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Tunable 3D cQED: Applications to Quantum Optics and Quantum Information MATTHEW REED, KEVIN CHOU, NISSIM OFEK, JACOB BLUMOFF, BRIAN VLASTAKIS, GERHARD KIRCHMAIR, ZAKI LEGHTAS, Yale University Dept. of Applied Physics, SIMON NIGG, Yale University Dept. of Physics, LUIGI FRUNZIO, Yale University Dept. of Applied Physics, STEVEN GIRVIN, Yale University Dept. of Physics, MAZYAR MIRRAHIMI, INIRA Paris-Rocquencourt, ROBERT SCHOELKOPF, Yale University Dept. of Applied Physics — The ability to control the frequency of a superconducting qubit on nanosecond timescales has been used, among other things, to generate multi-qubit entanglement. The recently developed 3D cQED architecture has yielded dramatic coherence improvements and novel methods of entangling fixed-tuned qubits, but has until now has lacked the ability to control qubit frequencies in situ. Adding this would grant several abilities. First, the coupling of a qubit to the cavity bus could be modulated to control both the inherited nonlinearity and the dispersive shift of the oscillator. Second, controlling the interactions between individual qubits, particularly those coupled to more than one cavity, could be used to shuttle quantum information between subsystems. Third, a small change to the physical implementation could yield efficient individual qubit QND readout or reset. These abilities are readily applicable to demonstrations of hardware-efficient quantum error correction, entanglement distillation between distant pairs of qubits, and teleportation of quantum information. In this talk, we will discuss our recent results toward achieving these capabilities using the tunable 3D cQED architecture introduced previously.

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