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Superconductivity Near a Quantum Critical Point

Andrey V. CHUBUKOV
University of Minnesota, Minneapolis, USA

Abstract:

I discuss the interplay between non-Fermi liquid behaviour and superconductivity near a quantum-critical point (QCP) in a metal. It was thought by many researchers that in D=2, non-Fermi liquid behaviour near a QCP extends to energies well above superconducting Tc, and that superconductivity involves non-Fermi-liquid quasiparticles and emerges due to peculiar interplay between strong attraction and strong pair-breaking effects from self-energy. I argue that this is not necessary always the case. I show an example when fermionic self-energy plays no role for superconductivity in 2D, despite that it is strong and destroys fermionic coherence. I discuss special role of "first Matsubara frequency" in this regard. I present explicit results for Tc for a set of Eliashberg-type models with frequency-dependent effective interaction and discuss the role of fluctuations beyond the Eliashberg approximation. I discuss in particular the value of Tc in the strong coupling limit of electron-phonon interaction.