Controlling Topological Phase Transitions of Kitaev Quantum Spin Liquids

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We show that topological phase transitions may be utilized to identify Kitaev quantum spin liquids. We investigate the interplay between topological and symmetric properties of Kitaev quantum spin liquids, finding characteristics of physical observables such as thermal Hall conductivity and specific heat. For example, we show specific directions of in-plane magnetic fields give gapless Majorana fermion excitations, constrained by the lattice symmetry. Furthermore, we also consider electric field effects and find that topological phase transitions may be controlled in sharp contrast to the common belief that an insulator is inert under weak electric fields due to charge energy gaps. We predict distinctive experimental signatures to detect Kitaev quantum spin liquids, especially in connection with the candidate materials such as α-$RuCl_3$.

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