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Superconductivity, magnetism, and pairing symmetry in Fe-based superconductors[1]

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We analyze antiferromagnetism and superconductivity within the renormalization group(RG) technique in novel Fe-based superconductors using the itinerant model of small electron and hole pockets near (0; 0) and (π,π), respectively, originating from the two strongly hybridized orbitals. We find that, for this model, the bare interactions in the Cooper channel are repulsive, and superconductivity does not occur at the mean-field level. However, under RG the effective interaction in the superconducting channel changes sign and becomes attractive. Furthermore, the effective interactions in antiferromagnetic and superconducting channels logarithmically flow towards the same absolute values at low energies, i.e., both must be treated on equal footings. The magnetic instability comes first for equal sizes of the two pockets, but looses to superconductivity upon doping. The superconducting gap has no nodes, but changes sign between the two Fermi surfaces (extended s-wave symmetry). We argue that the T dependencies of the spin susceptibility and NMR relaxation rate for such state are exponential only at very low T, and can be well fitted by power-laws over a wide T range below Tc. We further show that below Tc excitonic resonance appears in the spin excitations spectrum.

[1] M. Korshunov, and I. Eremin, Phys. Rev. B 78, 140509(R) (2008)
[2] A.V. Chubukov, D. Efremov, I. Eremin, Phys. Rev. B 78, 134512 (2008).
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[1]Work done in collaboration with A.V. Chubukov, D. Efremov, and M.M. Korshunov