Quantum origin of anomalous Floquet phases in cavity-QED materials

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Anomalous Floquet topological phases are a hallmark of periodically-driven systems lacking a static analog [1]. Simultaneously, the research in cavity-QED (c-QED) materials is booming due to recent experimental advances that allow to explore new regimes of light-matter interaction [2]. In this case, the material couples to quantized light and forms an isolated hybrid state with properties dictated by the mutual influence between electrons and photons. Inspired by the long-standing tradition of Floquet Engineering using classical electromagnetic radiation, Quantum Floquet Engineering [3] has recently emerged as a promising tool to tailor the properties of quantum materials through the interaction with quantum light in a cavity-QED set up.

While the later recovers the physics of Floquet materials in its semi-classical limit, the mapping between these two widely different scenarios remains mysterious in many aspects. In this work [4], we discuss the emergence of quantum anomalous topological phases in cavity-QED materials, and link the topological phase transitions in the electron-photon spectrum with those in the 0- and π-gaps of Floquet quasienergies in the semi-classical limit. Our results establish the microscopic origin of an emergent discrete time-translation symmetry in the matter sector, and link the physics of the isolated c-QED materials with that of periodically driven ones. Finally, we discuss the bulk-edge correspondence in terms of hybrid light-matter topological invariants.

References

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Figures

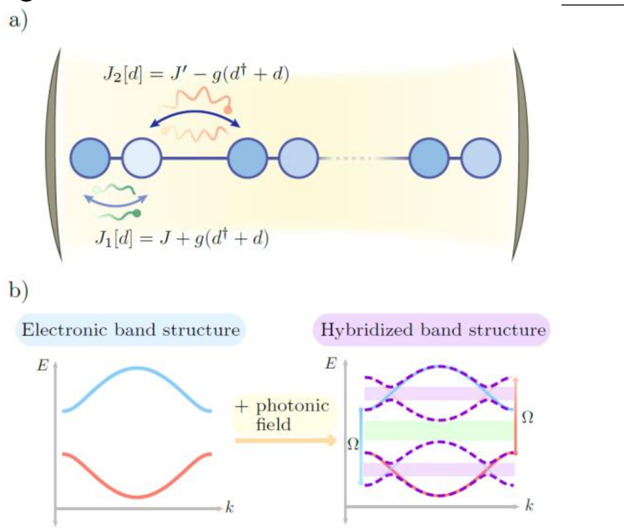

Figure 1: The SSH chain interacts with the cavity field through the photon-assisted hopping. the hybridized band structure showcases anomalous gaps (violet) and single-particle gaps (green), which can be both populated by topological edge states