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Thermal Hall transport in extended Kitaev models

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In this presentation, we discuss the thermal Hall conductivity in the Kitaev model with additional interactions under a magnetic field, employing a finite-temperature tensor network method. We find that the thermal Hall conductivity divided by temperature, κ_{xy}/T, significantly overshoots the value of the half-integer quantization and exhibits a pronounced hump while decreasing temperature, in agreement with the experimental observations in a candidate material α-$RuCl_3$. Moreover, we show that the field-direction dependence of κ_{xy}/T is consistent with the sign of the Chern number associated with the Majorana fermions across a wide range of magnetic fields, indicating that the topological Majorana fermion picture remains valid, even within the polarized phase beyond the quantum critical point. We also demonstrate that the additional off-diagonal interactions, known as the Γ and Γ' terms, significantly affect κ_{xy}/T. Our findings establish a comprehensive theoretical framework for understanding the thermal Hall transport in Kitaev materials such as α-$RuCl_3$ and provide key insights into the detection of exotic quasiparticles in quantum spin liquids.

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