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The Chiral Transition and Shear Viscosity in the NJL Model under a Magnetical Background

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Abstract: We investigate the chiral phase transition and the properties of the shear viscosity coefficient in a Nambu-Jona-Lasinio (NJL) model at finite temperature and chemical potential. We compare the contributions from the tensor spin polarization (TSP) and anomalous magnetic moment (AMM) of quarks in (2+1)-flavor NJL model. For light u and d quarks, when TSP and AMM are not considered, the magnetized system is characterized by magnetic catalysis. The introduction of TSP will further enhance the magnetic catalytic characteristics. On the other hand, when AMM is introduced, the phase-transition temperature decreases with the magnetic field, which is the feature of inverse magnetic catalysis.It is found that both the ratio η/s of shear viscosity coefficient to entropy and the collision relaxation time τ show similar trend with temperature, both of which reach minima around the critical temperature. The shear viscosity coefficient of the dissipative fluid system can be decomposed into five different components as the strong magnetic field exists. The influences of the order of chiral phase transition and the critical end point on dissipative phenomena in such a magnetized medium are quantitatively investigated. It is found that η_1, η_2, η_3, and η_4 all increase with temperature. For first-order phase transitions, η_1, η_2, η_3, and η_4 exhibit discontinuous characteristics.

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