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Electric conductivity of hot and dense quark matter in a magnetic field with Landau level resummation via kinetic equations

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This talk is based on 1711.01472 in which the longitudinal electric conductivity of hot and dense magnetized quark matter has been computed with full Landau level resummation which requires several nontrivial theoretical techniques. In contrast to the lowest Landau level approximation, there is no singularity in the massless limit, and we find that the resultant electric conductivity is surprisingly consistent with the qualitative features observed in condensed matter (using Weyl semimetals) experiment for the signature of the chiral magnetic effect. This means that our calculation correctly captures the essence of the topologically induced currents. Because the mass and magnetic dependence of the conductivity is found to be mild after the Landau level resummation, we also make a quantitative comparison with the recent lattice QCD simulation results without magnetic field to confirm that our estimate is again surprisingly consistent with the lattice-QCD values. We can apply our calculation to the finite density case, which provides us with theoretical predictions relevant for the beam energy scan program at finite density. Since quarks are enhanced but anti-quarks are suppressed, the longitudinal electric conductivity stays rather constant, which is intuitively natural, but this is theoretically seen only after subtracting coupling to hydrodynamic zero modes correctly. Not only the longitudinal conductivity (that is related to the chiral magnetic effect) but also the transverse conductivities will be discussed. At finite density, in fact, one component of the transverse electric conductivities newly grows up, that is the Hall conductivity. The Hall conductivity could result in more prospective effects observable in the heavy-ion collision experiment, which will be suggested in this talk.

Content type

Theory

Collaboration

Centralised submission by Collaboration

Presenter name already specified

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