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Fluctuation theorems and 1/f noise from a simple matrix

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Abstract

© 2016, EDP Sciences, SIF, Springer-Verlag Berlin Heidelberg.Here we present a model for a small system combined with an explicit entropy bath that iscomparably small. The dynamics of the model is defined by a simple matrix, M. Each row ofM corresponds to a macrostate of the system, e.g. net alignment, while the elements in therow represent microstates. The constant number of elements in each row ensures constantentropy, which allows reversible fluctuations, similar to information theory where aconstant number of bits allows reversible computations. Many elements in M come from themicrostates of the system, but many others come from the bath. Bypassing the bath statesyields fluctuations that exhibit standard white noise; whereas with bath states the powerspectral density varies as S(f) ∝ 1 /f overa wide range of frequencies, f. Thus, the explicit entropy bath is the mechanismof 1/f noisein this model. Both forms of the model match Crooks' fluctuation theorem exactly,indicating that the theorem applies not only to infinite reservoirs, but also tofinite-sized baths. The model is used to analyze measurements of 1/f-like noise from asub-micron tunnel junction.

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Keywords

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