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Evidence for individual quantum phase-slip events in homogeneous superconducting nanowires MITRABHANU SAHU, MYUNG-HO BAE, University of Illinois at Urbana-Champaign, ANDREY ROGACHEV, University of Utah, DAVID PEKKER, Harvard University, NAYANA SHAH, University of Illinois at Urbana-Champaign, TZU-CHIEH WEI, University of Waterloo, PAUL GOLDBART, ALEXEY BEZRYADIN, University of Illinois at Urbana-Champaign — We report strong evidence for individual quantum tunneling events undergone by the superconducting order-parameter field in homogeneous $Mo_{79}Ge_{21}$ nanowires. We obtain this via measurements of the distribution of switching currents, whose width exhibits a rather counter-intuitive, monotonic increase with decreasing temperature. We outline a stochastic model of phase-slip kinetics, which relates the basic phase- slip rates to switching rates. Comparison with this model indicates that the phase predominantly slips via thermal activation at high temperatures, but at sufficiently low temperatures switching is caused by individual topological tunneling events of the order-parameter field, i.e., quantum phase slips (QPS). Importantly, measurements on several wires show that quantum fluctuations tend to dominate over thermal fluctuations at larger temperatures in wires having larger critical currents. This fact supports the view that the anomalously high switching-rates observed at low temperatures are indeed due to QPS, and are not consequences of extraneous noise or inhomogeneity of the wire.

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