2D fermions near an antiferromagnetic instability: non Fermi liquid behavior and spin-mediated pairing

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I plan to review recent works with Ar. Abanov, B. Altshuler, A. Finkelstein and J. Schmalian on the properties of 2D fermions near the quantum-critical point towards antiferromagnetism. This problem is relevant to both cuprates and heavy fermion materials. I show that the width of the Fermi liquid region progressively shrinks as the system moves towards quantum criticality, and there is a wide range of quantum-critical behavior. In the quantum-critical regime, the fermionic spectral function interpolates between marginal behavior at intermediate frequencies, and $\sqrt{\omega, T}$ behavior at high frequencies. I discuss the pairing problem in the quantum-critical regime and show that it is qualitatively different from BSC theory because the pairing involves fully incoherent fermions and retarded, nearly gapless pairing potential. I show that due to the interplay between fermionic incoherence and the softening of the pairing boson the pairing instability temperature T_{ins} saturates at a finite value when the magnetic correlation length diverges. I then show that immediately below T_{ins} fermions form singlet pairs, but still remain incoherent. The coherence is recovered only at a much smaller temperature T_c which, at least in some doping range, scales inversely with the magnetic correlation length. I argue that the region between T_{ins} and T_c is the pseudogap region. I discuss experimental signatures of these results for the cuprates.

9.7 cm

13.4 cm

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