Dynamics of Nanotube Electromechanical Oscillator Coupled to Single Electron Transistor

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Recent experiments have investigated the interplay of mechanical dynamics and electron transport in suspended carbon nanotube mechanical oscillators, including the observation of a variety of hitherto unexplained nonlinear phenomena [1, 2]. We model the dynamics from first principles using coupled Fokker-Planck equations and derive a corresponding nonlinear Fokker-Planck equation valid in the limit that the transport is fast compared with the mechanical dynamics [3]. This equation is solved numerically using the corresponding stochastic differential equations, and the mechanical dynamics investigated as a function of the applied voltages. The steady-state mechanical probability density is used to determine the steady-state current through the nanotube as a function of applied voltage. The current calculated is compared with recent experimental results.

[1] Y. Wen, N. Ares, F.J. Schupp, T. Pei, G.A.D. Briggs and E.A. Laird, *Nat. Phys.* **16**, 75–82 (2020).

[2] K. Willick and J. Baugh, *Phys. Rev. Research* **2**, 033040 (2020).

[3] O. Culhane, M.T. Mitchison and J. Goold, *arXiv preprint* 2201.07819 (2022).