Peter Anthony Spring
University of Oxford

High coherence in a tileable superconducting circuit

We demonstrate high qubit coherence and single-qubit gate fidelities in a readily extensible superconducting circuit. Our four qubit device features 3D integrated “off-chip” control wiring, “reverse-side” readout-resonators fabricated on the back of the circuit substrate, and an inductively shunted enclosure. We show the device contains within it a unit-cell that can tile the plane while providing a clean electromagnetic environment to enclosed qubits; with spatially exponentially decaying crosstalk between them. Measurements establish the device design is compatible with high qubit coherence, with average T1 = 149 μs and T2* = 190 μs. Experimental analysis of crosstalk shows that the off-chip control wiring is highly selective. These results are borne out in simultaneous randomized benchmarking on the four uncoupled qubits, where we measure average single-qubit gate fidelities >99.98%. The results demonstrate a promising 3D integrated architecture for creating large 2D arrays of superconducting qubits.