Towards online-accessible photonic one-way quantum computing

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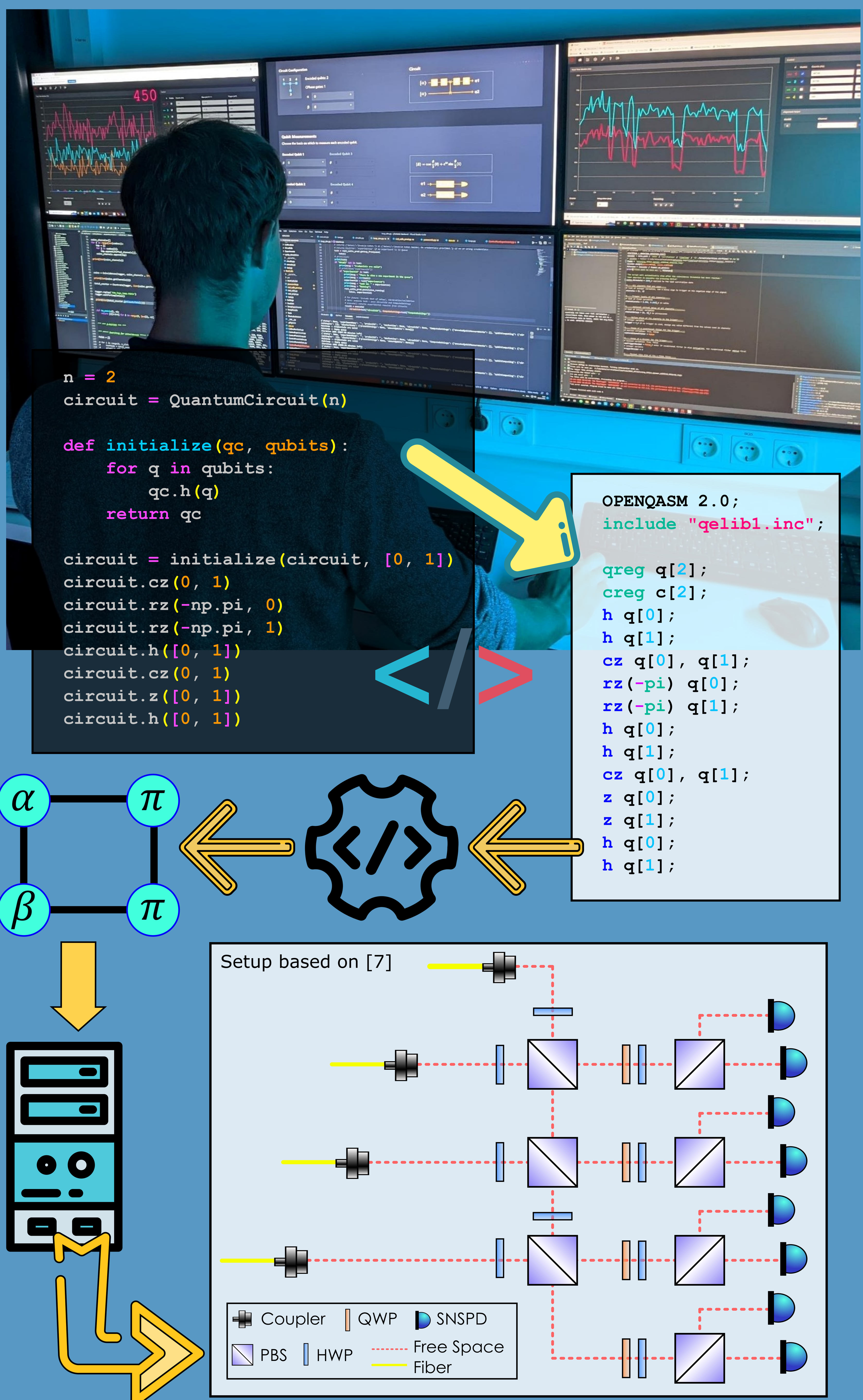
Abstract

Various quantum systems have become accessible via the internet, e.g., IBM's superconducting devices. Current hardware implements circuit-based models, annealers, or continuous-variable computing systems.
The discrete-variable one-way model of quantum computing is of special interest in photonic systems, although not limited to them. Quantum processors based on this model are not yet available to users. Here, we assess **(1) access**, **(2) applications**, **(3) software**, and **(4) benchmarking** for an online-accessible photonic one-way quantum computer implementation [1].



Online access & cloud

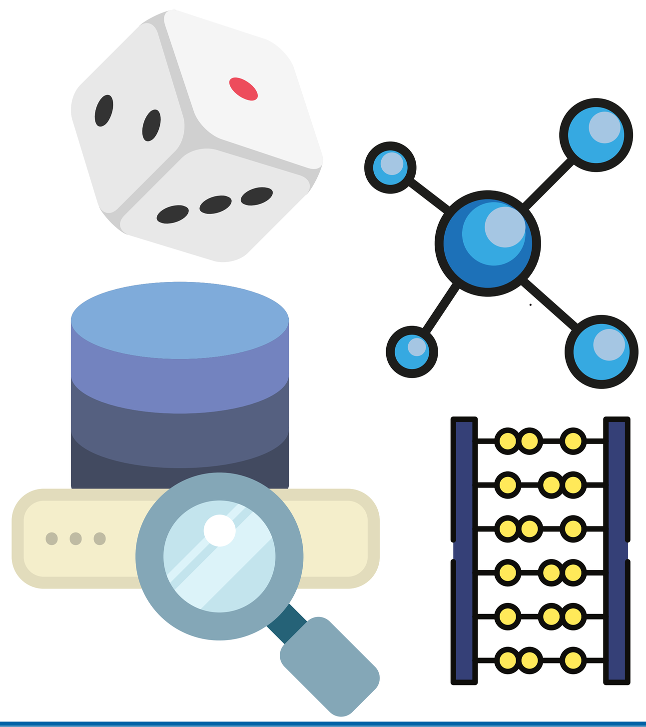
1

- **Web services** make quantum computing resources available online
- **Cloud-native** quantum computing services make it easier to integrate with traditional cloud services for orchestration, logging, analytics, visualization, and storage

➔ Real photonic quantum hardware based on the discrete-variable one-way model is currently not available to users
➔ **We want to provide such a service**

Quantum applications on near-term devices

2



- Game theory applications
- Database searching
- Studies of quantum-classical gaps in computational complexity
- Measurement-based variational quantum eigensolvers [2-4]

Software stack

3

- Quantum algorithms must be **implemented as software**
- Open-source quantum computing software does not support discrete-variable photonic one-way processors [5]
- The core of our photonic one-way computers' software stack is a **compiler** that converts quantum assembly code into a graph-like executable
- **Current research** is focused on the development of software components and the design of a software development life cycle for quantum computing software

Benchmarking

4

- Existing metrics include the number of qubits, connectivity, error-rates, and software stack performance
- Cross-verification techniques for comparing the system performance of photonic one-way computers to other platforms [6]

Outlook

Circuits with **4 qubits** can currently be run via our platform at **https://photonq.at** using a graphical web interface:

SCAN ME

Hardware ➔ focusing on large cluster state generation

Software ➔ to integrate with existing frameworks such as Qiskit, we created a compiler concept, and we are now working on the compiler's prototype implementations

References

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