Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

**STM images of carbon-nanotube quantum dots: Seeing a Wigner molecule of correlated electrons** ANDREA SECCHI, MASSIMO RONTANI, CNR-NANO S3 and University of Modena, Italy — The paradigm of few-electron complexes in quantum dots (QDs) relies on the idea that the lowest quantized levels are filled according to Pauli's exclusion principle. If Coulomb repulsion is sufficiently strong to overcome the kinetic energy cost of localization, a different scenario is predicted: a "Wigner" molecule (WM) forms, made of electrons frozen in space according to a geometrical pattern. Despite considerable experimental effort, evidence of the WM in semiconductor QDs has been elusive so far. Here we demonstrate theoretically that WMs occur in gate-defined QDs embedded in typical semiconducting carbon nanotubes (CNTs). The unambiguous signatures of the WM state must be searched in the scanning tunneling microscopy (STM) images of the electrons. Through exact diagonalisation (ED) calculations, we unveil the inherent features of the electron molecular states. We show that, like nuclei in a usual molecule, electrons have localized wave functions and hence negligible exchange interactions. ED results for single and double QDs provide a simple interpretation for transport experiments in ultraclean CNTs.

Andrea Secchi
CNR-NANO S3 and University of Modena, Italy

Date submitted: 06 Dec 2010 Electronic form version 1.4