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Coexistence of three-wave, four-wave and five-wave mixing processes and Autler-Townes splittings in a superconducting artificial atomic system[1] GUO-QIN GE, HAICHAO LI, Huazhong University of Science and Technology — We present a theoretical study of multi-wave mixing in a driven superconducting quantum qubit (artificial atom) with a $\triangle$-type three-level structure. We first show that three-wave mixing (TWM), four-wave mixing (FWM) and five-wave mixing (FIWM) processes can coexist in the microwave regime in such an artificial system due to the absence of selection rules. Because of electromagnetically induced transparency suppression of linear absorption in a standard ladder-type configuration, the generated FWM is enhanced greatly and its efficiency can be as high as 0.1% for only a single artificial atom, which is comparable to or even larger than that of many previous schemes in atomic systems. Moreover, it is possible to obtain a more higher conversion efficiency by using an array of such artificial atoms. We also show that quantum interference between TWM and FIWM signals has a significant impact on the total signal intensity being a coherent superposition of these two signals. Our scheme for the generation of microwave signals may have potential applications in solid-state quantum information processing.

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