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Symmetry and structure of the pairing gap in Fe-based superconductors[1]

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I review recent works on the symmetry and structure of superconducting gap in Fe-pnictides and related compounds. I show that the gap very likely has s-wave symmetry, and is either nodal or has nodes along the two electron Fermi surfaces, depending on the parameters. I argue that the nodal gap is most likely outcome in systems with less pronounced tendency towards antiferromagnetism. I compare 4-and 5-pocket models for Fe-pnictides and argue that the parameter range where the gap is nodal is much wider in 4-pocket models. I review recent experiments aimed to understand whether the gap has nodes, e.g., experiments on the variation in the field-induced component of the specific heat C(H) with the direction of the applied field in $FeSe_{0.4}Te_{0.6}$. I show that, for extended s-wave gap, C(H) has $\cos 4\phi$ component, where ϕ is the angle between H and the direction between hole and electron Fermi surfaces, but only if the gap has no nodes. When the gap has accidental nodes, the $\cos 4\phi$ variation does not hold. I also plan to discuss the interplay between direct Coulomb interaction at large momentum transfer and spin-fluctuation contribution to the pairing, and the interplay between antiferromagnetism and superconductivity. In particular, I show that in 4-pocket (but not in 5-pocket) model superconductivity becomes the leading instability in some range of parameters even at perfect nesting, i.e, antiferromagnetism is not a pre-condition for superconductivity. This agrees with functional RG studies.

[1]In collaboration with Ilya Eremin and Saurabh Maiti