Quantum Computer / Sensor Hardware Component Testbed in G-QuAT

Aiming for a sustainable supply chain of quantum hardware components

- Quantum hardware supply chain/ecosystem with standardization
- Electrical/thermal/optical measurements from low temperature to RT
- Reducing the entry barriers for non-quantum companies into the quantum business

G-QuAT

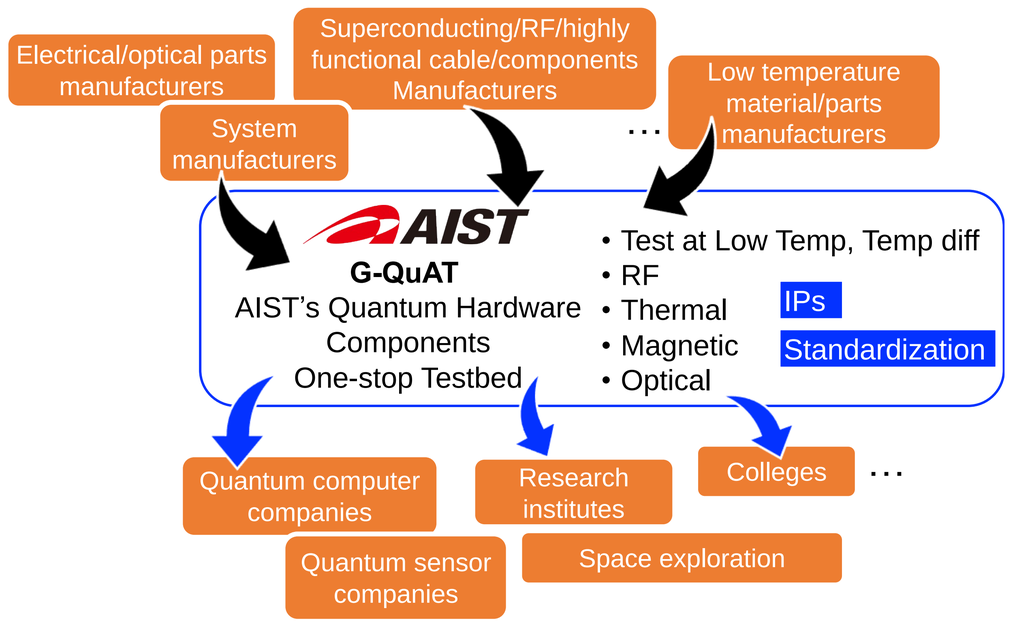
Quantum hardware testbed

- Facilities enabling the evaluation of components and materials from low temperatures (20 mK) to room temperature
  - ➡ Target: large-scale quantum hardware capable of handling up to 1000 qubits
- Testing, evaluation, certification, and standardization of components and materials.
  - ➡ Collaborating with Q-STAR, companies, academia, and research institutions
  - ➡ Commercialization by companies, strengthening of the supply chain.

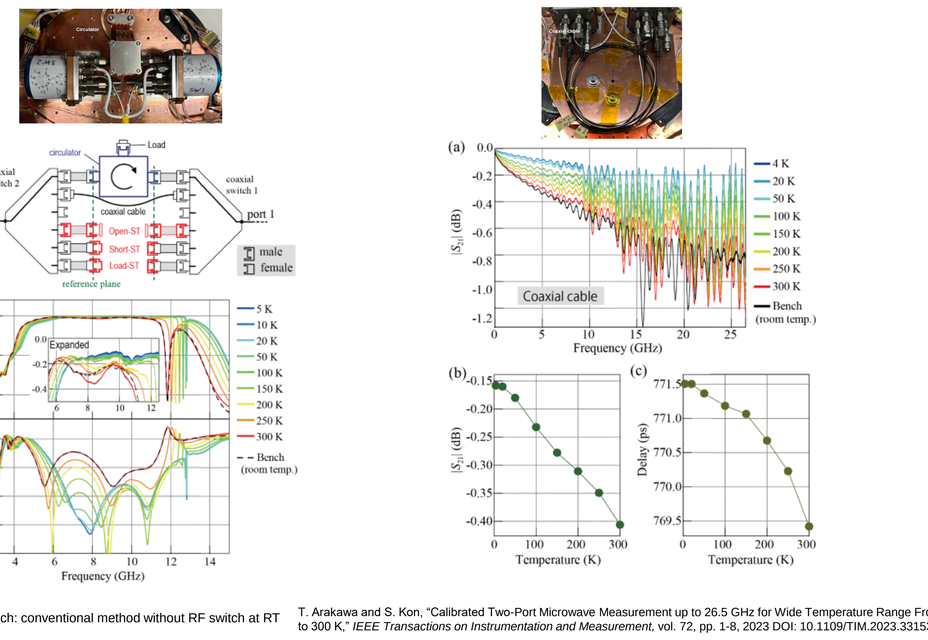
Components and parameters under test

- Active components
  - Amplifiers, semiconductor chips (Cryo-CMOS), MMIC, superconducting circuits/chips (e.g., AQFP, RSFQ), and others
- Passive components
  - Circulators, couplers, attenuators, capacitors, resistors, inductors, filters, chip carriers (RF), chip elements, cables (RF, SC, LF, DC), waveguides, connectors (e.g., high density), and others
- Optical components
  - Squeezed light sources, single photon sources, electrical-to-optical and optical-to-electrical transducers, fibers, others (mainly RT)
  - Squeezed light sources, single photon sources, optical wave guides, photon detectors, and others (20 mK to 4 K)
- Thermal properties of the above-mentioned components
  - thermal resistance/conductance, thermal expansion coefficient, and others
- Simulation and measurements of single and combined sets of the above-mentioned components, and consistency checks
- Screening of qubits (dilution fridges)

One-stop testbed



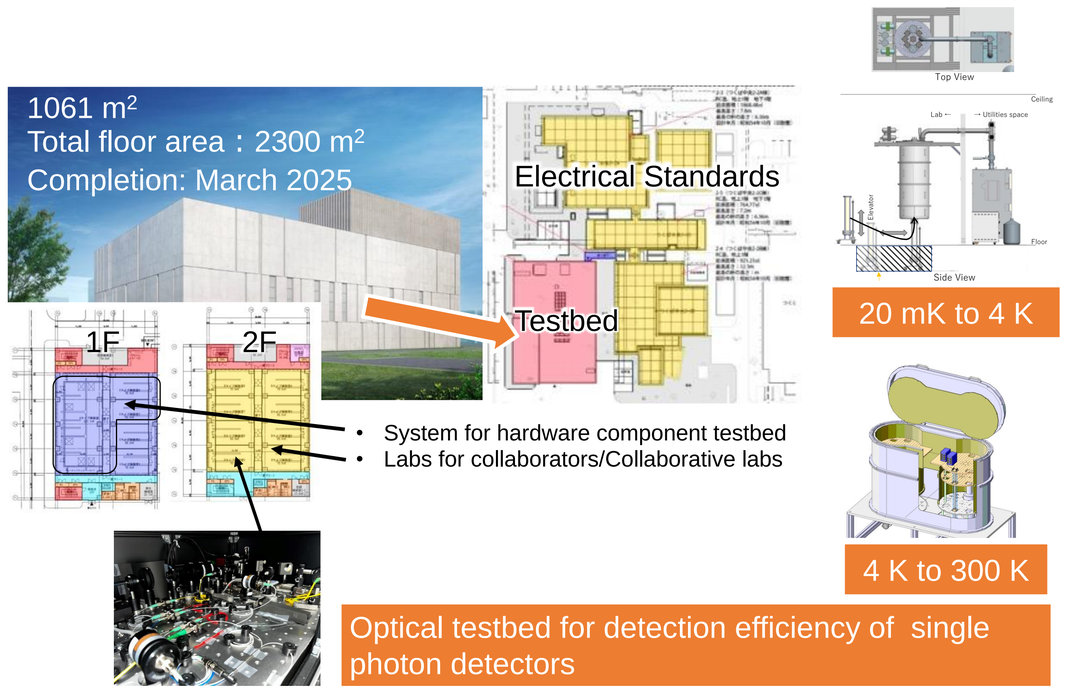
Preliminary test results



※bench: conventional method without RF switch at RT

T. Arakawa and S. Kon, "Calibrated Two-Port Microwave Measurement up to 26.5 GHz for Wide Temperature Range From 4 to 300 K," *IEEE Transactions on Instrumentation and Measurement*, vol. 72, pp. 1-8, 2023 DOI: 10.1109/TIM.2023.3315393

Quantum hardware testbed building and facilities



Optical testbed for detection efficiency of single photon detectors

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