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Differential measurements of Λ polarization in Au+Au collisions and a search for the magnetic field by STAR

Content

Lambda polarization $P_{\Lambda/\bar{\Lambda}}$ was measured by the STAR collaboration [1], confirming the existence of extremely large vorticities within the Quark-Gluon Plasma (QGP). A recent study using a high-statistics data set at $\sqrt{s_{NN}} = 200$ GeV has shown the dependence of $P_{\Lambda/\bar{\Lambda}}$ on collision centrality, azimuthal angle (φ), transverse momentum (p_T), pseudorapidity (η), etcetera [2][3]. Additionally suggested in [1] is an enhanced $P_{\bar{\Lambda}}$ relative to P_{Λ} across all beam energies; however, the statistics are too limited to make a significant measurement. No such splitting is observed in the high-statistics $\sqrt{s_{NN}} = 200$ GeV data set, but this splitting is expected to increase at lower beam energies. The splitting in polarization would be consistent with the effects of hyperon magnetic-moment coupling with the magnetic field sustained in the QGP; it would have far-reaching consequences important to magnetic-field-dependent observables such as the chiral magnetic effect and would set the scale on the conductivity of the QGP.

Recently, STAR has taken high-statistics data sets at $\sqrt{s_{NN}} = 27$ and 54.4 GeV. The 27 GeV data set is considered suitable to study the splitting between P_{Λ} and $P_{\bar{\Lambda}}$ since it includes the recently installed Event-Plane Detector (EPD), which significantly increases the event-plane resolution. Both data sets are used to study the splitting between P_{Λ} and $P_{\bar{\Lambda}}$ as well as the various differential measurements of $P_{\Lambda/\bar{\Lambda}}$. Implications of these measurements will also be discussed.

[1] The STAR Collaboration, Global Λ hyperon polarization in nuclear collisions, Nature 548 (2017) 62.

[2] The STAR Collaboration, Global polarization of Lambda hyperons in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV, Phys. Rev. C 98 (2018) 14910.

[3] The STAR Collaboration, Polarization of $\Lambda(\bar{\Lambda})$ hyperons along the beam direction in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV, arXiv:1905.11917.

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