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Two-dimensional array of superconducting qubits with vertical access

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Abstract

Superconducting circuits are one of the most promising platforms for quantum computing. With the rapidly improving fidelities of the control gates and readouts, more and more advanced computation becomes achievable. There are a few different architectures under intensive studies, roughly classified with tunable-frequency or fixed-frequency qubits and with tunable or fixed couplings. The less tunability tends to lead the longer coherence and less demands for wiring. On the other hand, the system could be vulnerable to the device parameter fluctuations in the fabrication as well as the energy coincidences with two-level fluctuators and the residual interactions between neighboring qubits, causing a trade-off. In this talk, we introduce our approach with a square lattice of fixed-frequency transmon qubits directly coupled with their nearest neighbors via capacitors. The circuit is controlled and read out only through microwave signals. To realize a tile-able design and mitigate the wiring issues in the planar approaches, we bring the control and readout lines vertically to the chip. We report the progress on the design and characterization of the chips and discuss the possible improvements and limitations.