

# Single Crystal Study of $S = 1$ Quasi-Two-Dimensional Heisenberg Triangular Antiferromagnet $\text{NiGa}_2\text{S}_4$

K. Onuma,<sup>1</sup> Y. Nambu,<sup>1</sup> S. Nakatsuji,<sup>1,2</sup> O. Sakai,<sup>1</sup> H. Tonomura<sup>1</sup> and Y. Maeno<sup>1</sup>

<sup>1</sup>*Department of Physics, Kyoto University, Kyoto 606-8502, Japan*

<sup>2</sup>*Institute of Solid State Physics, University of Tokyo, Kashiwa 277-8581, Japan*

We present the magnetic properties of single crystals of  $\text{NiGa}_2\text{S}_4$  [1], a rare example of two-dimensional quantum Heisenberg antiferromagnets. Our detailed magnetic and thermal measurements have revealed that  $S = 1$  spins on the triangular lattice are of *Heisenberg* type. The thermodynamic measurements have clarified the absence of long-range order or conventional spin glass ordering. The  $T^2$  dependent specific heat below 10 K, which suggests linearly dispersive modes in two dimensions, is insensitive to magnetic fields up to 7 T in both in-plane and out-of-plane directions (Fig. 1). The nearly constant susceptibility below 10 K is also insensitive to both strength and direction of the magnetic field up to 7 T. These unusual magnetic properties suggest the realization of a novel spin liquid or spin-freezing state below 10 K in  $\text{NiGa}_2\text{S}_4$ .

[1] S. Nakatsuji, Y. Nambu, H. Tonomura, O. Sakai, S. Jonas, C. Broholm, H. Tsunetsugu, Y. Qiu and Y. Maeno, *Science* **309**, 1697 (2005).

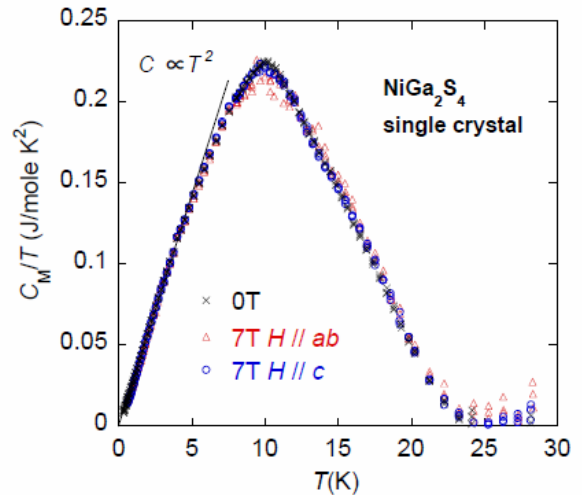


FIG.1: Temperature dependence of magnetic specific heat of  $\text{NiGa}_2\text{S}_4$  single crystals under magnetic fields along both in-plane ( $ab$ ) and  $c$ -axis directions.