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Temperature-induced stochastic resonance in non-linear modulated photonic cavities

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Abstract:

Driven linear and non-linear photonic cavities are extensively studied. Indeed, it can exhibit non-reciprocity[1], frequency conversion[2],thermal cooling[3], ... It is known that injected noise in a bistable modulated system can lead to periodic transitions between stable states, a phenomenon called stochastic resonance[4]. Recently, it has been shown both experimentally and numerically that such phenomenon can, for example, enhance energy harvesting[5]. Here, for the first time, we present stochastic resonance resulting from temperature-induced noise as well as a modulated monochromatic pump. We study thermal radiation and outgoing power from a non-linear photonic cavity coupled to an external channel. The cavity is driven by a modulated monochromatic pump and its mode evolution is described as a stochastic process due to temperature-induced noise. Such system exhibits frequency conversion and paves the way for temporal control of radiative heat transfer. We also suggest a semi-analytical approach for the estimation of coherent outgoing power into the external channel in the stochastic resonance regime.

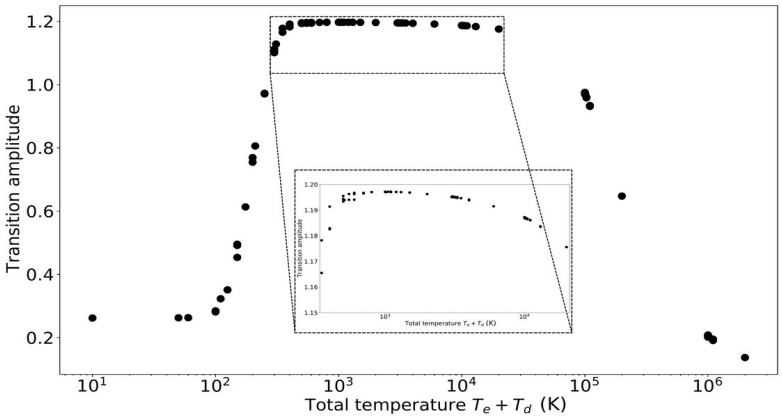

Figure 1: Stochastic resonance from temperature induced noise. Amplitude of transitions between stable states (ensemble average) is maximized for temperatures around 1000K.

References

[1] D. L. Sounas and A. Alù, 'Non-reciprocal photonics based on time modulation', *Nat. Photonics*, vol. 11, (2017).

[2] G. Altares Menendez and B. Maes, 'Selective frequency conversion with coupled time-modulated cavities', *Phys. Rev. B*, vol. 100, (2019)

[3] S. Buddhiraju, W. Li, and S. Fan, 'Photonic Refrigeration from Time-Modulated Thermal Emission', *Phys. Rev. Lett.*, vol. 124, (2020)

[4] L. Gammaitoni, F. Marchesoni, E. Menichella-Saetta, and S. Santucci, 'Stochastic Resonance in Bistable Systems', *Phys. Rev. Lett.*, vol. 62, (1989)

[5] K. J. H. Peters, Z. Geng, K. Malmir, J. M. Smith, and S. R. K. Rodriguez, 'Extremely Broadband Stochastic Resonance of Light and Enhanced Energy Harvesting Enabled by Memory Effects in the Nonlinear Response', *Phys. Rev. Lett.*, vol. 126, (2021)