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Theory of superconductive-resistive switching in nanowires due to heating by stochastic phase slips NAYANA SHAH, University of Illinois at Urbana-Champaign, DAVID PEKKER, Harvard University, PAUL GOLDBART, University of Illinois at Urbana-Champaign — We study the stochastic dynamics of superconductive-to-resistive switching in hysteretic current-biased superconducting nanowires undergoing phase-slip fluctuations. We assume that the hysteresis is thermal in nature, and postulate that the mechanism for the switching is thermal runaway, i.e. rare sequences of stochastic phase slips, closely spaced in time, that heat the nanowire. Thus, via the master-equation formalism, we obtain the distribution of currents at which switching occurs. If switching were caused by single, thermally-activated phase-slip events then this distribution would narrow as the temperature is reduced. However, at higher temperatures we find that several phase-slip events are typically necessary for inducing switching, and this results in an initial broadening of the distribution upon cooling. Quite generally, we predict that at low temperatures thermal runaway is caused by a single phase-slip event. Thus, measurements of switching-current distributions in this regime are a direct probe of this basic collective process. In particular, this regime could yield observations of individual quantum phase slips in nanowires.

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