

Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

A superconducting qubit coupled to propagating acoustic waves

MARTIN V. GUSTAFSSON, Columbia University (USA) and Chalmers University of Technology (Sweden), THOMAS AREF, ANTON FRISK KOCKUM, MARIA K. EKSTRÖM, GÖRAN JOHANSSON, PER DELSING, Chalmers University of Technology (Sweden) — Mechanical devices in the quantum regime have so far consisted mainly of suspended resonators, where standing modes can be populated with quanta of vibrational energy. We present a fundamentally different system, where the mechanical excitation is not restricted to a specific mode and location. Instead, we demonstrate strong non-classical coupling between *propagating* phonons and a superconducting qubit.¹ The qubit is fabricated on a piezoelectric substrate, and is designed to interact with Surface Acoustic Waves (SAWs) in the gigahertz frequency range. A separate on-chip transducer allows us to launch SAWs toward the qubit from a distance and pick up SAW phonons that the qubit reflects and emits. In a series of experiments where the qubit is addressed both electrically and acoustically, we show that the qubit couples much more strongly to SAWs than to any electrical modes. The low speed of sound sets phonons apart from photons as a medium for transporting quantum information, and should enable real-time manipulation of propagating quanta. The short acoustic wavelength and strong piezoelectric coupling should also allow regimes of interaction to be explored which cannot be reached in photonic systems.

¹Gustafsson *et al.*, Science **346**, 207 (2014)

Martin Gustafsson
Columbia University

Date submitted: 14 Nov 2014

Electronic form version 1.4