Unconventional behavior of superconductivity near a spin liquid phase

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The κ-$(ET)_2Cu_2(CN)_3$, which is quasi-two-dimensional Mott insulator shows no long range magnetic order down to 32mK due to the highly frustrated triangular lattice [1]. This material undergoes a superconducting phase transition under pressure. So this salt is suitable for investigating the relationship between a geometrical frustration and appearance of superconductivity.

To determine the symmetry of superconducting gap of κ-$(ET)_2Cu_2(CN)_3$, we performed ^{13}C-NMR measurement of a single crystal under hydrostatic pressure. The applied pressure is 0.4 GPa. The external filed of 2 T was applied parallel to the superconducting layer. Fig. 1. (a) is the temperature dependence of the spin-lattice relaxation rate, $1/T_1$. Below the transition temperature, $1/T_1$ follows T^3 law and shows no coherence peak just below T_c. These behaviors indicate the nodal structure of the superconducting gap. On the other hand, small reduction of the Knight shift below T_c is observed as shown in Fig.1 (b). In the singlet paring state, the Knight shift goes to zero far below T_c. So, this behavior is hard to be interpreted as a simple singlet pairing symmetry.

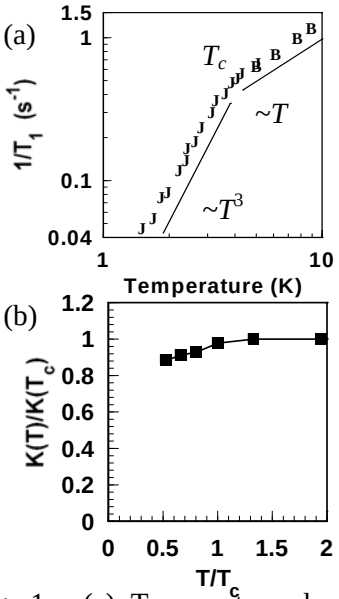

Fig. 1. (a) Temperature dependence of $1/T_1$. (b) Temperature dependence of Knight shift. The shift slightly decreases below T_c.

We also determine the upper critical field, $H_{c2}(T)$ by resistance measurement. We found the H_{c2} exceeds the Pauli paramagnetic limit H_p, which gives the upper critical field of a singlet superconductor.

[1] Y. Shimizu *et al*. Phys. Rev. Lett. **91**, 107001 (2003)