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Time evolution of global polarization within an improved microscopic approach

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Extremely large angular orbital momentum can be produced in non-central heavy-ion collisions, leading to a strong transverse polarization of partons that scatter through the quark-gluon plasma (QGP) due to spin-orbital coupling. To understand the hyperon polarization observed in relativistic nuclear collisions, we develop a microscopic approach to describe the formation and space-time evolution of quark polarization inside the QGP. Production of polarization both from the initial hard scatterings and during the QGP expansion have been consistently described using the quark-potential scattering approach, which has been coupled to realistic initial condition calculation and the subsequent (3+1)-dimensional viscous hydrodynamic simulation of the QGP for the first time. Within this improved approach, we have found that different rapidity-dependent initial energy density distributions generate different time evolution profiles of the longitudinal flow velocity gradient of the QGP, which further lead to an approximately 15% difference in the final polarization of quarks collected on the hadronization hypersurface of the QGP. Therefore, in addition to the collective flow coefficients, the hyperon polarization could serve as a novel tool to help constrain the initial condition of the hot nuclear matter created in high-energy nuclear collisions.

Present via

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