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•Editorial•
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Toward applications of cloud quantum computation

Quantum computation has attracted much attention from both academia and the public due to its great achievements. Along with its fast development and increasing investment, a series of problems are raised. For example, can quantum supremacy be realized? Recently, several results have been reported to address the problem of sampling random circuits, accompanied by classical improvements [1-3]. Another problem worthy of note is how to use a quantum computer. Irrelevant to specific problems that can be solved by a quantum computer, this is actually a problem about how many users can conveniently access quantum computation resources.

It is obvious that online quantum computation resources will facilitate various applications, such as teaching, researching, and solving everyday life problems, which makes the quantum computation ecosystem as important as that of classical computers. It is then demanding to attract users by the cloud approach at the present stage of noisy intermediate-scale quantum computation. Quantum experience of IBM[1)] paves the way for cloud quantum computation based on superconducting quantum computation by integrating tools such as the website interface, open QASM input by quantum assembly language, and qiskit as client-end of Python program. Hundreds of thousands of users have tried quantum devices with the number of qubits ranging from a few to more than a hundred. Other high-tech companies and research groups have also launched online cloud quantum computation platforms of their own.

In a paper published in *SCIENCE CHINA Physics, Mechanics* & *Astronomy*, researchers from the Institute of Physics of Chinese Academy of Sciences and Beijing Academy of Quantum Information Sciences report their cloud platforms of superconducting quantum computation [4]. In order to demonstrate the accuracy rate of their quantum cloud, they use a well-accepted benchmark in demonstrating the controllability and precision by generating Greenberger-Horne-Zeilinger (GHZ) states. Their quantum device consists of 10 qubits in a one-dimensional array. For such a chain of qubits, the controlled-NOT (CNOT) gates are tuned up for the pairs of nearest-neighboring qubits. The long-range CNOT gates for the chain can also be experimentally constructed by the original gates. The online preparation of GHZ states is motivated to demonstrate the accuracy rate and provide more information about the performance of the cloud. So arbitrary blocks of qubits in the chain can be involved in the states preparation. In terms of the 10-qubit GHZ state preparation, the fidelity of this work reaches the record high reported recently. Particularly, the authors present a parameter scan ability to verify the GHZ states based on the function of their experimental control system. This function will sufficiently improve the efficiency for running a broad range of quantum circuits. One can expect that other users may apply the quantum resource of entangled states to quantum computation tasks, such as quantum neuronetworks [5].

Citing the need for quantum computation resources, the quantum cloud developed by these authors will realize more applications of quantum computation and benefit all potential users worldwide.

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1) IBM quantum experience is available at https://quantum-computing.ibm.com.

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