Towards Microwave-Optical Transduction with an Embedded Mechanical Quantum Memory

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Being able to distribute operations on a quantum state over a network composed of spatially distant quantum registers has been a long-time interest for many researchers in the quantum information community [1-3].

To benefit from both the efficient processing of superconducting qubits and the ability of light to transport quantum information over long distances, it requires the ability to transduce microwave quantum states into optical quantum states.

Previous implementations of transduction schemes were limited either to the classical regime, where more than one quanta of input-referred added noise upon transduction was reported [4], or to a regime of low efficiency [5].

Soft-clamped SiN membrane resonators [6] offer long coherence times and can at the same time be coupled efficiently to optical and microwave degrees of freedom.

We have previously demonstrated ground state cooling through both optomechanical [7] and electromechanical coupling [8], signalling high quantum cooperativities >1 sufficient for low-noise transduction.

We here present our work towards building a quantum transducer with an embedded quantum memory using a phononic dimer [9] with two interaction zones.

References

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Figures

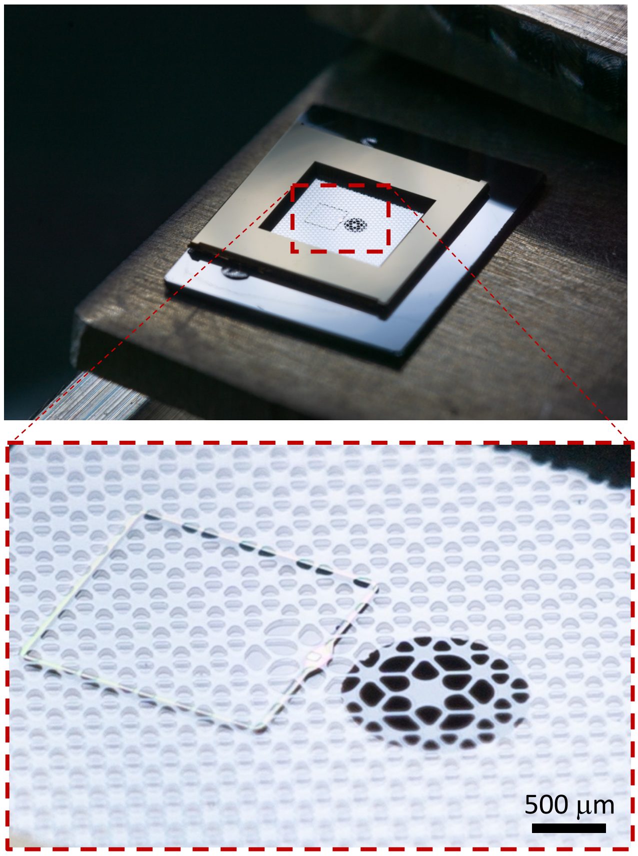

Figure 1: Photograph showing the coherent nanomembrane (patterned) that is coupled both to a microwave cavity underneath (square) and to an optical cavity with light propagation through the hole shown in black.