

December 20, 2023

Center for Quantum Information and Quantum Biology at Osaka University

RIKEN

National Institute of Information and Communications Technology

e-trees.Japan, Inc.

Fujitsu Limited

NTT Corporation

QuEL, Inc.

QunaSys Inc.

Systems Engineering Consultants Co.,LTD.

Research group launches Japan's third quantum computer at Osaka University

Quantum computer sources majority of components from Japanese makers

Tokyo and Osaka, December 20, 2023 – A consortium of joint research partners including the Center for Quantum Information and Quantum Biology at Osaka University, RIKEN, the Advanced Semiconductor Research Center at the National Institute of Advanced Industrial Science and Technology (AIST), the Superconducting ICT Laboratory at the National Institute of Information and Communications Technology (NICT), Amazon Web Services, e-trees.Japan, Inc., Fujitsu Limited, NTT Corporation (NTT), QuEL, Inc., QunaSys Inc., and Systems Engineering Consultants Co.,LTD. (SEC) today announced the successful development of Japan's third superconducting quantum computer (1) installed at Osaka University. Starting December 22, 2023, the partners will provide users in Japan access to the newly developed computer via the cloud, enabling researchers to execute quantum algorithms (2), improve and verify the operation of software, and explore use cases remotely.

The newly developed superconducting quantum computer uses a 64 qubit chip provided by RIKEN, which leverages the same design as the chip in RIKEN's first superconducting quantum computer, which was unveiled to users in Japan as a cloud service for non-commercial use on March 27, 2023 (3).

For the new quantum computer, the research team sourced more domestically manufactured components (excluding the refrigerator). The research team confirmed that the new quantum computer, including its components, provides sufficient performance and will utilize the computer as a test bed for components made in Japan.

Moving forward, the research group will operate the new computer while improving its software and other systems for usage including the processing of heavy workloads on the cloud. The research team anticipates that the computer will drive further progress in the fields of machine learning and the development of practical quantum algorithms, enable the exploration of new use cases in material development and drug discovery, and contribute to the solution of optimization problems to mitigate environmental impact.

The joint research group is comprised of: Dr. Masahiro Kitagawa, (Professor, Graduate School of Engineering Science, Director of the Center for Quantum Information and Quantum Biology at Osaka University), Dr. Makoto Negoro (Associate Professor, Vice Director of the Center for Quantum Information and Quantum Biology at Osaka University), Dr. Yasunobu Nakamura (Director of the RIKEN Center for Quantum Computing (RQC)), Dr. Katsuya Kikuchi (Group Leader of the 3D Integration System Group of the Device Technology Research Institute at AIST), Dr. Hirotaka Terai (Executive Researcher at the Superconductive ICT Device Laboratory at the Kobe Frontier Research Center of the Advanced ICT Research Institute of NICT), Dr. Yoshitaka Haribara (Senior Startup Machine Learning and Quantum Solutions Architect, Amazon Web Services), Dr. Takefumi Miyoshi (Director of e-trees.Japan, Inc., Specially Appointed Associate Professor, Center for Quantum Information and Quantum Biology at Osaka University, CTO of QuEL, Inc.), Dr. Shintaro Sato (Head of Quantum Laboratory, Fujitsu Research, Fujitsu Limited), Dr. Yuuki Tokunaga (Distinguished Researcher at NTT Computer & Data Science Laboratories), Yosuke Ito (CEO of QuEL, Inc.), Keita Kanno (CTO of QunaSys Inc.), and Ryo Uchida (Chief Technologist of Systems Engineering Consultants Co.,LTD. (SEC)).

Related links

Center for Quantum Information and Quantum Biology, Osaka University

<https://qiqb.osaka-u.ac.jp/en/>

Research support

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- Japanese Ministry of Education, Culture, Sports, Science and Technology's Quantum Leap Flagship Program (MEXT Q-LEAP) "Research and Development of Superconducting Quantum Computers" (Team Leader: Yasunobu Nakamura; Grant No. JPMXS 0118068682) and "Development of quantum software by intelligent

quantum system design and its applications” (Team leader: Keisuke Fujii; Grant No. JPMXS 0120319794)

- Japan Science and Technology Agency (JST) ERATO’s “Nakamura Macroscopic Quantum Machine Project” (Team leader: Yasunobu Nakamura, Grant No. JPMJER1601), the Program on Open Innovation Platforms for Industry-academia Co-creation (COI-NEXT) “Quantum Software Research Hub” (Team leader: Masahiro Kitagawa, Grant No. JPMJPF2014), and Moonshot Target 6 “Development of Integrated Technology for Superconducting Quantum Circuits” (Team leader: Tsuyoshi Yamamoto, Grant No. JPMJMS2067)
- Council for Science, Technology and Innovation (CSTI), Cross-ministerial Strategic Innovation Promotion Program (SIP), “Promoting the application of advanced quantum technology platforms to social issues” (Funding agency: QST) “Development and Operation of Test Beds with Domestic Quantum Computers” (Team leader: Shinichi Yorozu)

Notes

1. Superconducting qubits

A quantum computing system that uses a Josephson junction, a tunnel junction element, to realize quantum bits on an electronic circuit using a superconducting material. Because of the small scale of the energy difference of the 0 or 1 qubit state, it is necessary to cool the qubits to extremely low temperatures (to about -273°C) in a dilution refrigerator.

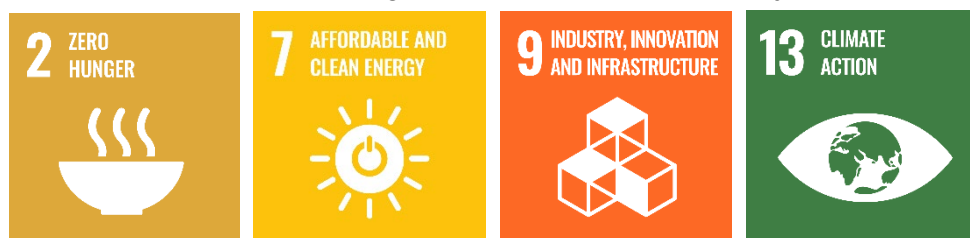
2. Quantum algorithm

An algorithm that can be run on a quantum computer. Quantum algorithms are represented by a sequence of qubits that are changed one after another into different states or interact with other qubits.

3. “Japanese joint research group launches quantum computing cloud service” (press release, March 24, 2023):

<https://www.fujitsu.com/global/about/resources/news/press-releases/2023/0324-01.html>

The SDGs goals most relevant to this project



About the Center for Quantum Information and Quantum Biology at Osaka University

The Center for Quantum Information and Quantum Biology consists of six research groups: Quantum Computing, Transdisciplinary Quantum Science, Quantum Information Devices, Quantum Communication and Security, Quantum Sensing, and Quantum Biology. QIQB promotes transdisciplinary research between each of these research groups and with other academic fields. The Center is an international research hub for quantum innovation by actively promoting international academic exchange and collaboration across borders. QIQB seeks to play a key role in nurturing future quantum leaders and specialists through education and training. For more information: <https://qiqb.osaka-u.ac.jp/en/>

About RIKEN

RIKEN is Japan's largest research institute for basic and applied research. Over 2500 papers by RIKEN researchers are published every year in leading scientific and technology journals covering a broad spectrum of disciplines including physics, chemistry, biology, engineering, and medical science. RIKEN's research environment and strong emphasis on interdisciplinary collaboration and globalization has earned a worldwide reputation for scientific excellence.

Website: www.riken.jp/en/

Facebook: www.facebook.com/RIKENHQ

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About NICT

As the only public research institution of Japan that specializes in the field of information and communications technology, the National Institute of Information and Communications Technology (NICT) promotes ICT R&D, from the foundational to the implementation, while collaborating with universities, industry, and domestic and overseas research institutions. NICT will be advancing R&D in the fields of advanced electromagnetic wave technology, innovative networks, cybersecurity, universal communication, and frontier science.

Furthermore, NICT will also actively be promoting R&D in four strategic research fields (Beyond 5G, AI, quantum ICT, and cybersecurity), which are essential cutting-edge technologies for next-generation ICT infrastructure for the early realization of Society 5.0. For more information, visit <https://www.nict.go.jp/en/>.

About e-trees.Japan, Inc.

e-trees.Japan, Inc. provides solutions and implements applications with powerful hardware and flexible software combinations. Our key concept is “Keep It Simple and Smart.” We primarily address R&D items, such as FPGA and network (with network protocol stack for FPGAs implemented by ourselves), embedded systems, and systems with low power consumption or renewable energy. Find out more: <https://e-trees.jp/en/>.

About Fujitsu

Fujitsu’s purpose is to make the world more sustainable by building trust in society through innovation. As the digital transformation partner of choice for customers in over 100 countries, our 124,000 employees work to resolve some of the greatest challenges facing humanity. Our range of services and solutions draw on five key technologies: Computing, Networks, AI, Data & Security, and Converging Technologies, which we bring together to deliver sustainability transformation. Fujitsu Limited (TSE:6702) reported consolidated revenues of 3.7 trillion yen (US\$28 billion) for the fiscal year ended March 31, 2023 and remains the top digital services company in Japan by market share. Find out more: <https://www.fujitsu.com/>.

About NTT

NTT contributes to a sustainable society through the power of innovation. We are a leading global technology company providing services to consumers and business as a mobile operator, infrastructure, networks, applications, and consulting provider. Our offerings include digital business consulting, managed application services, workplace and cloud solutions, data center and edge computing, all supported by our deep global industry expertise. We are over \$97B in revenue and 330,000 employees, with \$3.6B in annual R&D investments. Our operations span across 80+ countries and regions, allowing us to serve clients in over 190 of them. We serve over 75% of Fortune Global 100 companies, thousands of other enterprise and government clients and millions of consumers.

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About QuEL, Inc.

QuEL, Inc. is an Osaka University-affiliated startup established in 2021. We are a team of experienced researchers and engineers with various backgrounds, strongly supporting quantum computing researchers to supply novel qubit controllers.

Find out more: <https://quel-inc.com/>

About QunaSys Inc.

QunaSys is a Japanese startup engaged in advancing algorithms in chemistry to drive real-world applications of quantum technology. Our primary focus is on leveraging quantum computing potential by collaborating on research with industry leaders and fostering a community-driven approach within the QPARC industry network. Our flagship innovation, QURI, represents a user-friendly quantum computational web software. This platform allows users without specialized quantum algorithm expertise to engage in quantum calculations seamlessly. Additionally, our QURI Parts act as essential building blocks, aiding in the assembly of quantum algorithms into efficient Python code. For more information, visit us at <https://qunasys.com/en>

About Systems Engineering Consultants Co.,LTD.

Systems Engineering Consultants (SEC) is a software development company specialized in real-time technology, contributing to the safety and development of society. We offer real-time software in four different business fields: mobile networking, internet technology, public infrastructure, and space, robotics and advanced technologies. Find out more: <https://www.sec.co.jp/en/>

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