Quantum acoustics with surface acoustic wave resonators

Surface acoustic waves (SAW) can be coupled efficiently to superconducting qubits through piezoelectricity[1] and enable new regimes of field-matter interaction[2]. We are currently developing this platform further to leverage the features of SAW to design hybrid quantum acoustic devices with applications in quantum information processing.

Due to the short wavelength of sound, acoustic resonators can be engineered to support many more resonant modes than their electromagnetic counterparts. By coupling the modes together with superconducting circuits, we aim to create complex entangled states in a hardware-minimal fashion. Such states could potentially be used as a resource for certain schemes in quantum computing. Strongly coupled multimode quantum systems may also have potential in quantum simulation of solid-state systems.

Figure 1: Surface acoustic wave resonator for quantum information. The centered interedigital transducer and Bragg reflectors are fabricated from Aluminium on a piezoelectric Gallium Arsenide substrate. The right-hand side reflector has an integrated Superconducting Quantum Interference Device (SQUID) to provide nonlinear coupling between the resonator modes.

We are looking for a highly motivated master student to perform microwave measurements of quantum SAW devices at cryogenic temperatures. The candidate will acquire skills in state-of-the-art measurement techniques used in circuit quantum electrodynamics, as well as the analysis and interpretation of results. A suitable background may be physics, nanotechnology or electrical engineering, preferably with some familiarity with concepts of quantum mechanics.

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[1] Martin Gustafsson, Thomas Aref, Anton Frisk Kockum, Maria Ekström, Göran Johansson and Per Delsing, *Science* (2014)
[2] Gustav Andersson, Baladitya Suri, Lingzhen Guo, Thomas Aref and Per Delsing, *Nature Physics* (2019)