Enhancement of spin-fluctuation-mediated superconductivity due to orbital distillation and multiband effects

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In this talk, we compare how superconductivity can be enhanced in two kinds of multiband systems. In the first part, we will introduce a two-orbital Hubbard model for the high T_c cuprates, where not only the dx^2-y^2 but also the dz^2 orbital is taken into account. There it is shown that the "pure dx^2-y^2" Fermi surface is favorable for spin-fluctuation-mediated d-wave superconductivity, and the mixing of the dz^2 orbital character in the Fermi surface degrades superconductivity [1,2]. In this sense, "orbital distillation" is a key for enhancing T_c. This explains two of the well-known systematic material dependences of T_c in the cuprates. In the latter part, we will consider multiband systems with coexisting narrow and wide bands, where the multiple bands originate from multiple sites within a unit cell, not from different kinds of orbitals. In this case, when the Fermi level, intersecting the wide band, is placed very close to, but not within, the narrow band, the spin-fluctuation-mediated superconductivity is strongly enhanced[3,4]. We will discuss possibility of realizing this high T_c mechanism in actual materials [5].

References

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