Cavity optomechanics with nanomembranes and atoms

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Résumé

Past years have witnessed the development of a new research field that studies the interaction exerted by the radiation pressure of light on nano- or micromechanical resonators. This field of quantum optomechanics aims at studying basic concepts of quantum and measurement theories, such as the quantum nature of macroscopic objects or the backaction effects in very sensitive measurements. Applications range from novel classical force sensors with unprecedented sensitivity to the study of quantum limits in interferometric measurements such as gravitational-wave interferometers. Fundamental tests of quantum theory are also of concern, with the possibility to study the entanglement and decoherence of macroscopic objects, or how radiation-pressure backaction can be circumvented in optical measurements.

In that context, it is of great interest to couple the mechanical resonator to another quantum system: mechanical oscillators coherently coupled to other well-controlled quantum systems are an example of hybrid quantum systems which may be very helpful for quantum engineering, quantum information networking, and quantum information processing. We present an experiment aiming at coupling a suspended photonic-crystal nanomembrane to cold atoms.

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