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DISPATCH · PHONON HALL EFFECT · 2 MIN

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Sideways heat flow in a layered magnet tracks its magnetisation along one axis

In nickel phosphorus trisulfide, sideways heat flow carried by crystal vibrations is highly sensitive to magnetisation along one axis but not to phonon scattering, pointing to an intrinsic cause.

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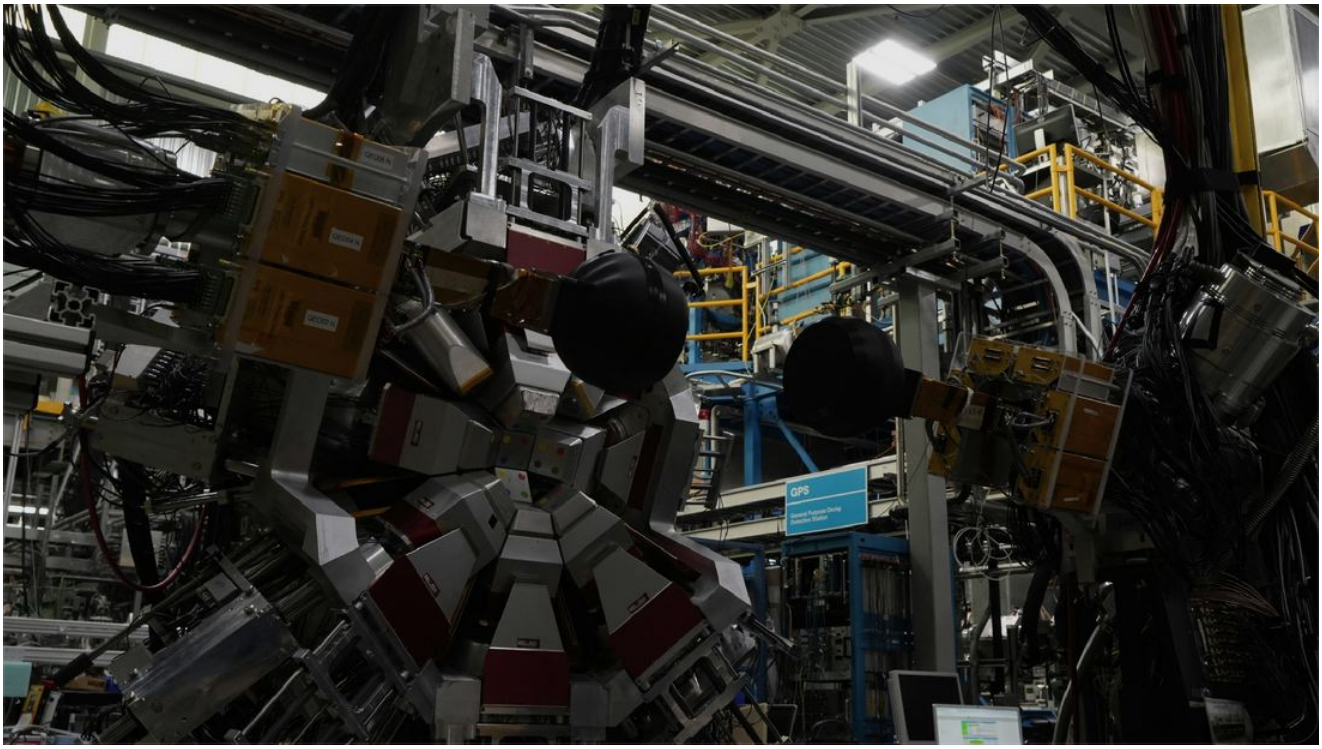


Photo: Daniel Miksha

In an electrical insulator, heat is carried mostly by phonons, the quantised vibrations of a crystal's atomic lattice. In a variety of insulators some of that heat also travels sideways, at right angles to the direction it is pushed. This is the thermal Hall effect, named by analogy with the way a magnetic field deflects an electric current. Phonons carry no electric charge, so why they should be deflected at all has not been settled. A study published in Science in 2026 by researchers from Huazhong University of Science and Technology, the Henan Academy of Sciences and the Quantum Science Center of Guangdong-Hong Kong-Macao Greater Bay Area reports measurements aimed at that question.

The team worked with nickel phosphorus trisulfide, NiPS3. It is a van der Waals material, meaning its atomic layers are stacked and held together only by weak forces, and each layer is a honeycomb lattice of atoms. It is also an antiferromagnet: its atomic magnetic moments are ordered so that

they point in opposing directions and cancel overall, and in this compound they are arranged in a zigzag pattern. The authors report a sizable thermal Hall conductivity in it, though the abstract gives no figure.

They compared two quantities. One is the ordinary, or longitudinal, thermal conductivity along one crystal direction, written κaa. The other is the transverse conductivity, κab, which measures the sideways flow. According to the study, both peak at the same temperature. At that peak, the thermal Hall angle, a measure of how strongly the heat is turned aside relative to how much flows straight on, respects a bound identified in earlier work. The abstract does not say what that bound is.

The central finding concerns what the sideways flow depends on. The authors report that the size of κab is extremely sensitive to how strongly the material is magnetised along one crystal direction, the b axis. It is not correlated, they say, with the phonon mean free path, the average distance a phonon travels before it is scattered. On that basis the authors argue that the effect is intrinsic, arising from the material's own properties rather than from how its phonons scatter, and the paper's title describes that origin as thermodynamic.

The abstract supports only a limited account. It gives no values for the conductivities, the peak temperature or the strength of the magnetic dependence, and it does not describe how the measurements were made. The abstract says the evidence points to an intrinsic origin, though the title states the case more firmly, and the study concerns a single compound, so whether the same explanation holds for the other insulators that show a phonon thermal Hall effect is left open.

PAPER	*Thermodynamic origin of the phonon Hall effect in a honeycomb antiferromagnet*
AUTHORS	Qingkai Meng, Xiaokang Li, Jie Liu, Lingxiao Zhao, Chao Dong, Zengwei Zhu et al.
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