Magnetic Susceptibility from Spin Density Wave State to Superconducting State in Quasi-one-dimensional Conductors

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Magnetic susceptibility has been examined when the crossover from the spin-density-wave to the superconducting state occurs in quasi-one-dimensional conductors with decreasing temperature. The 2-loop renormalization group method is applied to the extended Hubbard model with a quarter-filled band, in which both intrachain and interchain couplings are taken into account for electron hopping and repulsive interaction. D-wave singlet (SCd) and the f-wave triplet (SCf*)* superconducting states are examined using a four-patches Fermi surface with deviations to perfect nesting. When interchain interaction increases at low temperatures, there is a crossover from the SCd to the SCf state [1]. The charge-density-wave (CDW) state is obtained for large interchain interaction. The SCf state emerges due to the interplay of nesting deviation and the charge fluctuation while the SCd state is induced by the spin fluctuation. Using the renormalized coupling constants, it is shown that, with decreasing temperature, magnetic susceptibility in the SCd state decreases to zero due to the formation of a spin gap while for the SCf state, it is rather enhanced by the absence of spin gap suggesting a ferromagnetic contribution coming from spin fluctuation linked to the SCf state. The latter result contrasts with the role of interchain electron hopping, which favors antiferromagnetic fluctuations and reduces magnetic susceptibility at low temperature whenever the on-site repulsive interactions are dominant[2]. The exponential decrease of the magnetic susceptibility in both SCd and CDW states resembles to that obtained in the doped two-leg extended Hubbard ladder where the transition from the CDW to the SCd state occurs with increasing the doping rate from a half-filled band [3].

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