

Coupling Propagating Acoustic Waves to Quantum Circuits

M. Gustafsson^a, P.V. Santos^b, and P. Delsing^a

^aMicrotechnology and Nanoscience, Chalmers University of Technology, Göteborg, Sweden

^bPaul-Drude-Institut für Festkörperelektronik, Berlin, Germany

We present a method for coupling propagating Surface Acoustic Waves (SAW) to charge sensitive quantum circuits, by direct piezoelectric charge induction.

Using an RF-Single Electron Transistor¹ as a high-performance electrometer, and employing an on-chip mixing technique², we demonstrate ultra-high displacement sensitivity in the gigahertz frequency range, and an averaged detection sensitivity below the single-phonon level.

Based on these experimental results, we discuss how the method can be enhanced and extended to superconducting qubits, and what roles Surface Acoustic Waves could potentially play in novel hybrid quantum devices.

¹R.J. Schoelkopf, P. Wahlgren, A.A. Kozhevnikov, P. Delsing, and D.E. Prober, *Science*. **280**, 1238 (1998).

²R. Knobel, C.S. Yung, and A.N. Cleland, *Appl. Phys. Lett.* **81**, 532 (2002).