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Measurement of global and local spin polarization of Λ and $\bar{\Lambda}$ in Au+Au collisions from the RHIC Beam Energy Scan

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A significant global spin polarization of Λ hyperons in the first phase of RHIC Beam Energy Scan (BES-I) provided evidence of vorticity of the QGP created in heavy-ion collisions. The data also hint at a larger polarization of $\bar{\Lambda}$ than that of Λ, which can be produced by a strong late-stage magnetic field sustained by the medium. A decisive experimental test of this splitting is highly significant, as it could reveal valuable information about the electric conductivity of the QGP [1]. On the other hand, the local polarization of Λ and $\bar{\Lambda}$ hyperons are predicted to be different due to the polarization induced by the gradient of baryonic chemical potential (analogous to the electric field) and called baryonic spin Hall effect. This effect is expected to be observable through the energy dependence of the angular modulation of the net polarization [2], $P_{y,z}^{net} = P_{y,z}^{\Lambda} - P_{y,z}^{\bar{\Lambda}}$, as measured by $P_z^{net} sin\left(2\phi_\Lambda - 2\Psi_2\right)$ and $-P_y^{net} cos\left(2\phi_\Lambda - 2\Psi_2\right)$, where Ψ_2 is the second-order event-plane.

We present results of Λ global polarization as a function of centrality, transverse momentum, and rapidity in Au+Au collisions at $\sqrt{s_{NN}}$=7.7, 11.5 and 14.6 GeV from second phase of the RHIC Beam Energy Scan (BES-II) with the upgraded STAR detectors. We also present local polarization measurements in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7 - 27 GeV from BES-II. Our measurements can provide important insights into the late-stage magnetic field sustained by the QGP, as well as spin Hall currents possibly created in a highly dense baryonic environment.

[1]L. McLerran, V. Skokov, Nucl. Phys. A 922, 184 (2014).
[2]B. Fu et al, arXiv: 2201.12970 (2022).

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