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 \cite{1,2}. These results have been obtained in the regime $\hbar \omega_0 \ll k_B T \ll \hbar \Gamma$ where $\omega_0$, $T$ and $\Gamma$ 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 \cite{3}.


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