Entangled photon-pair emission in circuit QED from a Cooper pair splitter

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As a circuit QED architecture, we study the photon emission of a Cooper pair splitter formed by two double dots each of them coupled to a microwave transmission line. We demonstrate that it is possible to generate entangled photon pairs in frequency, in the left (L) and the right (R) line, namely two photon wavepackets with a superposition of states at different frequencies. The frequency entanglement of the two photons has origin in the particle-hole coherent superposition of the electronic entangled singlet that tunnels out from the superconducting nanocontact inserted between the two double dots. Using the parameters of the state of art of the circuit QED devices with quantum dots, we also estimate the efficiency of the entangled pair-photon generation assuming that non-radiative processes are also present in the two double-dots. So far no experiment has demonstrated that electrons leaking out in a Cooper pair splitter are entangled. Our proposal is a realistic and achievable within the reach of the state of art in quantum microwave engineering with quantum dots.

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