Thermodynamics of topological phase transitions

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I will explain the concept of Hill (nano)thermodynamics and how to apply it to topological insulators. I will start with the Ginzburg-Landau theory of phase transitions, the concept of an order parameter, and why this formalism cannot be applied to topological insulators. Then, I will introduce the Ehrenfest classification and thermodynamic observables, such as entropy and heat capacity. Finally, we will connect the results obtained to the Josephson hyperscaling relation and to critical exponents.

The technique will be applied to describe the topological phase transition for the Kitaev and SSH chains, Kane-Mele and BHZ models. We will also discuss the connections to the Berry and Uhlmann phases, and the concept of finite-temperature topological order.

Finally, the formalism will be generalized to the case of non-Hermitian topological systems, which require the concept of fractional calculus. If time permits, the case of long-range hopping will also be discussed.