

## InAs quantum dots and surface acoustic wave cavities for quantum transduction

Autry, Travis<sup>1</sup>, Berweger<sup>1</sup>, Samuel, Sletten<sup>2</sup>, Lucas, Mirin, Richard<sup>1</sup>, Kabos, Pavel<sup>1</sup>, Lehnert, Konrad<sup>2</sup>, Silverman, Kevin<sup>1,\*</sup>

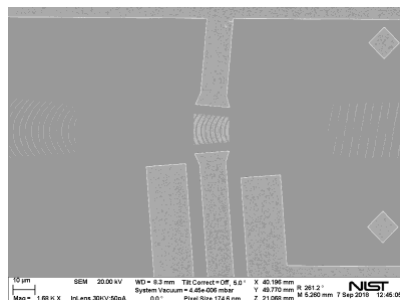
<sup>1</sup>NIST, Physical Measurement Laboratory, Boulder, CO USA

<sup>2</sup>JILA, National Institute of Standards and Technology and the University of Colorado, Boulder, Colorado 80309, USA

\*e-mail: [kevin.silverman@nist.gov](mailto:kevin.silverman@nist.gov)

Quantum information technology based on superconducting microwave technology is progressing rapidly and is now widely adopted by large corporations and small startup firms. These components operate at extremely cold (<20mK) temperatures requiring an isolated environment. Therefore, a critical problem is the transfer of quantum information out of and into the cryostat. Currently, the only viable method for transporting quantum information ~km distances is via optical photons. Subsequently, efficient and noise-free microwave-optical conversion is required. Recently, progress has been made by simultaneously coupling the light and microwave degrees of freedom to nanomechanical resonators. A successful approach is to place a SiN membrane in a high-Q Fabry-Perot cavity [1]. The motion of the membrane parametrically modulates the frequency of the cavity light via the index of refraction.

Here, we present progress on a new type of transducer where the optical cavity is replaced with an InAs quantum dot and the membrane is exchanged for a surface acoustic wave cavity (SAWc). Recently, hybrid quantum devices involving SAW cavities and superconducting qubits have been successfully integrated [2]. In a SAWc, phonons will parametrically modify the resonance frequency of a QD via strain [3]. In this work, we demonstrate progress in developing state-of-the-art, stable SAWc operating at ~ 3.4GHz. We demonstrate a reduction in the SAWc mode volume by using focusing SAW mirrors (Fig. 1). These devices are characterized using atomic force measurements of SAWc cavity-modes demonstrating high-quality focusing phononic wavefronts. Finally, we discuss reducing bulk scattering, theoretical coupling rates and discuss efficient photon extraction.



**Fig. 1.** SEM image of SAWc device.

### References

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