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Studying the intermediate regime between flux qubit and fluxonium TIKAI CHANG, Quantum Nanoelectronics Laboratory, Bar Ilan University, GIANLUIGI CATELANI, Forschungszentrum Jlich, Peter Grnberg Institut (PGI-2), 52425 Jlich, Germany, MICHAEL STERN, Quantum Nanoelectronics Laboratory, Bar Ilan University, QUANTUM NANOELECTRONICS LABORATORY COLLABORATION, GIANLUIGI CATELANI COLLABORATION — A flux qubit is a micron-size superconducting loop intersected by several Josephson junctions. When the number of junctions over the loop is small (3 - 4), the system has a rather limited coherence time but exhibits large quantum current fluctuations, a property that opens perspectives for coupling microscopic magnetic systems. When the number of junctions over the loop is increased to a large number (typ. 50), the qubit - known in this configuration as fluxonium - can become immune to both charge and quasiparticle noise, and exhibit long coherence times. However, its quantum current fluctuations are typically much smaller. There is therefore a trade-off to be found. In this work, we develop a numerical method using photonic basis representation which makes possible quantitative predictions and fast parameter space scanning for flux qubits with more than four junctions. This enables us to study the full Hamiltonian of the system including kinetic inductance and geometric capacitance terms. We show that both typically reduce the gap of the qubit by over 1GHz. Finally, we study the intermediate regime between the flux qubit and the fluxonium namely the sensitivity to charge and quasiparticle noise as the number of junctions increases.

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