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Towards a lossless and integrable circulator for quantum superconducting microwave systems: modelling and optimization KEVIN LALUMIERE, Département de Physique, Université de Sherbrooke, Sherbrooke, Québec, Canada J1K 2R1, JOSEPH KERCKHOFF, BENJAMIN J. CHAPMAN, K.W. LEHNERT, JILA, National Institute of Standards and Technology, and the University of Colorado, Boulder, Colorado 80309, USA, ALEXANDRE BLAIS, Département de Physique, Université de Sherbrooke, Sherbrooke, Québec, Canada J1K 2R1 — Microwave circulators are non-reciprocal devices allowing, for example, isolation of superconducting qubits from amplifier noise. Unfortunately, current commercial circulators are bulky and are moreover based on permanent magnets, prohibiting on-chip integration with superconducting quantum circuits. In this talk we show that an on-chip superconducting circulator can be realized by modulating the coupling between resonant modes and input/output transmission lines. The performance of this circulator depends on how the coupling is modulated. Using input-output theory, we obtain a transfer operator description of the circulator under arbitrary modulation, and show how to optimize the design and modulation scheme. We further show how this design minimizes frequency mixing between incident and scattered signals.

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