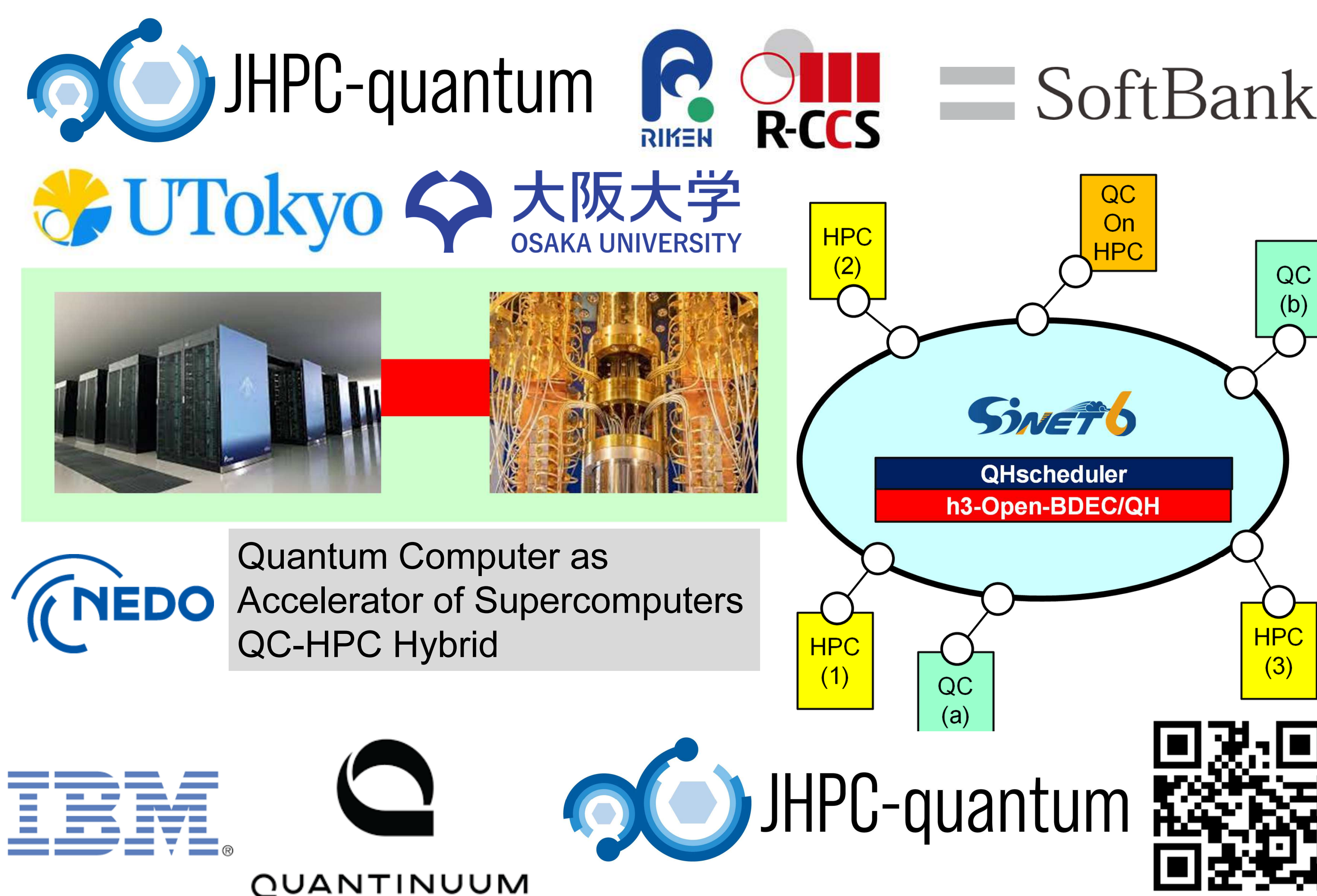


# QC-HPC Hybrid Computing

## Integration of Quantum Computing and Supercomputing

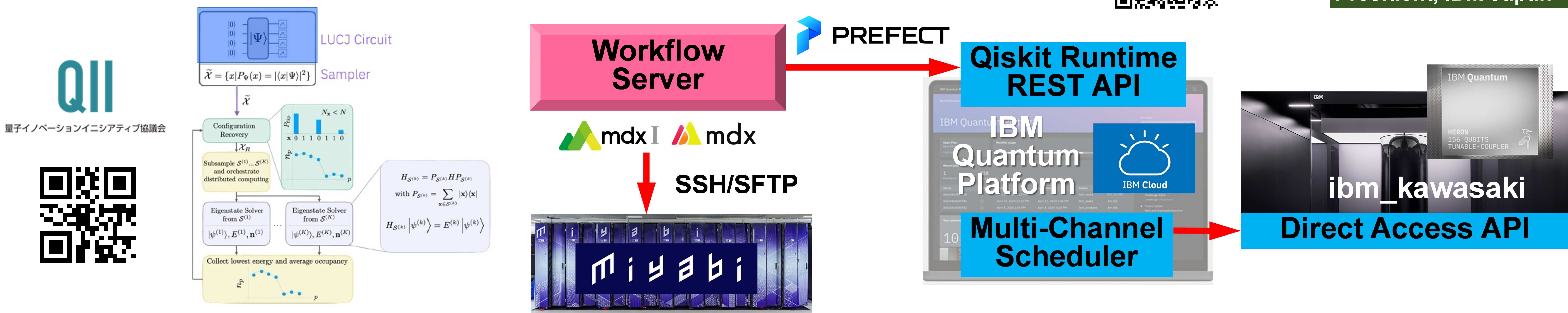
### JHPC-quantum

- In November 2023, new project on “Infrastructure for QC (Quantum Computers)-HPC Hybrid Computing (**JHPC-quantum**)” started. This is a 5-year project funded by Japanese Government (NEDO), and a joint project by **RIKEN R-CCS**, **Softbank**, **University of Tokyo (UTokyo)** and **Osaka University**.
- 2 Real QC systems have been introduced in this project in FY.2025 (IBM: 156 Qubit, Quantinuum: 20 Qubit).
- UTokyo Team will develop system software for efficient and smooth operation of QC-HPC Hybrid Environment, such as **(1)QHscheduler: A job scheduler that can simultaneously use multiple computational resources, and (2)h3-Open-BDEC/QH: Coupling for efficient communication and data transfer between QC-HPC on-line and in real time based on h3-Open-BDEC**.
- This is the world's first attempt to link multiple supercomputers and QC installed at different sites in real time. QC's will be used as accelerators of supercomputers, such as GPU.
- Service of QC-HPC Hybrid Computing using Fugaku and Miyabi will start in Fall-Winter 2025.**



### QII (Quantum Innovation Initiative): Miyabi - ibm\_kawasaki Integration

- On May 16 2025, the University of Tokyo (UTokyo) and IBM announced plans to deploy the latest 156-qubit IBM Quantum Heron processor, which will be operational in the IBM Quantum System One, administered by UTokyo for the members of the Quantum Innovation Initiative (QII) Consortium.
- The IBM Heron processor is significantly more powerful than the 127-qubit IBM Quantum Eagle processor previously installed in 2023, with an order of magnitude lower 100-qubit layered error rates.
- UTokyo is planning to link the IBM Quantum System One (ibm\_kawasaki) to the Miyabi supercomputer later this year, through “cloud bursting”, a long-distance networking connection.
- The combined quantum and HPC systems will give the industry and academic users of QII access to new computational capabilities and increasing performance in the domain areas such as chemistry, bioinformatics, high energy physics, materials science, finance and among many other disciplines.
- The Miyabi-ibm\_kawasaki hybrid service is beginning in January 2026.**
- Initial target application area is Quantum Chemistry, where large-scale diagonalization is executed on Miyabi.



### “Pseudo” QC-HPC Hybrid Computing using NVIDIA’s CUDA-Q

- We have established a “Pseudo” QC-HPC Hybrid Computing Environment on Wisteria/BDEC-01 utilizing h3-Open-BDEC and NVIDIA CUDA-Q, with the aim of promoting the adoption of QC-HPC Hybrid Computing, which also serves as a testing platform for software designed for QC-HPC hybrid applications.
- Using a small-scale Variational Quantum Eigensolver (VQE) as a case study, we conducted a tutorial in which Aquarius (NVIDIA A100 and CUDA-Q) was treated as QC, and Odyssey (Fugaku-compatible, A64FX) as HPC. A similar environment has also been successfully ported to Miyabi.

