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Relativistic second-order spin hydrodynamics: A correlation function approach using Zubarev's non-equilibrium statistical operator

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Utilizing Zubarev's nonequilibrium statistical operator, we derive the second-order expression for the dissipative tensors in relativistic spin hydrodynamics, namely the rotational stress tensor ($\tau_{\mu\nu}$), boost heat vector (q_μ), shear stress tensor ($\pi_{\mu\nu}$), and bulk viscous pressure (Π). The emergence of the first two terms, $\tau_{\mu\nu}$ and q_μ, is attributed to the inclusion of the antisymmetric part in the energy-momentum tensor. In this work, we also treat the spin density ($S^{\mu\nu}$) as an independent thermodynamic variable alongside energy density and particle density, leading to an additional transport coefficient characterized by the correlation between $S^{\mu\nu}$ and $\tau_{\mu\nu}$. Finally, we derive the evolution equations for the aforementioned tensors—$\tau_{\mu\nu}$, q_μ, $\pi_{\mu\nu}$, and Π.

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