Control and Readout of a Superconducting Qubit Using a Photonic Link

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***Abstract*— As superconducting quantum circuits continue to increase in size and complexity, one bottleneck for scaling becomes the large number of microwave signals lines that must connect room temperature electronics to the cryogenic environment of the device. Typical experiments require multiple coaxial cables per qubit, each heavily filtered and attenuated to ensure excess noise will not degrade qubit coherence, gate fidelity or measurement efficiency. An alternative to this brute force method is to use optical fiber and cryogenic high-speed photodetection as an optical-to-microwave converter, capable of generating shot-noise limited microwave signals directly at millikelvin temperatures. Leveraging the low thermal conductivity, low loss and large intrinsic bandwidth of optical fiber would allow for efficient, massively multiplexed delivery of coherent microwave control pulses. In this talk we demonstrate the control and readout of a superconducting qubit using microwave signals transmitted over optical fiber to the ultracryogenic environment (< 20 mK) and show a proof of principle that this novel method can meet the stringent requirements for superconducting quantum information processing.**

***Keywords (Index Terms)* — Quantum, superconducting, quantum computing, qubits, measurement, scalability.**

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