

# Operating Detectors Far From Equilibrium Can Improve Sensitivity?

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**Abstract.** Tiny vibrations of mechanical structures are a limiting cause in a number of high sensitivity measurement apparatus, chief among them the most sensitive displacement apparatus on earth: the gravitational wave interferometer. It is remarkable that all the noise studies, as well as the operational condition of the interferometers, are considered under the assumption that the entire system is stationary and at equilibrium.

In this talk we present an approach aimed at operating the detector out of equilibrium. We show that selective cooling of single oscillatory modes of a detector mechanical structure is able to positively impact the measurement sensitivity of an interferometric detector by decreasing the fluctuation amplitude and increasing the SNR in the case of transient target signals. Experiments conducted with bench interferometers on thin silica membranes have shown promising results for the implementation of such technique in high sensitivity measurement apparatus[1]. It has to be underlined that this technique can be applied not only in the selective cooling of thermal noise peaks but also with other equilibrium fluctuation cases, like seismic or structural peaks in general.

## References

- [1] Igor Neri, Miquel Lopez-Suarez, Luca Gammaitoni, *Classical and Quantum Gravity*, 35, 155018, 2018.