

Topological Protection by Local Support Symmetry and Destructive Interference

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Conventionally, symmetry-protected topological (SPT) phases and band-crossings have been considered as protected by global symmetries, such as time-reversal and mirror symmetries, applied to the entire system. We propose another class of solid-state phases, where symmetries preserved only in a partial region, termed local support symmetries (LSSs), serve as a protective mechanism for the topological nature of the whole system. The LSS itself generally lacks inherent topological protection and necessitates specific conditions for the hopping processes between two distinct parts of the system. We establish the explicit forms of these conditions for both the insulating and metallic cases, highlighting that a destructive interference of the Bloch wave function can play a crucial role in the fulfillment of these conditions. We explore various tight-binding models featuring band-crossings and topological bands protected by local support crystalline and time-reversal symmetries. Employing density functional theory (DFT), we additionally introduce a practical material, the fluorinated biphenylene network, where a band-crossing is protected by the local support C_2 symmetry.