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Shear and bulk viscous coefficients in thermal QCD within the weak magnetic field regime

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We have studied the shear (η) and bulk (ζ) viscosities of hot QCD medium in a weak magnetic field. These viscosities are calculated by using the relaxation time approximation of kinetic theory in weak magnetic field limit, where temperature scale dominates over the energy scale related to magnetic field. It is found that the weak magnetic field reduces both η and ζ, contrary to their enhancement at finite chemical potential. So, the magnetic field decreases the momentum transfer across and along the layer, whereas the density facilitates this. This study sheds light on the sound attenuation through the Prandtl number (Pr), the nature of flow through the Reynolds number (Re), the fluid characteristic and the conformal symmetry of medium through the ratios η/s and ζ/s, respectively. Weak magnetic field increases the Prandtl number, whereas finite chemical potential reduces it. The observation on the Prandtl number also indicates that the energy dissipation due to the sound attenuation is mostly carried out by the momentum diffusion. The Reynolds number gets increased in a weak magnetic field and gets decreased at finite chemical potential, thus explaining that the weak magnetic field makes the medium less viscous, whereas the chemical potential makes the viscous nature of medium more evident. It is observed that, in a magnetic field, η/s gets closer to the lower bound $1/(4\pi)$ and ζ/s gets nearer to the value at conformal symmetry.

Experiment/Theory

Theory/Phenomenology

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