


Internship proposal 2009-2010

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Tunneling spectroscopy of individual nanocrystals in the regime of quantum confinement

Scientific project :

At very low temperature, the electronic spectrum of metallic nanoparticles (~10 nm) becomes discrete and can be observed by tunneling spectroscopy. Fig. 1. Past experiments on simple metal nanoparticles as Gold, where electron-electron interactions can be neglected, have shown that the electron levels distribution is determined by random matrix theory.

How electronic interactions modify the statistics of electronic levels distribution? We want to explore this question through tunneling spectroscopy of nanoparticles where exists strong interactions between the electrons.

A first part of the project is to realize these tunneling experiments on metallic gold nanoparticles and superconducting lead (Pb) nanoparticles, Fig2, as synthesized in the laboratory. In a second part of the project, we want to study VO₂ nanoparticles where strong electron correlations are known to induce a Mott insulator in this material.

Figure 1: Discrete electronic spectrum of gold nanoparticles, by D.C. Ralph et al. *Nano Lett.*, 8 (12), 4506-4512 (2008)

Figure 2: Superconducting Lead Nanoparticles as synthesized in the laboratory. *I.Resa et al. J. Phys. Chem. C, 2009, 113 (17),*

Techniques in use : Scanning probe microscope (AFM/STM), Electronic lithography, He3 Cryostat (250 mK), Chemical synthesis and handling of nanocrystals.

Applicant skills : Experimentalist motivated by measurements of weak signals in very low temperature cryostats. Interested by fundamental aspects of condensed matter physics.

Granted internship : yes (_398_ €/month) /
C'nano IdF laboratory (France only) : yes /
Possibility for a thesis : yes (type of grant : ANR)