Mechanical nonlinear dynamics of a suspended photonic crystal membrane with integrated actuation

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Nonlinearities in nanomechanical systems can arise from various sources such as spring and damping mechanisms and resistive, inductive, and capacitive circuit elements. Beyond fundamental interests for testing the dynamical response of discrete nonlinear systems with many degrees of freedom, non-linearities in nanomechanical devices, open new routes for motion transduction, nanomechanical sensing, and signal processing. We investigate the nonlinear response of a nanomechanical resonator consisting in a suspended photonic crystal membrane acting as a deformable mirror. Actuation of the membrane motion in the MHz frequency range is achieved via interdigitated electrodes placed underneath the membrane. The applied electrostatic force induces mechanical non-linearities, in particular bistability, superharmonic and stochastic resonances.

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