Topology of multi-terminal Josephson junctions with interacting two and three quantum-dot systems

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In the past few years, multi-terminal Josephson junctions have attracted considerable attention due to their non-trivial topological properties [1,2]. Theoretical predictions of topological Andreev bands have now been confirmed in four-terminal Josephson-junction heterostructures that were modeled using three quantum dots [3]. However, theoretical descriptions of these complex devices are typically restricted to the non-interacting limit, while on-site Coulomb interactions can be sizable in realistic systems. We have recently introduced the Chain Expansion (ChE) method [4], which maps each superconducting lead onto a short tight-binding chain. The resulting effective models enable a controlled treatment of complex interacting structures at a reasonable computational cost. Here, we apply ChE to systems of two and three quantum dots coupled to multiple superconducting leads. We first demonstrate that, in the non-interacting limit, the topology agrees with established predictions. We then show how the topological features evolve as interactions are turned on.

References:

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