Thermal-transport Measurements in Spin-1/2 Triangular Antiferromagnets κ-(BEDT-TTF)$_2$Cu$_2$(CN)$_3$ and EtMe$_3$Sb[Pd(dmit)$_2$]$_2$

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The quest of the ground state of quantum spins (S = 1/2) under a geometrical frustration such as triangular lattice and kagomé lattice has been attracting tremendous attention for several decades, especially about the low-lying excitations in quantum-spin-liquid states. One promising method to unveil the ground state is to measure the thermal conductivity because it is very sensitive to delocalized low-lying quasiparticles. Here, we report thermal-transport measurements of κ-(BEDT-TTF)$_2$Cu$_2$(CN)$_3$ [1] and EtMe$_3$Sb[Pd(dmit)$_2$]$_2$ [2] to elucidate the low-lying excitation. Both organic insulators are known to possess a nearly ideal triangular lattice and show no magnetic ordering down to very low temperatures.

In κ-(BEDT-TTF)$_2$Cu$_2$(CN)$_3$, thermal conductivity (κ) shows a broad peak around 6 K followed by a gapped temperature dependence ($\kappa \propto \exp(-\Delta/T)$) with vanishing κ/T as $T \rightarrow 0$ [3]. The gap size is determined as ~J/500 where J = 250 K is the spin interaction energy.

In sharp contrast, in EtMe$_3$Sb[Pd(dmit)$_2$]$_2$ (J ~ 235 K), κ is found to show no sign of a transition down to the lowest temperature and κ/T increases as lowering temperature, suggesting a divergent γ term in the zero-temperature limit. To extract the spin contribution to the thermal conductivity, we will also report thermal-transport measurements of Et$_2$Me$_2$Sb[Pd(dmit)$_2$]$_2$ and EtMe$_3$P[Pd(dmit)$_2$]$_2$ where a spin gap opens in low temperature by a charge ordering and a transition to a valence-bond-solid state, respectively.

We will discuss this contrasting behavior of low-lying spin excitations found in these very similar spin-liquid materials with respect to some possible underlying mechanisms of the gapped thermal conductivity in κ-(BEDT-TTF)$_2$Cu$_2$(CN)$_3$ and the divergent γ term in EtMe$_3$Sb[Pd(dmit)$_2$]$_2$.

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