Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Real-Space Tailoring of the Electron-Phonon Coupling in Ultra-Clean Nanotube Mechanical Resonators AVISHAI BENYAMINI, ASSAF HAMO, Weizmann Institute of Science, SILVIA VIOLA KUSMINSKIY, FELIX VON OPPEN, Freie Universitat Berlin, SHAHAL ILANI, Weizmann Institute of Science — The coupling between electrons and phonons is at the heart of many fundamental phenomena in nature. Despite tremendous advances in controlling electrons or phonons in engineered nanosystems, the control over their coupling is still widely lacking. Here we demonstrate the ability to fully tailor electron-phonon interactions using a new class of suspended carbon nanotube devices, in which we can form highly-tunable single and double quantum dots at arbitrary locations along a nanotube mechanical resonator. We find that electron-phonon coupling can be turned on and off by controlling the position of a quantum dot along the resonator. Using double quantum dots we structure the interactions in real-space to couple specific electronic and phononic modes. This tailored coupling allows measurement of the phonons' spatial parity and imaging of their mode shapes. Finally, we demonstrate coupling between phonons and internal electrons in an isolated system, decoupled from the random environment of the electronic leads, a crucial step towards fully-engineered quantum-coherent electron-phonon systems.

Avishai Benyamini
Weizmann Institute of Science

Date submitted: 13 Nov 2013 Electronic form version 1.4