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Coupled nanomechanical resonators in a multi-tone control scheme

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The multimode systems in optomechanics and nano/micro-electromechanics have stimulated strong interests in the study of interference processes through multi-tone control. It not only offers the method to cancel the back-action effects of the “cavity force”, but also provides the way to create non-reciprocal transmission by generating destructive interferences, in coupled multimode systems [a]. In addition, it also gives an access to form a mechanical “dark state” which can effectively isolate the mechanical system from thermal-induced noise, thus allowing mechanical system to access the quantum limited region [b]. Here, we present our recent progress in controlling of multimode interaction in a coupled nanoelectromechanical system by manipulating of the double pump tones and the double electromechanically induced transparency. The cancellation of the destructive interference clearly shows the "dark state" effects in isolating the mechanical mode from other coupled modes, in agreement with the calculation results. In addition, the amplitude responses of the cavity, which are sensitive to the relative phase of the multiple input signals, will also be discussed. Our results open up new possibilities for the study of frequency conversions mediated by nanomechanical multi-mode interactions in the classical and, potentially in the future, the quantum regime.

References

[a]<https://doi.org/10.1038/s41467-017-00447-1>

[b]DOI: 10.1126/science.1228370