Superconducting flux qubit

- Toward two qubit operation -

Motivation

Any quantum computation can be expressed in terms of single qubit operations and controlled NOT gates. We propose the scheme of the controlled gate involving any pair of qubits which can be realized by coupling superconducting flux qubits through a superconducting LC resonator.

Originality

Controlled gate between two neighboring qubits has been realized in solid-state system. This proposal can make it possible to choose any two qubits. The idea is to use a common resonator coupled to every qubit.

Impact

This proposal gives us an example of a scalable quantum computer in solid state device.
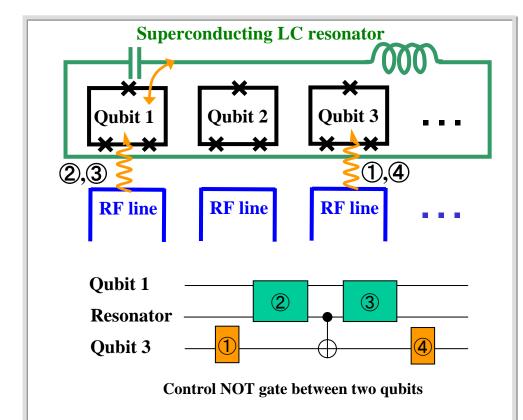The gate operations between any two qubits provide a way to perform a quantum algorithm efficiently.

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Control NOT gate between two qubits

[Simulation of CNOT gate]

We performed numerical simulations of the CNOT gate by using realizable parameters. We obtained a fidelity of the gate operation of 99% in the ideal decoherence free system, which was composed of two qubits and a resonator.