

Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Superfluid Helium-4 as an Ultra-low Loss Optomechanical Element LAURA DE LORENZO, KEITH SCHWAB, Caltech — We investigate the low loss acoustic motion of superfluid He-4 parametrically coupled to a high Q, superconducting niobium TE₀₁₁ microwave resonator, forming a gram-scale, sideband resolved, optomechanical system. We demonstrate the detection of a series of acoustic modes with quality factors as high $3 \cdot 10^7$. The lowest dissipation modes are limited by an intrinsic three phonon process at higher temperatures, which leads to a T^4 dependent attenuation. In isotopically purified samples at temperatures below 10 mK, acoustic quality factors over 10^{10} may be possible. A system of this type may be utilized to study macroscopic quantized motion and as a frequency tunable, ultra-sensitive sensor of extremely weak displacements and forces, such as continuous gravity wave sources.

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Date submitted: 14 Nov 2014

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