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

Here begins our new MIRAI
MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Development of a Scalable, Highly Integrated Quantum Error Correction System

Project manager

(selected in 2025)

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R&D institutions

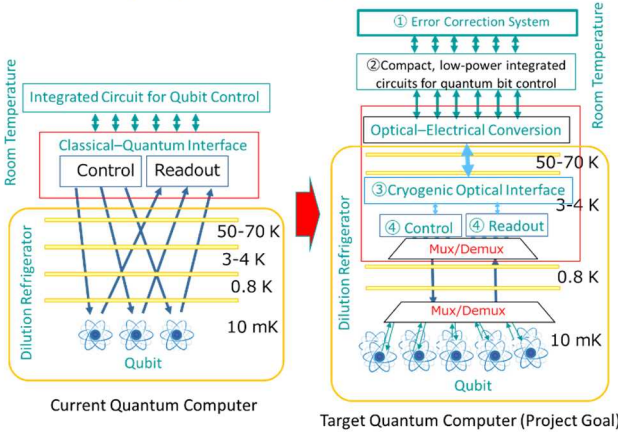
RIKEN, The University of Tokyo, Kumamoto University, QunaSys Inc., QuEL Inc. The University of Osaka, Kyoto Institute of Technology, Kyoto University, Keio University, Kansai University, High Energy Accelerator Research Organization (KEK), Fukui University, Toyama Prefectural University,

QUBECS

Summary of the project

The mission of this research and development project is to agilely adapt to a wide variety of qubit modalities, ranging from superconducting to neutral atoms, and to realize error correction systems as well as compact, low-power qubit control devices.
To achieve this, we will undertake the following research and development items using superconducting qubits. We will also extend the results to other quantum bit schemes.

◇Item 1: Scalable Backend for Error Correction
・Quantum error correction and real-time decoding for logical quantum gate operations
◇Item 2: Advanced Controller (Frontend)
・Compact, low-power controller
◇Item 3: Scalable Classical-Quantum Interface via Optical/Cryo CMOS*1-2 Integrated Circuits
・Room-temperature/4K communication using optical IF/Cryo CMOS and Cryo PDK*3
◇Item 4: Qubit Control SoC Using Cryo CMOS*4
・Control multiple qubits from cryogenic environments



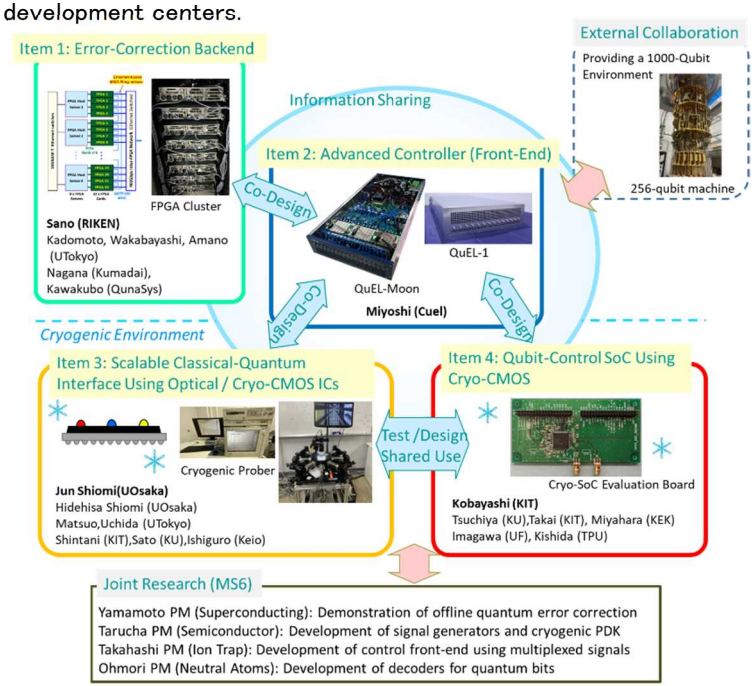
*1 Cryo:Cryogenic Temperature, *2 CMOS:Complementary Metal-Oxide-Semiconductor, *3 PDK:Process Design Kit, *4 SoC: System on a Chip

Milestone by 2030

Control and Error Correction of 1,000 Physical Superconducting Qubits from Room Temperature
* Establish compact/low-power control and error correction systems working at a room temperature and semiconductor chips integrating optical interfaces and qubit controllers working at a cryogenic temperature.

Project structure

The research is driven by a core group of 20 project leaders selected from universities, research institutions, and companies. They are supported by numerous researchers specializing in quantum and classical computing, as well as semiconductor chips. Furthermore, close collaboration is maintained with major quantum computer development centers.



Japan Science and Technology Agency