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Axion Electrodynamics in High-T QCD in the Presence of a Magnetic Field

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Axion electrodynamics of high-T QCD with topological charge changing transitions in the presence of a magnetic field is investigated. We find that this system exhibits two currents depending on the time derivative of the axion field θ, which have the same magnitude but opposite directions along the magnetic field. The anomalous current is produced by a time dependent medium polarization of topological origin, while the ordinary current is due to the chiral imbalance on the non-trivial background of quarks in the lowest Landau level. Only, if an electric field is present, a non-anomalous Hall current perpendicular to the plane formed by the magnetic and the electric fields can take place. Thus, the axion electrodynamics reduces to the ordinary Maxwell theory with an ordinary charge and Hall current and as a consequence, the net charge separation in the system along the magnetic field is zero, what implies that the chiral magnetic effect is absent. We discuss the analogies and discrepancies with Weyl semimetals in a magnetic field.

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