Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Nonlinear Dynamics of Nanomechanical Resonators SUBRAMANIAN RAMAKRISHNAN, YUIRY GULAK, Rutgers University , BALA SUNDARAM, University of Massachusetts - Boston, HAYM BENAROYA, Rutgers University — Nanoelectromechanical systems (NEMS) offer great promise for many applications including motion and mass sensing. Recent experimental results suggest the importance of nonlinear effects in NEMS, an issue which has not been addressed fully in theory. We report on a nonlinear extension of a recent analytical model by Armour et al [1] for the dynamics of a single-electron transistor (SET) coupled to a nanomechanical resonator. We consider the nonlinear resonator motion in both (a) the Duffing and (b) nonlinear pendulum regimes. The corresponding master equations are derived and solved numerically and we consider moment approximations as well. In the Duffing case with hardening stiffness, we observe that the resonator is damped by the SET at a significantly higher rate. In the cases of softening stiffness and the pendulum, there exist regimes where the SET adds energy to the resonator. To our knowledge, this is the first instance of a single model displaying both negative and positive resonator damping in different dynamical regimes. The implications of the results for SET sensitivity as well as for, as yet unexplained, experimental results will be discussed. 1. Armour et al. Phys.Rev.B (69) 125313 (2004).

Subramanian Ramakrishnan
Rutgers University

Date submitted: 20 Nov 2006 Electronic form version 1.4