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Ultrasensitive superconducting photon detectors for axions observation

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We theoretically investigate the possibility of realizing single-photon counters for photon frequencies down to 10 GHz. We propose three schemes. The first one consists of a cold electron nanobolometer, coupled to an antenna, as in Ref. [1]. In this case, the photon excites the antenna and then dissipates its energy into the normal metal island of the nanobolometer. As a consequence, the temperature of the island increases, which produces a current or voltage pulse in a couple of normal metal-insulator-superconductor tunnel junctions, used as thermometer.

In the second and third schemes, the antenna is coupled–in series or capacitively–to a Josephson junction. We present the corresponding quantum circuits and show that the schemes are mathematically equivalent. They both can be represented as a quantum particle moving in a two-dimensional potential. We analyze the mechanisms of detection in each scheme and we discuss the values of the detectors parameters which permit the photon detection.

[1] D. V. Anghel and L. Kuzmin, Appl. Phys. Lett. 82, 293 (2003).

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