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Berry Curvature and the Z_2 Topological Invariants of Spin-Orbit-Coupled Bloch bands.[1] F. D. M. HALDANE, Princeton University — The ("anomalous") integer quantum Hall effect can occur in non-interacting models of band insulators with broken time-reversal- (T-)symmetry where the sum of Chern invariants of occupied bands of Bloch states is non-zero. These topological invariants can be computed from the zeroes of certain functions in the Brillouin zone (BZ), but have a simpler formulation as BZ-integrals of Berry curvature. Recently, Kane and Mele found that T-invariant 2D systems with strong spin-orbit coupling possess a "Z_2" (+ or −) analog of the Chern invariant, which they formulated in terms of zero-counting arguments (3D generalizations have also been found). I give an alternate formulation in terms of Berry-curvature integrals, in the case that spatial-inversion-(I-)symmetry is broken, but T-symmetry is not. In 2D, such bands generically form a genus-5 2-manifold, with antipodal points paired by Kramers degeneracy: the Z_2 invariant is obtained by integration over a Kramers-distinct half-manifold; the 3D case is similar. I also discuss the case of doubly-degenerate bands with unbroken I-symmetry: despite recent suggestions, it does not appear that the Z_2 invariant of such systems can be obtained purely from knowledge of the parity quantum numbers at T-invariant points in the BZ.

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