Bistability and displacement fluctuations in a quantum nanomechanical oscillator

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Remarkable features have been predicted for the mechanical fluctuations at the bistability transition of a classical oscillator coupled capacitively to a quantum dot [1,2]. These results have been obtained in the regime $\hbar\omega_0 \ll k_B T \ll \hbar\Gamma$ where ω_0, T and Γ are the mechanical resonating frequency, the temperature, and the tunneling rate, respectively. A similar behavior could be expected in the quantum regime of $\hbar\Gamma \ll k_B T \ll \hbar\omega_0$.

We thus calculate the energy and displacement fluctuation spectra and study their behavior as a function of the electro-mechanical coupling constant when the system enters the Frank-Condon regime. We find that, in analogy with the classical case, the energy fluctuation spectrum and the displacement spectrum widths show a maximum for values of the coupling constant at which a mechanical bistability establishes [3].

[1] G. Micchi, R. Avriller and F. Pistolesi, *Mechanical Signatures of the Current Blockade Instability in Suspended Carbon Nanotubes,* Phys. Rev. Lett. **115**, 206802 (2015).
[2] G. Micchi, R. Avriller and F. Pistolesi, *Electro-Mechanical Transition in Quantum dots,* Phys. Rev. B. **94**, 125417 (2016).
[3] R. Avriller, B. Murr and F. Pistolesi, *Bistability and Displacement Fluctuations in a Quantum Nano-mechanical Oscillator,* Phys. Rev. B. **97**, 155414 (2018).

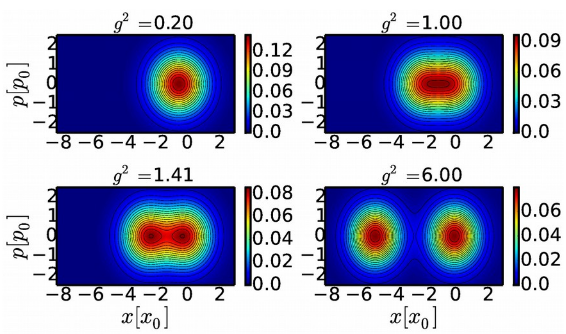

Figure 1 : The Wigner distribution of a quantum nanomechanical oscillator coupled to tunneling electrons while increasing electromechanical coupling g^2. Extracted from [3].