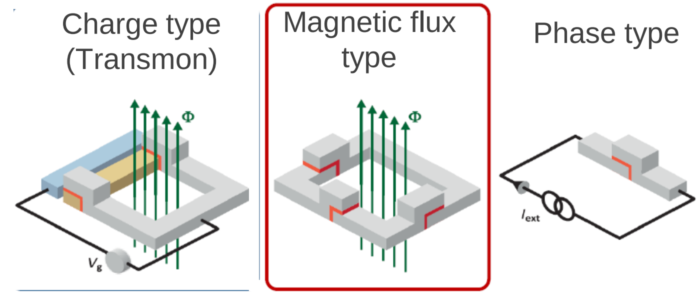
Tohoku Univ. Technology

Self shunted flux type super conducting quantum circuit element

Realization of high performance, highly integrated quantum computer by increased coherence time, anharmonicity, and reduced footprint of qubit



- Current mainstream type
- Leakage, etc. due to small anharmonicity

- High anharmonicity
- Improved coherence time/yield due to capacitor shunting

Overview

The superconducting quantum bit is composed of a single or multiple superconducting tunnel junctions (Josephson junctions). Research and development of typical charge type and magnetic flux type qubits are active. The current mainstream of high integration is Transmon, a modified version of the charge type, which has advantage of long coherence time, but has disadvantage of small anharmonicity, which can cause error. On the other hand, the magnetic flux type has advantage of large anharmonicity, but has disadvantage of short coherence time. Adding a shunt capacitor to increase coherence time causes increased footprint (the area occupied by a single qubit).

This invention solves above problem, and it is about a technology that can achieve high integration with a small footprint while maintaining a practically tolerable coherence time and anharmonicity.

Increased anharmonicity, reduced footprint, excellent noise tolerance

Designed models by full Hamiltonian

Anharmonicity (larger is better)

	Model	f_{01} [GHz]	f_{anharm} [MHz]	Shunt capacitor
This invention	**SSFQ-A**	4.3	403	0
This invention	**SSFQ-B**	3.3	1049	0
This invention	**SSFQ-C**	4.2	606	0
	C-shunt [1]	4.3	830	200x300 μm^2
	Mergemon [2,3]	4-5	200-400	0

[1] F. Yan *et al.*, *Nat. Commun.* **7**, 12964 (2016).
[2] R. Zhao *et al.*, *Phys. Rev. Appl.* **14**, 064006 (2020).
[3] H. J. Mamin *et al.*, *Phys. Rev. Appl.* **16**, 024023 (2021).

Product Application

- ☐ High performance and highly integrated quantum computer (quantum gate method, quantum annealing method)

IP Data

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