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Anomalous electromagnetic field reflection and transmission in Weyl and Dirac semimetals

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The current response to an electromagnetic field in a Weyl or Dirac semimetal becomes nonlocal due to the chiral anomaly activated by an applied magnetic field. The nonlocality develops under the conditions of the normal skin effect and is related to the valley charge imbalance generated by the joint effect of the electric field of the impinging wave and the static magnetic field. The length scale for the nonlocality is determined by the diffusion length of the valley charge imbalance, which does not violate the local electric charge neutrality. It is predicted that the signatures of this nonlocality can be found in the transmission and reflection of electromagnetic waves. In view of a weaker decay of the anomalous components of the electric field in the nonlocal regime, it is possible to achieve an enhancement of the electromagnetic wave penetration depth. For reflected electromagnetic waves, the chiral anomaly leads to a decrease of the dissipative part of the surface impedance with the magnetic field; these anomalous effects are reduced in the nonlocal regime.

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