QUANTUM SPIN LIQUID STATE IN THE TRIANGULAR-LATTICE MOTT INSULATOR EtMe$_3$Sb[Pd(dmit)$_2$]$_2$ OBSERVED BY $^{13}$C-NMR

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The organic Mott insulator EtMe$_3$Sb[Pd(dmit)$_2$]$_2$ is a quasi-two-dimensional 1/2-spin system on a nearly-regular triangular lattice with antiferromagnetic exchange interactions $J = 220$–250 K. We have performed $^{13}$C-NMR measurements for this material and have found that it exhibits a spin liquid state [1-3]. Figures 1 and 2 show the temperature dependence of the $^{13}$C-NMR spectra and spin-lattice relaxation rate $T_1^{-1}$ measured for a single crystal under a field of 7.65 T. The $^{13}$C-NMR spectra are within ±30 kHz down to 25.4 mK. These widths are much smaller than the scale of the hyperfine coupling, indicating that the ground state does not have classical magnetic ordering. One possible scenario to explain such a quantum phase realized in spin systems is “spin-liquid state with spinon Fermi surface”. However, our NMR result is not consistent with this picture. This picture predicts that $(T_1T)^{-1}$ remains constant (Fermi-liquid case) or diverges (non-Fermi-liquid case) on cooling, whereas our experimental result under 7.65 T shows that $(T_1T)^{-1}$ disappears in proportion to $T$ on approaching absolute zero after showing a peak around 1 K, as shown in the inset of Fig. 2. Our NMR data rather implies that the ground state is likely to have an exotic broken-symmetry and/or topological structure [2,3].

I will present recent NMR data such as the field direction and amplitude dependence of $T_1^{-1}$ and discuss the nature of the ground state of this system from the viewpoint of NMR.

Fig. 1: $^{13}$C-NMR spectra of EtMe$_3$Sb[Pd(dmit)$_2$]$_2$ under a field applied perpendicular to the 2D plane.

Fig. 2: Temperature dependence of $T_1^{-1}$.