

# Abstract

Dr. Konrad Lehnert proposed work will advance this new science of quantum sound from rudimentary capabilities to a qualitatively new regime of high-fidelity quantum control of single phonons. The proposed work will yield a 10,000-fold increase in the coherent cooperation between superconducting qubit circuits and phononic cavities, while preserving the useful ways that acoustical phenomena differ from electronics and optics.

Specifically Dr. Lehnert proposes to advance quantum sound by: 1.) understanding and eliminating sources of decoherence in both phononic cavities and the qubits that couple to them 2.) validating the increased coherence by creating non-Gaussian states of motion and highly entangled states relevant to quantum error correction 3.) investigating unique qubit-phonon interactions enabled by quantum acoustics.

In the regime of high-fidelity phonon control, quantum information can be encoded in logical qubits and preserved using error-correction algorithms or encoded in highly non-classical states with quantum enhanced strain sensitivity. In addition, the most promising way to transduce quantum information between the optical and electrical domains is through a quantum phononic intermediary systems. Successful outcome of this research would have a profound but hard to anticipate impact on information processing, information security, and sensing.