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Topological Phase Transitions for Interacting Finite Systems[1] KAI SUN, University of Maryland, College Park, CHRISTOPHER VARNEY, MARCOS RIGOL, Georgetown University, VICTOR GALITSKI, University of Maryland, College Park — We investigate topological phase transitions in interacting systems via the observation of a topologically protected level crossing. This level crossing is robust and sharply defines a topological transition even in finite-size systems. For Chern insulators, this technique gives the same topological transition point as obtained in the Chern number calculation (via flux insertion). However, in the presence of space inversion symmetry, we proved that if the topological index changes by an odd integer at the topological transition, the level crossing can only arise under (some of) the four high-symmetry boundary conditions. This discovery provides a very efficient way to detect topological phase transitions, which reduces the computational load dramatically. In contrast to the standard Chern number technique, which requires to compute the ground state wave function for hundreds of different boundary conditions, our technique achieves the same result by calculating the excitation gap for only four different boundary conditions. We demonstrate this technique in the Haldane-Fermi-Hubbard model utilizing exact diagonalization. Generalization to time-reversal invariant Z_2topological insulators will also be discussed.

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