Nonclassical mechanical states in cavity optomechanics in the strong coupling regime

Jonathan Wise*†[1], Clément Dutreix[1], and Fabio Pistolesi[1]

[1]Laboratoire Ondes et Matière d'Aquitaine – Centre National de la Recherche Scientifique : UMR5798, Université de Bordeaux : UMR5798, Université de Bordeaux, Centre National de la Recherche Scientifique – Université de Bordeaux, PAC Talence, bât. A4N, 351 Cours de la Libération, 33405 Talence Cedex, France

Résumé

Introducing a controlled and strong anharmonicity in mechanical systems is a present challenge of nanomechanics, since the anharmonicity may be exploited to generate nonclassical states of motion. Such states could not only be exploited to investigate the fundamental physics of macroscopic quantum mechanics, but also allow the development of novel quantum technologies. We present a protocol for the generation of such nonclassical mechanical states in the context of cavity optomechanics, where the intrinsic nonlinear interaction between cavity and oscillator provides an ideal platform for manipulating the mechanical state. While most previous works have focused on the steady state solution, we propose here a simple method for generating nonclassical mechanical states in the transient dynamics via driving of the optical cavity. A perturbative analytical treatment for weak drive explains well the physics of these states, which resemble quantum superpositions of coherent states of different amplitude. The strong nonclassicality of the oscillator state is manifested in its Wigner function and is shown via numerical simulation to be robust against weak dissipation.

*Intervenant

†Auteur correspondant: jonathan.wise@u-bordeaux.fr