Effect of disorder on 2D topological merging transition from a Dirac semi-metal to a normal insulator

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Résumé

We study the influence of disorder on the topological transition from a two-dimensional Dirac semi-metal to an insulating state. This transition is described as a continuous merging of two Dirac points leading to a semi-Dirac spectrum at the critical point [1]. The latter is characterized by a dispersion relation linear in one direction and quadratic in the orthogonal one. Recently such a merging of tunable Dirac points has been realized using a degenerate Fermi gas trapped in a 2D honeycomb optical lattice [2], in photonic graphene [3] and in microwave experiments [4]. Using the self-consistent Born approximation and renormalization group we calculate the density of states above, below and in the vicinity of the transition in the presence of different types of disorder. Beyond the expected disorder smearing of the transition we find an intermediate disordered semi-Dirac phase. On one side this phase is separated from the insulating state by a continuous transition while on the other side it evolves through a crossover to the disordered Dirac phase [5]. [1] G. Montambaux, et al, Eur. Phys. J. B, **72**, 509, (2009).

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