Single artificial-atom lasing

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Single-artificial atom lasing We demonstrate lasing action with a single Josephson charge qubit coupled to a superconducting Nb coplanar waveguide resonator. Photons in the resonator are generated by one and the same atom and estimated to be more than 30. The lasing emission is measured at a resonance frequency of the resonator 10 GHz. The energy splitting of the qubit with two states |0 > and |2 >, differed by one Cooper pair (consisting of a pair of electrons), is electrically controlled by external gate voltages. An additional electrode, connected to the metallic island of the qubit through a high resistive tunnel junction, is biased so that an extra Cooper pair (if the qubit is in the state |2 >) escapes from the island in a sequential incoherent process : |2 >→ |1 >→ |0 >, where |1 > denotes a state with an extra electron in the island. To achieve population inversion in the three-level quantum system (artificial atom), the energy of the state |0 > is adjusted to be higher than that of the state |2 >. The lasing action takes place when the qubit energy is tuned to the resonance of the resonator.