Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Nonlinear Optical Response of Individual Carbon Nanotubes
TATYANA SHEPS, BRAD L. CORSO, ERIC O. POTMA, PHILIP G. COLLINS, Department of Physics and Astronomy and Department of Chemistry, Univ. of California at Irvine, Irvine, CA 92697 — Single walled carbon nanotubes (SWCNTs) are low dimensional conductors with unique nonlinear electro-optic properties. To investigate these properties we study the third-order, coherent anti-stokes (CAS) response of electrically connected individual SWCNTs on quartz substrates, using a four-wave-mixing (FWM) technique with femtosecond laser pulses. Because the CAS response is primarily electronic in nature [1], the signal from metallic SWCNTs is much stronger than from semiconducting ones. CAS easily distinguishes between the two types, as well as between semiconducting SWCNTs doped to be conductive or insulating. Furthermore, the CAS signal is sensitive to excitation resonances, the same effect that allows SWCNT fingerprinting by photoluminescence and Raman techniques. In addition to the strong electronic signal, we can also resolve a vibrational signal component at the G-band frequency, which suggests a method for studying chemical bond vibrations with this coherent technique. The good spatial resolution and high signal-to-noise achieved with femtosecond laser pulses provides opportunities for time-resolved optical measurements of SWCNT excitation dynamics. Funded by NSF Center for Chemistry at the Space-Time Limit at UCI (CHE-0847097).

[1] H. Kim et al, Nano Lett. 9 2991-2995 (2009)

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Date submitted: 03 Jan 2011 Electronic form version 1.4