

Nonlinear heat transport in altermagnets

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Heat transport in magnetic materials provides a powerful probe of elementary excitations, including phonons, magnons, and unconventional quasiparticles. While conventional thermal transport has been extensively investigated in the linear-response regime, nonlinear heat transport remains largely unexplored. Such nonlinear responses can emerge from broken symmetries and nontrivial quantum geometry, including Berry curvature, offering new opportunities to explore unconventional transport phenomena and their underlying excitations.

Altermagnets [1] provide one of the promising platforms for exploring such nonlinear thermal transport phenomena. In particular, recent theoretical studies have predicted third-order thermal Hall responses arising from magnon Berry curvature, even when lower-order responses are suppressed by symmetry [2]. Here, we investigate nonlinear heat transport in MnTe, an altermagnetic candidate, focusing on its transverse thermal response under magnetic fields. By systematically measuring the longitudinal and transverse temperature differences, we identify a nonlinear transverse contribution consistent with a third-order response. Remarkably, this contribution persists in a high-field regime where the linear thermal Hall response is strongly suppressed, whereas the longitudinal response remains predominantly linear. These observations suggest a distinct nonlinear transverse transport mechanism beyond conventional longitudinal thermal transport nonlinearities.

We discuss possible microscopic origins of the observed response, including the roles of magnetic symmetry, magnon Berry curvature, and phonon–magnon coupling. Our results highlight nonlinear heat transport as a promising approach to exploring unconventional excitations and quantum geometric phenomena in magnetic materials.

[1] L. Šmejkal *et al.*, Phys. Rev. X **12**, 031042 (2022).

[2] Y.-M. Li *et al.*, Phys. Rev. B **114**, L140406 (2026).