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Coupling quantum microwave circuits to quantum optics via cavity electro-optic modulators¹ MANKEI TSANG, National University of Singapore — Experimental circuit quantum electrodynamics has made great strides in recent years, but it remains an open question how the quantum information stored in the microwave circuits can be transferred for long distances. Just as in classical information, the most promising solution is to convert the microwave fields to optical frequencies, where ultra-low-loss photonic devices such as optical fibers can be used. Here I propose the use of cavity electro-optic modulators for coherent coupling between microwave and optical fields. The electro-optic effect is the change in optical refractive index in certain materials, such as lithium niobate, under an applied voltage. Leveraging the fact that cavity electro-optics has the same physics as cavity optomechanics, a cavity electro-optic modulator can realize various joint quantum operations on the microwave and optical fields, including coherent frequency conversion, laser cooling of microwave resonance, hybrid entanglement, hybrid parametric amplification and oscillation, and optical quantum-nondemolition measurements of microwave quadrature and energy.

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Mankei Tsang
eletmk@nus.edu.sg
National University of Singapore

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