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**Two-tone experiments and time domain control in circuit nano-electromechanics** F. HOCKE, H. HUEBL, Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, Garching, Germany, X. ZHOU, A. SCHLIESSER, T. J. KIPPENBERG, Ècole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland; Max-Planck-Institut für Quantenoptik, Garching, Germany, R. GROSS, Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften and Physik-Department TU München, Garching, Germany — In the field of optomechanics, a light field trapped in an optical resonator dynamically interacts with a mechanical degree of freedom, enabling cooling and amplification of mechanical motion. This concept of light matter interaction can be transferred to the microwave (MW) regime combining superconducting MW circuits with nanometer-sized mechanical beams, establishing the class of circuit nano-electromechanics. Here, two-tone spectroscopy is a tool to access a wider class of phenomena, employing interference of a pump and a probe tone inside the MW cavity. We discuss electromechanically induced transparency and electromechanically induced absorption employing continuous and pulsed excitation. With the latter technique, we access the dynamics of the hybrid system revealing that the switching dynamics of the transmitted light are not limited by the time constant imposed by the mechanical beam, the slowing of light pulses, and the phonon repopulation of a precooled mechanical mode due to thermal decoherence [1,2]. Our experiments provide a key tool towards full quantum control of electromechanical systems, including squeezing, state transfer and entanglement between mechanical and optical degree of freedom. [1] X. Zhou et al. arXiv:1206.6052 [2] F. Hocke et al. arXiv:1209.4470

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