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Topological phases and associated low-energy excitations in condensed matter

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Topological insulators and semimetals represent novel states of quantum matter, whose electronic properties are determined by the topological properties of the bulk electron wavefunction. In the last decade, various theoretically predicted topological phases, associated with unavoidable or protected energy band crossings, have been successfully identified experimentally in condensed matter. As an emergent phenomenon, the low-energy excitations near the crossing points in these topological phases behave as various massless fermions, leading to exotic properties, e.g. chiral anomaly in Weyl semi-metals. In this presentation, I will show the electronic structures of selected topological materials and demonstrate how they are realized experimentally.