Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Flux-charge duality and quantum phase fluctuations in one-dimensional superconductors[1] ANDREW KERMAN, MIT Lincoln Laboratory — It has long been thought that superconductivity breaks down in one dimension due to enhanced quantum phase fluctuations. However, the exact mechanism for this is still an active research area. One common feature of existing theories is the idea of "quantum phase-slip" (QPS): quantum tunneling of the superconducting order parameter between states where the relative phase between the wire ends differs by $\pm 2\pi$. Many experiments have been carried out to investigate QPS, and a wide range of phenomena have been observed, including resistive fluctuations well below T_C and an apparent quantum phase transition to an insulating state in the narrowest wires. Although these are all likely connected to QPS, a unified understanding has not yet been possible. I will describe a theory for QPS which is based on the idea that flux-charge duality, a classical symmetry of Maxwell's equations, relates the phase fluctuations associated with QPS to the well-known charge fluctuations associated with Josephson tunneling, at a microscopic level. The predictions of this theory compare favorably with a wide range of experimental observations, and may also provide a conceptual link to 2D phase fluctuation phenomena and insulating transitions in thin films.

[1]This work is sponsored under Air Force Contract Number FA8721-05-C-0002. Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the United States Government.

Andrew Kerman
MIT Lincoln Laboratory

Date submitted: 05 Dec 2011 Electronic form version 1.4