Measurements of global and local spin polarization of hyperons in Au+Au collisions at RHIC-STAR

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Abstract

In non-central heavy ion collisions, substantial angular momentum is generated, resulting in significant vorticity and the spin polarization of particles with finite spin along the global angular momentum. Additionally, anisotropic flow can produce local vorticities in both in-plane (z) and out-of-plane (y) directions, leading to local polarization. The RHIC Beam Energy Scan II (BES-II) program, including the Fixed-Target (FXT) mode at STAR, provides a unique opportunity to investigate hyperon (Λ, $\overline{\Lambda}$, $\Xi^{\pm}$, $\Omega^{\pm}$) global polarization over a wide range of baryon chemical potential. This study probes the vortical characteristics of the medium and can serve as a tool for exploring the nuclear matter equation of state. Also, the second harmonic of local spin polarization (P_{2y} and P_{2z}) for Λ and $\overline{\Lambda}$ and their difference, are predicted to be a sensitive probe for the spin Hall effect driven by gradients in baryon chemical potential.

In this talk, we present measurements of the global polarization of Λ, $\overline{\Lambda}$, $\Xi^{\pm}$ and $\Omega^{\pm}$ at $\sqrt{s_{NN}}$ = 7.7 - 27 GeV in BES-II Au+Au collisions, and the global Λ polarization at $\sqrt{s_{NN}}$ = 3.0 - 6.2 GeV in FXT Au+Au collisions. Additionally, we report the second harmonics of local Λ, $\overline{\Lambda}$ polarization and their difference at $\sqrt{s_{NN}}$ = 7.7 - 27 GeV. These measurements provide valuable insights into the spin dynamics within the QCD medium produced in heavy ion collisions.