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Vortex-assisted photon counts and their magnetic field dependence in superconducting nano-wire single-photon detectors LEV BULAEVSKII[1], MATTHIAS GRAF, SHIZENG LIN, Los Alamos National Laboratory, VLADIMIR KOGAN[2], Ames National Laboratory — We argue that photon counts in a superconducting nanowire single-photon detector (SNSPD) are caused by the transition from a current-biased metastable superconducting state into the normal state. Such a transition is triggered by photons with the frequency ω above the critical frequency ω_c or by photons with the frequency $\omega < \omega_c$ and subsequent vortex crossing from one edge of the superconducting strip to the other. The vortex is pushed across the strip due to the Lorentz force in the presence of the bias current I. We calculate the efficiency of photon counts as a function of ω, I, bath temperature, and the strip geometry. We derive the dependence of the rate of vortex-assisted photon counts on the bias current at given ω and strip geometry. The resulting photon count rate has a plateau at high currents, close to the critical current, and drops as a power-law with high exponent at lower currents. While a magnetic field applied perpendicular to the superconducting strip does not affect the formation of hot spots by photons, it increases the rate of vortex crossings (with and without photons). We show that by applying a magnetic field one may identify the origin of dark and photon-assisted counts.

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