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Landau levels and longitudinal magnetoresistance in generalized Weyl semimetals XIAO LI, BITAN ROY, Condensed Matter Theory Center and Joint Quantum Institute, University of Maryland — The notion of axial anomaly is a venerable concept in quantum field theory that has received ample attention in condensed matter physics due to the discovery of Weyl materials (WSMs). In such systems Kramers non-degenerate bands touch at isolated points in the Brillouin zone that act as (anti)monopoles of Berry flux, and the monopole number (m) defines the topological invariant of the system. Although so far only simple WSMs (with $m = 1$) has been found in various inversion and/or time-reversal asymmetric systems, generalized Weyl semimetals with $m > 1$ can also be found in nature, for example double-Weyl semimetals in $HgCr_2Se_4$ and $SrSi_2$ and triple-Weyl semimetals. In this work, we demonstrate the Landau level spectrum in generalized Weyl systems and its ramification on longitudinal magnetotransport measurements. We show that in the quantum limit generalized Weyl semimetals display negative longitudinal magnetoresistance due to the chiral anomaly. Moreover, the magnetoresistance has nontrivial dependence on the relative orientation of the external fields with the crystallographic axis, stemming from underlying anisotropic quasiparticle dispersion in the pristine system. Our theory can thus provide diagnostic tools to pin the quasiparticle properties in Weyl systems.

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