

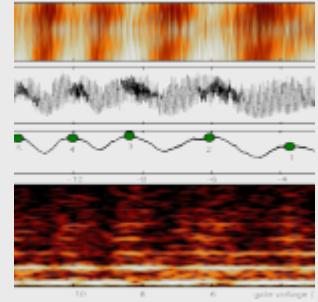
## Unexpected Phenomena In The Quantum Transport Through Carbon Nanotubes

Title: Unexpected Phenomena In The Quantum Transport Through Carbon Nanotubes.

When: Tuesday, February 14, (2017), 12:30.

Place: Departamento de Física de la Materia Condensada, Facultad de Ciencias, Module 3, Seminar Room (5th Floor).

Speaker: Christoph Strunk, Regensburg University, Germany.



Carbon nanotubes have reached a quality that allows for stringent tests of theory. Applying high magnetic fields we perform transport spectroscopy on the first excess electron above the band gap. The observed single particle spectra allow to quantitatively probe the fine structure corrections to the simple Dirac Hamiltonian. The results only superficially agree with expectations based upon accepted models. In particular, we find an unexpected orbital degeneracy of the ground state, and a mismatch of the orbital magnetic moments extracted from low and high magnetic field regimes.

In addition, the line intensities strongly vary, if the magnetic field shifts the levels across the Dirac cone. This effect can be traced back to deviations from the standard ‘particle in a box’ boundary conditions that apply to the bipartite graphene lattice. The boundary conditions couple the longitudinal and radial parts of the electronic wave functions and drastically affect the transmission amplitude in magnetic field.

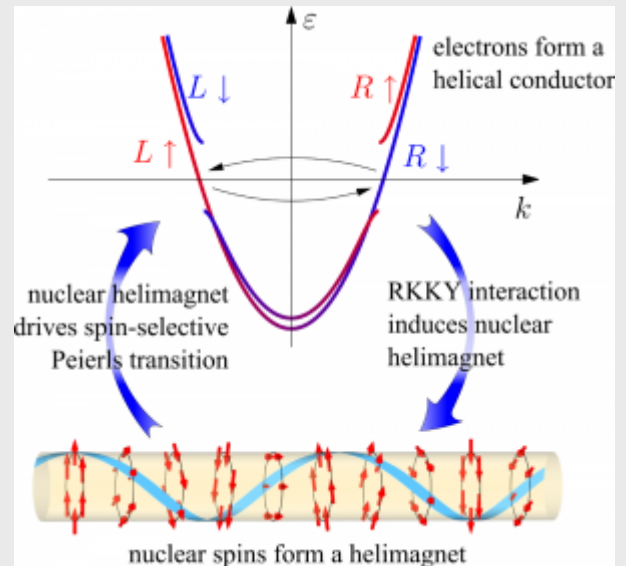
Finally, we trace the signatures of the trigonal warping of the Dirac cone at higher energies in the Fabry-Perot-like interference pattern at the highly transmissive hole side of the spectrum. These can be exploited to determine the tube’s chiral angle from transport measurements.

[More information on IFIMAC Website](#)

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[Spin-orbit interaction in carbon nanotubes and its utility for proving entanglement of electrons](#)

Wednesday, 21st November 2012. 12:00-13:00



*Bernd Braunecker*

Departamento de Física Teórica de la Materia Condensada, UAM

ABSTRACT:

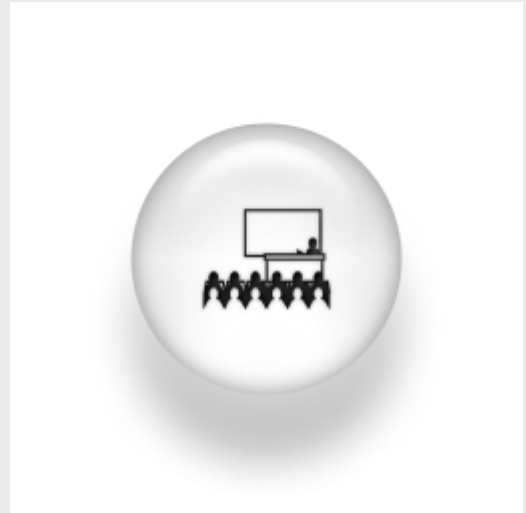
Spin-orbit interaction in condensed matter systems has attracted much attention very recently. It underlies the general goal of controlling and detecting spins by electric fields, and is an essential ingredient for the currently very popular topological insulators and Majorana bound states.

In this talk I will show that the spin-orbit interaction in carbon nanotubes has distinct features that allow to obtain information on the entanglement of injected pairs of electrons. I will give an introduction to the spin-orbit interaction in single-wall nanotubes and then discuss the cases of a nanotube cross-junction and a double-dot Cooper pair splitter setup. For the cross-junction I will show that spin-orbit interaction causes an entanglement-dependent noise spectrum with a richer spin structure than in previously discussed setups. For the double-dot system I will demonstrate that tunable spin-orbit induced spin-filtering allows to implement entanglement detectors, such as violations of a Bell inequality or quantum state tomography, by conductance measurements alone.

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[Spectroscopy of the Andreev Bound States in a Carbon Nanotube](#)

Wednesday, 21 April 2010, 11:30-12.30



*Prof. Jean-Damien Pillet*

Quantronics Group

CEA-Saclay

ABSTRACT:

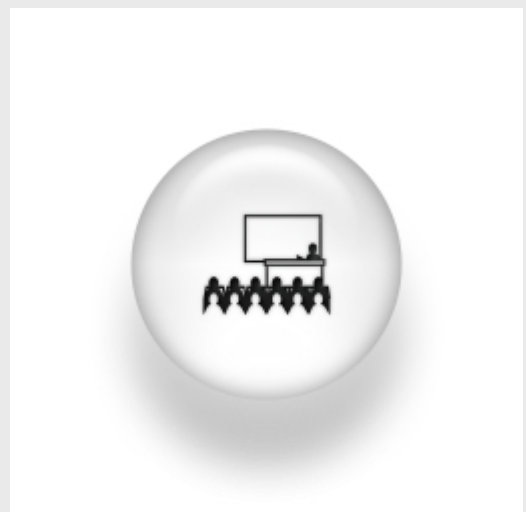
Carbon Nanotubes are not intrinsically superconducting, but when they are connected to superconducting leads they can carry a supercurrent. This supercurrent is carried by the Andreev Bound States (ABS) which provide a universal description of the Josephson effect in coherent quantum nanostructures (molecules, nanowires, normal or magnetic layer...) connected to superconductors. We have performed the first tunnel spectroscopy of individually resolved ABS in a nanotube-superconductor device. We analyze the spectrum using a double quantum dot model which reveals notably the spin structure of these levels. Furthermore this device constitutes a new type of SQUID magnetometer.

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[Excitons in Carbon based quasi-1D systems: an ab-initio study of nanotubes and graphene ribbons](#)

Wednesday, 10 December 2008, 12:00-13.00

*Dr. Deborah Prezzi*



Physics Dept, University of Modena, and Natl Center S3 of INFM-CNR, Modena, Italy

We discuss the main characteristics of optical excitations in C semiconductor nanotubes and nanoribbons, as obtained from ab-initio many-body calculations. Our theoretical approach includes both self-energy corrections and excitonic effects through the GW-BSE formalism, providing full understanding of excited-state properties. Electron-hole interaction is found to suppress the van Hove singularities -as known for other 1D systems- and introduces strongly bound excitonic peaks. For C nanotubes, we show that exciton binding energy must thus be extracted from two-photon optical spectra and is of the order of several tenths of eV. A complete symmetry analysis of the excitonic states allows to understand the luminescence features observed in experiments [1]. In graphene ribbons we analyse different geometries and show that strong exciton binding is accompanied by relevant effects of the ribbon termination [2]. Based on simple prototype structures, we also discuss the possibility to obtain strong 0D confinement in graphene dots and antidots [3].

[1] Maultzsch et al., Phys. Rev. B 72, 241402(R) (2005) [2] D. Prezzi et al., arXiv:0706.0916v1 (2007) [3] D. Prezzi et al., in preparation (2007).

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