F. 2002
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FACULTAD DE CIENCIAS EXACTAS Y NATURALES

U.B.A

1 .- DEPARTAMENTO : Física

2 .- CARRERA de: a) Licenciatura en..... ORIENTACION.....

b) Doctorado y/o Post-Grado en.....Doctorado.....

c) Profesorado en.....

d) Cursos Técnicos en Meteorología.....

e) Cursos de Idiomas.....

3 .- 1er. CUATRIMESTRE/2do. CUATRIMESTRE Año:.....Año 2002 (22-7-02 al 26-7-02).....

4 .- Nº DE CODIGO DE CARRERA:

5 .- MATERIA."4ta. Escuela de Invierno"J.J.Giambiagi" Nanofísica,Nanociencia y Nanotecnología" Nº DE CODIGO

6 .- PUNTAJE PROPUESTO: 1(un) punto

7 .- PLAN DE ESTUDIO : 1987

8 .- CARACTER DE LA MATERIA: Optativo

9 .- DURACION: 22-7-02 al 26-7-02

10 .- HORAS DE CLASES SEMANAL: 30 hs.

a) Teóricas.....30..... hs. d) Seminarios..... hs.

b) Problemas..... hs. e) Teórico-problemas..... hs.

c) Laboratorio..... hs. f) Teórico-prácticas..... hs.

g) Totales Horas:.....30..... hs.

11.- CARGA HORARIA TOTAL:.....hs.

12.- ASIGNATURAS CORRELATIVAS:

13.- FORMA DE EVALUACION: Examen Final Escrito

14.- PROGRAMA ANALITICO: (Se adjunta)

15.- BIBLIOGRAFIA:

FECHA: 28-8-02

FIRMA PROFESOR:

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Cuarta Escuela de Invierno J.J.Giambiagi
Nano-Ciencia en Buenos Aires
Julio 22-26, 2002

La Escuela fue realizada en el Departamento de Física de la Facultad de Ciencias Exactas y Naturales de la Universidad de Buenos Aires, en el marco de la Cuarta Escuela J. J. Giambiagi, que tuvo lugar entre el 22 y el 26 de julio de 2002.

El tema de la Escuela es "Nano-ciencia, nano-fisica y nano-tecnología". Se invitaron a 14 expertos en el área, 4 estadounidenses, 3 brasileños (uno residente en USA) y 7 argentinos.

Una información mas detallada se encuentra en la página
http://www.df.uba.ar/~giambiagi2002/

El comité organizador estuvo compuesto por los siguientes profesores del Depto. de Física de la FCEyN, UBA:

Dra. Victoria Bekeris
Dr. Oscar E. Martínez
Dr. Pablo Tamborenea.

Expositores invitados

Armando Aligia	Centro Atómico Bariloche, Argentina.
Ernesto Calvo	Inquimae, FCEyN, UBA, Argentina.
Karen Hallberg	Centro Atómico Bariloche, Argentina.
Charlie Johnson	University of Pennsylvania, USA.
Hari Manoharan	Stanford, USA.
Ernesto Marceca	Inquimae, FCEyN, UBA, Argentina.
Oscar E. Martínez	Laboratorio de Electrónica Cuántica, FCEyN, UBA, Argentina.
Gilberto Medeiros-Ribeiro	National Synchrotron Light Laboratory (LNLS), Brazil.
Peter Nordlander	Rice University, Houston, USA.
Hernán Pastoriza	Centro Atómico Bariloche, Argentina.
Luis Rego	National Synchrotron Light Laboratory (LNLS), Brazil.
Roberto Salvarezza	INIFTA, Argentina.
Gustavo Scuseria	Rice University, Houston, USA.
Daniel Ugarte	National Synchrotron Light Laboratory (LNLS), Brazil.

Resúmenes de las conferencias

Armando Aligia
Many-body theory of the quantum mirage.

In recent scanning tunneling microscopy experiments, confinement in an elliptical corral has been used to project the Kondo effect from one focus to the other one. The first theories proposed to explain the experiment either neglect the many-body effects or introduce the Kondo resonance in a phenomenological way. Ordinary Lanczos diagonalizations are unable to explain the observed line shape. We solve the Anderson model either by perturbation theory, or using Lanczos with an embedding method, for an impurity hybridized with eigenstates of an elliptical corral, each of which has a resonant level width d . This width is crucial. If d < 20 meV, the Kondo peak disappears, while if d > 80 meV, the mirage disappears. For particular conditions, a stronger mirage with the impurity out of the foci is predicted. We also discuss what happens if two impurities are included in the corral.

Ernesto J. Calvo
Nanostructured organized self-assembled thin films

We shall describe the preparation of well organized multilayers of polyelectrolytes and biomolecules self-assembled layer-by-layer on gold monocrystalline substrates modified with mercaptane molecules carrying a net charge. The assembly of the supramolecular structures is achieved by electrostatic adsorption from aqueous solutions with charge reversal in every alternate immersion step. The thiol modified surface carries a net surface charge that favours the adsorption of polyelectrolyte of oposite electrical charge in a sequential ABABA..... deposition process. The deposited thin films have been characterized by quartz crystal microbalance, ellipso-metry, atomic force microscopy, Fourier Transform Infrared Spectroscopy and electro-chemical measurements. Enzyme molecules have also been assembled in these thin films which were subsequently connected electrically to the underlying electrode by "molecular wires" covalently attached to the polymer electrolytes. This allowed us to build up nanostructured biosensors where molecular recognition of biologically significant substrates such as glucose can be transduced into an electrical signal by electron hopping in the nanostructured multilayer and electrochemical reaction resulting in an electrical current. The posibility to integrate these bio-recognition systems in molecular transistors and nanosized molecular transistors (polyaniline nanotubes) responsive to biologically active molecules will be discussed.

Karen Hallberg
Spectroscopic and magnetic mirages in nanoscopic systems.

Interference of electron wave-functions is a common phenomena in condensed matter physics which leads to a plethora of effects. Some examples are the formation of energy bands in crystals, the Friedel oscillations in the screening of charged impurities or the Aharonov-Bohm effect in mesoscopic circuits. The behaviour of impurities in systems with focusing properties

like quantum corrals are another beautiful example. I will present exact calculations in these systems where spectroscopic and magnetic mirages are observed at the antipodes of the impurity location. This implies that in a nanoscopic system, two impurities placed at special points, determined by the geometry, can strongly interact even if they are at relatively large distances (50 to 100 angstroms).

Charlie Johnson
Single-wall Carbon Nanotubes.

Hari Manoharan
Quantum Mirages.

Ernesto Marceca
Supersonic beams of atomic and molecular clusters.

Experimental studies on isolated particles within the cluster domain have nowadays become widespread among scientists and engineers and have proved to contribute to the understanding of matter from the nanoscopic point of view. Physics of nanoparticles not only reveals the novel optical, electric, magnetic and catalysis properties that characterize small finite systems, but also deepens the comprehension of different phenomena occurring in bulk phases, e.g. chemical reactivity, solvation effects, etc., since the measurement of overall (average) properties exhibited by macroscopic systems does not provide a realistic information on the local structure.
Clusters from tens up to thousands of atoms or molecules can be built by isoentropic expansion of a small amount of vaporized matter into a high vacuum chamber. By this technique, supersonic beams of a wide variety of isolated neutral nanoaggregates can be generated in a gas phase collision-free regime, away from solvents, substrates, matrices or any other sources of interference. Experimental results in cluster physics are normally correlated to the size (mass) of the particle, variable of major importance in small systems. Particle size-selection and mass-coincidence experiments are achieved by means of mass spectrometry techniques. Technological applications of both atomic and size-selected cluster beams to develop new generation electronic devices have significantly grown up in the last few years, i.e. modification of semiconductor surfaces, alternative lithographic techniques, etc.

Oscar E. Martínez
Is there new optics ar the nanoscale ?

Hernán Pastoriza
Modifications of vortex structures by artificially generated pinning potentials.

The problem of interconnecting two structural symmetries that cannot be interconnected by a continuous transition appear in several fields of physics.

We have been able to obtain details of how one of these structures changes to the other at mesoscopic scale using vortices as elemental particles. We have been able to force different symmetries in a vortex crystal by means of a lithographic-ally patterned pinning potential. As one of the techniques used in these experiments is e-beam lithography, I will devote part of the time in this talk to present and describe the possibilities of these fabrication procedure.

Gilberto Medeiros-Ribeiro

Epitaxial Growth and Electronic Properties of Strained Nanocrystals.

Peter Nordlander

Nonequilibrium Kondo physics in the single electron transistor

The single electron transistor, i.e. a quantum dot sandwiched between two conducting electrodes provides a tunable system in which the Kondo efect can be studied experimentally for a broad range of parameters. In this talk, I will review the topic and present a theoretical investigation of the response of a single electron transistor in the Kondo regime to time-dependent bias. I will show how nonadiabatic and nonequilibrium properties of the Kondo state can be probed experimentally by measuring the transient conductance of a quantum dot subject to various time-dependent perturbations on its gates.

Electronic structure and optical properties of metallic nanoshells

The metallic nanoshell is a new nanoparticle with unique optical properties and many intersting applications in biotechnology, photonics and spectroscopies. In the lecture I will review some of the basic properties of nanoshells and present a method for the calculation of their electronic structure and optical properties. The method utilizes a jellium model and the Time Dependent Local Density Approximation. An efficient numerical implementation of our method enables applications to nanoshells with a very large number of conduction electrons. The frequency dependent polarizabilities of nanoshells are calculated using the Random Phase Approximation. The optical response of these systems is characterized by both single particle and collective plasmon excitations. The energies of the plasmon resonances are calculated for different sizes of the metallic nanoshells and for different dielectric embedding media and nanoshell cores. The results are compared with results obtained using classical Mie scattering and the results from a semiclassical model.

Luis Rego

Thermodynamics of Nanoscopic Systems.

It was recently predicted that phonon (or heat) transport through quasi-one-dimensional structures should exhibit a universal conductance in the quantum ballistic regime. Analogously to the quantum of electrical conductance (G = e^2/h), the quantum of thermal conductance is independent of material and geometrical parameters: K=(pi^2 / 3) (k_B^2T / h), where T is the temperature, k_B the Boltzmann constant and h Planck's constant. Conclusive evidence for the

existence of K has been given by a remarkable experiment performed on suspended dielectric quantum wires at low temperatures. However, differently from its classical analog, K is independent of the statistics of the carriers, being the same for phonons, electrons and particles of generalized statistics. In this talk we summarize the ideas involved in this problem and review a model for phonon transport in quasi-one-dimensional dielectric quantum wires. The problem of charge transport in metallic nanowires will also be addressed. Here we show a formalism that describes the quantum conductance behavior of such nanowires, taking complete account of there atomic arrangement.

Roberto Salvarezza

Metal Electrodeposition on Self-Assembled Monolayers : A Versatile Tool for Pattern Transfer on Metal Thin Films.

Self-assembled monolayers (SAMs) of thiols on metals have attracted considerable scientific interest because they provide a method for tailoring the properties of solid surfaces. In recent years the surface structure of SAMs on Au, Ag and Cu have been characterized at the molecular level by different surface-sensitive techniques. In electrolyte solutions, the most important environment for technological applications, the surface structure of SAMs reflects adsorbate-substrate, adsorbate-adsorbate, and adsorbate-solvent interactions. In-situ STM images have shown potential-independent reversible surface structure transitions and slow defect fluctuations. SAMs electrodesorption from terraces leads to the formation of nanometer-sized physisorbed micelles while thiol molecules remain adsorbed at step edges. In electrolyte solutions SAMs stability increases in the following order SAMs/Au < SAMs/Ag < SAMs/Cu.
SAMs on metals can be patterned by photo-oxidation, contact printing, pen writing, electron beam lithography, ion beam lithography, physical abrasion and SPM-based methods. Metal electrodeposition from electrolyte solutions on patterned SAMs (hydrocarbon chain length (n) > 15 C units) on Cu have been used to fabricate ordered nano/microstructures. On the other hand, direct molding and replication of a metallic master with architectures involving nano/micrometer sized features have been easily produced by metal electrodeposition on SAM-covered Cu (10 < n < 12). Nanometer-sized defects in SAMs, and enhanced lateral growth of the metallic deposit play a key in the process. By using dodecanethiol-covered Cu masters Cu, Ni, Co, and soft magnetic Ni-Co-Fe alloy molds and replicas have been fabricated by galvanostatic electrodeposition.. Potential applications of this method are related to serial fabrication of nano/microstructured metallic architectures.

Gustavo Scuseria

Electronic structure of carbon nanotubes.

Daniel Ugarte

Structural and electronic properties of metal nanowires.

Nanometric metal wires (NWs) can be generated by stretching metal contacts ; during the elongation and just before rupture, the NW conductance shows flat plateaus and abrupt jumps of approximately a conductance quantum (G0 = 2e2/h). In this kind of experiment, both the NW atomic arrangement and its conductance change simultaneously, making difficult to discriminate

between electronic and structural effects in the conductance. We have tackled this problem using two dedicated experiments, one to determine the atomistic nature of NW structural evolution (time-resolved HRTEM) and, a second one (UHV mechanically controllable break junction) to measure the electrical properties. We have observed that metal (Au, Ag, Pt) junctions generated by tensile deformation display narrowest region, which is crystalline and free of defects. The neck structure and morphology is strongly dependent on the surface properties of the analyzed metal, what accounts for the different observed conductance behaviors.