Multiple ferromagnetic states revealed by transport experiments in the van der Waals ferromagnet VI_3

David Soler-Delgado,[1,2] Fengrui Yao,[1,2] Nicolas Ubrig,[1,2] Enrico Giannini,[1] Ignacio Gutierrez-Lezama,[1,2] and Alberto Morpurgo[1,2]

[1] *Department of Quantum Matter Physics, University of Geneva, Switzerland*
[2] *Group of Applied Physics, University of Geneva, Switzerland*

Magnetic layered van der Waals materials (vdW) is an emergent platform to study and engineer novel phenomena in the 2D limit, however, detecting magnetism at this scale remains extremely challenging. While transport experiments have been vital in investigating the magnetic structure of this class of materials, the information withdrawn from these experiments was limited to certain cases. For instance, the magnetic phase diagram of vdW anti-ferromagnets was successfully determined employing simple conductance measurements [1, 2].

In this work, we report transport experiments performed on thin flakes of VI_3: a newly discovered vdW ferromagnet. In particular, our magneto-resistance measurements show distinctive features which demonstrate that VI_3 undergoes two ferromagnetic transitions at temperatures $T_{FM1} \approx 58$ K, and $T_{FM2} \approx 36$ K, in agreement with magnetization and specific heat measurements previously reported for bulk samples [3]. Our results show the possibility to realize field-effect transistors based on magnetic vdW materials and demonstrate that magneto-transport measurements are a powerful tool to determine the peculiar phase diagram of atomically thin VI_3.

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[3] E. Gati et al. Phys. Rev. B 100, 094408 (2019).