



Nanobio Spectroscopy Group and ETSF Scientific Development Centre
European Theoretical Spectroscopy Facility (ETSF)
Department of Materials Physics and
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Homework related to the lectures on “Low dimensional systems” (Master in Nanoscience 2013-14)

Please provide a detailed answer to the following questions and send them to me (angel.rubio@ehu.es) before the end of the year.

1. Define the concept of super-atom and superstructure: magic numbers in structural stability, reactivity, electronic properties. Links to the properties known for atoms in the periodic table (e.g. oscillations of the ionization potential and electron affinities). Address the difference of quantum confinement in one, two and three dimensions.
2. What are the key fundamental concepts behind molecular electronics?. Describe differences and similarities between: electron, spin and thermal transport, and what are the physical quantities are probed through transport measurements?
3. Nanotubes: prove that carbon nanotubes are able to sustain their own weight when use as cables joining the earth to a geostationary satellite (placed at an altitude of approximately 35,800 kilometers directly over the equator, that revolves in the same direction the earth rotates, west to east. (Note assume a young modulus of 1Tpa for the carbon nanotube)
4. What it is and how one can understand supramolecular chemistry? Describe also implications in nanoscience linked to the present course.
5. Explain what do you think it implies the famous sentences “small is different” and “more is different”. What are the implications for nanoscience.
6. What are biological molecular markers? How their performance is linked to their size, chemical composition and environment (eg. Fluorescent proteins, noble prize in chemistry en 2008)
7. Define a challenge in the field of nanoscience , either experimental or theoretical that you would like to work on? Why? (Brief and personal opinion)
8. Select one technological application based on nanostructures and explain briefly why going nano has been fundamental in such application