strongest magnetic field ever made by mankind, the chirality imbalance caused by vacuum transition, and the chiral symmetry restoration in the deconfined nuclear matter. However, the correlation signal is contaminated with the background driven by the elliptic flow (v_2) of the collision system [2], and an effective approach is needed to remove the flow background from the correlation.

In this talk, we will disclose a few shortcomings of a previous attempt of the event shape engineering (ESE) based on the "event-by-event v_2" [3]. We will further present a novel ESE technique [4] utilizing the magnitude of the flow vector to select spherical events in heavy-ion collisions, which leaves the charge separation measurements free of flow contributions. The simplified Monte Carlo simulations and a multi-phase transport model (AMPT) are employed to develop the ESE scheme to reveal the true CME signals from the experimental observation. Caveats regarding artificial effects and extreme conditions in this method will also be discussed.

References

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