

Experimental study of thermal noise of oscillators in non-equilibrium steady-states

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The thermal noise is often a limit to high sensitivity experimental apparatus such as ground-based gravitational wave (GW) detectors: these are macroscopic instruments with displacement sensitivity approaching the limit set by the uncertainty principle. From the thermodynamic viewpoint, GW experiments are usually modeled as equilibrium systems, but it is doubtful that this description is justified. To assess this issue, we have conducted a systematic experimental study to investigate the spontaneous vibration fluctuations of low-loss mechanical oscillators in non-equilibrium steady-states due to thermal differences across the oscillator themselves. We show the experimental findings and discuss the conclusions we can infer for the gravitational wave detectors and in general for the statistical mechanics of non-equilibrium systems.