

Quantum simulation with Fluxonium Qutrit Arrays

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Abstract

Fluxonium superconducting circuits were originally proposed to realize highly coherent qubits. In this talk, we explain how these circuits can be used to implement and harness qutrits, by tuning their energy levels and matrix elements via an external flux bias.

In particular, we investigate arrays of fluxonium qutrits, and their potential for the quantum simulation of exotic quantum matter. We identify four operational regimes, classified according to the plasmon-like versus fluxon-like nature of the qutrit excitations. Highly tunable on-site interactions are complemented by correlated single-particle hopping, pair hopping and non-local interactions, which naturally emerge and have different weights in the four regimes. We investigate the rich ground-state phase diagram of qutrit arrays and propose practical dynamical experiments to probe the different regimes. Altogether, fluxonium qutrit arrays emerge as a versatile and experimentally accessible platform to explore strongly correlated bosonic matter beyond the Bose-Hubbard paradigm, and with a potential toward simulating lattice gauge theories and non-Abelian topological states.

Figures

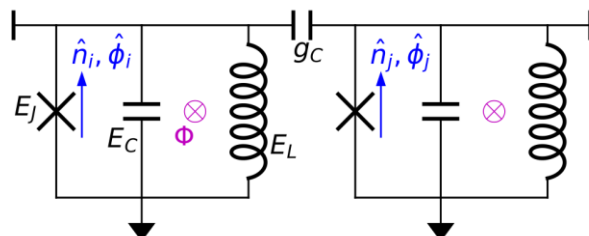


Figure 1: Two coupled fluxonium circuits form the basis of array of qutrits, a powerful platform for quantum simulation.

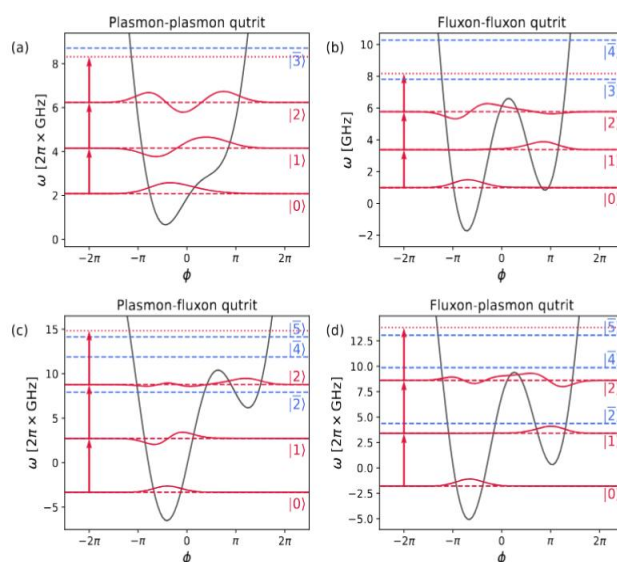


Figure 2: The four regimes that can be realized in a qutrit. Operating the qutrits at different regimes allows one to control the strength of the exotic emergent processes: correlated single-particle hopping, pair hopping and non-local interactions.

References

- [1] I. Amelio, Q. Ficheux, and N. Goldman, arXiv:2601.21507