Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Vortex-induced dissipation in narrow current-biased thin-film superconducting strips L.N. BULAEVSKII, C.D. BATISTA, M.J. GRAF, Los Alamos National Laboratory, V.G. KOGAN, Ames Lab and Iowa State Univ. — We consider a vortex crossing a narrow superconducting strip from one edge to the other, perpendicular to a bias current, as the dominant mechanism for dissipation in thin-film superconductors of thickness d of order of the coherence length ξ. The width w of the strip is much narrower than the Pearl length $\Lambda = 2\lambda^2/d$, with $\Lambda \gg w \gg \xi$. Every crossing of a vortex results in a detectable voltage pulse. We derive the rate of vortex crossings and the rate of pulses using the general theory of transition rates between metastable states. For the first time, we account for the renormalization of the vortex crossing rate by superconducting fluctuations and estimate the amplitude of voltage pulses and their consequences for the I-V characteristics. We find ohmic I-V behavior at low bias currents, power laws at intermediate currents, and exponential dependence close to the critical current I_c. We argue that pulse rate measurements may provide crucial information on the thermal and quantum dynamic nature of fluctuations, vortices, and the superconducting state. Finally, we discuss the impact of vortex-induced dissipation on the fundamental limitations for dark counts in superconducting nanowire single-photon detectors.

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Date submitted: 20 Nov 2009 Electronic form version 1.4