Frequency comb formation in a driven mechanical oscillator

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Optical frequency combs have significantly transformed modern metrology and molecular spectroscopy [1]. In this work, using a resonantly driven nonlinear nanomechanical resonator with a high quality factor, we demonstrate direct analogue for an optical comb in the radio frequency domain. While optomechanical frequency combs have been previously demonstrated [2,3], they always rely on non-linear coupling between several mechanical modes. Here we demonstrate such combs achieved from a single mechanical mode of a doubly-clamped semiconductor beam strongly driven by gradient forces in the deep Duffing regime. Similar system has been theoretically predicted very recently [4,5]. Study of the non-linear effects leading to the spontaneous formation of equally frequency spaced mechanical oscillations reveals strong modulation of the carrier frequency. Moreover we show through homodyne detection that thermally induced classical fluctuations about the stable states of forced vibrations are squeezed. This work could be interesting in precision sensing enabling the advent of a new generation of nanomechanical detectors at room temperature.

References

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