

## Coexistence of superfluid and metallic-like state in two-component fermionic systems

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We study the possibility of coexistence in a two component fermionic system of a superfluid state with a metallic-like state with gapless excitations at a Fermi surface. We consider a two-band system with mixing (hybridization) between them and attractive interactions between only one type of quasi-particles. Besides a conventional BCS regime, we find for sufficiently strong interactions a superfluid state of Bose condensed pairs at zero temperature. We investigate whether these pairs can coexist with a metallic-like state characterized by gapless electronic excitations. The zero temperature phase diagram as a function of the strength of the attractive interaction and the mixing is obtained. For simplicity and to clarify the nature of the quantum phase diagram we consider the case of s-wave pairing.