Search for the Chiral Magnetic Wave at STAR with Isobar and Au+Au collisions

(for the STAR Collaboration)

Abstract

The chiral magnetic wave (CMW) in heavy-ion collisions probes the topological sector of quantum chromodynamics, where parity and charge-parity symmetries are locally violated. Unlike the Chiral Magnetic Effect (CME), where the induced dipole moment fluctuates randomly from event to event, the CMW generates an electric quadrupole moment with a same sign for a given net charge state of the system, thus CMW can be observed even when CME is not detected. The CMW leads to charge-dependent elliptic flow (v_2) which correlates with charge asymmetry (A_{ch}) of the system. Experimental searches for the CMW, however, face challenges from background contributions related to elliptic flow and nonflow. The correlation between triangular flow v_3 and A_{ch} will be discussed as a background indicator. Similar to the CME search, we use RHIC isobar collisions ($^{96}_{44}$Ru $+^{96}_{44}$ Ru and $^{96}_{40}$Zr$+^{96}_{40}$Zr) at STAR for the CMW search, anticipating a stronger signal in $^{96}_{44}$Ru$+^{96}_{44}$Ru due to its larger magnetic field. In addition, we compare with Au+Au to study the system dependence at the top RHIC energy, examining the magnetic field effects from isobar to Au+Au. The prerequisite of the CMW is expected to change with collision energy. We present the measurement of slope r_2 of v_2 vs. A_{ch} correlation in isobar collisions and Au+Au collisions with BES-II data at $\sqrt{s_{NN}} =$ 7.7, 19, 27 and 200 GeV. 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. We will also explore the feasibility of the event-shape selection scheme to subtract the flow-related background in CMW search.