Goal 6 Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.

Large-scale Silicon Quantum Computer

Project manager

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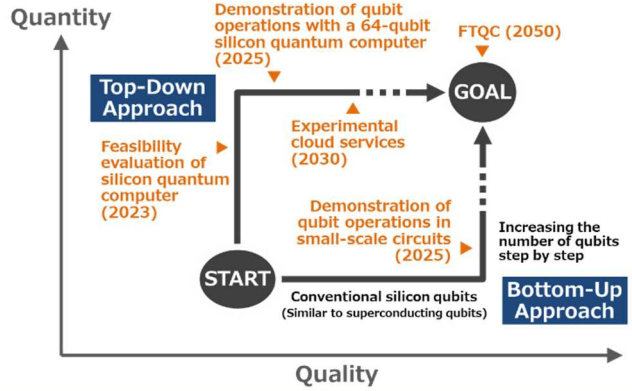
Summary of the project

In order to realize a quantum error tolerant general-purpose quantum computer, it is necessary to improve both "quality" and "quantity" aspects of quantum computers. While the current development of quantum computers is dominated by a bottom-up approach that prioritizes "quality" and increases the number of qubits, this project will take the opposite top-down approach. In other words, in order to take advantage of the advanced integration capability of silicon semiconductor technology (i.e., the ability to implement a large number of elements with uniform characteristics), we will promote a system design that emphasizes "quantity" from the beginning. Next, we will develop various technologies (two-dimensional qubit arrays, cryogenic CMOS circuits and mounting systems, hot silicon qubits, digital correction, etc.) made possible by this high silicon integration to improve the "quality" of the system as a whole and realize an error-resistant general-purpose quantum computer.



Milestone by year 2030

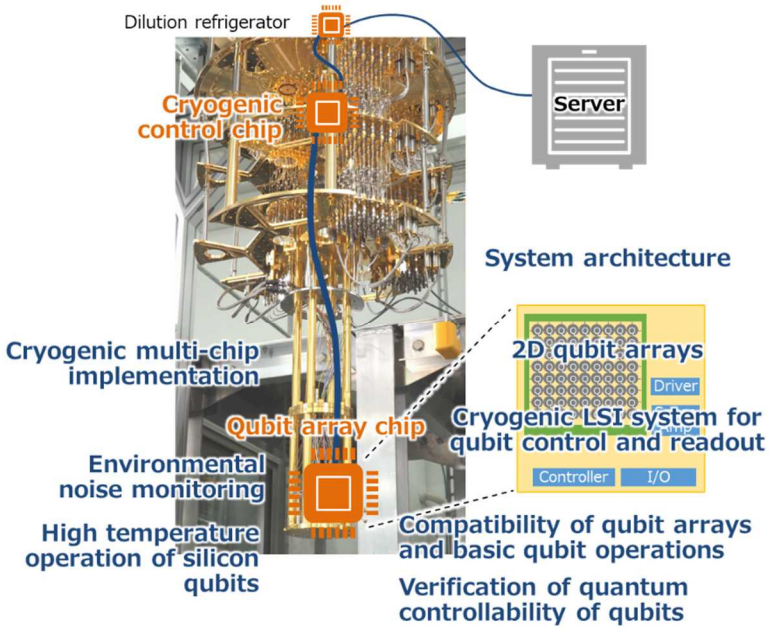
We will launch an experimental cloud service that will enable large-scale silicon quantum computers and demonstrate the effectiveness of error correction and silicon quantum computers.

Milestone by year 2025

We will develop a two-dimensional qubit array and demonstrate qubit operations on a silicon quantum computer using this array.

R&D theme structure of the project

R&D Theme	Performer	R&D challenge
1 Quantum computing system	Hitachi/ Hiroyuki Mizuno	1 2D qubit arrays 2 Cryogenic LSI system for qubit control and readout 3 System architecture
2 Multi-chip cryogenic packaing technology	Kobe Univ./ Makoto Nagata	4 Cryogenic multi-chip implementation 5 Environmental noise monitoring
3 Hot silicon qubits	Tokyo Tech/ Tetsuo Kodera	6 High temperature operation of silicon qubits
4 Quantum computing in small qubit systems	Tokyo Tech/ Jun Yoneda RIKEN/ Takashi Nakajima	7 Compatibility of qubit arrays and basic qubit operations 8 Verification of quantum controllability of qubits



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