

Weyl Josephson Circuits

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Multiterminal superconductor-normal-superconductor junctions have been a focus of theoretical and experimental work due to their potential topological properties, but so far, they remain far out of experimental reach due to lack of microscopic control. Here we propose an alternative approach based on standard Josephson tunnel junction circuits, immediately enabling experimental pursuit. We find that these circuits can be designed to simulate Weyl band structures, which can mimic the properties of massless ultra-relativistic particles known as Weyl fermions. We dubbed these Weyl Josephson circuits.

In this work, we first explain a general approach to construct small quantum circuits that exhibit topological band structures of a desired symmetry class, and which are governed by a designable set of controllable parameters. We then construct and analyze in detail a six-junction device that produces a 3D Weyl Hamiltonian with broken inversion symmetry and in which topological phase transitions can be triggered *in situ*. Finally, we propose specific experiments probing the topological character of Weyl Josephson circuits which are readily accessible using standard nanofabrication and measurement techniques.

This work breaks open a field of research that merges the technological readiness and theoretical clarity of superconducting circuits with the notions of quantum geometry and band topology.

References

- [1] V. Fatemi, A. R. Akhmerov, L. Bretheau, *Physical Review Research* **3**, 013288 (2021),
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