

Neutral Atom-Based Fault-Tolerant Quantum Computer

Project manager

(selected in 2025)

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Leader's institution

Institute for Molecular Science (IMS), National Institutes of Natural Sciences

R&D institutions

IMS, RIKEN, Kyoto University, Hitachi, Ltd., National Institute for Fusion Science, National Institute of Advanced Industrial Science and Technology, Yaqumo Inc.

Summary of the project

Neutral-atom quantum computers use the arrays of ultracold atoms assembled with optical tweezers, in which each single atom serves as a high-quality qubit, whereas the whole system operates at room temperatures. We develop, operate, and upgrade neutral atom-based fault-tolerant quantum-computer systems, where we will fully utilize our various core competencies in qubit control / manipulation, scalability, ultrafast laser technologies, and system engineering (as exemplified in Fig. 1), etc. Tight industry-academia collaborations will lead to all the components modularized and packaged, achieving unprecedented levels of stability and usability.

Milestone by 2030

A universal gate set with logical qubits is implemented. External users outside the Ohmori project run logical circuits with our quantum computer systems.

Milestone by 2028

The effectiveness of quantum error correction is demonstrated. External users within the Ohmori project run quantum circuits with our quantum computer systems.

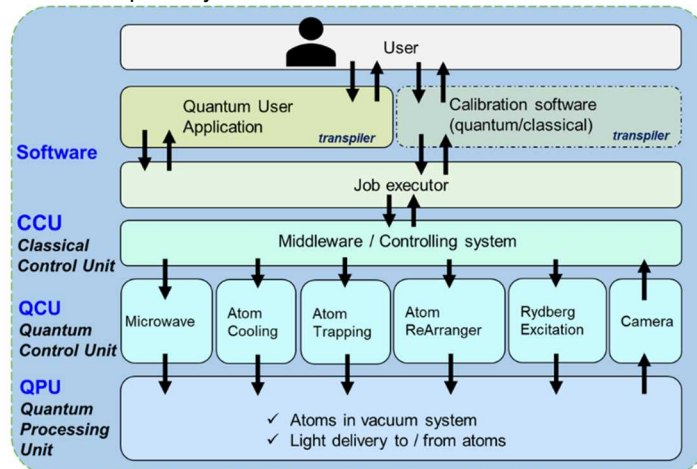


Fig. 1. IMS Full-Stack Quantum-Computer Layers

Project structure

The research themes and team structure are shown in Fig. 2. We have assembled the most suitable PIs from a broad range of academia and industries collaborating with one another. The themes will also interact strongly with one another, and therefore some PIs are assigned to multiple themes. For **Theme 1** (Development and Upgrade of Full-Stack Quantum-Computer Systems), leading neutral-atom scientists from IMS, RIKEN, and Kyoto University participate. The other two PIs from Hitachi, Ltd. and Yaqumo Inc. participate for tight industry-academia collaborations. We collaborate closely with KOBAYASHI, YAMAMOTO Takashi, and KOASHI projects on control systems, network, and error-correction codes. For **Theme 2** (Development of High-Performance Laser Systems), we have formed a joint team of experts of laser development and neutral-atom scientists. **Theme 3** (Development of Game-Changing Technologies) focuses on the development of game-changing technologies for atom manipulation and transport, as well as large-scale integration of neutral-atom arrays.

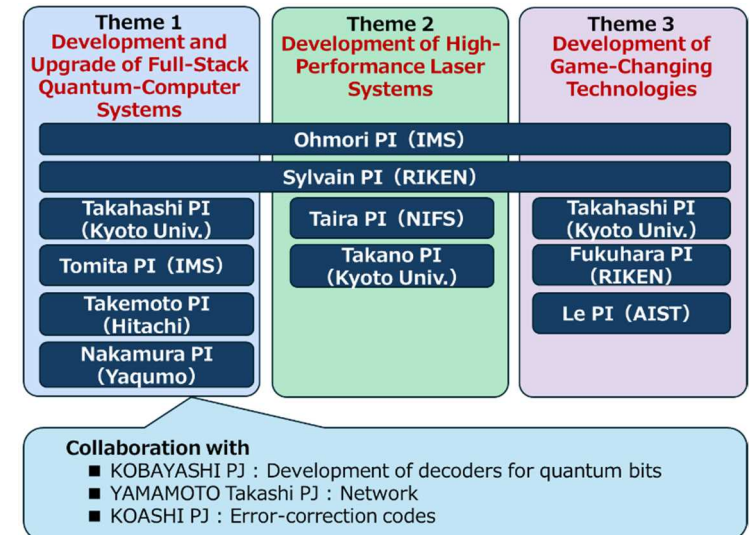


Fig. 2. R&D Themes and Team Structure