AIST
Create the Future, Collaborate Together

G-QuAT

The ABCI-Q Challenge
Accelerating Quantum Computing
with GPU - Based High-Performance Computing (HPC)

- ABCI-Q was developed **to solve societal challenges through Quantum–Classical Hybrid Computing**.
- A **seamless, user-friendly computing environment** streamlines application development.
- Operational since Oct. 2025. Usage: 88 organizations / 433 users (as of the end of Sep. 2026)

Use Cases

01 ACHIEVEMENT — Scaling a Full CI Validation Platform to Ensure Quantum Algorithm Reliability

Visit the Fujitsu Ltd. Booth 4619

Background

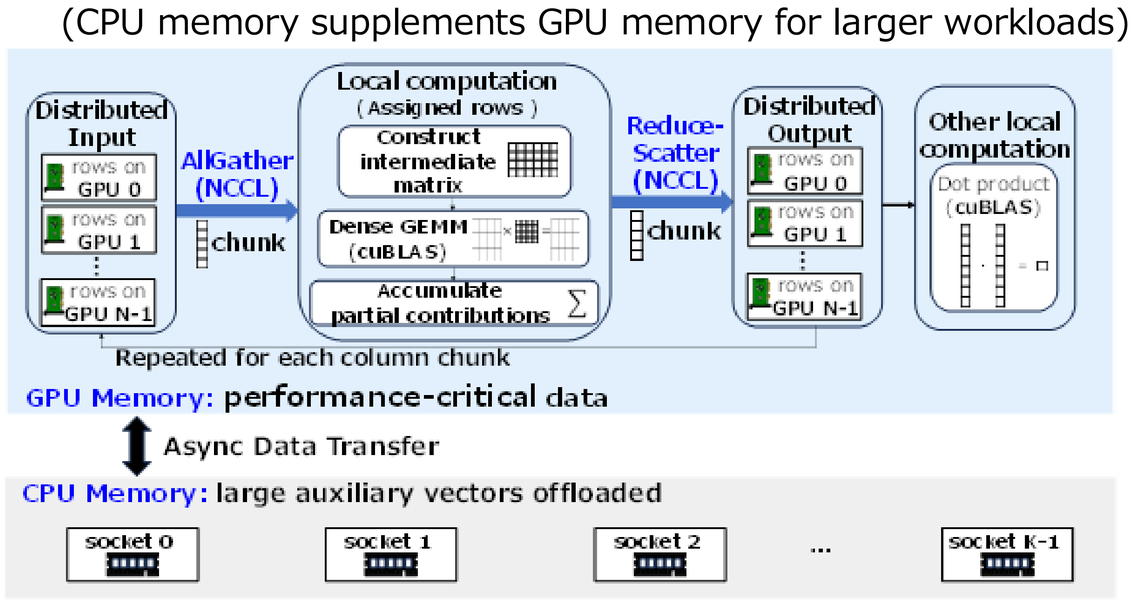
- Scaling quantum computing requires reliable & objective validation.
- Full Configuration Interaction (Full CI) is an ideal reference method, but large-scale validation was previously limited by computing resources and runtime.

Objective

- Scale up Full CI execution.
- Enable quantitative evaluation of quantum-algorithm outputs in Early FTQC. *
  *An early stage of quantum computers capable of error correction

ABCI-Q Approach

- Full GPU implementation and distributed-data parallelism (Exclusive access to 1,024 GPUs for 48 hours)
- Hybrid use of CPU and GPU memory (CPU memory supplements GPU memory for larger workloads)



Demonstration Results

Executed Full CI at an unprecedented scale

NH_2OH/ 6-31G Results
(vs. Previous Results)

1.7×10^{12}
(~1.3x)
Matrix parameters

13.4 hours
(~1/8) Runtime

LiH/ cc-PV5z Validation Results

Solved a 292 Qubit-equivalent problem in 26 seconds

Value Delivered by ABCI-Q

Provide a reliable validation environment for large-scale quantum computing using massive GPU & CPU resources.

02 ACHIEVEMENT — Developing an AI Agent to Execute Quantum Workflows

Background

- Large language models (LLMs) can assist with quantum experiment design.
- However, they cannot directly interact with QPUs/HPC systems or manage computational resources.

Related Paper

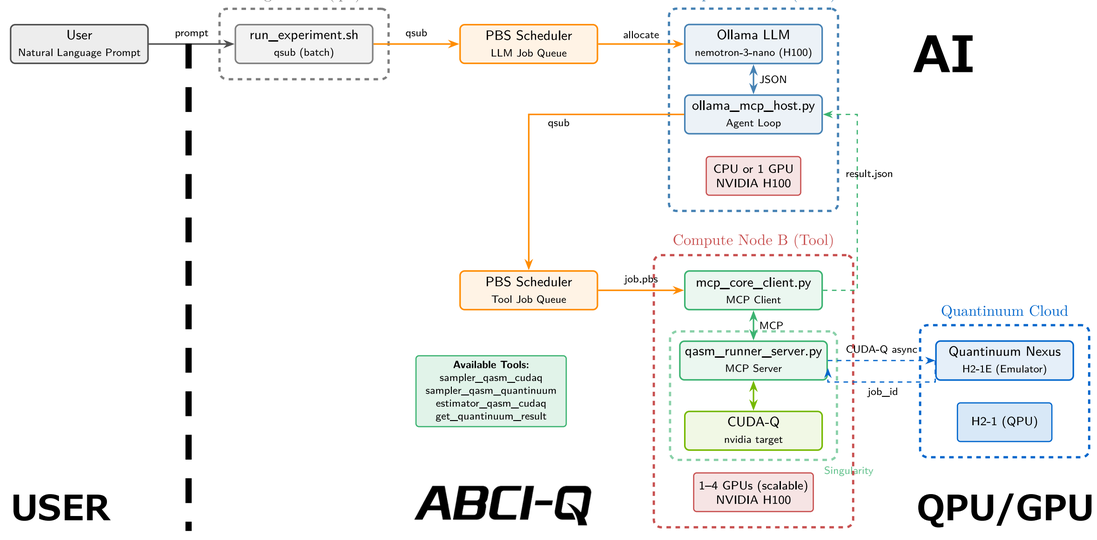
✓Idea → ✓Design → ✕ Execution

Objective

- Develop a Model Context Protocol (MCP) server on ABCI-Q, enabling AI agents to access quantum computing resources & execute workflows from natural-language prompts.
- Enable AI agents to run using a LLM server hosted on ABCI-Q.

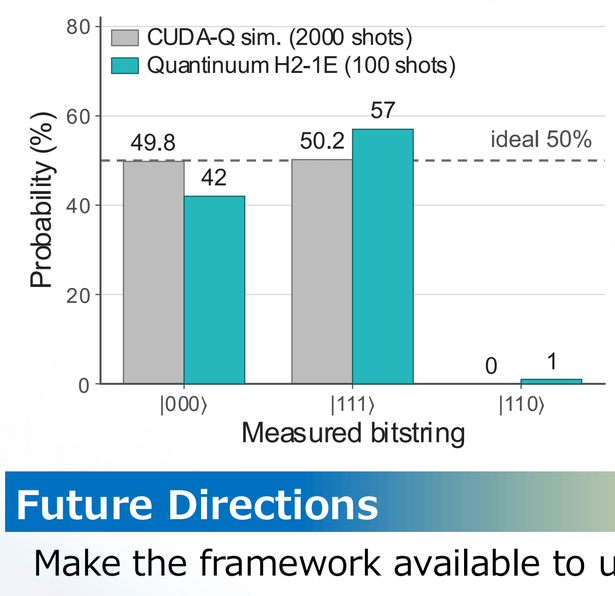
ABCI-Q Approach

AI agent (external API or local server) → MCP tools → PBS batch job → NVIDIA H100 / Quantinuum / IBM



Demonstration Results

- GHZ-state sampling confirmed correct circuit generation.
- Solving MaxCut with QAOA confirmed the execution of quantum optimization algorithms.



Ideal Distribution Reproduced
GHZ-state sampling using Open QASM generated by an AI agent

QAOA MaxCut : $\langle H_C \rangle$ =0.0299
Closely matches the theoretical value.

107-192s
End-to End Runtime

Future Directions

Make the framework available to users as a service on ABCI-Q.

ABCI-Q *From Validation to Real-Scale Execution*

AIST SC Website