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Acoustic equivalents of experiments from quantum optics THOMAS AREF, MARTIN GUSTAFSSON[1], ANTON KOCKUM, MARIA EKSTRÖM, GÖRAN JOHANSSON, PER DELSING, Chalmers University of Technology — On-chip quantum optics at microwave frequencies is a recent development, where solid-state qubits couple to itinerant photons in a one-dimensional electrical transmission line. We have demonstrated a new electromechanical hybrid, where a superconducting qubit couples to Surface Acoustic Waves (SAW), which propagate freely on the surface of piezoelectric microchip. This allows us to perform direct equivalents of quantum-optical experiments, with acoustic phonons taking over the role of photons as carriers of quantum information. We can address the qubit both electrically and with SAW, and listen to its quantized acoustic emission with an on-chip mechanical transducer. Our experiments are done at microwave frequencies, and compared to electromagnetic signals, the acoustic waves propagate orders of magnitude slower and have correspondingly shorter wavelengths. This, along with the potential for very strong coupling via the piezoelectric effect, opens for phononic exploration of quantum regimes that are difficult or impossible to reach with photons. In this talk, we present data from acoustic quantum experiments, with a focus on the prospective future role of propagating phonons in quantum informatics.

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