Topological Josephson Plasma in Honeycomb Junction Array

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Topology in condensed matter physics is attracting significant interests [1]. This concept has also been extended to electromagnetic waves and other systems with the bosonic feature, which provides a new facet towards realizing novel properties and functionality based on the topological interface transport immune to back scattering and robust to disorder [2-4]. Here we report our recent work on Josephson junction arrays (JJA) [5]. The system consists of a honeycomb JJA with superconducting islands residing on sites of honeycomb lattice and JJ on the links between sites; each superconducting island is connected by a capacitor to the common ground. Interestingly, the system exhibits a Dirac-like linear frequency dispersion similar to that seen in graphene, which one can call an artificial graphene. We reveal that assigning a two-valued texture in critical Josephson current I_c, whereby I_c inside the hexagonal unit cells is smaller than I_c between the unit cells, opens a gap in the Dirac dispersion, and that a topological Josephson plasma mode appears accompanied by a p-d band inversion [5]. We are going to show the details of our theory and discuss experimental realizations as well as possible merits for applications.

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References

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