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Chiral Hall Effect and Chiral Electric Waves in Strongly Coupled Plasmas

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The electromagnetic-field-induced transport related to the axial chemical potential may play an important role in many chiral systems such as the quark gluon plasma (QGP) created in relativistic heavy ion collisions. It has been found that the presence of both a vector and an axial chemical potential could induce an axial current parallel to the applied electric field known as the chiral electric separation effect (CESE), where the axial conductivity is proportional to the product of the small vector and axial chemical potentials in QED and weakly coupled QCD plasmas. By implementing the gauge/gravity duality, we qualitatively obtain the same relation in the strongly coupled scenario. On the other hand, we find that an axial Hall current can also be generated when introducing an electric field and a magnetic field perpendicular to each other with an axial chemical potential, which could be dubbed as the chiral Hall effect (CHE). The fluctuations of chemical potentials will further result in chiral electric waves (CEW) as propagating density waves led by the applied electromagnetic fields. Interestingly, the Hall density waves propagating perpendicular to both applied fields may exist even at zero chemical potentials and become non-dissipative. The transport coefficients including the Hall conductivities, damping times, wave velocities, and diffusion constants of CEW in a strongly coupled plasma via the AdS/CFT correspondence will be presented. We argue that the CHE could lead to nontrivial charge distributions at different rapidity in asymmetric heavy ion collisions. The presentation is based on Phys.Rev. D89 (2014) 8, 085024 and Phys.Rev. D91 (2015) 2, 025011.

On behalf of collaboration:

NONE

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