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Discerning the transport coefficients and observables of a rotating QGP medium in the novel relaxation time approximation method

This work focuses on the effects of rotation on the transport coefficients and observables of the QGP medium. Since the noncentral heavy ion collisions possess finite angular momentum with a finite range of angular velocity, the rotation gets incited in the produced medium. The rotation could significantly alter the transport coefficients and observables, such as the electrical conductivity, the thermal conductivity, the Knudsen number, the elliptic flow, the trace anomaly and the isothermal compressibility. We have determined the transport coefficients using a novel relaxation time approximation method within the kinetic theory approach in association with the finite angular velocity. We have compared them with their values in the relaxation time approximation and with their counterparts in the nonrotating medium. It is observed that the introduction of angular velocity enhances the transport of both charge and heat in the medium. Further, as compared to the relaxation time approximation, the novel relaxation time approximation estimates smaller values of the electrical and thermal conductivities. Additionally, the aforesaid observables get conspicuously modulated by the rotation of the medium. Our observation shows a decrease in the Knudsen number and an increase in the elliptic flow when rotation is incorporated into the medium. This suggests an enhancement in the interactions among the produced particles in heavy ion collisions, leading to faster thermalization of the medium. Thus, as angular velocity increases, the medium moves closer to equilibrium. Further, we have found an increasing trend of the trace anomaly with the rising angular velocity and its slope decreases as the temperature increases. Thus, at high temperatures, the rotation has a paltry impact on the trace anomaly. Overall, the rotation makes the constituents of the medium more interactive and as a result, the medium gets deviated away from the conformal symmetry. We have further observed that the introduction of rotation into the medium reduces the isothermal compressibility and allows the medium to exhibit nearly perfect fluid behavior. This suggests that, with the increasing angular velocity, it is difficult to compress the system. Consequently, the matter becomes stiffer as the rotation becomes more rapid.

Category

Theory

Collaboration (if applicable)

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