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**Theory of an on-chip Josephson quantum michomaser**[1] CHENXU LIU, MARIA MUCCI, XI CAO, MICHAEL HATRIDGE, DAVID PEKKER, Department of Physics and Astronomy, Univ of Pittsburgh — Solid-state superconducting qubit systems are one of the most promising systems to achieve quantum computing. One of the shortcomings of this architecture is the lack of an on-chip coherent microwave source. To solve this problem, we explore the feasibility of building a Josephson micromaser powered by tunable superconducting transmon qubit(s) (which serve as an artificial three-level atom). Specifically, we explain how to engineer a system composed of two qubits (one a conventional transmon, the other a transmon with a SNAIL element) to construct an element that behaves like a 3-level atom coupled to a dissipative bath. We construct a master equation description of the maser and estimate its properties, like its coherence time, and their dependence on the pump power, pump noise, cavity widths, etc. We show that the linewidth of the micromaser approaches the Schawlow-Townes (ST) limit with feasible experimental parameters. We further notice that the nonlinear couplings between the superconducting qubit and the cavity can suppress the linewidth beyond the ST limit. Finally, we note that the possibility for highly non-linear devices in the microwave regime allows our maser to generate quantum (i.e. non-Gaussian) light.

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