Special Seminar

Theoretical Condensed Matter Physics

Wednesday, March 3, 2021 → Zoom → 9:30 AM

"Defect Modes in Topological Materials"

Topological materials are common in the solid state, particularly those protected by crystalline symmetries. In this talk, I will show how we can explore the interplay between crystalline symmetries preserved by the crystal lattice and the topology of electronic structures to realize topologically robust modes in these materials and measurably affect their bulk material properties.
I will show that topological phases protected by point group symmetries can host helical modes along screw or edge dislocations similar to what is observed for those protected by translation symmetry, i.e., weak topological insulators. However, when this occurs, the helical mode is necessarily bound to a dislocation characterized by a fractional Burgers vector and macroscopically detected by the existence of a stacking fault. The robustness of a helical mode on a partial defect is demonstrated by an adiabatic transformation that restores translation symmetry in the stacking fault. Since partial defects and stacking faults are commonplace in bulk crystals, the existence of such helical modes can measurably affect the expected conductivity and thermoelectric properties of these materials. Finally, I will describe a general framework towards the classification of symmetry breaking defects based on symmetry representations and show how these defects can help find other exotic phenomena in the solid state, such as nonabelian Majorana fermions.

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