^{13}C NMR study of the spin-liquid state in the triangular quantum antiferromagnet EtMe$_3$Sb[Pd(dmit)$_2$]$_2$

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The family of layered organic salts X[Pd(dmit)$_2$]$_2$ are Mott insulators and form scalene-triangular spin-1/2 systems[1]. Among them, EtMe$_3$Sb[Pd(dmit)$_2$]$_2$ has a nearly regular-triangular lattice. We reported the spin state of this salt by ^{13}C NMR and static susceptibility measurements[2]. The temperature dependence of the susceptibility is described as that of a regular-triangular antiferromagnetic spin-1/2 system with an exchange interaction $J = 220 - 250$ K. Regardless of the large magnetic interactions, the ^{13}C NMR measurements reveal that there is no indication of either spin ordering/freezing or an appreciable spin gap down to 1.37 K, which is lower than 1% of J. Therefore, the quantum spin-liquid state is considered to be realized in this system[2].

Recently, theoretical studies have proposed that the quantum spin-liquid state may have several symmetry breaking instabilities. To investigate whether or not symmetry breaking occurs in the present spin-liquid material EtMe$_3$Sb[Pd(dmit)$_2$]$_2$, and to clarify the nature of the low-energy excitation, we have performed the ^{13}C NMR measurements down to 19.4 mK by using a dilution refrigerator.

We observe no critical broadening of the spectrum characteristic of spin ordering/freezing down to 19.4 mK. It means that the spin system is in a quantum state. Figure 1 shows the temperature dependence of the spin-lattice relaxation rate of EtMe$_3$Sb[Pd(dmit)$_2$]$_2$. A kink is observed around 1 K, suggesting a 2nd-order phase transition accompanied by symmetry breaking. Below 300 mK, the spin-lattice relaxation rate is proportional to the square of the temperature, which implies nodally-gapped spin excitation.

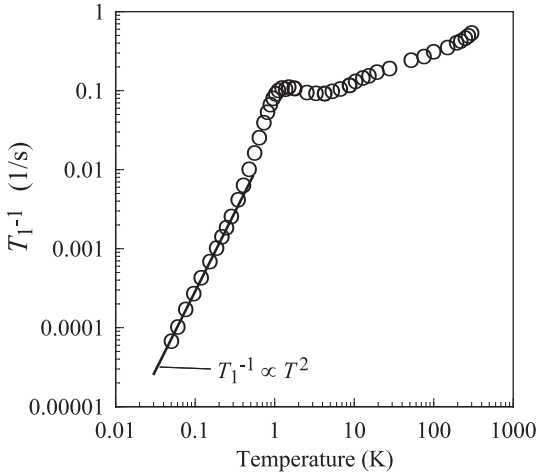

Figure 1 Temperature dependence of ^{13}C nuclear spin-lattice relaxation rate of EtMe$_3$Sb[Pd(dmit)$_2$]$_2$.

References

[1] R. Kato, Chem. Rev. **104**, 5319 (2004).
[2] T. Itou, *et al.*, Phys. Rev. B **77**, 104413 (2008).