Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Tunable and Broadband Nonlinear Nanomechanical Resonators

HANNA CHO, MIN-FENG YU, ALEXANDER F. VAKAKIS, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, LAWRENCE A. BERGMAN, D. MICHAEL MCFARLAND, Department of Aerospace Engineering, University of Illinois at Urbana-Champaign — Recent advance has seen the development of nanomechanical resonators operated in the linear regime that are capable of detecting extremely small physical quantities and even quantum interactions. However, the reduced device size reduces its dynamic range (down to nanometer) for linear operation, which makes developing the required measurement system difficult and accordingly limits their sensitivity, especially in ambient and room temperature environments. We design and develop a conceptually new nanomechanical resonator integrating an essential nonlinearity, which consists of a simple doubly clamped carbon nanotube driven with an oscillating concentrated force. We demonstrate the RF broadband nanoresonator that realizes a tunable bandwidth over three times its natural frequency and a room temperature mass sensitivity up to 0.1 zg/ Hz, over two orders of magnitude better than the corresponding linear nanoresonator. This intrinsically nonlinear design can be readily integrated into the ongoing development of nanoscale electromechanical systems to extend their practical operation for ultrahigh sensitivity sensing.

Hanna Cho
Department of Mechanical Science and Engineering,
University of Illinois at Urbana-Champaign

Date submitted: 14 Dec 2009 Electronic form version 1.4