Search for the Chiral Magnetic Effect Using STAR BES-II Data with Event Shape Selection

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Abstract

Heavy-ion collisions may form topological domains with chirality imbalance in quark-gluon plasma medium, which can lead to the chiral magnetic effect (CME) in the presence of the strong magnetic field from spectator protons. Recently, STAR reported precision measurements of the charge-separation difference between Ru+Ru and Zr+Zr isobar collisions at $\sqrt{s_{\rm NN}} = 200$ GeV showing the pre-defined CME signatures to be absent. However, these results cannot rule out a possible CME signal in Au+Au collisions owing to the weaker magnetic field and the larger background in isobar collisions. We present new measurements from STAR in Au+Au collisions from the Beam Energy Scan II, where the magnetic field may last longer, and nonflow effects are expected to be smaller than those at the top RHIC energy. We employ an event-shape selection method, aided by the Event Plane Detector (EPD), to measure the CME-sensitive $\Delta\gamma_{112}$ correlator from a class of selected events with minimum flow and finite spectator protons. Results obtained with various event-shape selection techniques are compared to investigate the sensitivity to the CME signal in Au+Au collisions at $\sqrt{s_{\rm NN}} = 27$ GeV and 19.6 GeV.