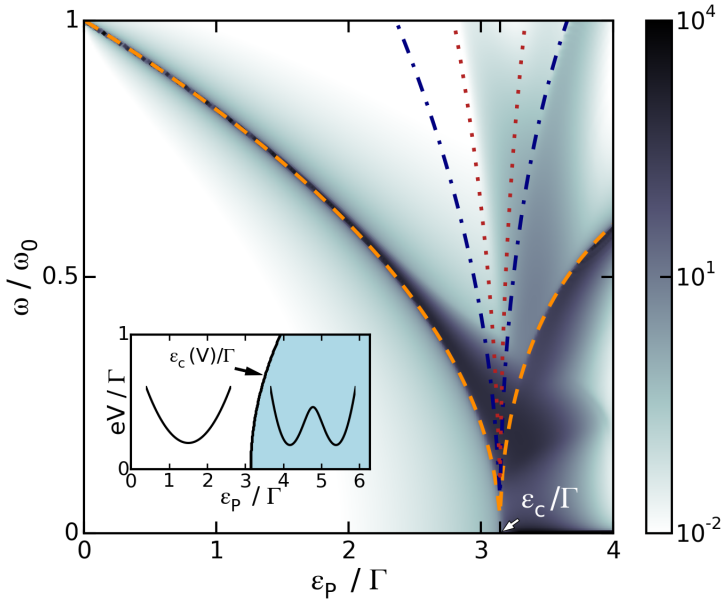
Mechanical Signatures of Current Blockade Instability in Suspended Carbon Nanotubes

G. Micchi, R. Avriller, and F. Pistolesi
LOMA, Univ. Bordeaux and CNRS, Talence

Transport measurements allow sensitive detection of nanomechanical motion of suspended carbon nanotubes. It has been predicted that when the electromechanical coupling is sufficiently large a bistability with a current blockade appears. Unambiguous observation of this transition by current measurements may be difficult. Instead, we investigate the mechanical response of the system, namely, the displacement spectral function, the linear response to a driving, and the ring-down behavior. We find that by increasing the electromechanical coupling the peak in the spectral function broadens and shifts at low frequencies (see Figure) while the oscillator dephasing time shortens. These effects are maximum at the transition where nonlinearities dominate the dynamics. These strong signatures open the way to detect the blockade transition in devices currently studied by several groups.



Displacement spectrum, $S_{xx}(\omega)$, as a function of the coupling strength ϵ_P. The softening is clearly at the critical value $\epsilon_P = \pi\Gamma$.

Ref. G. Micchi, R. Avriller, F. Pistolesi, Phys. Rev. Lett. **115**, 206802 (2015)