Boosting the nonlinearity of mechanical resonators approaching the quantum regime

A. Bachtold

ICFO, 08860 Barcelona, Spain

An open question in mechanics is whether mechanical resonators can be made nonlinear with vibrations approaching the quantum ground state. This requires engineering a mechanical nonlinearity far beyond what has been realized thus far. In this talk, I will present a mechanism to boost the Duffing nonlinearity by coupling the vibrations of a nanotube resonator to single-electron tunneling and by operating the system in the ultrastrong coupling regime [1]. Remarkably, thermal vibrations become highly nonlinear when lowering the temperature. The average vibration amplitude at the lowest temperature is 13 times the zero-point motion, with approximately 42% of the thermal energy stored in the anharmonic part of the potential. Our work paves the way for realizing mechanical qubits [2] and quantum simulators emulating the electron-phonon coupling [3,4].

References:

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