

Topological Landau theory

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I will discuss a notion of topology “hidden” in Landau’s theory of phase transitions. When the order parameter comprises several components in the same irreducible representation of symmetry, it can possess a nontrivial topology and acquire a Berry phase under the variation of thermodynamic parameters. To illustrate this idea, I will focus on the superconducting phase transition of an electronic system with tetragonal symmetry and a two-component order parameter. From the time-dependent Ginzburg-Landau equation in the adiabatic limit, we find that the order parameter acquires a Berry phase after a cyclic evolution of parameters. I will discuss two concrete models—one preserving time-reversal symmetry and one breaking it—and show that the nontrivial topology of the order parameter originates from thermodynamic analogs of gapless Dirac and Weyl points in the phase diagram. Finally, I will propose an experimental realization of a thermodynamic Dirac point in chiral superconductors under strain, and its detectable signature in the Josephson effect, the geometry of vortices, and the upper critical field.