“Interplay between superconductivity and non-Fermi liquid above a quantum critical point in a metal”

I discuss the interplay between non-Fermi liquid behaviour and superconductivity near a quantum-critical point (QCP) in a metal. It is widely thought that the tendency towards superconductivity and towards non-Fermi liquid behaviour compete, such that when the pairing interaction is reduced below a certain threshold, the system displays a naked non-Fermi liquid QC behaviour. I show that the situation is more complex as there are multiple solutions for Tc at a QCP. For all solutions, except one, Tc vanishes when the pairing interaction drops below the threshold. However, for one solution Tc remains finite even at arbitrary small pairing interaction, despite that there is no Cooper logarithm. I argue that superconductivity between this Tc and a lower T, when other solutions appear, is special, as it is entirely induced by fermions with the first Matsubara frequency. I discuss the implications for the density of states and the spectral function. I argue that there are two qualitatively different regimes of system behaviour below the onset of pairing – at low T the pairing gap closes with increasing T, while at higher T it gets filled in, but remains finite. I discuss pairing fluctuations and argue that in the “gap filling” regime long-range superconducting order is destroyed, and the system displays a pseudogap behaviour.