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【649】Weak Localization and Antilocalization in Nodal-Line Semimetals: Dimensionality and Topological Effects

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Nodal-line semimetals offer a unique setting for novel transport phenomena. With weak disorder, the torus-shaped Fermi surface and encircled π Berry flux carried by the nodal loop generate a fascinating interplay between the effective dimensionality of electron diffusion and band topology, which depends on the scattering range of the impurity potential relative to the size of the nodal loop. For a short-range impurity potential, backscattering is dominated by the interference paths that do not encircle the nodal loop, yielding a 3D weak localization effect. In contrast, for long-ranged impurities, diffusion occurs in effective 2D planes and backscattering is dominated by interference paths that encircle the nodal loop, leading to weak antilocalization with a 2D scaling law.

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