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Helicity polarization and vorticity contribution to the spin alignment in hydrodynamic approaches

We present a study of local hydrodynamic helicity polarization at RHIC-BES energies using the relativistic (3+1)D CLVisc hydrodynamics framework. Our analysis includes the effects of thermal vorticity, shear tensor (SIP), and the spin Hall effect (SHE) on the helicity polarization. We find that, similar to RHIC top energy collisions, the hydrodynamic helicity polarization is primarily driven by thermal vorticity and is predominantly contributed by fluid vorticity after cancellation of other effects. We verify that this conclusion is not sensitive to the initial conditions or the bayon diffusion coefficient, although the magnitude of the helicity polarization may vary. Our findings may help distinguish the local spin polarization induced by thermal vorticity and enable extraction of the local vorticity structure of quark gluon plasma through the helicity polarization. Additionally, our results provide a baseline for future analysis of the helicity-helicity correlation induced by local parity violation.

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