Search for the chiral magnetic effect with spectator and participant planes in STAR

Jie Zhao (for the STAR collaboration)

Department of Physics and Astronomy, Purdue University

Abstract

In the initial stages of heavy-ion collisions, topological QCD vacuum fluctuations can induce local parity and charge-parity violations, evincing charge separation in the presence of strong magnetic field, a phenomenon known as the chiral magnetic effect (CME). The CME-driven charge separation is along the magnetic field direction, mainly produced by the spectator protons in relativistic heavy-ion collisions. The major background to the CME is related to the elliptic flow anisotropy (v_2), determined by the initial participant geometry. Because of fluctuations, the harmonic planes determined by spectators ($\psi_{\rm sp}$) and participants ($\psi_{\rm pp}$) are different. In other words, a heavy-ion collision provides us two distinct planes; the v_2 is stronger along $\psi_{\rm pp}$ and weaker along $\psi_{\rm sp}$, whereas the magnetic field is weaker along $\psi_{\rm pp}$ and stronger along $\psi_{\rm sp}$. The $\Delta\gamma$ measured with respect to $\psi_{\rm sp}$ and $\psi_{\rm pp}$, therefore, contain different amounts of the CME signal and non-CME background and this offers us an opportunity to separate these two contributions [1]. We report the azimuthal correlator $\Delta\gamma$ measurements with respect to $\psi_{\rm sp}$ measured by spectator neutrons using the zero degree calorimeters with shower maximum detector (ZDC-SMD) and to $\psi_{\rm pp}$ measured by the 2nd harmonic event plane of produced particles using time projection chamber (TPC). We extract the fraction of the possible CME signal (and the background) from those measurements in 200 GeV Au+Au collisions, and discuss implications on topological QCD and future opportunities.

[1] Hao-Jie Xu, et al., Chin. Phys., C42 (2019) 084103, arXiv:1710.07265