Giant current fluctuations in an overheated single electron transistor

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Interplay of cotunneling and single-electron tunneling in a thermally isolated single-electron transistor (SET) leads to peculiar overheating effects. In particular, there is an interesting crossover interval where the competition between cotunneling and single-electron tunneling changes to the dominance of the latter. In this interval, the current exhibits anomalous sensitivity to the effective electron temperature of the transistor island and its fluctuations.[1]
We present a detailed study of the current and temperature fluctuations at this interesting point.[2] The methods implemented allow for a complete characterization of the distribution of the fluctuating quantities, well beyond the Gaussian approximation. We reveal and explore the parameter range where, for sufficiently small transistor islands, the current fluctuations become gigantic. In this regime, the optimal value of the current, its expectation value, and its standard deviation differ from each other by parametrically large factors. This situation is unique for transport in nanostructures and for electron transport in general. The origin of this spectacular effect is the exponential sensitivity of the current to the fluctuating effective temperature.

[1]M. A. Laakso, T. T. Heikkilä, and Y. V. Nazarov, Phys. Rev. Lett. **104**, 196805 (2010).
[2]M. A. Laakso, T. T. Heikkilä, and Y. V. Nazarov, Phys. Rev. B **82**, 205316 (2010).