Making hybrid quantum systems on a chip

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In this talk I will present three platforms that are at the interface of superconducting, phononic (mechanical), and photonic devices.

I will first present our results on coupling superconducting qubits to nanomechanical resonators. We strongly coupled a mechanical system 2.4 GHz to a superconducting qubit at the same frequency. The coupling is sufficiently large that we can resolve different phonon number states through the off-resonant shift they induce on the qubit frequency. This allows us to resolve the energy levels of a mechanical resonator.

Secondly, I will discuss measurements at the interface of superconducting qubits and photonics. I will discuss our platform for quantum electro-optics. I will present a platform where we have co-integrated photonic circuits with microwave resonators and discuss recent measurement results.

Finally, I will discuss new measurements on optomechanical systems that are can provide an alternate scheme for coupling light, sound, and microwaves, on the same chip.