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NTU Q

HIGHLIGHTING NEWS

QUANTUM COMPUTING FOR NEAR-TERM APPLICATIONS IN GENERATIVE CHEMISTRY AND DRUG DISCOVERY

This reviewing paper explores the potential of quantum computing for near-term applications in generative chemistry and drug discovery.

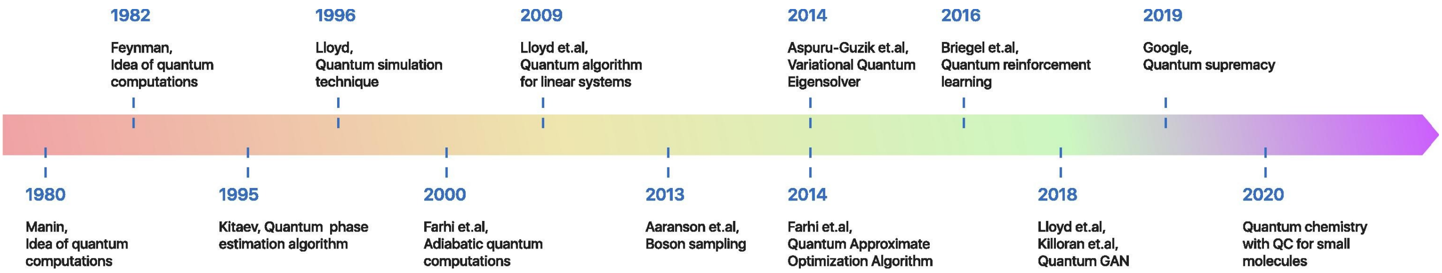
The aspects including:

Advantages of Quantum Computing: Quantum computing offers the ability to tackle problems in molecular systems that classical computing struggles with, especially in calculating complex molecular electronic structures and many-body interactions.

Applications in Generative Chemistry: The paper discusses how quantum algorithms can aid in generative chemistry, particularly in generating and optimizing molecular structures, thus accelerating the design of new compounds.

Applications in Drug Discovery: It explores the potential of quantum computing in drug screening, molecular docking, and simulating drug-target interactions, with a focus on predicting chemical reaction pathways and optimizing drug molecules.

Overall, the paper suggests that while quantum computing is still in its early stages, it has considerable potential to provide groundbreaking solutions in generative chemistry and drug discovery in the near future.



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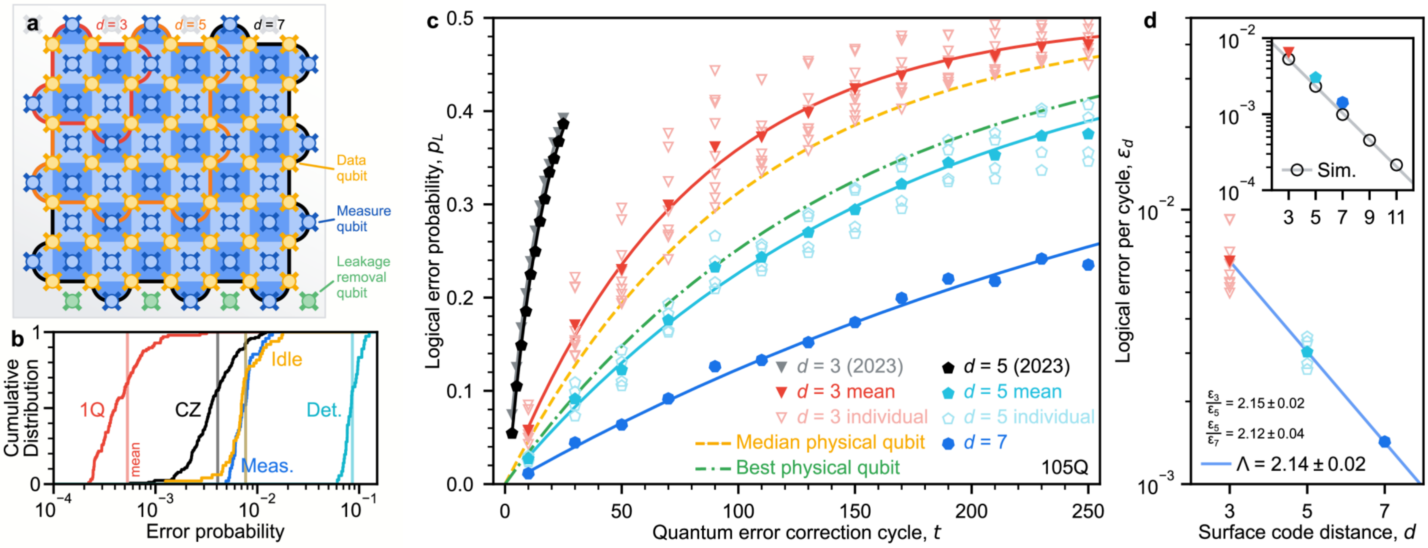
QUANTUM ERROR CORRECTION BELOW THE SURFACE CODE THRESHOLD

Abstract: Quantum error correction [1–4] provides a path to reach practical quantum computing by combining multiple physical qubits into a logical qubit, where the logical error rate is suppressed exponentially as more qubits are added. However, this exponential suppression only occurs if the physical error rate is below a critical threshold. In this work, we present two surface code memories operating below this threshold: a distance-7 code and a distance-5 code integrated with a real-time decoder. The logical error rate of our larger quantum memory is suppressed by a factor of $\Lambda = 2.14 \pm 0.02$ when increasing the code distance by two, culminating in a 101-qubit distance-7 code with 0.143% ± 0.003% error per cycle of error correction. This logical memory is also beyond break-even, exceeding its best physical qubit's lifetime by a factor of 2.4 ± 0.3. We maintain below-threshold performance when decoding in real time, achieving an average decoder latency of 63 μs at distance-5 up to a mil- lion cycles, with a cycle time of 1.1 μs. To probe the limits of our error-correction performance, we run repetition codes up to distance-29 and find that logical performance is limited by rare correlated error events occurring approximately once every hour, or 3×10^9 cycles. Our results present device performance that, if scaled, could realize the operational requirements of large scale fault-tolerant quantum algorithms.



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