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Quantum critical Dirac semimetals and finite-temperature effects

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The chiral Ising-, XY-, and Heisenberg models serve as effective descriptions of Dirac semimetals undergoing a quantum phase transition into a symmetry-broken ordered state. Interestingly, their quantum critical points govern the physical behavior of the system in the vicinity of the transition even at finite temperatures. In this contribution, we explore the chiral models at zero and finite temperature, both in the Dirac phase as well as in the symmetry-broken phases. To that end, we set up a functional renormalization group approach, which allows us to systematically track (1) the phenomenon of pre-condensation, (2) the manifestation of the Mermin-Wagner-Hohenberg theorem due to pseudo-Goldstone fluctuations at finite temperatures, and (3) the quantitative behavior of the system in the quantum critical fan, e.g., by calculating the quasiparticle weight. Our work aims at a more holistic understanding of chiral models near their quantum critical point, including, e.g., the description of non-Dirac-liquid behavior, in analogy to the non-Fermi-liquid behavior in metallic quantum critical points.

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