Analogies between the topologial insulator phase of 2D Dirac materials and the superradiant phase of atom-field systems

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Abstract

A semiclassical phase-space perspective of band- and topological-insulator regimes of 2D Dirac materials, and normal- and superradiant-phases of atom-field interacting models is given in terms of delocalization, entropies, and quantum correlation measures. From this point of view, the low-energy limit of tight-binding models describing the electronic band structure of topological 2D Dirac materials like phosphorene and silicene with tunable band gaps, share similarities with Rabi-Dicke and Jaynes-Cummings atom-field interaction models, respectively. In particular, the edge state of 2D Dirac materials in the topological insulator phase exhibits a Schrödinger cat structure similar to the ground state of two-level atoms in a cavity interacting with a one-mode radiation field in the superradiant phase. Delocalization seems to be a common feature of topological insulator and superradiant phases.

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