

Symmetry-driven transitions between flat bands and Dirac cones in bilayer kagome lattices

Engin Durgun¹

Taylan Gorkan¹, Dogukan Hazar Ozbey¹, Cem Sevik², Milorad V. Milosevic²

¹UNAM-National Nanotechnology Research Center and Institute of Materials Science and Nanotechnology, Bilkent University, TR-06800 Ankara, Turkey

²COMMIT, Department of Physics, University of Antwerp, B-2020 Antwerp, Belgium

durgun@unam.bilkent.edu.tr

Abstract:

Flat bands (FBs) and Dirac cones represent two distinctive features of topological electronic systems [1]; however, a unified mechanism enabling transitions between them has remained elusive to date. Here, we demonstrate a symmetry-governed and tunable transition from flat bands to Dirac cones in AB-stacked bilayer kagome lattices. This transition is mediated by the interplay among destructive quantum interference (DQI), C_3 rotational symmetry, and spatial inversion symmetry. Strong interlayer coupling enhances DQI and stabilizes compact localized states that produce FBs, while weaker coupling allows C_3 and inversion symmetries to dominate, giving rise to robust Dirac nodal points. Using a minimal tight-binding model, we map the continuous evolution of topological states, including type-II and type-III Dirac cones, spin-1 Dirac nodes, and partial flat bands, as a function of interlayer coupling. We further demonstrate this transition mechanism by examining an AB-stacked bilayer derived from the experimentally synthesized Nb_3TeCl_7 structure. In particular, first-principles calculations on bilayer Nb_3TeCl_7 reveal that vertical strain (or pressure) modulates the interlayer interactions, enabling the full FB-Dirac cone transition sequence. These findings [3] establish a realistic pathway for gaining deeper insight into flat-band physics and for engineering

tunable topological phases in two-dimensional materials.

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References

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Figures

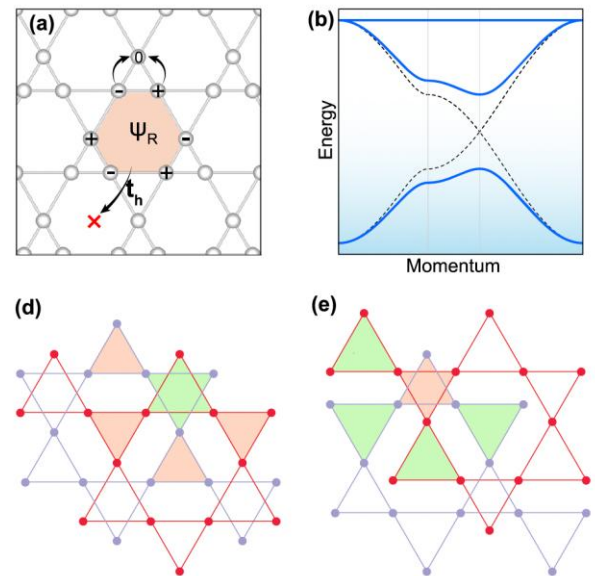


Figure 1: The AB-stacked bilayer bk lattice and emergence of FBs.