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Global and local spin-polarization of Λ-hyperons in relativistic heavy-ion collisions

As recently observed by the STAR and ALICE collaborations, the global and local spin polarization of Λ-hyperons provides new insights into spin dynamics in heavy-ion collisions. There are various contributing factors that could be the source of hyperon polarization. However, among them, the vorticity field is widely considered as the primary source of particle polarization in heavy-ion collisions. Recent findings suggest that the transverse component of the vorticity field drives global spin polarization, while the longitudinal component accounts for local polarization. For the first time, within the framework of second-order relativistic viscous hydrodynamics, we incorporate vorticity, viscosity, and magnetic field effects into a unified hydrodynamic model to estimate the global polarization of Λ-hyperons, using vorticity evolution data at the freeze-out hypersurface. Additionally, to further elucidate spin-polarization dynamics, we explore the local polarization of Λ-hyperons due to thermal vorticity and the thermal shear tensor in Au+Au and Pb+Pb collisions at $\sqrt{s_{NN}} = 200$ GeV and 5.02 TeV, respectively, by employing hydrodynamic and transport models. As the coupling between vorticity, viscosity, and magnetic field makes medium evolution highly complex, our findings provide a unique insight into understanding the hyperon polarization in relativistic heavy-ion collisions

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