

NTU Q

UPCOMING EVENT

2026 KISS SCIENCE: NTU-IBM QUANTUM 量子電腦導航

- Time: 7th November, 10:00 A.M. – 11:30 A.M.
- Venue: R111, 1F, Center for Condensed Matter Sciences and New Physics Building, NTU
- Registration is limited to 70 participants.
- Participants need to bring your own computer.

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時間	內容
09:30 ~ 10:00	報到
10:00 ~ 11:30 (90分鐘)	量子電腦簡介、使用 Qiskit 編寫量子程式 (實作)、Q&A
11:30 ~ 11:40 (10分鐘)	填寫活動滿意度調查問卷

HIGHLIGHTING NEWS

IBM NIGHTHAWK R2 DELIVERS 25× QUANTUM CIRCUIT OVER HERON

Quantum computing performance depends not only on the number of programmable qubits, but also on how quickly and reliably a processor can execute repeated circuits. A major limitation in earlier IBM systems was the time required to return qubits to their ground state between circuit runs. Nighthawk r2 addresses this bottleneck with a new reset architecture while retaining 120 programmable qubits. IBM presents the processor as a step toward delivering more useful computation from existing hardware rather than simply increasing qubit counts.

The processor replaces Heron's measurement-based conditional reset with an active dissipative reset gadget. Each programmable qubit is connected through a high-dynamic-range tunable coupler to a cold environment, which rapidly removes energy and returns the qubit to its ground state. IBM reports that this reduces the effective reset time from hundreds of microseconds to as little as one microsecond, while lowering the qubit's effective T_1 (energy relaxation time) from a median of ~ 200 microseconds to ~ 25 nanoseconds during reset. Nighthawk r2 therefore reaches more than 100,000 circuits per second, compared with approximately 4,000 for the Heron fleet—a 25-fold throughput improvement. Early advantage-candidate tests showed runtimes up to 10 times faster without sacrificing accuracy. The system contains 120 programmable qubits, 218 dedicated couplers, and 120 reset elements, totaling 458 physical quantum elements. IBM also reports around a 25-fold reduction in initialization error, Heron-class gate fidelity, and accurate observable estimation for circuits exceeding 7,500 gates.

IBM expects the increased throughput and neighbor-safe reset to benefit repetitive application workloads, dynamic circuits, quantum error correction, and experiments involving quantum advantage. The processor has already supported doped Clifford sampling experiments, 7,500-gate observable estimation using probabilistic error amplification, and neutron-scattering simulations that produced spectra comparable with laboratory data in ~ 60 seconds—12 times faster than before. Because reset can also occur during circuit execution, auxiliary qubits can be reused in error-detection and error-correction procedures such as space-time checks. Looking ahead, IBM sees Nighthawk r2 as both a platform for scaling useful quantum applications and a testbed for increasingly sophisticated error-corrected operations. These results remain milestones toward fault-tolerant quantum computing.

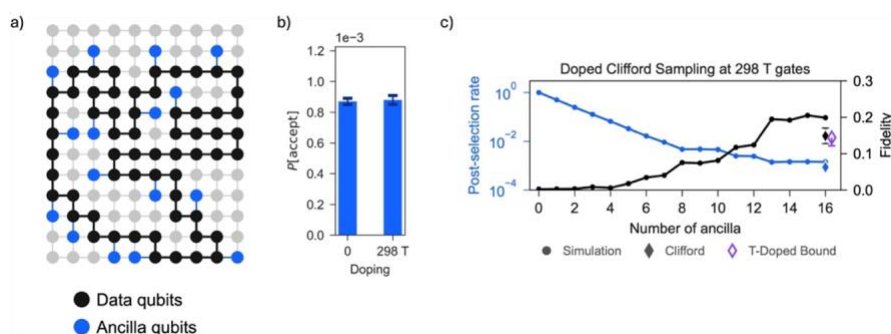


Fig. Doped Clifford sampling advantage experiments using Nighthawk r2.

[READ MORE \(Press Release & Research Article\)](#)

DEBUT OF 1000 TIMES FASTER BOSONIC QUANTUM OPERATIONS

Quantum computers are highly sensitive to noise and other environmental disturbances, so quantum operations must be completed quickly enough to prevent errors from accumulating. Researchers at Chalmers University of Technology have developed a theoretical method that could accelerate certain bosonic quantum operations by more than 1,000 times. The approach addresses a major challenge in bosonic quantum codes, which encode information in the collective states of microwave or optical resonators rather than in individual qubits. Earlier methods often constructed and manipulated these states gradually through thousands of repeated driving cycles. Although such approaches can support error-protected encoding, their long duration increases the time during which quantum information may be corrupted. By substantially shortening these operations, the researchers hope to reduce error accumulation and bring bosonic quantum codes closer to practical fault-tolerant quantum computing.

The central element is a recently proposed universal set of quantum lattice gates. These gates act as elementary building blocks for controlling bosonic quantum states and are designed to implement more complicated operations directly, rather than assembling them through many small, sequential steps. The researchers combine them with Floquet control, in which a quantum system is driven by a periodic control signal. In earlier Floquet-based approaches, the desired evolution generally emerged only after many driving periods. The new protocol instead engineers the control sequence so that a quantum lattice gate is realized in one period, effectively functioning as a shortcut through the state-manipulation process. Numerical demonstrations were carried out for several bosonic-code settings, including binomial, cat, and GKP-like states, with some logical operations taking only a few microseconds.

[READ MORE \(News & Research Article\)](#)

計畫補助單位：



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