Hyperon Polarization in Heavy-Ion Collisions from STAR

Xingrui Gou for the STAR Collaboration

The observation of hyperon polarization has revealed the existence of large vorticities in the medium created by heavy-ion collisions. Global polarization indicates vorticities perpendicular to the reaction plane due to the system's orbital angular momentum. The difference of global polarization between Λ and $\bar{\Lambda}$ hyperon can provide essential insights into the late-stage magnetic field sustained by the QGP[1]. With the high-statistics data collected by the STAR experiment for isobar Ru+Ru and Zr+Zr collisions at $\sqrt{s_{\rm NN}} = 200$ GeV, we present the measurements of global polarization for Λ, $\bar{\Lambda}$, and $\Xi^{\pm}$ as a function of centrality, transverse momentum, pseudorapidity, and azimuthal angle relative to the event plane. In addition, we present the correlation between the initial tilt of the system and the vorticity[2] through the dependence of the Λ global polarization and directed flow on the first-order flow vector (q_1) in Au+Au collisions at $\sqrt{s_{\rm NN}} = 19.6$ GeV.

The local polarization indicates vorticities along the beam direction due to anisotropic transverse expansion of the medium. We present the first measurements of Λ, $\bar{\Lambda}$ hyperon local polarization in isobar collisions at $\sqrt{s_{NN}}$= 200 GeV and Au+Au collisions at $\sqrt{s_{NN}}$= 19.6, 27 GeV. Comparisons with previous measurements in Au+Au and Pb+Pb collisions at RHIC and LHC provide important insights into the collision system size and energy dependence of the vorticities. Furthermore, the local polarization measurements at lower beam energies can probe the predicted baryonic spin hall effect in a dense baryonic environment[3] in heavy-ion collisions.

References

[1] L. McLerran, V. Skokov, Nucl. Phys. A 922, 184 (2014).

[2] S. A. Voloshin, EPJ Web Conf. 171 (2018) 07002.

[3] B. Fu et al, arXiv: 2201.12970 (2022).