

Statistics of temperature fluctuations in superconductor-normal metal tunnel structures

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Recently, temperature fluctuation statistics has been studied in non-interacting islands,¹ and overheated single-electron transistors.^{2,3}

Here we present a detailed study of the fluctuating temperature on a normal metal island coupled by tunnel junctions to two superconducting leads, forming a so called SINIS structure. We also study the effect of these temperature fluctuations on the noise of the electric current through the structure. We find that near the threshold voltage, $V = 2\Delta$, fluctuations of temperature are large compared to the temperature of the normal metal island. These fluctuations give rise to large fluctuations in the electric current, with a noise power that can exceed the intrinsic current fluctuations by a factor of 10^2 . We also find that due to the cooling effect in SINIS structures the island temperature is low enough that the effect of the electron-phonon coupling to these results is negligible in practical devices.

¹T. T. Heikkilä and Y. V. Nazarov, Phys. Rev. Lett. **102**, 130605 (2009).

²M. A. Laakso, T. T. Heikkilä, and Y. V. Nazarov, Phys. Rev. Lett. **104**, 196805 (2010).

³M. A. Laakso, T. T. Heikkilä, and Y. V. Nazarov, Phys. Rev. B **82**, 205316 (2010).