Topological states in superlattices of HgTe-class materials

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In search of superlattices with topological phases, using ab-initio computations, we investigate how topological phases evolve as a function of hydrostatic pressure and uniaxial strain in two types of superlattices: HgTe/CdTe and HgTe/HgSe [1]. In short-period HgTe/CdTe superlattices, our analysis unveils the presence of isoenergetic nodal lines at the Fermi level. In contrast, HgTe/HgSe short-period superlattices are found to harbor a rich phase diagram with a plethora of topological phases. Notably, the unstrained superlattice realizes an ideal Weyl semimetal with Weyl points situated at the Fermi level. A small-gap topological insulator with multiple band inversions can be obtained by tuning the volume: under compressive uniaxial strain, the material transitions sequentially into a Dirac semimetal to a nodal-line semimetal, and finally into a topological insulator with a single band inversion.

References

[1] Rajibul Islam, Barun Ghosh, Giuseppe Cuono, Alexander Lau, Wojciech Brzezicki, Arun Bansil, Amit Agarwal, Bahadur Singh, Tomasz Dietl, Carmine Autieri, *"Topological states in superlattices of HgTe-class materials"* (arXiv preprint arXiv:2112.15548), under review.