# Low Noise Opto-Electro-Mechanical Modulator for RF-to-Optical Transduction in Quantum Communications

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Quantum transduction plays a crucial role in quantum technologies [1,2]. One of the primary focus lies on achieving coherent conversion between optical and microwave/radiofrequency (Mw/RF) photons since optical spectrum is well-suited for long-distance communication, while the lower frequencies prove advantageous for precise local quantum operations. In this talk we present a complete theory to sympathetic cool a macroscopic radio-frequency LC electrical circuit to its ground state by means of an electro-optomechanical system, consisting of an optical cavity dispersively coupled to a nanomechanical oscillator, which is in turn capacitively coupled to the LC circuit of interest [3]. We show the realization of a novel electro-opto-mechanical device that can be used for the sympathetic cooling of the LC circuit, and as building block of an RF/Mw-optical transducer [4]. The key element of the device is a mechanical resonator based on a metal coated circular membrane capacitively coupled to an electrical circuit. We present the measurement of mechanical and electro-mechanical properties of the device. The quality factor of the mechanical oscillator has been characterized at room and cryogenic temperatures. The frequency shift of the fundamental mode of the oscillator due to the application of a potential difference is the evidence of the presence of the electro-mechanical coupling.

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