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Tunable quantum gate between a superconducting atom and a propagating microwave photon[1] KAZUKI KOSHINO, Tokyo Medical and Dental University, KUNIHIRO INOMATA, ZHIRONG LIN, RIKEN Center for Emergent Matter Science, YUUKI TOKUNAGA, NTT Secure Platform Laboratories, TSUYOSHI YAMAMOTO, NEC IoT Device Research Laboratories, YASUNOBU NAKAMURA, The University of Tokyo, RIKEN Center for Emergent Matter Science — We propose a two-qubit quantum logic gate between a superconducting atom and a propagating microwave photon. The atomic qubit is encoded on its lowest two levels and the photonic qubit is encoded on its carrier frequencies. The gate operation completes deterministically upon reflection of a photon, and various two-qubit gates (SWAP, $\sqrt{\text{SWAP}}$, and Identity) are realized through *in situ* control of the drive field. The proposed gate is applicable to construction of a network of superconducting atoms, which enables gate operations between non-neighboring atoms.

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