Large thermal Hall effect in a frustrated pyrochlore magnet

MAX HIRSCHBERGER, Department of Physics, Princeton University, JASON KRIZAN, ROBERT J. CAVA, Department of Chemistry, Princeton University, N. PHUAN ONG, Department of Physics, Princeton University — In frustrated magnetism, the nature of the ground state and its elementary excitations are a matter of considerable debate. We present a detailed study of the full thermal conductivity tensor $\kappa_{ij}$, including the Righi-Leduc (or thermal Hall) effect, in single crystals of the frustrated quantum spin-ice pyrochlore $\text{Tb}_2\text{Ti}_2\text{O}_7$. The off-diagonal response $\kappa_{xy}/T$ is large in this insulating material, despite the absence of itinerant electrons experiencing the Lorentz force. Our experiments over the temperature range of 0.8 – 200 K and in fields up to 14 T reveal a remarkable phenomenology: A sizeable field-linear Hall effect $\kappa_{xy}/T$ is observed below 100 K, and its slope with respect to magnetic field increases strongly as we cool the sample. We observe significant curvature in the field dependence of $\kappa_{xy}/T$ below 15 K. At the lowest temperatures, both $\kappa_{xx}/T$ and the initial slope $\lim_{B\to 0}[\kappa_{xy}/TB]$ are constant in temperature, behavior reminiscent of fermionic heat conduction in dirty metals. Experimental methods and verification of the intrinsic nature of the effect will be discussed.

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