Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Universal response of single-wall carbon nanotubes to radial compression: theory and experiment HELIO CHACHAM, ANA PAULA M. BARBOZA, BERNARDO R. A. NEVES, Departamento de Fisica, Universidade Federal de Minas Gerais, Brazil — Since the early 90's, the electronic and structural properties of single-wall carbon nanotubes (SWNTs) have been thoroughly investigated. Regarding SWNT mechanical properties, most of the attention has been given to their large resistance to axial tension, even though several electromechanical effects have been observed on radially compressed SWNTs, such as the predicted [1], and recently observed [2], metal-insulator transition. The present work brings a unifying picture to the process of radial compression/deformation of SWNTs, where experimental data are analyzed through a rescaling model yielding a universal-type behavior. Specifically, our AFM measurements show that the quantity $Fd^{3/2}(2R)^{-1/2}$, where F is the force applied by the AFM tip (with radius R) and d is the SWNT diameter, is a universal function of the compressive strain. Such universality is reproduced analytically in a model where the graphene bending modulus is the only fitting parameter. The application of the same model to the radial Young modulus E_r leads to a further universal-type behavior that explains the large variations of the SWNTs E_r reported in the literature. [1] M. S. C. Mazzoni and H. Chacham, Appl. Phys. Lett. 76, 1561 (2000). [2] A. P. M. Barboza et al., Phys. Rev. Lett. 100, 256804 (2008).

Helio Chacham
Departamento de Fisica, Universidade Federal de Minas Gerais, Brazil

Date submitted: 20 Nov 2008 Electronic form version 1.4