

Fluctuations in a NESS: is there a universal behavior ?

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The fluctuation-Dissipation Theorem is a cardinal tool of Statistical Physics. This relation yields to the Equipartition Principle, thanks to which we can link the fluctuations of an observable with the temperature of the system. All of this is nevertheless granted at *equilibrium*. Our purpose is to test what happens out of this safe region.

In our experiment, shown in Fig. 1, we study a system in a Non equilibrium Steady State (NESS): a silicon micro-cantilever subject to a heat flux due to a laser heating. We measure the thermal noise driven deflexion and torsion and quantify the amplitude of the fluctuations with an effective temperature T^{eff} , extending the equipartition principle:

$$\frac{1}{2}k_B T^{\text{eff}} = \frac{1}{2}k \langle x^2 \rangle$$

with k_B Boltzman's constant, k the stiffness and $\langle x^2 \rangle$ the mean square deformation. Out of equilibrium, an *excess* of fluctuations is usually expected, as found out for example by Conti et al. in a similar system¹ (Fig. 1). Following Geitner et al.² we find on the contrary a strong *deficit* of thermal noise of the cantilever with respect to the average temperature T^{avg} of the system ! Further experiments and theoretical progress are thus necessary to clarify these contracticting behaviors.

[1] L. Conti, et al. , J. Stat. Mech. P12003 (2013).

[2] M. Geitner, et al. Physical Review E **95**, 032138 (2017).

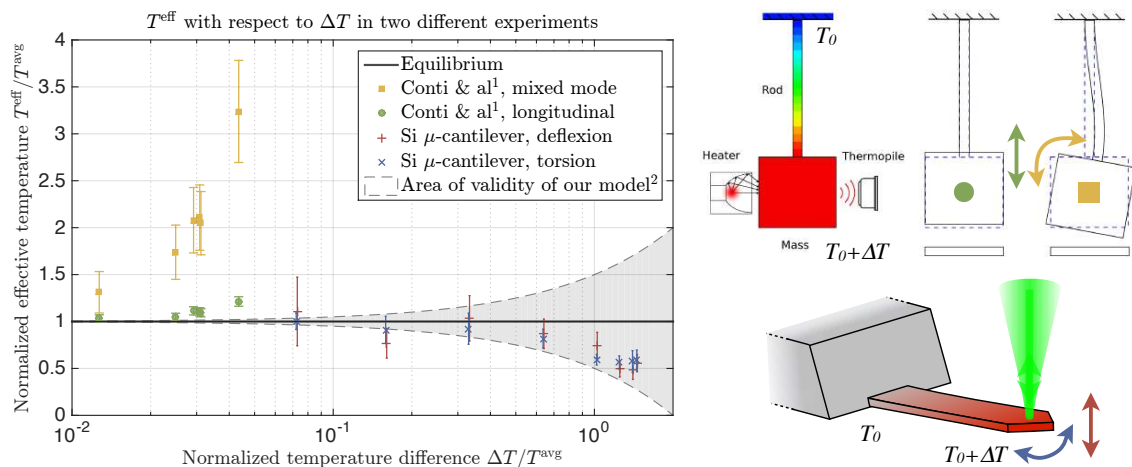


Figure 1: (Left) Effective temperature T^{eff} of a system under a heat flow as a function of the difference of temperature ΔT at its extremities. All temperatures are normalized to the average temperature T^{avg} . (Upper right) Conti's setup¹. (Lower right) Our experiment².