Novel Mechanisms of Spin-Triplet Superconductivity in the Anisotropic Triangular-Lattice Systems

Y. Ohta,[1,2] T. Shirakawa,[2] and S. Nishimoto[3]

[1]*Department of Physics, Chiba University, Chiba 263-8522, Japan.*
[2]*Graduate School of Science and Technology, Chiba University, Chiba 263-8522, Japan.*
[3]*Max-Planck-Institut für Physik complexer Systeme, 01187 Dresden, Germany*

The density-matrix renormalization group (DMRG) method is used to study the ground state of the two-chain zigzag-bond Hubbard model at quarter filling. We show [1] that, with a proper choice of the signs of hopping integrals, the ring exchange mechanism yields ferromagnetic spin correlations between interchain neighboring sites, and produces the attractive binding energy between electrons as well as the long-range pair correlations in the spin-triplet channel, thereby leading the system to triplet superconductivity. From the analysis of the pair correlations, we find that the Cooper-pair wave function has the *f*-wave symmetry. We argue that this novel mechanism may be a possible explanation for observed superconductivity in Bechgaard salts.

We have also studied some relating models consisting of two or three Hubbard chains coupled with interchain ferromagnetic exchange interactions. We use the DMRG method and Lanczos exact diagonalization technique on small clusters to calculate the charge gap, spin gap, binding energy, pair correlation functions, anomalous Green's function, and symmetries of the Cooper-pair wave function of the models. We thereby show that the models have the ground state of spin-triplet superconductivity in a wide parameter and filling region, where the Cooper-pair wave function can have the *f*-wave symmetry only when the hopping of electrons is allowed between the chains.

[1] Y. Ohta, S. Nishimoto, T. Shirakawa, and Y. Yamaguchi, Phys. Rev. B **72**, 012503 (2005).