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Topological invariants of time-reversal-invariant band structures JOEL MOORE, UC Berkeley and LBNL, LEON BALENTS, UC Santa Barbara — The topological invariants of a time-reversal-invariant band structure in two dimensions are multiple copies of the Z_2 invariant found by Kane and Mele. Such invariants protect the topological insulator and give rise to a spin Hall effect carried by edge states. Each pair of bands related by time reversal is described by a single Z_2 invariant, up to one less than half the dimension of the Bloch Hamiltonians. In three dimensions, there are four such invariants per band pair. The Z_2 invariants of a crystal determine the transitions between ordinary and topological insulators as its bands are occupied by electrons. We derive these invariants using maps from the Brillouin zone to the space of Bloch Hamiltonians and clarify the connections between Z_2 invariants, the integer invariants that underlie the integer quantum Hall effect, and previous invariants of $\mathcal{T}$-invariant Fermi systems.

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