NANOTUBE AND GRAPHENE ELECTROMECHANICS

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Mechanical resonators based on carbon nanotube or graphene hold promise for many scientific and technological applications. Nanotube resonator devices are outstanding inertial mass sensors with a sensitivity that enables the detection of the mass of individual atoms [1]. In addition, nanotubes are an excellent system to study quantum electromechanics, since the mutual interaction between the charge transport through the nanotube and its mechanical degree of freedom are remarkably strong. A proposal for ground-state cooling of the mechanical oscillations using back-action with constant electron current will be discussed [2].

A novel detection method of the vibrations of nanotubes [3] and graphene [4], based on atomic force microscopy, will be presented. This method enables the detection of the resonances up to 3.1 GHz with subnanometer resolution in vibration amplitude. Importantly, it allows the imaging of the mode-shape for the first eigenmodes.

I will also report on a new artificial nanofabricated motor in which one short nanotube moves relative to another coaxial nanotube [5]. The motion is shown to be controlled by how the atoms are arranged within the two nanotubes. The motion is actuated by imposing a thermal gradient along the device, allowing for sub-nanometer displacements. This is, to our knowledge, the first experimental demonstration of displacive actuation at the nanoscale by means of a thermal gradient.

References:

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Figures: