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Negative magnetoresistance induced by longitudinal photons in Dirac/Weyl semimetals

A low-energy model is built to study systems such as Dirac/Weyl semimetals, according to statistical quantum electrodynamics formalism. We report that the introduction of a pseudoscalar, associated to longitudinal photons propagating along a magnetic field B, could transforms a Dirac semimetal into a Weyl semimetal with a pair of Weyl nodes for each point of Dirac. The nodes are separated by a pseudovector electric field induced dynamically along B associated to a chiral effect on the Fermi surface. A topological quantum transition is produced between a chiral-and non-chiral symmetry phase. A general expression to the longitudinal magnetoconductivity is found. It provides the possibility of generalizing the usual expressions of the magnetoconductivity reported in the literature. This has a quadratic dependence on B, which is associated with a positive contribution to the magnetoconductivity. This is a prominent signature of the chiral magnetic effect in Dirac/Weyl systems in parallel electric and magnetic fields. We report a chiral effect induced by longitudinal photons associated to a negative longitudinal magnetoresistance in Dirac systems via an axial anomaly relation. We show some numerical results, and reproduced with a high level of accuracy some of the experimental results, in the low temperature region, obtained to the magnetoresistance of ZrTe5 and Na3Bi. We believe that a wide variety of these semimetals can be studied by using our general expression to the negative longitudinal magnetoresistance.

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