Low power microwave photon detector based on Superconducting Qubit Network

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In the view of low power microwave photon detector application, we have carried out a comparison between novel theoretical approach and experiments on quantum collective dynamics of superconducting qubit network (SQN) embedded in microwave planar resonators. Experiments were done on T-type two resonators SQN with 10 flux qubits. We have observed for SQN with 10 qubits a sharp shift of the position of the resonant transmission dip as a function both of amplitude and of frequency of the second-tone signal. Experimental results are in a good agreement with the theoretical approach based on a non-linear multiphoton interaction between pump (second tone) microwave signal and a qubit system of the SQN. In the framework of this model, the frequency shift is the sum of the multiphoton AC Stark shift values of each qubit and the increase of the dip sharpness manifests the observation of quantum collective state stimulated by the second-tone microwave signal. Number of photons related to low microwave power of the second tone signal , has been estimated by fit procedure of microwave resonant measurements of scattering parameters of the planar resonators. We have proposed a novel principle of detection of low power microwave signal based on collective quantum states established in SQN embedded in microwave resonators. We theoretically predicted and experimentally demonstrated that SQN detector with collective quantum state permits to detect a low power microwave signal with a frequency of 7.748 GHz in the range between -110 dBm and -75 dBm which is lower than the microwave power range of conventional Schottky detector.