CNEA NT - 35/86

Progress Report 1984/1985

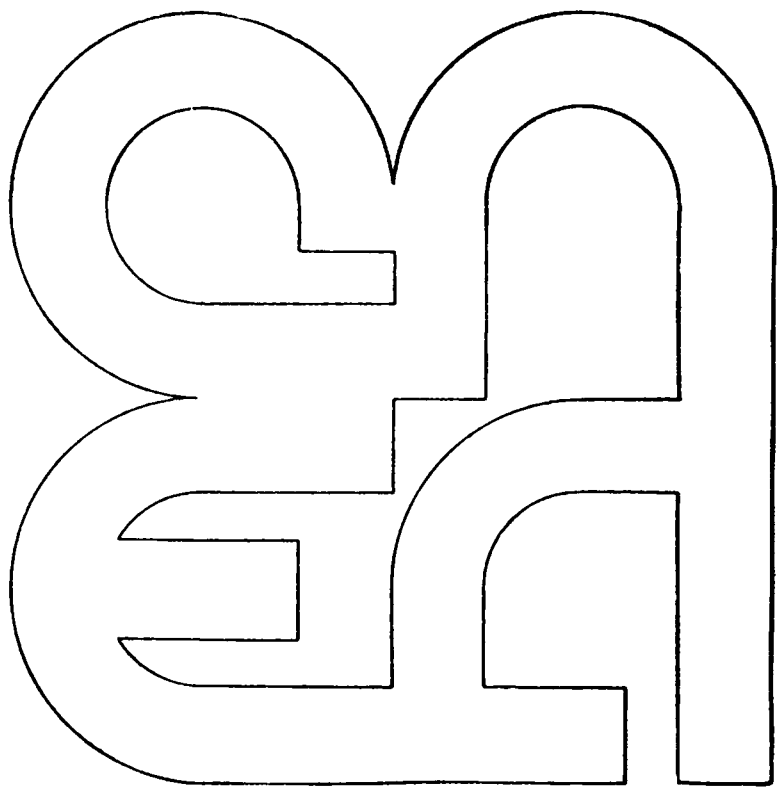
Basic Research Department

Comisión Nacional
de Energía Atómica

Dirección de
Investigación y Desarrollo

Gerencia
Centro Atómico Bariloche

8400 - Bariloche (R. N.) Argentina
1986



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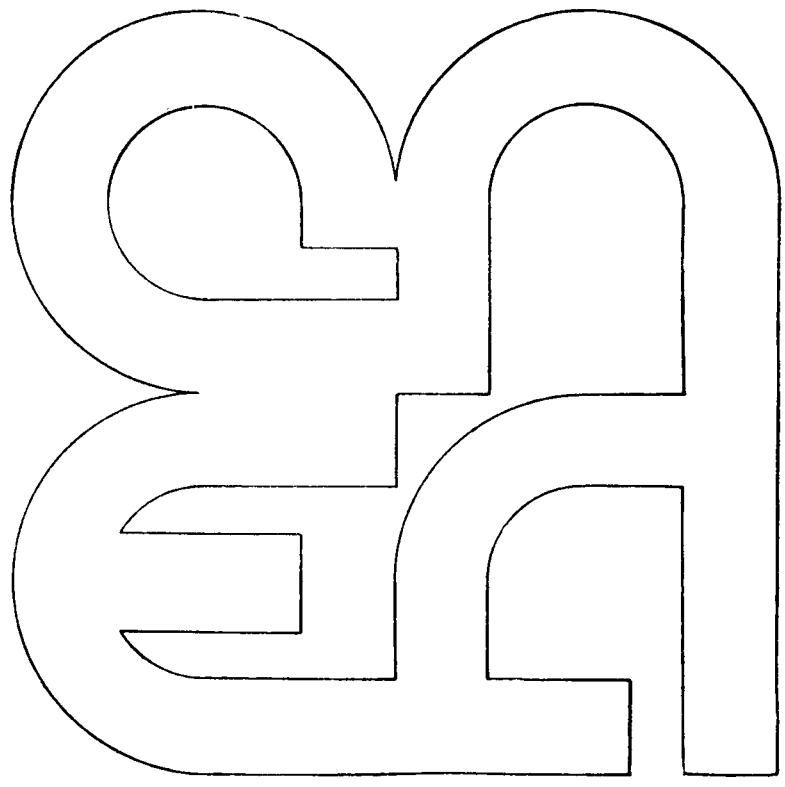

INTRODUCTION

This Progress Report for the period 1984-1985 records the scientific activities carried on at the six Divisions which, together, constitute the Basic Research Department of the Centro Atômico Bariloche (CAB). They are: Atomic Collisions, Low Temperatures, Metals Physics, Magnetic Resonances, Neutron Physics and Reactors and Theoretical Physics. A group working on Relativity has recently been formed and it appears under the heading Instituto Balseiro.

A fundamental characteristic of CAB is the close relationship between the research groups and the Instituto Balseiro (IB). Teachers belonging to the faculty of IB are actively involved in the research groups of CAB. It is in these groups where IB students work towards their Master's and PhD's theses.

The equipment and infrastructure of the laboratories are not the result of large, isolated investments, but rather the continuing allotment of fair budgets. Increasing difficulties with purchases abroad, added to the limited offerings of the local industry, with prices much higher than in the international market, have hindered a rational use of the budgets.

These conditions are responsible for the experimental groups having to work with equipment that, under any other circumstances, would have long been declared obsolete. It is the dedication of technicians, engineers and researchers what keeps the equipment in working condition. To insure the competitiveness and relevance of current research, the Department is committed to a policy of equipment renewal.

The Department has a staff of 61 physicists, 27 graduate students and 8 technicians (see Appendix I for a report as to how their

salaries are financed). The graduate students come from the IB as well as from other universities in the country. They hold fellowships from the Comisión Nacional de Energía Atómica (CNEA) to work at CAB.

During the 1984-1985 period, 156 papers were published in International scientific journals and ten PhD theses were completed. Sixty four scientists from other research institutions have visited CAB during the same period (see Appendix II).

Joint research projects with other countries have been instrumental for the Department to keep up with work at the most important research centers. It should be emphasized that the geographical isolation of Bariloche and budget restrictions regarding attendance to International Courses and Symposia are, as well as low salaries, discouraging factors among scientists, inasmuch as interaction with members of other research institutions is essential to produce relevant results.

This report was edited under the supervision of María Elena de la Cruz with the collaboration of all the Basic Physics Department Staff and the help of Madeleine Ferreira. Alejandra Cohen contributed the information about publications and Ana Emilia Ronco gave enthusiastic support whenever it was needed. The English edition was prepared by Alejandra Cohen under the supervision of Norma Badino for the translation.

A. López Dávalos
Head Basic Research Department

San Carlos de Bariloche, March, 1986

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R.A. Baragiola
R.O. Barrachina*
G.C. Bernardi+
A. Ceballos
L. de Ferrariis+
J. Eckardt
F. Focke
D.H. Fujii#
C.R. Garibotti●
C.E. Gonzalez Lepera
O. Grizzi*
M.M. Jakas
G.H. Lantschner
M. Martiarena+
W. Meckbach**
A. Nikolic*
I.B. Nemirovsky
V.H. Ponce
H. Raiti
G. Zampieri

*Fellow CNEA
+Fellow CONICET
#Fellow OAS
**Researcher CNEA/CONICET
●Researcher CONICET

Technicians

J. de Pellegrin
C. Wenger

Undergraduate IB Students

H. Ascolani
A. Goñi
S. Suarez
M. Guraya
V. Ganduglia
N. Capuj

2. GENERAL DESCRIPTION

In this laboratory several processes of interaction of ions and electrons with matter are studied. These include processes in solids, surfaces, gases and plasmas.

2.1 Facilities:

Atomic collisions experiments are performed using several electrostatic accelerators, which include a 300-KV (Kevatron), a 100-KV (Kevatrito), a 10-KV (TOF) accelerators and a 2-MV van de Graaf accelerator. The laboratory also has a surface analysis equipment, which uses Auger, XPS, LEED and SIMS techniques. High vacuum systems, sample evaporators, electrostatic analyzers, particle detectors, and data acquisition systems, are other standard equipment.

2.2 Cooperation Agreements:

The various lines of research carried out have enabled the group to develop cooperation agreements with various local and foreign laboratories. In recent years joint research programs with the following groups have been particularly relevant:

- Oak Ridge National Laboratory and University of Tennessee, Atomic Collisions Group: Studies of electron transfer to the continuum processes (NSF - CONICET Cooperation Agreement).

- University of Georgia, Department of Physics: Electron emission induced by atomic collisions (NSF - CONICET Cooperation Agreement).

- Institut für Kernphysik, Universitat Frankfurt: Electron emission induced by atomic collisions on gaseous and solid targets (German-Argentine Cooperation Agreement CNEA-KfK).

- Université de Bordeaux, Laboratoire des Collisiones Atomiques: Studies on atomic collisions (French - Argentine Cooperation Agreement).

- New York University, Radiation and Solid State Laboratory.

- Hahn-Meitner-Institut, Berlin

Within Argentina the laboratory works in cooperation with:

- Instituto de Física de Rosario (IFIR), CONICET, Rosario.

- Instituto de Astronomía y Física del Espacio (IAFE), Buenos Aires.

- Instituto para el desarrollo Tecnológico de la Industria Química (INTEC), Santa Fé.

- Laboratorio TANDAR, CNEA, Buenos Aires.

2.3 Conferences:

During the period 1984-1985, research papers have been sent to international conferences in Hungary, U.S.A., Italy and Denmark.

Members of the laboratory have taken part in organizing the "Symposium on Forward Electron Ejection in Ion Collisions", 29-30 June 1984, in Aarhus, Denmark, as well as in the editing of the Proceedings, which appeared as Lecture Notes in Physics (Edited by K.O. Groeneveld, W. Meckbach and I.A. Sellin, Springer-Verlag 1984).

3. RESEARCH PROGRAMS

A. Emission and Capture of Electrons in Solids and Gases:

This research line covers processes of electron emission induced by the interaction of atomic projectiles with gaseous and solid tar-

gets. With the Kevatron accelerator a beam of ionized atomic projectiles is used on several targets, producing electron emission due to ionization of the target or sometimes of the projectile. Gaseous targets are generated through a low speed molecular jet, and solid foils for targets are prepared through vacuum evaporation techniques.

We study the double differential distribution -in angles and energies- of the emitted electrons, which contains detailed information about the collision processes. The case in which electrons are emitted with the same velocity (both in direction and magnitude) as the emerging projectiles is especially interesting. For these electrons the postcollisional interaction is quite strong and gives rise to a divergent cross section. The experimental distribution of electron velocities shows a strong cusp-like peak (convoy electrons).

The emission process is described in terms of a many body system with Coulomb potentials, using a treatment based on scattering theory when dealing with simple collisions, as is the case for gaseous targets. For solid targets there are additional problems due to collective effects produced by ion-plasma interactions. Electron transport to the surface and passage through it are also important effects. To be able to explain the convoy-electron phenomena properly a simultaneous description of these different processes is required.

B. Interaction of fast ions with matter:

This research line includes experimental as well as theoretical work on energy loss, multiple scattering and angular and energy distribution of ions transmitted in different media. This allows the study of different phenomena associated with the penetration of fast particles through matter.

Up to now there is no theory which explains simultaneously the angular and energy distributions. We are working to get a better

knowledge of energy transfer in atomic collisions, as a function of the impact parameter and of dispersion angle, and to understand the effects of multiple scattering on the energy loss distribution. In the case of molecular projectiles we have developed a description of the dynamic interaction between correlated ions in motion in a solid and associated collective effects.

Experimental studies in these areas are carried out using light ion beams (H^+, H_2^+, He^+) produced by the Kevatron, with energies up to 350 KeV, impinging on a variety of targets (C, Al, Au, Ag, etc.) in the form of thin films. Thicknesses of 100 to 1000Å are obtained through especially developed evaporation techniques. After traversing the films, ions are analyzed in angle and energy, to obtain relevant information about energy loss, straggling and angular dispersion produced by multiple scattering. Information on the interaction of fast ions in a solid can be obtained through a comparison of results for atomic and molecular ions.

This work is also related to similar penetration processes in dense and dilute plasmas. In particular the theoretical treatment has been extended to include a simultaneous description of thermal and quantum effects on electronic excitations, collective effects and energy loss in plasmas.

C. Interaction of ions with solid surfaces:

This research line comprises studies of electron emission from solids and electronic processes on surfaces. The main techniques used are Auger (AES) and X-ray photoemission spectroscopies.

Studies of electron emission refer to kinetic and Auger emission, produced by interaction between low energy incident ions and various solid materials.

The behaviour of kinetic emission near the emission edge is an important point. The possible relation of this phenomenon with the fluctuations in the inelastic energy losses produced in individual collisions is of great interest.

Through Auger emission studies the effect of atomic deexcitations produced inside and outside the solid on the energy spectra of the emitted electrons is determined. For this the spectra obtained with solid and gaseous targets are compared. This study includes calculations describing the collision cascades and is able to separate the contributions from emissions produced inside and outside the solid.

Studies of the electronic structure of impurities in solids are also carried out. Impurities are produced by ionic implantation "in situ" and then analyzed through XPS and AES. This provides information on electronic levels of valence electrons in the impurity and in the surrounding media.

A new collision chamber has been developed in the Kevatrito, which allows studies of electron emission in conditions of grazing incidence, with energies of up to 110 KeV, on solid surfaces. Differential analysis in angle and energy of emitted electrons is carried out. This facility can be used to study details of the ion-surface interaction, through neutralization, ionization and emission processes.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences

4.1.a International Conferences:

- "Symposium on Forward Electron Ejection in Ion Collisions" Aarhus, Denmark (29-30 June 1984):

  THREE DIMENSIONAL CONVOY ELECTRON VELOCITY DISTRIBUTIONS PRODUCED BY 60-270 KeV PROTON IMPACT ON CARBON FOILS
  K.O. Groeneveld, W. Meckbach and I.A. Sellin

  THE INFLUENCE OF THE DIFFUSE TARGET ON ELECTRON LOSS INTO THE CONTINUUM DOUBLE DIFFERENTIAL DISTRIBUTIONS
  K.O. Groeneveld, W. Meckbach and I.A. Sellin

  DOUBLE DIFFERENTIAL CROSS SECTION FOR ELECTRON CAPTURE TO THE CONTINUUM WITH MOLECULAR PROJECTILES
  C.E. González Lepera and V.H. Ponce

  CONVOY ELECTRONS FOR ATOMIC AND MOLECULAR HEAVY ION COLLISIONS WITH SOLIDS
  K.O. Groeneveld, W. Meckbach, I.A. Sellin

- "2nd. Workshop on High-Energy Ion-Atom Collisions", Hungary (27-28 August 1984):
  CONVOY ELECTRON YIELD ENHANCEMENT BY MOLECULAR HEAVY IONS
  P. Koschar, J. Kemmler, M. Burkhard, D. Hoffmann, R. Schramm, M. Breining, S.B. Elston, I.A. Sellin, W. Meckbach and K.O Groeneveld

- "APS Atomic Physics Meeting" (1984):

  TWO-DIMENSIONAL ENERGY ANGULAR DISTRIBUTIONS OF ELC ELECTRONS FOR 41 MeV AND 82 MeV O^{5+} PROJECTILES ON He and Ne
  S.B. Elston, M. Breining, I.A. Sellin, S. Berry, D. Hoffmann, I.B. Nemirovsky and P. Koschar

  BEAM FOIL CONVOY ELECTRON DISTRIBUTION AS FUNCTION OF ENERGY AND ANGLE OF EMISSION
  P. Focke, I.B. Nemirovsky, C.E. González Lepera, W. Meckbach, I.A. Sellin and K.O. Groeneveld

- "14th International Conference on the Physics of Electronic and Atomic Collisions", Santa Barbara, U.S.A. (July 1985):

  CONVOY ELECTRONS FROM 100 KeV H ON CARBON FOILS MEASURED IN COINCIDENCE WITH EMERGING PROTONS AND H ATOMS
  P. Focke, W. Meckbach, I.B. Nemirovsky, S. Berry, I.A. Sellin, M.G. Menéndez and M.M. Duncan

  POTENTIAL SCREENING IN INNER-SHELL CAPTURE
  J.E. Miraglia, R.O. Barrachina and C.R. Garibotti

- "Spring College on Plasma Physics", I.C.T.P., Trieste, Italy. (27 May - 21 June 1985):

  ENERGY LOSS OF CHARGED PARTICLES IN DENSE PLASMAS
  N.R. Arista

ENERGY LOSS OF IONS IN DILUTE PLASMAS: CLASSICAL VS. QUANTUM DESCRIPTIONS AND EFFECTIVE-CHARGE DEPENDENCE
N.R. Arista and L. de Ferrariis

- "IX International Seminar on Ion-Atom Collisions", Palo Alto, U.S.A. (1985):
ON THE COULOMB OFF-SHELL T-MATRIX. ITS INFLUENCE TO INNER-SHELL ELECTRON CAPTURE
J.E. Miraglia, R.O. Barrachina and C.R. Garibotti

4.1.b Local Conferences:

- "69a. Reunión de la A.F.A.", Buenos Aires (1984):

EMISION CINETICA DE ELECTRONES INDUCIDA POR IONES DE BAJAS ENERGIAS
M.A. Alurralde, E.V. Alonso and R.A. Baragiola

CARGA EFECTIVA Y LOGARITMO DE COLISION PARA IONES LENTOS EN PLASMAS DE FUSION
N.R. Arista

FRENAMIENTO DE PARTICULAS CARGADAS DE UN PLASMA PARCIALMENTE DEGENERADO: UNA EXTENSION A LA FORMULA DE FERMI-TELLER
N.R. Arista

ESTUDIO DE FUNCIONES DOBLEMENTE DIFERENCIALES DE ELECTRONES EMITIDOS EN COLISIONES H^- He y $H^\pm$ He
G.C. Bernardi, W. Meckbach, I.B. Nemirovsky and C.R. Garibotti

ESTRUCTURA DEL PICO DE PERDIDA ELECTRONICA AL CONTINUO
G.C. Bernardi, A. Gonzalez, R.O. Barrachina and C.R. Garibotti

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G.C. Bernardi, I.B. Nemirovsky, W. Meckbach and C.R. Garibotti

TRANSFORMADA EN TEMPERATURA DE LA ECUACION DE BOLTZMANN NO LINEAL
C.R. Garibotti, R.O. Barrachina and D.H. Fujii

RESOLUCION DE LA ECUACION DE BOLTZMANN NO LINEAL MEDIANTE APROXIMANTES RACIONALES
C.R. Garibotti, D.H. Fujii and R.O. Barrachina

DEPENDENCIA ANGULAR DE LA ENERGIA DE PROYECTIL A LA QUE OCURRE LA MAXIMA PERDIDA DE ENERGIA INELASTICA
J.C. Eckardt, M.M. Jakas and G.H. Lantschner

DISEÑO Y CONSTRUCCION DE UN ANALIZADOR ELECTROSTATICO Y CAMARA DE VACIO
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MEDICION DE DISTRIBUCIONES DOBLEMENTE DIFERENCIALES DE ELECTRONES CONVOY PARA PROTONES INCIDENTES EN LAMINAS DE CARBONO
P. Focke, W. Meckbach and I.B. Nemirovsky

- "70a Reunión de la A.F.A.", Rosario (1985):

TRATAMIENTO SISTEMATICO DE LA APROXIMACION ADIABATICA. APLICACION AL CASO DE UN OSCILADOR ARMONICO CON FRECUENCIA VARIABLE
M.V. Ganduglia, E.C. Goldberg and V.H. Ponce

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DEPENDENCIA CON EL PARAMETRO DE IMPACTO DE LA PERDIDA DE ENERGIA DE PROTONES EN COLISIONES CON ATOMOS
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CASCADAS NO LINEALES DE COLISIONES ATOMICAS EN LOS FENOMENOS DE SPUTTERING
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L. de Ferrariis, O. Grizzi, G.E. Zampieri and R.A. Baragiola

RESOLUCION ITERATIVA DE LA ECUACION DE BOLTZMANN
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SIMULACION POR MONTE CARLO DE LA EMISION AUGER DE SUPERFICIES SOLIDAS POR IMPACTO IONICO
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SEPARACION ENTRE LOS FRAGMENTOS DE LA DISOCIACION DE H_2^+ TRANSMITIDOS EN LAMINAS DELGADAS DE CARBONO
M.M. Jakas and V.H. Ponce

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- "10eme. Colloque National sur la Physique des Collisions Atomiques et Electroniques", Aussois, France, (1984):

FACTEURS DE TRANSLATIONS DANS LES COLLISIONS ATOMIQUES A BASSES ENERGIES
V.H. Ponce

4.3 Theses:

EFECTOS NO LINEALES EN LA ECUACION DE BOLTZMANN
Raúl O. Barrachina - Directed by Prof. Carlos R. Garibotti

PROCESOS AUGER EN COLISIONES ION-SUPERFICIE
Guillermo Zampieri - Directed by Prof. Raúl A. Baragiola.

4.4 Publications:

FORMATION OF AUTOIONIZING STATES OF Ne IN COLLISIONS WITH SURFACES
G. Zampieri, F.Meier and R.A. Baragiola
Physical Review A. 29, 1984)

ION INDUCED AUGER EMISSION FROM SOLIDS: CORRELATION BETWEEN AUGER ENERGIES AND WORK FUNCTIONS
G. Zampieri and R.A. Baragiola
Physical Review B 29, 1480 (1984)

DOUBLE DIFFERENTIAL DISTRIBUTIONS PRODUCED BY COLLISIONAL ELECTRON LOSS INTO THE CONTINUUM, USING THE H^0-He SYSTEM
W. Meckbach, R. Vidal, P. Focke, I.B. Nemirovsky and C.E. González Lepera
Physical Review Letters. 52, 621 (1984)

COLLISIONAL ELECTRON TRANSFER INTO THE CONTINUUM OF IONIC PROJECTILES.
K.O. Groeneveld, W. Meckbach, I.A. Sellin and J. Burgdorfer
Comments on Atomic Molecular Physics 4, 187 (1984)

THE CORRELATION BETWEEN INELASTIC ENERGY LOSS AND SCATTERING ANGLE IN TRANSMISSION EXPERIMENTS
J.C. Eckardt, G.H. Lantschner, M.M. Jakas and V.H. Ponce
Nuclear Instruments and Methods B 2, 168 (1984)

STUDY ON THE ANGULAR DEPENDENCE OF THE AVERAGE ENERGY LOSS FOR IONS IN SOLIDS
M.M. Jakas, G.H. Lantschner, J.C. Eckardt and V.H. Ponce
Physical Review A 29, 1838 (1984)

CLASSICAL AND QUANTUM-MECHANICAL TREATMENTS OF THE ENERGY LOSS OF CHARGED PARTICLES IN DILUTE PLASMAS
L. de Ferrariis and N.R. Arista
Physical Review A 29, 2145 (1984)

DIELECTRIC RESPONSE OF QUANTUM PLASMAS IN THERMAL EQUILIBRIUM
N.R. Arista and W. Brandt
Physical Review A 29, 1471 (1984)

EFFECTIVE CHARGE AND COLLISION LOGARITHM FOR SLOW IONS IN FUSION PLASMAS
N.R. Arista and W. Brandt
Physical Review A 30, 630 (1984)

THE INFLUENCE OF A DIFFUSE TARGET ON ELECTRON LOSS INTO THE CONTIUUM DOUBLE DIFFERENTIAL DISTRIBUTIONS
G.C. Bernardi, I.B. Nemirovsky, W. Meckbach and C.R. Garibotti
Lecture Notes in Physics 213, 67 (1984) (Springer-Verlag 1984)

THREE DIMENSIONAL CONVOY ELECTRON VELOCITY DISTRIBUTIONS PRODUCED BY 60-270 Kev PROTON IMPACT ON CARBON FOILS
W. Meckbach, I.B. Nemirovsky and P. Focke
Lecture Notes in Physics 213, 105 (1984) (Springer-Verlag 1984)

CONVOY ELECTRONS FROM ATOMIC AND MOLECULAR HEAVY ION COLLISIONS WITH SOLIDS
P. Koschar, R. Latz, J. Kemmler, M. Butkard, H.J. Frischkorn, D. Hoffmann, J. Schrader, R. Schramm, K.O. Groeneveld, M. Breining, S. Elston, I.A. Sellin and W. Meckbach
Lectures Notes in Physics 213, 128 (1984) (Springer-Verlag 1984)

DOUBLE DIFFERENTIAL CROSS SECTION FOR ELECTRON CAPTURE TO THE CONTINUUM WITH MOELECULAR PROJECTILES
C.E. González Lepera and V.H. Ponce
Lecture Notes in Physics 213, 128 (1984)

EFFECT OF OXYGEN ON SECONDARY ION EMISSION FROM Al
R.A. Baragiola, J. Ferrón and G. Zampieri
Nuclear Instruments and Methods B 2, 614 (1984)

ANOMALOUS ENHANCED BACK SCATTERING OF FAST LIGHT IONS FROM AMORPHOUS SOLID TARGETS
M.M. Jakas and V.H. Ponce
Journal of Physics D 17, 1303 (1984)

ORIGIN OF FEATURES IN THE ENERGY SPECTRA OF ELECTRONS DETACHED FROM FAST H^- IN COLLISIONS WITH He AND Ar ATOMS
V.H. Ponce and R.A. Baragiola
Journal of Physics B 17, 2467 (1984)

MOLECULE TRANSMISSION AND CONVOY ELECTRON PRODUCTION BY FAST PROJECTILES IN THIN SOLIDS
R. Latz, J. Schader, H.J. Frischkorn, P. Koschar, D. Hoffmann, K.O. Groeneveld and W. Meckbach
Nuclear Instruments and Methods B 2, 265 (1984)

TEST OF SECOND BORN CONTRIBUTIONS TO THE ELECTRON CAPTURE TO THE CONTINUUM
R.O. Barrachina and W. Meckbach
Physical Review Letters 52, 1053 (1984)

BEAM FOIL CONVOY ELECTRON DISTRIBUTION AS A FUNCTION OF ENERGY AND ANGLE OF EMISSION
P. Focke, I.B. Nemirovsky, C.E. González Lepera, W. Meckbach, I.A. Sellin and K.O. Groeneveld
Nuclear Instruments and Methods B 2, 235 (1984)

Be K-SHELL AUGER ELECTRON EMISSION IN SLOW ION-SURFACE COLLISIONS
O. Grizzi and R.A. Baragiola
Physical Review A 30, 2297 (1984)

ION INDUCED DESORPTION OF SURFACE CONTAMINANTS
R.A. Baragiola
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V.H. Ponce
Proceedings of the "10eme. Colloque sur la Physique des Collisions Atomiques et Electroniques", Aussois, France, 170 (1984)

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P. Koschar, J. Kemmler, M. Burkhard, D. Hoffmann, R. Schramm, M. Breining, S.B. Elston, I.A. Sellin, W. Meckbach and K.O. Groeneveld.
Proceedings of the "2nd Workshop on High-Energy Ion Atom Collisions", Hungary (1984).

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R.O. Barrachina, C.R. Garibotti and J.E. Miraglia
Physical Review A 31, 4026 (1985)

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J.E. Miraglia, C.R. Garibotti and A.D. González
Physical Review A 32, 250 (1985)

DESCRIPTION OF THE APPROACH TO EQUILIBRIUM IN THE BOLTZMANN EQUATION
R.O. Barrachina, D.H. Fujii and C.R. Garibotti
Physics Letters A 109, 447 (1985)

SELECTION RULES FOR ELECTRON TRANSFER TO THE CONTINUUM IN ION-ATOM COLLISIONS
R.O. Barrachina, G.C. Bernardi and C.R. Garibotti
Journal de Physique 46, 1671 (1985)

LOW VELOCITY STOPPING POWER OF SEMIDEGENERATE QUANTUM PLASMAS
N.R. Arista
Journal of Physics C 18, 5127 (1985)

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M.L. Martiarena, and C.R. Garibotti
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M.M. Jakas and D.E. Harrison, Jr.
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DEPENDENCE OF ATOM EJECTION ON ELECTRONIC ENERGY LOSS
M.M. Jakas and D.E. Harrison, Jr.
Physical Review B 32, 2752 (1985)

MANY BODY EFFECTS IN ATOMIC COLLISIONS CASCADES
M.M. Jakas and D.E. Harrison, Jr.
Physical Review Letters 55, 1782 (1985)

OBSERVATION OF A NEW ATOMIC-LIKE PEAK IN THE ION-INDUCED AUGER SPECTRUM OF Si
L. de Ferrariis, O. Grizzi, G. Zampieri, E.V. Alonso and R.A Baragiola
To be published in Surface Science Letters

INELASTIC ENERGY LOSSES IN CASCADES AND THE THEORY OF ATOM EJECTION.
D.E. Harrison, Jr. and M.M. Jakas
To be published in Nuclear Instruments and Methods

THE COMPUTER SIMULATION OF ATOMIC COLLISIONS IN SOLIDS
R. Webb, M.M. Jakas and D.E. Harrison, Jr.
To be published in Nuclear Instruments and Methods

KINETIC ELECTRON EMISSION FROM SOLIDS INDUCED BY SLOW HEAVY IONS
E.V. Alonso, M.A. Alurralde and R.A. Baragiola
To be published in Surface Science Letters

ADIABATIC LIMIT FOR THE TIME DEPENDENT COULOMB PROBLEM
M.V. Ganduglia and V.H. Ponce
To be published in Journal of Chemical Physics

COINCIDENCE EXPERIMENT CONCERNING THE ORIGIN OF CONVOY ELECTRONS PRODUCED BY SWIFT DEUTERIUM BEAMS TRAVERSING CARBON FOILS
M.G. Menendez, M.M. Duncan, S.D. Berry, I.A. Sellin, W. Meckbach, P. Focke and I.B. Nemirovsky
To be published in Physical Review A

LOW TEMPERATURE PHYSICS

1. PERSONNEL

Scientists

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G. Nieva*
M. Núñez Regueiro**
E.J. Osquiguil+
A. Ridner
J.G. Sereni

Technicians

R. Scotti
S. Trochine
H. Tutzauer

Undergraduate IB Students

C. D'Ovidio
P. Mateos

*Fellow CNEA
+Fellow CONICET
**Reseacher CNEA/CONICET

2. GENERAL DESCRIPTION

Through the years the laboratory has grown in a way that frames the present activities and shows the way to future development. The group has developed its own cryogenic equipment and has generated the basic structure for samples preparation laboratory.

2.1 Facilities:

With the existing facilities experiments in the range from 0.03 K to room temperature, with magnetic fields of up to 3,5 T. can be performed.

Properties that can be measured are: specific heats, electrical and thermal conductivities and AC and DC electric and magnetic susceptibilities. There is equipment for the preparation and heat treatment of metallic alloys and of amorphous metals.

The group has given support for the construction of a Faraday Magnetometer which is currently operating in the Magnetic Resonance Division.

In recent years the laboratory has incorporated data-acquisition systems for on-line experiments.

Research covers several aspects of condensed matter physics: Magnetism, Superconductivity and Disorder. Recently the study of structural phase transitions has been undertaken associated to new collective modes (Fröhlich superconductivity) in low-dimensional compounds. Ultrasound technology will be incorporated in the near future, to study disorder in metals and insulators.

Cryogenics Section:

The Cryogenics Section, as part of the Low Temperature Division,

is in charge of providing 3000 lts/month of liquid air and nitrogen and 300 ltr/month of liquid helium to different groups at CAB. This section has 3 air liquefiers and 2 He liquefiers.

Some of these machines have run for over 50.000 hours and the oldest one is from 1959.

Liquifying and distributing liquid He is a non trivial task which is carried out with imported and Argentine equipment, some of it developed here. Three laboratory technicians cover the activities related with the Cryogenic Service and with the scientific work.

2.2 Cooperation Agreements:

The continuity of scientific work and the topics developed have allowed the laboratory to keep cooperation agreements with research groups in France, Germany and U.S.A.. A cooperation program with Brazil is under way.

The laboratory has contributed to research programs in other centers in Argentina, in particular with the Low Temperature groups at the Facultad de Ciencias Exactas and the Facultad de Ingeniería in Buenos Aires, as well as in La Plata and in the Instituto Nacional de Tecnología Industrial.

2.3 Conferences:

During the period 1984-1985 scientists from the laboratory have given seminars in France, Germany, Brasil and Mexico and have taken part in four international meetings. Some scientists have been members of the organizing committies of the following international conferences: International Conference in Low Temperature Physics LT-17, Phonon Scattering in Condensed Matter and the Workshop on Intermediate Valence held in Bariloche.

3. RESEARCH PROGRAMS

Research in superconductivity and disorder allows the transfer of knowledge within CAB and the country, in topics of current interest which include stability of metastable thermodynamic systems (amorphous or crystaline), superconductivity in homogeneous media, topological defects in amorphous systems and effects of electronic localization caused by disorder.

Research in low dimensional compounds concentrates in a new approach: study of how and why low dimensional systems present states of charge density waves and Frohlich quasi-superconducting modes. Current interest in this direction points to the obtention of room temperature superconductors.

Research in magnetism makes it possible for this laboratory to take part in the international activity in the area. Interest is focused in the properties of d and f states. Research is oriented towards phenomenological and microscopic understanding of transition metals, mixed valence compounds and lately of the so-called heavy fermion systems.

A. Amorphous metals

It has been shown that pinning forces on magnetic vortices in amorphous superconductors are a sensitive tool to study the presence and characteristics of topological defects in disordered structures. Interaction forces between the magnetic vortex lattice and defects in the material can be modified through thermal treatments. It has been shown that the magnetic structure forms a periodic lattice with much larger correlation lengths than the lattice constant. Interaction forces are weak and cannot destroy the vortex lattice, and for this reason pinning forces have a statistical origin based on spatial fluctuations in the defect concentration.

Due to the ideality of the system, the possibility of controlling the lattice parameter with external variables (H and T) and of modifying the interaction through thermal treatments makes these materials an ideal case for the study of phenomena associated with periodic systems, more difficult to observe in periodic atomic systems.

Recent experiments carried out at the laboratory have shown for the first time the observability of dimensional transitions in the collective behaviour of the pinning forces.

B. Metallic multilayers

Superconducting and normal behaviour of Nb/Al multilayers have been studied. It has been shown that a change in the total thickness of the samples, keeping constant the period of the superstructure, modifies the critical temperature in a similar way to that observed in Nb films.

Research in superconducting critical fields and in the behaviour of the resistivity of the material shows that the microscopic effect (of unknown origin) giving rise to the (increase/decrease) in Tc does not appear to be associated to the effects of surface proximity, nor to structural defects generated during sample preparation.

C. Low Dimensionality

A theory has been developed to explain the so called saturation of electrical resitivity in materials showing a tendency to structural phase transitions of electronic origin. This theory is based on a new and original concept: the molecular states that appear before the onset of these transitions.

D. Intermediate Valence and Heavy Fermions

Valence instabilities shown by several Rare Earths or Actinides

have their origin in the delocalization of a 4f or 5f electron. The mixture of localized and conduction electron states increases the density of states of the system up to three orders of magnitude (Heavy Fermions).

A direct measurement of the density of states is obtained through the electonic specific heat. Among the systems studied in our laboratory there is Ce Pd_3 B_x which has the largest density of states observed to date (γ = 3,5J/mol K^2). Other compounds studied with similar characteristics are the ternaries $XInAu_2$ (X = Y, Ce, U). On the other hand U Si_2Ru_2 besides having a high density of states shows two transitions; one superconducting and one magnetic.

Among the dilute alloys, Tb impurities in Th also show a strong enhancement of the density of states, which is an exception for Tb, considered to be of stable valence.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences

4.1.a International Conferences:

- "International Conference on Valence Fluctuations", Cologne, Germany (August 1984):
  MAGNETIC TRANSITION IN THE $CePd_3B_x$ SYSTEM
  J.P. Kappler, M.J. Besnus, A. Meyer, J.G. Sereni and G. Nieva

- "Conference on Electronic Structure and Properties of Rare Earth and Actinide Intermetallics", St. Pölten, Austria (3-6 September 1984):
  CRYSTALLOGRAPHIC AND MAGNETIC PROPERTIES OF RE IN Au_2 INTERMETALLICS
  M.J. Besnus, J.P. Kappler, A. Meyer, J.G. Sereni, E. Siaud, R. Lahiouel and J. Pierre

- "17th International Conference on Low Temperature Physics", Karlsruhe, Germany (1984):

  HYBRIDIZATION EFFECTS BETWEEEN d AND s BAND IN AMORPHOUS MATERIALS
  F. de la Cruz, M.E. de la Cruz, L. Civale and R. Arce

  THE TUNNELING MODEL - INCORRECT FOR AMORPHOUS METALS?
  H. Neckel, P. Esquinazi, G. Weiss and S. Hunklinger

- "Deutsche Physikalische Gesellschaft E.V.", Münster, West Germany, (12 March 1984):
  FLUX PINNING IN DISORDERED $La_{70}Cu_{30}$
  P. Esquinazi

- "8th International Conference on Rare Earth Metals", Zurich, Switzerland (1985):
  INTERMEDIATE VALENCE MAGNETIC ORDERING AND VOLUME EFFECT IN THE Ce-Pd SYSTEM
  J.P. Kappler, M.J. Besnus, P. Lehmann, A. Meyer and J.G. Sereni

- "Fifth General Conference of the Condensed Matter Division of the EPS" Berlin, West Germany (1985):
  STRONG COUPLING BETWEEN TUNNELING SYSTEMS AND CONDUCTION ELECTRONS
  H.M. Ritter, H. Neckel, P. Esquinazi and G. Weiss

- "IX SLAFES", Mar del Plata, Argentina (19-24 August 1985):

  ALTA DENSIDAD DE ESTADOS EN LOS SISTEMAS X In Au_2 (X=Ce,U)
  G. Nieva, J.G. Sereni and J.P. Kappler

  PINNING COLECTIVO BIDIMENSIONAL EN EL AMORFO SUPERCONDUCTOR $Zr_{70}Cu_{30}$
  E.N. Martinez, V.L.P. Frank, E.J. Osquiguil and F. de la Cruz

  DETECCION DE DEFECTOS EN MATERIALES AMORFOS
  V.L.P. Frank, E.J. Osquiguil, J. Luzuriaga and F. de la Cruz

  THERMAL CONDUCTIVITY OF CHARGED DENSITY WAVE COMPOUNDS
  M. Núñez Regueiro, J. López Castillo and C. Ayache

  ION DECHANNELING IN LAYERED DICHALOCOGENIDES 1T-TaS_2 AND 1T-$TiSe_2$
  M. Núñez Regueiro, B. Daudin, M. Dubus and C. Ayache

CAMPOS CRITICOS SUPERCONDUCTORES EN MULTICAPAS DE Nb/Al
J. Guimpel, M.E. de la Cruz, F. de la Cruz, H. Fink, O. Laborde and J.C. Villegier

EFECTOS DE TAMAÑO EN LA TEMPERATURA CRITICA SUPERCONDUCTORA DE MULTICAPAS DE Nb/Al
J. Guimpel, M.E. de la Cruz, F. de la Cruz, H. Fink, O. Laborde and J.C. Villegier

EFECTO DE LA DILUCION DEL Tb EN Th SUPERCONDUCTOR
J.G. Sereni, G. Nieva, J.G. Huber

SUPERCONDUCTIVIDAD EN $Th_7 M_3$ (M=Fe, Co y Ni)
G. Nieva, J.G. Sereni and J.G. Huber

4.1.b Local Conferences:

- "69a. Reunión de la A.F.A.", Buenos Aires (1984):

MEDICION DE CORRIENTE Y CAMPO CRITICO SUPERCONDUCTOR EN $Zr_{75}Rh_{25}$ AMORFO Y SU EVOLUCION CON RECOCIDO
C. D'Ovidio, J. Luzuriaga and F. de la Cruz

CAMPO DE NUCLEACION Y EFECTOS DE TAMAÑO EN SUPERESTRUCTURAS SUPERCONDUCTORAS DE Nb-Al
O. Laborde, F. de la Cruz, M.E. de la Cruz and J.C. Villegier

CARACTERIZACION DE ALEACIONES AMORFAS METALICAS SUPERCONDUCTORAS MEDIANTE SUS CORRIENTES CRITICAS
E. Osquiguil, V.L.P. Frank and F. de la Cruz

- "70a. Reunión de la A.F.A.", Rosario, Santa Fe (1985):

MODELO DE KRONIG-PENNEY DIMERISADO
A. Goñi, A. Rojo and E.N. Martinez

4.1.c Invited Talks:

- "Simposio Latinoamericano de Física dos Sistemas Amorfos", Niteroi, Brazil (1984):
STRUCTURAL RELAXATION: LOW TEMPERATURE PROPERTIES
F. de la Cruz

- "International Workshop on Glasses and Crystalline Defect Systems", Bad Honnef, Germany (1984):
TRANSPORT AND SUPERCONDUCTING PROPERTIES OF METALLIC GLASSES
F. de la Cruz

- "Workshop on Intermediate Valence and Heavy Fermions", Bariloche, Argentina (1985):
CALOR ESPECIFICO EN SISTEMAS DE ALTA DENSIDAD DE ESTADOS
J.G. Sereni, en colaboración con J.P. Kappler, M.J. Besnus, A. Meyer and G. Nieva

- "VI Reunión de Invierno de Física de Bajas Temperaturas", Oaxtepec, Mexico (January 1985):
SUPERCONDUCTIVIDAD EN SISTEMAS AMORFOS METALICOS
F. de la Cruz

4.2 Seminars:

- ETH, Zurich, Switzerland (June 1984):
  SUPERCONDUCTIVITY IN AMORPHOUS METALLIC SYSTEMS
  F. de la Cruz

- Université Louis Pasteur, Strasbourg, France (1984):
  ROLE OF p-LIKE ORBITALS IN Ce VALENCE INSTABILITIES
  J.G. Sereni

- Tandar, CNEA, Buenos Aires, Argentina (1985)
  METALES AMORFOS
  F. de la Cruz

- Dep. de Química, UNAM, Mexico (January 1985):
  COMPORTAMIENTO DE LA DENSIDAD DE ESTADOS EN SISTEMAS METALICOS AMORFOS
  F. de la Cruz

- Dep. de Ciencias de Materiales, UNAM, Mexico (January 1985):
  EFECTOS DE LA RELAJACION EN SISTEMAS DE DOS NIVELES EN AMORFOS METALICOS
  F. de la Cruz

- Institut Laue-Langevin, Grenoble, France (January 1985):
  PHONON TRANSPORT IN CHARGE DENSITY WAVE SYSTEMS
  M. Núñez Regueiro

- Laboratoire de Chimie des Solides, Université de Nantes, France (Januar 1985):
  PROPIETES DE TRANSPORT DES DICHALCOGENURES DES METAUX DE TRANSITION
  M. Núñez Regueiro

- Universidade Estadual de Campinas (UNICAMP), Brazil (October 1985):

  HIBRIDIZACION VERSUS CAMPO CRISTALINO EN COMPUESTOS DE CERIO
  J.G. Sereni

  DESARROLLO DE LOS PROGRAMAS DE INVESTIGACION EN EL CENTRO ATOMICO BARILOCHE
  J.G. Sereni

  HIBRIDIZACION VERSUS CAMPO CRISTALINO EN EL SISTEMA ThTb
  J.G. Sereni

  SUPERCONDUCTIVIDAD EN EL SISTEMA $Th_7(Fe,Cu,Ni)_3$
  J.G. Sereni

- Universidade de Sao Paulo (USP), Brazil (October 1985):
  SUPERCONDUCTIVIDAD EN COMPUESTOS DE TIERRAS RARAS Y ACTINIDOS
  J.G. Sereni

- Centro Brasileiro de Pesquisas Físicas (CBPF), Río de Janeiro, Brazil (October 1985):
  SISTEMA DE ALTA DENSIDAD DE ESTADOS
  J.G. Sereni

- Universidade Federal Fluminense, Niteroi, Brazil (November 1985):
  CALOR ESPECIFICO DE COMPUESTOS DE Ce DE ALTA DENSIDAD DE ESTADOS
  J.G. Sereni

4.3 Theses:

MOVIMIENTO COLECTIVO DE LOS VORTICES. EFECTOS DE LA DIMENSIONALIDAD DEL SISTEMA; ESTUDIO DE LA ESTABILIDAD DE DEFECTOS EN LA RED DE VORTICES
Víctor L. P. Frank - Directed by Prof. F. de la Cruz

4.4 Publications:

LOW TEMPERATURE SPECIFIC HEAT OF DOW CORNING SILICON OIL N°704 BETWEEN 2 AND 18 K
V.L.P. Frank and M.E. de la Cruz
Cryogenics 24, 311 (1984)

RARE EARTHS MELTING-TEMPERATURE ANOMALIES
J. G. Sereni
Journal of Physics and Chemistry of Solids 45, 1219 (1984)

HYBRIDIZATION EFFECTS BETWEEN d AND s BANDS IN AMORPHOUS MATERIALS
F. de la Cruz, M.E. de la Cruz, L. Civale and R. Arce
Proceedings of the International Conference on Low Temp. Physics, LT17, Ed. U. Eckern, A. Schmid, W. Weber and H. Wühl, 1301 (Elsevier Science Publishers B.V. 1984)

STRUCTURAL RELAXATION: LOW TEMPERATURE PROPERTIES
F. de la Cruz
Anais do Simposio Latinoamericano de Física dos Sistemas Amorfos, Niteroi, Brazil (1984) Ed. E. Anda 1, 144 (1984)

THE ROLE OF "p-LIKE" ORBITALS IN Ce VALENCE INSTABILITIES
J.G. Sereni
Journal of Magnetism and Magnetic Materials 47-48, 228 (1985)

CRYSTALLOGRAPHIC AND MAGNETIC PROPERTIES OF RE In Au_2 INTERMETALLICS
M.J. Besnus, J.P. Kappler, A. Meyer, J.G. Sereni, E. Siaud, R. Lahiouel and J. Pierre
Physica B 130, 240 (1985)

MEASUREMENTS OF SUPERCONDUCTING CRITICAL CURRENTS WITH AN APPLE II + MICROCOMPUTER
V.L.P. Frank
International Instruments and Computers 3, 4 (1985)

TWO DIMENSIONAL COLLECTIVE FLUX PINNING IN MELT SPUN SUPERCONDUCTING AMORPHOUS $Zr_{70}Cu_{30}$
E.J. Osquiguil, V.L.P.Frank and F. de la Cruz
Solid State Communications 55, 227 (1985)

INTERMEDIATE VALENCE MAGNETIC ORDERING AND VOLUME EFFECT IN THE Ce-Pd SYSTEM
J.P. Kappler, M.J. Besnus, P. Lehmann, A. Meyer and J.G. Sereni
Jnl. of the Less Common Metals 111, 261 (1985)

MAGNETIC TRANSITION IN THE $CePd_3B_x$ SYSTEM
J.P. Kappler, M.J. Besnus, J. Baurepaire, A. Meyer, J.G. Sereni and G. Nieva
Journal of Magnetism and Magnetic Materials 47-48, 111 (1985)

ION DECHANNELING IN LAYERED DICHALOCOGENIDES 1T-TaS_2 AND 1T-$TiSe_2$
M. Núñez Regueiro, B. Daudin, M. Dubus and C. Ayache
Solid State Communications 54, 457 (1985)

THERMAL CONDUCTIVITY OF 1T-TaS_2 AND 1T-$TiSe_2$
M. Núñez Regueiro, J.M. López-Castillo and C. Ayache
Physical Review Letters 55, 1931 (1985)

FLUX PINNING IN $La_{70}Cu_{30}$ DISORDERED SYSTEM
P. Esquinazi, B. Guillet, R. Steinmann and H. Dussel
Journal of Non Crystalline Solids 69, 171 (1985)

IDEAL TWO DIMENSIONAL FLUX PINNING INDUCED BY ANNEALING IN SUPERCONDUCTING AMORPHOUS $Zr_{75}Rh_{25}$
J. Luzuriaga, C. D'Ovidio and F. de la Cruz
To be published in Solid State Communications

DRASTIC INCREASE OF FREQUENCY AND DAMPING OF A SUPERCONDUCTING VIBRATING REED IN A LONGITUDINAL APPLIED FIELD
E.H. Brandt, P. Esquinazi, H. Neckel and G. Weiss
To be published in Physical Review Letters

THE TUNNELING MODEL-INCOMPLETE FOR AMORPHOUS METALS
H. Neckel, P. Esquinazi, G. Weiss and S. Hunklinger
To be published in Solid State Communications

SIZE DEPENDENCE OF THE SUPERCONDUCTING CRITICAL TEMPERATURE AND FIELDS OF Nb/Al MULTILAYERS
J. Guimpel, M.E. de la Cruz, F. de la Cruz, H. Fink, O. Laborde and J.C. Villegier
To be published in Journal of Low Temperature Physics

A SUPERCONDUCTING VIBRATING REED APPLIED TO FLUX LINE PINNING. I - THEORY
E.H. Brandt, P. Esquinazi and H. Neckel
To be published in Journal of Low Temperature Physics

LOW TEMPERATURE THERMAL PROPERTIES OF THE $CePd_3B_x$ SYSTEM
J.G. Sereni, G. Nieva, J.P. Kappler, M.J. Besnus and A. Meyer
To be published in Journal of Physics F (Metal Physics)

MAGNETIC RESONANCES

1. PERSONNEL

Scientists

M.T. Causa

C. Fainstein

E. Gagliano *

C.A. Ramos

H. Salva **

C.E. Soliverez **

M. Tovar **

Technicians

I.C. Pérez

Undergraduate IB Students

A. Fainstein

M. Prado

M. Servin

R.D. Zysler

* Fellow CONICET

** Researcher CNEA/CONICET

2. GENERAL DESCRIPTION

The main interest of this group is the study of Magnetic Properties of Solids. Present research covers measurements of Magnetization and Magnetic Resonance in compounds exhibiting different magnetic behaviour: paramagnetic ions diluted in solids, spin-glasses and antiferromagnets.

2.1 Facilities:

- Magentic Resonance Spectrometer (ESR) operating at 9.5GHz and at 35GHz in the range between 1.5K and room temperature.
- Double Nuclear and Electronic Resonance Spectrometer (ENDOR) operating at 35GHz and radio-frequencies from 10MHz to 80MHz.
- Faraday magnetometer, operating in magnetic fields up to 1.3T and temperatures from 1.5K to 300K.
- Resistivity bridge with cryostat working between 55K and 300K.
- Limited facilities for preparation of samples and their thermal and mechanical treatment. Atomic absorption spectrometer Perkin Elmer 290 B.

2.2 Cooperation agreements:

The group conducts research programs in cooperation with the following laboratories:

- Magnetic Resonance Laboratory, Physics Dept., University of California, San Diego, U.S.A..
- Laboratorio de Resonancias Magnéticas, INTEC, CONICET, Santa Fé, Argentina.
- Laboratorio de Resonancias Magnéticas, Centro de Física, Instituto Venezolano de Investigaciones Científicas (IVIC), Caracas, Venezuela.
- Laboratorio de Espectroscopía Mössbauer, Depto. de Física, Facultad de Ciencias Exáctas, Universidad Nacional de La Plata, Argentina.
- Centre des Recherches sur les Très Basses Temperatures, CNRS, Grenoble, France.
- Institute de Physique Appliqué, Ecole polytechnique Fédérale, Lausanne, Switzerland.

2.3 Conferences:

Research results have been presented at the following international meetings:

- AIP 30th Annual Conference on Magnetism and Magnetic Materials, San Diego, U.S.A., (1984).
- European Workshop on Charge Density Waves in Solids, Zagreb, Yugoslavia (1985).
- 11° Simposio Latinoamericano de Física del Estado Sólido (SLAFES), Mar del Plata, Argentina (1985).

3. RESEARCH PROGRAMS

A. Paramagnetic ions in solids:

The interactions of paramagnetic impurities with ligands in a diamagnetic crystal are studied through Electron Paramagnetic Resonance (EPR) and Electron-Nuclear Double-Resonance (ENDOR). Crystal field parameters and transferred-hyperfine constants are measured as a function of temperature (down to 1.5K) and applied uniaxial stress. Phenomenological models for the stress dependence of the EPR and ENDOR spectra are used to analyze the experimental data. Comparison is made with microscopic models taking into account the local distortion of the lattice and changes in the compressibility around the impurity.

B. Spin glasses:

The magnetic properties of spin glasses are studied with Electron Spin Resonance (ESR) techniques. The magnetic anisotropy of these systems is determined as a function of temperature and the previous history of the material. This is a joint project with physicists of the University of California, San Diego (USA).

C. Antiferromagnets:

Insulators showing a paramagnetic-to-antiferromagnetic transition as a function of temperature are characterized through antiferromagnetic resonance spectroscopy (AFMR). Measurements at different temperatures as a function of frequency allow us to analyze the role of the interaction mechanisms: exchange, dipole-dipole interactions, crystal field and spin lattice relaxation.

D. Organo - Metallic compounds:

The magnetic susceptibility and ESR spectra of metal -aminoacid complexes are measured as a function of temperature. This is a joint project with INTEC physicists.

E. Electrical resistivity in onedimensional systems:

The non-linear behaviour of the electric current as a function of applied electric field is studied in compounds such as TaS_3 and $NbSe_3$. The transition to the Peierls state, characterisitic of onedimensional systems, is analyzed through measurements of the electrical resistivity as a function of temperature.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences:

4.1.a International Conferences:

- "30th. Conference on Magnetism and Magnetic Materials", San Diego, U.S.A (27-30 November 1984):
  DEPENDENCE OF THE MAGNETIC PROPERTIES OF THE SPIN-GLASS AgMn ON THE ADDITION OF MAGNETIC AND NON-MAGNETIC IMPURITIES
  M. Tovar, C. Fainstein, S. Oseroff and S. Schultz

- "European Workshop on Charge Density Waves in Solids", Zagreb, Yugoslavia (October 1985):
  NON-LINEAR TRANSPORT PROPERTIES IN A NEW POLYTYPE OF NbS_3
  P. Monceau, H. Salva, Z.Z. Wang, C. Roucau, L. Guemas and A. Meerschaut

- "IX SLAFES", Mar del Plata, Argentina (19-24 August 1985):

  DISTORSIONES ALREDEDOR DE IMPUREZAS DE TIERRAS RARAS EN REDES TIPO FLUORITA: CALCULO Y EVIDENCIAS EXPERIMENTALES
  C.A. Ramos, M. Tovar and C. Fainstein

  DEPENDENCIA DE LAS PROPIEDADES MAGNETICAS DEL VIDRIO DE SPIN AgMn CON LA ADICION DE IMPUREZAS MAGNETICAS
  M. Tovar, C. Fainstein, S. Oseroff and S. Schultz

  CONDUCTIVIDAD ELECTRICA DE TaS_3 ORTORROMBICO EN ALTOS CAMPOS ELECTRICOS
  H. Salva

4.1.b Local Conferences:

- "69a. Reunión de la A.F.A.", Buenos Aires, (1984):

  METODO DE HEITLER-LONDON EXTENDIDO Y HAMILTONIANOS MODELO: HAMILTONIANO DE INTERCAMBIO PARA LA MOLECULA DE H_2
  C.E. Soliverez, E.R. Gagliano and G.A. Arteca

  RESONANCIA MAGNETICA DE $GdVO_4$ EN LA FASE PARAMAGNETICA SATURADA
  H. Salva and M.T. Causa

  FACTOR GIROMAGNETICO NUCLEAR DE ^{19}F EN FLUORITAS CON IMPUREZAS DE TIERRAS RARAS
  C.A. Ramos, C. Fainstein and M. Tovar

- "70a Reunión de la A.F.A.", Rosario (1985):

  MOMENTO NUCLEAR APARENTE DE ^{19}F en Tm^{2+}: MF_2 (M=Ca,Sr,Ba)
  C.A. Ramos, C. Fainstein and M. Tovar

  DEFORMACIONES INDUCIDAS EN CRISTALES: RESONANCIAS MAGNETICAS Y ENERGIA DE COHESION
  C.A. Ramos, M. Tovar and C. Fainstein

  TRANSICION DE FASE ANTIFERROMAGNETICA-PARAMAGNETICA EN $GdVO_4$. ESPECTRO DE RESONANCIA MAGNETICA
  M.T. Causa and H. Salva

ANALISIS NUMERICO DE MODELOS CUANTICOS EN LA RED: UNA MEJORA AL METODO LANCZOS
E.R. Dagotto, A. Moreo and E.R. Gagliano

HAMILTONIANOS EFECTIVOS EN FISICA ATOMICA: UN METODO ITERATIVO PARA MEJORAR LA APROXIMACION DE HARTREE-FOCK
E.R. Gagliano and C.E. Soliverez

4.2 Seminars:

- Centro Atômico Bariloche, Argentina (April 1985):

  TRANSICION DE PEIERLS - H. Salva

  ANISOTROPIA EN VIDRIOS DE ESPIN - M. Tovar

- Dept. de Physique de la Matiere Condensée, Université de Geneve, Geneva Switzerland (October 1985):
  CONDUCTIVITE ELECTRIQUE EN TaS_3 - H. Salva

4.3 Theses:

ENDOR DE ^{19}F ALREDEDOR DE IMPUREZAS DE TIERRAS RARAS EN CRISTALES FLUORITA Y EFECTOS DE DEFORMACION.
C.A. Ramos - Directed by Prof. Carlos Fainstein

4.4 Publications:

CHARGE DENSITY WAVE DEPINNING IN TaS_3
H. Salva, Z.Z. Wang, P. Monceau, J. Richard and M. Renard
Philosophical Magazine B 49, 385 (1984)

THE $(Fe_1Nb)\ Nb_2Se_{10}$ FAMILY: RESISTIVITY AND MAGNETIC MEASUREMENTS
A. Ben Salem, A. Heerschant, H. Salva, Z.Z. Wang y T. Sambogni
Journal de Physique 45, 771 (1984)

DERIVATION OF MODEL HAMILTONIANS FOR INTERACTING SUBSYSTEMS OF NONIDENTICAL PARTICLES
E.R. Dagotto y C.E. Soliverez
Physical Review A 30, 1616 (1984)

STRUCTURAL AND MAGNETIC PROPERTIES OF A COPPER-AMINO ACID SALT: COPPER (II) BIS (α-AMINO ISOBUTYRATO)
R. Calvo, M. Mesa, G. Oliva, J. Zuckerman Schpector, O.R. Nascimento M. Tovar and R. Arce
Journal of Chemical Physics 81, 4584 (1984)

LIGAND ELECTRON-NUCLEAR DOUBLE RESONANCE OF ^{19}F IONS AROUND YB^{3+} IMPURITIES IN FLUORITES
C.A. Ramos, C. Fainstein and M. Tovar
Physical Review B 32, 64 (1985)

DERIVATION OF MODEL HAMILTONIANS: EXCHANGE HAMILTONIAN FOR H_2
C.E. Soliverez, E.R. Gagliano and G.A. Arteca
Physical Review A 32, 81 (1985)

ORTHONORMALIZATION ON THE PLANE: A GEOMETRIC APPROACH
C.E. Soliverez and E.R. Gagliano
Revista Mexicana de Física 31, 743 (1985)

X-BAND ANTIFERROMAGNETIC RESONANCE MEASUREMENT IN $KNiF_3$
M.T. Causa and M.C.G. Passeggi
Physical Review B 32, 3229 (1985)

DEPENDENCE OF THE MAGNETIC PROPERTIES OF THE SPIN-GLASS AgMn ON THE ADDITION OF MAGNETIC IMPURITIES
M. Tovar, C. Fainstein, S. Oseroff and S. Schultz
Journal Applied Physics 57, 3438 (1985)

NON-LINEAR TRANSPORT PROPERTIES IN A NEW POLYTYPE OF $NbSe_3$
P. Monceau, H. Salva, Z.Z. Wang, C. Roucau, L. Guemas and A. Meerschaut
Proceedings of the "European Workshop on Charge Density Waves in Solids", Zagreb, Yugoslavia (1985) p. 41

METALS PHYSICS

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2. GENERAL DESCRIPTION

The Metals Physics Division of the CAB is one of the oldest in the institution. The growth of the laboratory is due to the efforts of many Argentine and foreign scientists, many of whom are still connected with it.

What is today the Applied Physics Department (from which sprang INVAP. S.E., the first high technology industrial enterprise in Argentina) originated in this division. Many of its scientists are now continuing with their work in other offcial or private institutions, thus creating a valuable two-way flow of knowledge.

2.1 Facilities:

a. Metallographic Laboratory

The group has the necessary equipment for surface treatment of metal specimens and for the observation by optical microscopy. There are several metallographic microscopes and accessories also for applying tensile loads during observation and for varying the temperature between 77K and 973K.

b. Electron Microscopy Laboratory

There is a Philips 300 transmission electron microscope with which areas with a maximum thickness of 0.3 microns can be studied, with a resolution of 1.2nm. Specimen holders for deformation, heating, cooling and rotation are available.

c. Internal Friction Laboratory

There are three automated pendulae that operate in the 77K to 623K range, with measurable deformation amplitude of 10^{-7} to 10^{-3}. One of these pendulae has a window for electron irradiation. Oscillation frequencies are in the range of 1 to 5 Hz and 20 to 80 Hz, depending on the pendulum.

There is also another pendulum for plastic deformation and cooling down to 4K. Finally, there is a system to excite vibrations in flat specimens from 30 to 50 Hz, automated for a constant amplitude of 10^{-7} to 10^{-5}, which functions from 77K up to 550K.

d. Other equipment

- Deformation machine: An Instron 1123 for applying loads of up to 2,500 kg with adjustable cross head velocities between 0.05 and 500 mm/min. It allows to program experiments and posesses accessories for operating at different temperatures from 200K to 588K, from room temperature to 1473K (in a vacuum or in a controlled atmosphere) and from 77K to room temperature.

- Dilatometer: The laboratory has a high speed quenching dilatometer LK02 for programmable thermal treatments. The equipment has a range of K = 200, 400, 1000, 2000, 10000 and 2000, where $K = \frac{\Delta l_d}{\Delta l_m}$ is the ratio between the length changes Δl_d recorded on the chart and that of the specimen itself, Δl_m. Operating temperatures range from 55K to room temperature or from room temperature to 1473K; 1623K can be reached, but only in a fast cycle.

- Resistive and inductive furnaces for thermal treatments, alloy preparation and single crystal growth.

- X-ray equipment including the standard facilities

- Automated equipment for coupled measurement of calorimetry and acoustic emission

- Cryostat: The construction of a cryostat which will operate at liquid He temperatures has recently been completed to be installed and tested in the semiconductor laboratory (LASEM).

d. Development of New Facilities:

As part of the Argentine-Spanish cooperation agreement on Thermoelastic Transformations, an automated facility for detecting simultaneously acoustic emission and heat evolution taking place during transformation has been designed, installed and perfected in cooperation with Spanish scientists from the Universidad de Barcelona and Palma de Mallorca.

2.2 Cooperation Agreements:

The laboratory has cooperation programs with foreign and local research groups. These are:

Foreign institutions:
- INSA, Lyon, France.
- Université Catholique de Louvain, Belgium.
- Universidades de Barcelona y Palma de Mallorca, Spain.

Argentine Institutions:
- FAMAF, Universidad de Córdoba: Study of precipitation in aluminium base alloys.
- Dirección de Agua Pesada: Fragilization Project of Stainles Steel 304 L with Hydrogen (CNEA).
- Universidad de Ciencias Exáctas e Ingeniería, Universidad Nacional de Rosario.
- Instituto de Física de Rosario, (IFIR) CONICET - Universidad Nacional de Rosario
- Instituto para el Desarrollo Tecnológico de la Industria Química, (INTEC) Santa Fé
- Universidad Nacional del Centro, Tandil

2.3 Conferences:

During the period 1984-1985 the group has contributed papers to international conferences in Belgium, Hungary, U.S.A., Spain, Colombia and Argentina.

3. RESEARCH PROGRAMS

Research is mainly devoted to the study of the martensitic transformation in Cu-Zn base alloys, but martensitic phases in steels and precipitation reactions in aluminium alloys are also being investigated by means of internal friction, an excellent technique to study point and linear defects and the different interphases. The study of martensitic transformations in the brasses is of particular interest not only because of the shape memory and double memory effects associated with them, but also because they serve as models for more complex materials, and because they show phenomena which are also of general interest in the field of metallurgy and the physics of metals. Cu-Zn and Cu-Zn-Al alloys are particularly well suited for studying the thermodynamics, crystallography and kinetics of the martensitic transformation, as well as the stability of the phases involved.

A. Phase Stability:

As the martensitic transformation takes place without diffusion in the solid state, once the atomic distribution on the lattice sites of one of the phases is known, their distribution on the other phase is also known. This simplifies the analysis of the stability of the phases involved, and permits to obtain information on the factors which control it by measuring the entropy and enthalpy of the transformation.

B. Fatigue:

It is important to understand the irreversible processes that take place in the material during repeated transformation cycles, which may be induced by the application of tensile loads. An understanding of the fatigue mechanisms associated with the transformation is also essential for the development of these alloys for their applications.

C. Stabilization of the Martensite:

This phenomenon, in which the retransformation temperature from the martensite to the matrix rises is brought about by martensite ageing near room temperature and strongly affects the behaviour of the material and therefore its use; it is linked to fundamental processes such as vacancy migration and changes in the state of order.

D. Acoustic Emission and Calorimetry of the Transformation:

Acoustic and thermal phenomena occur during the martensitic transformation and retransformation, and can be adequately detected. By calorimetry the enthalpy of the transformation can be measured, and by its coupling to acoustic emission information can be obtained about the mechanisms associated with the nucleation, growth and, fundamentally, the kinetics of the transformation.

E. Internal Friction:

This valuable technique, allows to study the configuration, concentration and mobility of interstitial and substitutional defects and the dislocation and interphases between different structures and grain boundaries. Research is carried out on the following subjects:

i) Martensitic transformation in Cu-Zn-Al alloys and its influence due to defects (introduced either by thermal treatment or by electron irradiation in LINAC) and precipitates. These results are complemented by those obtained through other techniques (electrical resistivity, acoustic emission, etc.).

ii) Characterization of martensitic phases found in stainless steel after cold working and/or a cathodic charge with hydrogen, in order to improve the knowledge of the fragilization of steel in the presence of H and to quantify the martensitic phases present by means of this nondestructive technique.

iii) Precipitation sequences, degree of recrystallization and the state of deformation in aluminium alloys during hardening.

F. Electron Microscopy:

i) Experimental and theoretical study of the martensite phases and their relationship with the habit plane and the fault density has been carried out.

ii) Structures and defects in metals have been analysed by means of high resolution electron microscopy at the University of Antwerp, Belgium, by one of the scientists of the Division.

G. Ion implantantion in Silicon:

A theoretical study on the distribution of implanted ions in single crystalline silicon has been started. The implantation profile has been calculated as a function of the type and energy of the incident ion using a Pearson IV type distribution function which describes the experimental results better than a gaussian distribution. The generalization of the method to different incident ions, energies and substrates is in progress.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences:

4.1.a International Conferences:

- "Discussion Meeting on Cu-Zn-Al Martensite Shape Memory Alloys", Leuven, Belgium (19-21 June 1984):

  FREE ENERGY DIFFERENCE, COMPOSITION ATOMIC INTERACTIONS AND M_s
  M. Ahlers

  AGEING AND STABILIZATION
  M. Chandrasekaran and J. Van Humbeeck

  A STUDY ON THE STABILIZATION OF Cu-Zn-Al MARTENSITE
  A. Mantel, J.L. Macqueron, R. Rapacioli and G. Guenin

  STABILIZATION FROM AGEING Cu-Zn-Al SHAPE MEMORY ALLOYS IN THE MARTENSITIC STATE
  A. Abu Arab, M. Chandrasekaran y M. Ahlers

  AGEING BEHAVIOUR IN THE MARTENSITIC AND bcc PHASES OF Cu-Zn-Al SINGLE CRYSTALS
  A. Abu Arab, M. Chandrasekaran and M. Ahlers

  128-DEFECTS AND STABILIZATION OF MARTENSITE
  M. Andrade, L. Delaey and M. Chandrasekaran

  CHARACTERIZATION OF DEFECTS AND TWIN BOUNDARIES IN 2H AND 18R MARTENSITES OF Cu-Al ALLOYS. A HIGH RESOLUTION ELECTRON MICROSCOPY STUDY
  F.C. Lovey, G. Van Tendeloo, J. Van Landuyt and S. Amelinckx

  INFLUENCE OF DISORDER AND THE VACANCIES ON THE MARTENSITIC TRANSFORMATION
  R. Rapacioli, J.L. Macqueron and G. Guenin

  INTERNAL FRICTION IN ß PHASE Cu-Zn-Al SINGLE CRYSTALS
  M. Ahlers

  FATIGUE IN SINGLE CRYSTALS Cu-Zn-Al
  M. Sade, R. Rapacioli and M. Ahlers

- "Discussion Meeting on Electron Microscopy", Brussels, Belgium (May 1984):
  HREM IN MATERIALS SCIENCE
  F.C. Lovey, G. Van Tendeloo, J. Van Landuyt and S. Amelinckx

- "Jornadas de Transformaciones Termoelásticas", Palma de Mallorca, Spain, (May 1984):

  INFLUENCIA DE LA HISTORIA TERMICA SOBRE LA TRANSFORMACION MARTENSITICA
  R. Rapacioli, J.L. Macqueron and G. Guenin

  UN ETUDE DE LA STABILISATION DE LA PHASE MARTENSITIQUE D'UN ALLIAGE Cu-Zn-Al
  M. Mantel, G. Guenin and R. Rapacioli

-"8th European Congress on Electron Microscopy", Budapest, Hungary, (August 1984):

INCOMMENSURATE ELECTRON DIFFRACTION PATTERNS AND MICRODOMAIN STRUCTURE IN γ BRASS TYPE PRECIPITATES IN β Cu-Zn-Al ALLOYS
F.C. Lovey, G. Van Tendeloo, J. Van Landuyt, M. Chandrasekaran and S. Amelinckx

IMAGING CONDITIONS FOR THE STACKING SEQUENCE IN 18R MARTENSITE IN Cu-Al ALLOYS
F.C. Lovey, W. Coene, D. Van Dyck, G. Van Tendeloo, J. Van Landuyt and S. Amelinckx

QUANTITATIVE AND SEMIQUANTITATIVE X-RAY MICROANALYSIS OF γ PHASE PRECIPITATES IN Cu-Zn-Al SHAPE MEMORY ALLOYS BASED ON A PARAMETERLESS CORRECTED ANALYSIS OF THE MATRIX
E. Van Capellen and F.C. Lovey

HREM INVESTIGATION ON THE NATURE OF SOME TWO DIMENSIONAL DEFECTS IN 18R AND 2H MARTENSITE IN Cu-Al ALLOYS
F.C. Lovey, J. Van Landuyt, G. Van Tendeloo and S. Amelinckx

- "International Conference on Internal Friction", Urbana, Illinois, U.S.A. (1985):

ANELASTIC BEHAVIOR OF COLD ROLLING 304L STAINLESS STEEL
J. Quiroga, A. Ghilarducci, M. Mondino, A. Lamagna and J. Caro

NEW ASPECTS OF THE INTERNAL FRICTION SPECTRUM OF A COMMERCIAL Al-Mg-Si ALLOY
A. Ghilarducci, S. Urreta and H. Bertorello

- "Reunión Latinoamericana de Teoría de Aleaciones y Equilibrio de Fases" Buenos Aires, Argentina (12-15 August 1985):
DESCOMPOSICION DE ALEACIONES DE Al-ZN SOBRESATURADAS
A. Ghilarducci

- "Shape Memory Seminars", Palma de Mallorca, Spain (September 1985):

DEVELOPMENT OF A LOW COST EXPERIMENTAL SYSTEM FOR THE ENERGY STUDIES IN THE MARTENSITIC TRANSFORMATIONS
G. Padin, R. Rapacioli, S. Ortin and V. Torra

EFECTOS DE FACTORES EXTERNOS A LA TRANSFORMACION MARTENSTICA SOBRE LA DETECCION DE LA EMISION ACUSTICA ASOCIADA
R. Rapacioli, J. Ortin and V. Torra

- "Curso Internacional de Ciencias de los Materiales", Cali, Colombia (18-29 November, 1985):
TRANSFORMACIONES DE FASE EN ESTADO SOLIDO: TRANSFORMACIONES MARTENSITI-- CAS
M. Ahlers

4.1.b Local Conferences:

- "IX Jornadas Metalúrgicas", Sociedad Argentina de Metales (May 1985):

DISLOCACIONES EN FATIGA PSEUDOELASTICA EN LATONES
M. Sade, A. Uribarri and F.C. Lovey

EFECTOS DEL ENVEJECIMIENTO EN ALEACIONES DE Cu-Zn-Al
A. Abu Arab, M. Chandrasekaran and M. Ahlers

- "Vibraciones de Metales", Jornada de Trabajo de la Sociedad Argentina de Metales, Facultad Tecnológica de Buenos Aires (August 1985):
  INTRODUCCION A LA FRICCION INTERNA Y APLICACION DEL PICO DE SNOEK A LA DETECCION DE GASES EN SOLIDOS
  A. Ghilarducci

- "70a Reunión de la A.F.A.", Rosario (1985):

  INFLUENCIA DE LA MARTENSITA ESTABILIZADA SOBRE LOS EFECTOS MEMORIA Y DOBLE MEMORIA DE FORMA
  R. Rapacioli, G. Guenin and M. Mantel

  TRANSFORMACION MARTENSITICA EN Cu-Zn-Al. MEDICIONES ACOPLADAS DE CALORIMETRIA Y EMISION ACUSTICA
  R. Rapacioli, G. Guenin and M. Mantel

  ENERGIAS ACUSTICA Y TERMICA ASOCIADAS CON LA TRANSFORMACION MARTENSITICA EN Cu-Zn-Al
  C. Picarnell, C. Segui, V. Torra, E. Cesari and R. Rapacioli

  EFECTOS DEL CICLAJE PSEUDOELASTICO SOBRE LA SUPERFICIE EN MONOCRISTALES DE Cu-Zn-Al
  M. Sade

  DECONVOLUCION DE TERMOGRAMAS DE CALORIMETROS POR CONDUCCION
  E. Cesari and A. Uribarri

  ESTUDIO DE DEFECTOS EN METALES CON MICROSCOPIA ELECTRONICA DE ALTA RESOLUCION
  F.C. Lovey

  EFECTO DE LA SOLUCION SOLIDA Y LA INTERACCION DE PRECIPITADOS CON DISLOCACIONES EN ALGUNAS ALEACIONES BASE ALUMINIO
  A. Ghilarducci

4.1.c Invited Talks:

- "Hume-Rothery Memorial Symposium", New York, U.S.A. (25-27 February 1985):
  PHASE RELATIONSHIPS AND STABILITIES OF THE α, THE β AND VARIOUS MARTENSITIC PHASES IN BRASSES
  M. Ahlers

4.2 Seminars:

- Colegio de Químicos de Cataluña, Barcelona, Spain (September 1985):

  ALEACIONES CON MEMORIA DE FORMA - INVESTIGACION Y APLICACIONES
  R. Rapacioli

- Universidad Complutense, Madrid, Spain (September 1985):
  ALEACIONES CON MEMORIA DE FORMA - INVESTIGACION Y APLIACIONES.
  R. Rapacioli.

4.3 Theses

FATIGA Y TRANSFORMACION MARTENSITICA EN MONOCRISTALES DE Cu-Zn-Al
Marcos Sade - Directed by Prof. Manfred Ahlers.

4.4 Publications:

THE ORIGIN OF THE INCOMMESURATE ELECTRON DIFFRACTION PATTERNS IN γ-BRASS TYPE PRECIPITATES IN ß Cu-Zn-Al ALLOYS
F. C. Lovey, G. Van Tendeloo, J. Van Landuyt, M. Chandrasekaran and S. Amelinckx
Acta Metallurgica 32, 879 (1984)

AN ANALYSIS OF THE UNMIXING KINETICS OF ALUMINIUM ALLOYS IN TERMS OF NUCLEATION AND SPINODAL DECOMPOSITION MODELS
J.P. Simon, P. Guyot, and A. Ghilarducci
Philosophical Magazine A 49, 151 (1984)

MARTENSITE AGEING AND ITS STABILISATION IN Cu-Zn-Al SHAPE MEMORY ALLOYS
A. Abu Arab, M. Chandrasekaran and M. Ahlers
Scripta Metallurgica 18, 709 (1984)

AGEING BEHAVIOUR IN THE MARTENSITIC AND THE bcc PHASES OF Cu-Zn-Al SINGLE CRYSTALS
A. Abu Arab, M. Chandrasekaran and M. Ahlers
Scripta Metallurgica 18, 1125 (1984)

ELECTRICAL RESISTIVITY OF AN EQUIATOMIC SOLID AND LIQUID Au-Cd ALLOY
K. Mukherjee, M. Chandrasekaran and M. Kato
Physica Status Solidi (a) 83, 657 (1984)

THE NATURE OF SOME PLANAR DEFECTS IN 2H MARTENSITE OF Cu-Al ALLOYS AS DETERMINED BY HREM
F.C. Lovey, G. Van Tendeloo and S. Amelinckx
Physica Status Solidi (a) 85 29 (1984)

THE BASAL PLANE STACKING FAULTS IN 18R MARTENSITE OF COPPER BASE ALLOYS
M. Andrade, M. Chandrasekaran and L. Delaey
Acta Metallurgica 32, 1809 (1984)

ON THE NATURE OF VARIOUS STACKING DEFECTS IN 18R MARTENSITE IN Cu-Al ALLOYS
F.C. Lovey, G. Van Tendeloo, J. Van Landuyt, L. Delaey and S. Amelinckx
Physica Status Solidi (a)86, 553 (1984)

HREM IMAGING CONDITIONS FOR THE STACKING SEQUENCE IN 18R MARTENSITE OF Cu-Al ALLOYS
F.C. Lovey, W. Coene, D. Van Dyck, G. Van Tendeloo, J. Van Landuyt and S. Amelinckx
Ultramicroscopy 15, 345 (1984)

LOW TEMPERATURE FATIGUE IN Cu-Zn-Al SINGLE CRYSTALS
M. Sade and M. Ahlers
Scripta Metallurgica 19, 425 (1985)

FATIGUE IN Cu-Zn-Al SINGLE CRYSTALS
M. Sade, R. Rapacioli and M. Ahlers
Acta Metallurgica 33, 487 (1985)

ON THE INFLUENCE OF CRYSTAL ORIENTATION ON THE HIGH RESOLUTION IMAGE CONTRAST OF POLYTYPES
W. Coene, H. Bender, F.C. Lovey, D. Van Dyck and S. Amelinckx
Phys. Stat. Sol (a) 87 483 (1985)

THE HIGH RESOLUTION ELECTRON MICROSCOPY OF TWIN INTERFACES IN 2H AND 18R STRUCTURES
F.C. Lovey, G. Van Tendeloo, J. Van Landuyt and S. Amelinckx
Scripta Metallurgica 19, 1223 (1985)

NEUTRONS PHYSICS AND REACTORS

1. PERSONNEL

Scientists

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V.H. Gillette[*]
J.R. Granada
F. Kropff
R.E. Mayer
L.D. Salem[*]
M.M. Sbaffoni
M.E. Spina
H.S. Wio[**]

Technicians

R.E. Bravo
L. Capararo

Undergraduate IB Students

J. Dawidowski

[*] Fellow CNEA
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2. GENERAL DESCRIPTION

In this Laboratory research is related to the interaction of neutrons with matter, which involves experimental, theoretical and computational activities.

Thermal neutron diffraction and transmission techniques are being employed to study the structural properties of materials and to determine the nuclear constants which characterize the interactions of slow neutrons with nuclei, respectively. In the Neutron Physics area the research is on the properties and characteristics of the neutron field in several systems of interest and under different conditions. Theoretical studies related to nuclear processes in the frame of non-equilibrium statistical mechanics and stochastic phenomena are also under way.

2.1 Facilities:

The experimental activity of the Laboratory is based on a pulsed neutron source, constituted by the electron beam accelerated (25 MeV) in a LINAC which hits a heavy target. The intensity of the fast neutrons produced in each pulse is around 10^{12} n/cm^2.

The time of flight technique is employed to perform the experiments; at present the laboratory has a flight tube 70m long, with detection stations at 17m, 8m and 3m. This line is usually employed for neutron spectroscopy and total cross section measurements. There is also a 5m flight tube, at the end of which a time-focussed diffractometer has been mounted. The facility also includes a data acquisition system, which involves timing and pulse height analysis as well as the "on-line" data recording through a time encoder and a computer.

A new acquisition system based on a dedicated computer is under development. Other experiments make use of foil activation tech-

niques, employing a Ge-Li detector for the corresponding measurements.

Three personal computers which can also be connected to the VAX 11/780 system, are used to process the data, carry out calculations and develop new computer programs. The Laboratory has a library of computer codes of more than 150 elements, most of them developed locally.

2.2 Cooperation Agreements

Several cooperation agreements have been entered into with other laboratories through various agencies such as SECYT, CONICET, NSF and the Argentine-German Cooperation Agreement.

At present the following projects are under way:

- "Neutronic Studies in Compact Lattices", with the support of the U.N. Development Program and of the IAEA.
- "Neutron Coherent and Incoherent Cross Sections", in collaboration with the FRM Reaktorstation Garching der Technischen Universitat Munchen, within the framework of the Argentine-German Cooperation Agreement.

The laboratory is also connected with the following institutions:

- Virginia Polytechnic Institute and S.U., Blacksburg, Virginia, USA.
- Physik Department, TUM, München, West Germany.
- Kernforschungzentrum Karlsruhe, Karlsruhe, West Germany.
- Technische Universität zu Braunschweig, Braunschweig, West Germany.
- Universität Stuttgart, Stuttgart, West Germany.
- Physics Laboratory, University of Kent, Canterbury, England.
- Physics Department, University of Guelph, Guelph, Canada.

- Centro di Calcolo di Bologna, Bologna, Italy.
- Dipartamento di Fisica, Universita di Catania, Catania, Italy.
- Schweizer Bundesinstitut für Kernforschung, Würenlingen, Switzerland.
- Departamento de Física, Universidad de Barcelona, Barcelona, España.

2.3 Conferences:

Researchers of the Laboratory take part regularly in international conferences, either with invited talks, in person, or with contributed papers (see 4.1)

3. RESEARCH PROGRAMS

A. Neutron Interaction with Condensed Matter:

Neutron diffraction techniques are a valuable tool for condensed matter research, due to their ability to determine the structure and dynamics of a system through the measurement of elastic and inelastic cross sections, respectively. A pulsed neutron source permits a high momentum transfer to be reached in scattering experiments, thus allowing a large number of Bragg reflections to be observed in the case of crystalline solids or well defined oscillations in the case of liquids or amorphous systems.

The experimental activity comprises total and differential cross section measurements, using the LINAC as a pulsed neutron source in combination with time-of-flight techniques. Diffraction experiments are carried out on samples within a wide range of temperatures, which provide information on the thermal displacements of the nuclei and anharmonic motion in crystalline solids, phase transitions and the structure of solids and liquids.

Transmission experiments are performed using neutrons with energies from subthermal up to epithermal values. Those measurements,

when combined with a precise calculation of the total cross section, provide a consistent set of values for the coherent and incoherent cross sections. These magnitudes characterize the slow neutron - nucleus interaction and enable the prediction of the total cross section of an element at any given temperature.

A theoretical model has been developed to describe the interaction of thermal neutrons with molecular gases. The model has been applied to neutron thermalization problems in moderators, with satisfactory results. At present inelasticity corrections required in structural studies on molecular systems are being evaluated with the use of the synthetic scattering function derived from the model.

B. Neutron Physics Studies of Nuclear Systems:

To obtain data on neutron properties, and to understand neutron field behaviour, neutron physics studies are carried out in different kinds of multiplying and non-multiplying assemblies, as well as in homogenenous or heterogeneous systems.

The experimental techniques used, that can be included under the label of "neutron spectroscopy techniques", are those commonly employed for differential and integral spectrum measurements: time-of-flight, foil activation, die-away, etc.. By such means, different kinds of neutron parameters can be obtained, such as neutron cross sections, neutron diffusion constants, multiplication factors, reaction rates, neutron energy spectra, etc..

Up to now, thermal energies have been studied; development of the possibilities of research in intermediate and fast energy ranges is currently under way.

Sets of neutron cross sections are also tested and validated by comparison of the experimental results with numerical calculations, by means of different computational codes.

From the theoretical point of view, various methods of solving the neutron transport equation are being studied, as well as the acceleration methods used by Sn codes. A new method has been developed, and implemented in DOT 3.5 - CAB code.

C. Theory of Non-equilibrium Processes in Nuclear Dynamics:

The theoretical research on non-equilibrium processes in nuclear dynamics concentrates on those cases which can be adequately described in terms of non-equilibrium statistical mechanics of transport theory.

These processes, usually classified as large amplitude nuclear collective motion of dissipative character, have as typical examples nuclear fission, deep inelastic collisions between heavy ions, giant resonances, etc.. Such processes lead us to a deeper analysis of stochastic processes, particularly in relation with kinetic, transport and non-equilibrium processes.

Processes under study at present are, for example:

- Nuclear Dynamics in phase space studied by means of the nuclear Vlasov equation, to obtain frequencies and intensity fragmentation, and to analyze the decay width of giant resonances. The effect of self consistency, two-body collision terms and quantum connections are also studied.
- Derivation of transport equations, for the above mentioned nuclear processes, through path integral methods and comparison with projection techniques.
- Solution of multidimensional Fokker-Planck equations, connected with the Linear Response Theory as applied to nuclear fission.
- Elimination of irrelevant variables in multidimensional Fokker-Planck equations through influence functional schemes.
- Random Walk problems, related with diffusion processes and percolation.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences:

4.1.a International Conferences:

- "ELAF '84", Santiago de Chile, Chile (July 1984):
  PHASE-BREAKING IN ANISOTROPIC COUPLED CONTINUOUS TIME RANDOM WALK
  M.O. Cáceres and H.S. Wio

- "Discussion Meeting on Cu-Zn-Al Martensite Shape Memory Alloys", Leuven Belgium (19-21 June 1984):
  THE INFLUENCE OF ANHARMONICITY ON THE VIBRATIONAL BEHAVIOUR OF ß Cu-Zn-Al CRYSTALS
  V.H. Gillette and J.R. Granada

- "International Conference on Nuclear Data for Basic and Applied Science Santa Fe, New Mexico, U.S.A. (May 1985):
  A SYNTHETIC SCATTERING LAW FOR THE INTERACTION OF THERMAL NEUTRONS WITH MOLECULAR GASES. APPLICATIONS TO HYDROGENEOUS MODERATORS
  J.R. Granada

- "ELAF '85", Universidad del Valle, Cali, Colombia (July 1985).
  PHASE TRANSITION IN A NON-MARKOVIAN DIFFUSION EQUATION
  M.O. Cáceres

- "International Conference on Neutron Scattering", Santa Fe, New Mexico, U.S.A. (August 1985):
  INELASTICITY CORRECTIONS IN THERMAL NEUTRON SCATTERING BY MOLECULES USING A SYNTHETIC SCATTERING FUNCTION
  J.R. Granada, V.H. Gillette and R.E. Mayer

- "Topical Meeting on Phase Space Approach to Nuclear Dynamics", Trieste, Italy (October 1985):
  REDUCED KINETIC EQUATIONS: AN INFLUENCE FUNCTIONAL APPROACH
  H.S. Wio

- "Winter Meeting of the American Nuclear Society", San Francisco, U.S.A. (November 1985):
  XLACS VS XLACS-IIA FOR GENERATING NEUTRON MASTER LIBRARIES FOR HYDROGEN
  H.M. Antúnez and H.S. Wio

4.1.b Local Conferences:

- "XII Reunión Científica de la A.A.T.N.", Buenos Aires (November 1984).
  SCATTERING DE NEUTRONES TERMICOS POR MOLECULAS: MODELO SINTETICO PARA LA FUNCION S(Q,W)
  J.R. Granada

- "69a. Reunión de la A.F.A.", Buenos Aires (1984):

  ALGORITMO PARA LA EVALUACION NUMERICA DEL PROPAGADOR DE FEYNMAN
  L. Salem and H.S. Wio

  DETERMINACION DEL FACTOR DE DEBYE-WALLER Y TEMPERATURA DE DEBYE MEDIANTE DIFRACCION DE NEUTRONES
  V.H. Gillette, J.R. Granada and R.E. Mayer

DISPERSION DE NEUTRONES TERMICOS POR GASES MOLECULARES. MODELO SINTETICO DE LEY DE DISPERSION
J.R. Granada

METODO DE DESARROLLO EN POLINOMIOS ORTOGONALES POR MONTE CARLO Y SU APLICACION A LA DISPERSION DE NEUTRONES TERMICOS
L. Salem and H.S. Wio

PSEUDO-DIFUSION EN SISTEMAS CON SCATTERING ANISOTROPICO Y ABSORBENTE
M.O. Cáceres and H.S. Wio

- "XIII Reunión de la A.A.T.N.", Buenos Aires (1985):

SECCIONES EFICACES Y TERMALIZACION DE NEUTRONES EN MODERADORES USANDO UNA FUNCION SINTETICA DE SCATTERING
J.R. Granada

DOT 3.5 CAB
M.M. Sbaffoni and M.J. Abbate

- "70a Reunión de la A.F.A.", Rosario, Santa Fe (1985):

PROCESOS DE TRANSPORTE CON SCATTERING ANISOTROPICO: UNA ECUACION DE PSEUDO DIFUSION NO-MARKOVIANA
M.O. Cáceres and H.S. Wio

CORRECCIONES POR INELASTICIDAD EN SCATTERING DE NEUTRONES TERMICOS POR MOLECULAS USANDO UNA FUNCION DE SCATTERING (INCOHERENTE) SINTETICA
J.R. Granada, V.H. Gillette and R.E. Mayer

TERMALIZACION DE NEUTRONES EN H_2O Y D_2O USANDO UNA FUNCION DE SCATTERING SINTETICA
J.R. Granada, V.H. Gillette and R.E. Mayer

ECUACIONES DE FOKKER-PLANCK MULTIVARIADAS: DESCRIPCION REDUCIDA POR MEDIO DE FUNCIONALES DE INFLUENCIA
H.S. Wio and C. Budde

DESCRIPCION SEMICLASICA DE LA EXCITACION COULOMBIANA Y NUCLEAR EN COLISIONES DE IONES PESADOS MEDIANTE UN ESQUEMA PERTURBATIVO
V.D. Rodríguez and H.S. Wio

4.1.c Invited Talks:

- "VII Reunión de Trabajo en Física Nuclear", TANDAR, CNEA, Buenos Aires (June 1984):
DISIPACION EN COLISIONES DE IONES PESADOS E INTEGRALES DE CAMINO
H.S. Wio

- "9th International Conference on Transport Theory", Montecatini Terme, Italy (June 1985):
GROUP BY GROUP UPSCATTERING SCALING METHOD.
M.M. Sbaffoni and M.J. Abbate

- "American Nuclear Society ROD Topical Meeting", Williamsburg, U.S.A. (August 1985):
ROLE OF TRT REACTORS IN DEVELOPING COUNTRIES.
M.J. Abbate and J.V. Lolich

4.2 Seminars:

- Institut für Theoretische Physik, Technische Universitat München, Germany (March 1984):
  RANDOM-WALK APPROACH TO PSEUDO-DIFFUSION PROBLEMS
  H.S. Wio

- FRM Reaktorstation Garching, Technischen Universitat München, Germany (July 1984):
  RESEARCH ACTIVITIES AT NEUTRON PHYSICS DIVISION, CENTRO ATOMICO BARILOCHE
  J.R. Granada

- Technischen Universitat Braunschweig, Germany (June 1985):
  NEUTRON PHYSICS STUDIES IN COMPACT LATTICES
  M.J. Abbate

- Kernzentrale Wurenlingen, Switzerland (1985):
  EXPERIMENTS AND CALCULATIONS RELATED TO ADVANCED PRESSURIZED REACTORS
  M.J. Abbate

- Istituto Dipartamentale di Fisica, Universita di Catania, Italy (September 1985):
  RANDOM WALK APPROACH TO ANISOTROPIC PSEUDO DIFFUSION PROBLEMS: A NON MARKOVIAN EQUATION
  H.S. Wio

- Departamento de Física, Universidad de Barcelona, Spain (October 1985):
  RANDOM-WALK PERSISTENTES: UNA ECUACION DE DIFUSION NO-MARKOVIANA
  H.S. Wio

- Departamento de Física, Universidad de Santander, Spain (October 1985):
  ESQUEMAS DE RANDOM-WALK Y DIFUSION ANISOTROPICA DE NEUTRONES
  H.S. Wio

4.4 Publications:

MULTIENERGETIC CONTINUOUS TIME RANDOM WALK
M.O. Cáceres and H.S. Wio
Z. Physik B 54, 175 (1984)

RANDOM WALK APPROACH FOR NEUTRON DIFFUSION WITH STRONG ABSORPTION
M.O. Cáceres and H.S. Wio
Nuclear Instruments and Methods 219, 441 (1984)

A NEW SERIES EXPANSION APPROACH IN MONTE CARLO: APPLICATION TO NEUTRON SHIELDING
A. Noel and H.S. Wio
Annals of Nuclear Energy 11, 225 (1984)

PHASE TRANSITION IN ANISOTROPIC COUPLED RANDOM WALK
H.S. Wio and M.O. Cáceres
Physics Letters A 100, 279 (1984)

TOTAL SCATTERING CROSS SECTION OF SOLIDS FOR COLD AND EPITHERMAL NEUTRONS
J.R. Granada
Z. Naturforschung A 39, 1160 (1984)

TRANSFORMATION LAW FOR RESPONSE FLUXES WITHIN THE COLLISION PROBABILITY METHOD
H.S. Wio
Annals of Nuclear Energy 11, 425 (1984)

SLOW NEUTRON SCATTERING BY MOLECULAR GASES: A SYNTHETIC SCATTERING FUNCTION
J.R. Granada
Physical Review B 31, 4167 (1985)

COUPLED CONTINUOUS-TIME RANDOM WALK: PSEUDO DIFFUSION WITH ANISOTROPIC SCATTERING
M.O. Cáceres and H.S. Wio
Z. Physik B. 58 329 (1985)

TREATMENT OF SCATTERING ANISOTROPY IN NEUTRON DIFFUSION THROUGH A RANDOM-WALK SCHEME
H.S. Wio and M.O. Cáceres
Annals of Nuclear Energy 12, 263 (1985)

A COMMENT ON SOME RECENT MEASUREMENTS OF THE TOTAL CROSS SECTION OF MOLYBDENUM IN THE THERMAL NEUTRON RANGE
J.R. Granada
Atomkernenergie 47, 128 (1985)

NEUTRON THERMALIZATION IN H_2O AND D_2O WITH THE USE OF A SYNTHETIC SCATTERING FUNCTION
J.R. Granada
Physical Review B 32, 7555 (1985)

ROLE OF TRT REACTORS IN DEVELOPING COUNTRIES
M.J. Abbate and J.V. Lolich
Transactions ANS 49, Sup. 2, 57 (1985)

COUPLED GENERALIZED MASTER EQUATION FOR BROWNIAN MOTION ANISOTROPICALLY SCATTERED
M.O. Cáceres
To be published in Physical Review A

GROUP BY GROUP UPSCATTERING SCALING METHOD
M.M. Sbaffoni and M.J. Abbate
To be published in Annals of Nuclear Energy

ON THE DESIGN OF TIME-FOCUSSED DETECTOR BANKS FOR PULSED NEUTRON TOF SPECTROSCOPY
F. Kropff
To be published in Nuclear Instruments and Methods

INELASTICITY CORRECTIONS IN THERMAL NEUTRON SCATTERING BY MOLECULES USING A SYNTHETIC (INCOHERENT) SCATTERING FUNCTION
J.R. Granada, V.H. Gillette and R.E. Mayer
To be published in Physica B+C

ON THE NUMERICAL EVALUATION OF THE FEYNMAN PROPAGATOR
L. Salem and H.S. Wio
To be published in Physics Letters A

THEORETICAL PHYSICS

ELEMENTARY PARTICLES

1. PERSONNEL

Scientists	Undergraduate IB Students
G. Aldazabal*	R. Aguilar
S. Bacci**	M. Carena
M.L. Bruschi●●	C. Wagner
E. Dagotto*	
A. García	
L. Masperi	
D. Mazzitelli*	
E. Miranda*	
R. Montemayor●	
A. Moreo*	
N. Parga	
R.C. Trinchero●	

*Fellow CNEA

●Researchers CONICET

●●IB

2. GENERAL DESCRIPTION

Research on Elementary Particles at the CAB may be traced back to the works directed by Francisco Morey Terry on dispersion relations in 1963 and by Guido Beck on quantization of coupled fields in 1965.

The group began its activity in 1968 with research on strong interaction phenomenology by means of Regge poles and dual models. In subsequent years the group made contributions to reggeon field theory. In the last five years the activity has been devoted to the study of phase transitions in spin and gauge models on the lattice, of topological aspects of field theories, of stochastic quantization methods and of supersymmetry phenomenology.

The results were reflected in nearly ninety articles published in international journals. Seven PhD. theses were completed in the group.

In 1970 and 1973 two Argentine symposia on fields and particles were organized in Bariloche and attended by almost all the physicists interested in the subject resident in the country and a few invited from abroad.

2.2 Cooperation Agreements:

The International Centre for Theoretical Physics in Trieste has had an important role in the formation of the first members of the group, as well as in the updating of the research subjects through the associateship scheme of which three particle physicists of Bariloche currently take part.

From the very beginning of its formal activity in 1968 the Bariloche group kept a strong collaboration with the group in La Plata through shared projects, researchers exchange and periodical meetings.

Since 1970 the group also received the benefit of the visit of foreign experts sponsored by the OAS multinational plan of physics.

In 1978 a collaboration with the University of California at Santa Barbara was established on the basis of mutual visits with the support of NSF and the CONICET.

The same kind of cooperation is currently taking place with the Universidad Autónoma de Barcelona, thanks to the favourable attitude of the Spanish government

There were other important cooperation agreements with visits to and from CERN and the universities of Rome, Naples, Paris, Marseille, Madrid, Zaragoza, Rio de Janeiro, São Carlos, São Paulo and Mexico.

RESEARCH PROGRAMS

Recent research works and those currently in progress may be classified as follows:

3. A. Lattice theories

The lattice models are relevant both due to their direct importance in condensed matter and because they represent a field theoretical regularization procedure particularly suitable to analyze non perturbation phenomena.

In 1984 and 1985 an intense activity on the subject was performed, essentially devoted to obtain model properties by means of semi-analytical methods which give a satisfactory comparison with numerical simulations with the advantage of a better comprehension of the

physical mechanism. In this way variational and mean-field methods were improved to analyze spin and gauge systems corresponding to Z(N) and SU(N) symmetries, as well as strong interaction expansions were applied to fermion interaction and the stochastic quantization was used for local U(N) and SU(N) theories.

In the near future the study of Quantum Chromodynamics corresponding to the interaction among quarks, will be continued for finite temperature to analyze the deconfinement phase transition.

At the same time efforts will be devoted to the study of spin glasses, systems of interest for condensed matter, gauge theories and artificial intelligence by means of numerical simulations and renormalization groups.

B. Topological properties of field theories

The existence of classical solutions of field theories has introduced a series of possible phenomena which cannot be perturbatively explained. In this way magnetic monopoles have been predicted to act as catalyzers for proton decay and Skyrme solitons with baryonic properties were described.

In the last two years, the influence of proton-monopole bound state formation on the so called Rubakov effect has been studied. In addition, the reasons of the poor predictions of the Skyrme soliton regarding the axial current weak coupling were understood.

The effects of the existence of unstable solutions both in the Skyrme model and in the Salam-Weinberg model are currently under study, being, in the latter case related to baryonic number non conservation.

C. Phenomenology with supersymmetric theories

Supersymmetry theory has put the fermionic and bosonic constituents of matter on an equal footing.

During the last year cross-sections for supersymmetric particle production in electron-positron scattering were calculated to compare them with future experimental results.

In the future this line of research will include phenomenological effects due to supergravity, which emerges from making the supersymmetry property local. We will also study the symmetry breaking mechanisms responsible for the lack of degeneration between borons and fermions which is apparent in nature.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences:

4.1.b Local Conferences:

- "69a. Reunión de la A.F.A.", Buenos Aires (1984):

  ANALISIS DE LA TEORIA DE SU(3) DE MEDIDA EN LA RED MEDIANTE EL METODO DE CAMPO MEDIO EN VARIABLES DE PLAQUETAS
  E. Dagotto and A. Moreo

  UNA TECNICA VARIACIONAL HAMILTONIANA MEJORADA PARA MODELOS EN LA RED
  E. Dagotto and A. Moreo

- "70a Reunión de la A.F.A.", Rosario (1985):

  REGLA DE SUMA DE ADLER WEISBERGER Y MODELOS HADRONICOS
  D. Mazzitelli and L. Másperi

  SOBRE LOS ESTADOS LOCALMENTE ESTABLES EN EL MODELO ± J
  E.N. Miranda and N. Parga

  CROMODINAMICA CUANTICA A TEMPERATURA FINITA CON FERMIONES LIVIANOS
  R.C. Trinchero

4.3 Theses:

CUANTIZACION ESTOCASTICA DE TEORIAS DE CAMPO SOBRE LA RED Y MODELOS SUPERSIMETRICOS
Gerardo Aldazabal - Directed by Prof. Néstor Parga

METODOS ANALITICOS APROXIMADOS EN TEORIAS DE MEDIDA EN LA RED
Elbio Dagotto - Directed by Prof. Luis Masperi

METODOS ANALITICOS APLICADOS AL ESTUDIO DE TEORIA DE MEDIDA Y DE SPIN EN LA RED
Adriana Moreo - Directed by Dr. Elbio Dagotto and Prof. Luis Masperi

4.4 Publications:

DERIVATION OF MODEL HAMILTONIANS FOR INTERACTING SUBSYSTEMS OF NONIDENTICAL PARTICLES
E.R. Dagotto and C.E. Solivérez
Physical Review A 30, 1616 (1984)

BETHE-PEIERLS APPROXIMATION FOR LAGRANGIAN AND HAMILTONIAN LATTICE MODELS
E. Dagotto and A. Moreo
Physical Review D 29, 300 (1984)

STOCHASTIC QUANTIZATION AND MEAN FIELD APPROXIMATIONS
N. Parga and R. Jengo
Physics Letters B 134, 221 (1984)

HAMILTONIAN VARIATIONAL STUDY OF SU(2) LATTICE GAUGE THEORY
E. Dagotto and A. Moreo
Physical Review D 29, 2350 (1984)

AN IMPROVED MEAN-FIELD CALCULATION FOR THE Z(2) HIGGS MODEL
E. Dagotto
Physics Letters B 136, 60 (1984)

MEAN FIELD WITH CORRECTIONS APPROACH TO THE MIXED U(1) LATTICE GAUGE THEORY
E. Dagotto
Physical Review D 30, 1276 (1984)

MEAN PLAQUETTE TREATMENT OF THE MIXED FUNDAMENTAL-ADJOINT SU(2) LATTICE GAUGE THEORY
E. Dagotto and A. Moreo
Physical Review D 30, 1271 (1984)

A NUMERICAL INVESTIGATION OF THE OVERLAP DISTRIBUTION AMONG PURE STATES IN THE SPIN GLASS PHASE
N. Parga, G. Parisi and M. Virasoro
Journal de Physique Lettres 45, L1063 (1984)

ON THE ABSENCE OF ORDER IN 2-DIMENSIONAL SYSTEMS WITH COMPACT SYMMETRY
M.L. Bruschi, A.A. García, L. Masperi and C.A. García Canal
Revista Brasileira de Física 14, 302 (1984)

BOUND STATES BETWEEN PROTONS AND MAGNETIC POLES: INFLUENCE OF THE RUBAKOV EFFECT
L. Masperi and D. Mazzitelli
Nuovo Cimento 43, 123 (1985)

MEAN PLAQUETTE ANALYSIS OF THE SU(3) LATTICE GAUGE THEORY
E. Dagotto and A. Moreo
Physical Review D 31, 944 (1985)

SU(N) x SU(N) CHIRAL MODELS ON ASYMMETRIC LATTICES WITH STANDARD AND IMPROVED ACTIONS
E. Dagotto and A. Moreo
Physical Review D 31, 377 (1985)

IMPROVED HAMILTONIAN VARIATIONAL TECHNIQUE FOR LATTICE MODELS
E. Dagotto and Adriana Moreo
Physical Review D, 31, 865 (1985)

GAUSSIAN CORRECTIONS AROUND THE MEAN FIELD APPROXIMATION FOR THE MIXED SU(2) LATTICE GAUGE THEORY
H. Cecatto, E. Dagotto and A. Moreo
Physical Review D 31, 1465 (1985)

ANALYSIS OF SPIN AND GAUGE MODELS WITH VARIATIONAL METHODS
E. Dagotto, L. Masperi, A. Moreo, A. Della Selva and R. Fiore
Physical Review D 32, 1491 (1985)

MEAN PLAQUETTE APPROXIMATION FOR LATTICE GAUGE THEORIES AT FINITE TEMPERATURE
E. Dagotto and A. Moreo
Physical Review D 32, 1004 (1985)

EVALUATION OF CRITICAL EXPONENTS ON THE BASIS OF STOCHASTIC QUANTIZATION
V. Alfaro, R. Jengo and N. Parga
Physical Review Letters 54, 369 (1985)

THE STOCHASTIC QUANTIZATION OF U(N) AND SU(N) LATTICE GAUGE THEORY AND LANGEVIN EQUATIONS FOR THE WILSON LOOPS
G.A. Aldazabal, A. González-Arroyo and N. Parga
Journal of Physics A 18, 2975 (1985)

PATTERNS OF TWO-DIMENSIONAL SUPERSYMMETRY BREAKING: A MONTE CARLO STUDY
N. Parga, A. Schwimmer and E. Rabinovici
Nuclear Physics B255, 383 (1985)

NEW STOCHASTIC TREATMENT OF FERMIONS WITH APPLICATIONS TO A DOUBLE-CHAIN POLYMER
D. Kung, D. Dahl, R. Bankenbecler, R. Deza and J.R. Fulco
Physical Review B 32, 2022 (1985)

GAUGE INVARIANT MEAN FIELD TECHNIQUE FOR LATTICE GAUGE THEORIES WITH SCALAR MATTER
E. Dagotto and A. Moreo
Physics Letters B 165, 366 (1985)

WEAK AND STRONG QUANTUM VACUA IN BIANCHI TYPE-I UNIVERSES
M. Castagnino and D. Mazzitelli
Physical Review D 31, 742 (1985)

FIRST ORDER PHASE TRANSITION IN LATTICE QCD AT FINITE TEMPERATURE: AN ANALYTICAL STUDY
E. Dagotto, A. Moreo and R.C. Trinchero
To be published in Physical Review D

ON THE LOCALLY STABLE STATES OF THE SHERRINGTON-KIRKPATRICK MODEL
N. Parga and G. Parisi
To be published in Journal of Physics C

THE ULTRAMETRIC ORGANIZATION OF MEMORIES IN A NEURAL NETWORK
N. Parga and M. Virasoro
To be published in Journal de Physique

THEORETICAL PHYSICS

SOLID STATE

1. PERSONNEL

Scientists

B. Alascio**
A.A. Aligia
R. Allub
C.A. Balseiro##
A. Caro
V. Grünfeld
A. López Dávalos**
M.D. Núñez Regueiro●
C.R. Proetto
J. Simonin+
C. Wiecko

Undergraduate IB Students

D. Castello
G. Chiappe
G. Ortíz
G. Pastor
S. Ramos de Debiaggi
A. Rojo

●Researcher CONICET
+Fellow CONICET
**Researcher CNEA/CONICET
##Guggenheim Fellow, 1985

2. GENERAL DESCRIPTION

The Theoretical Solid State Group was formed in the early 70's. Today it has a staff of seven permanent CNEA researchers, three members of CONICET and several PhD students holding CNEA and CONICET fellowships.

2.1 Facilities:

The group uses the general facilities of the CAB, in particular the central computer (VAX 11/780) and the library. There are in the Division computers and a small specialized library.

2.2 Cooperation Agreements:

Members of the group have actively participated in joint research programs with individuals and with scientific centers of Brazil, Mexico, Germany, France and the U.S.A..

Some of the scientists of this group are Associated Members of the ICTP (Trieste, Italy), which enables them to interact with scientists of many other countries. In 1985 the group organized a Workshop on Intermediate Valence and Heavy Fermions which took place in Bariloche.

3. RESEARCH PROGRAMS

A. Intermediate valence:

Research in these systems (Rare Earth compounds and alloys) involves theoretical studies of phase transitions, thermodynamic and transport properties, and the analysis of high energy spectroscopy results.

B. Electronic structure of disordered systems:

The influence of disorder on the electronic properties on one-dimensional systems is studied, particularly localization and transport properties.

C. Lattice dynamics in defect-crystals:

Mechanical properties of solids are sensitive to the presence of structural defects. Dislocations in pure crystals and alloys are studied to understand the plastic behaviour of metals.

D. Superconductivity:

Superconducting properties of heterogeneous systems (layered compounds and superconducting networks) are relevant in the field of macroscopic quantum mechanics and in the generalization of the Landau-Ginzburg theory.

E. Low dimensional systems:

Phase transitions and physical properties of distorted phases in quasi-one dimensional compounds are analyzed, particularly in connection with charge-transfer organic compounds.

4. CONFERENCES AND PUBLICATIONS

4.1 Contributions to Conferences

4.1.a International Conferences:

- "International Conference on Valence Fluctuations", Cologne, Germany (1984):

  EFFECTIVE HYBRIDIZATION IN MIXED VALENCE SYSTEMS
  M.D. Núñez Regueiro and M. Avignon

  DENSITY OF 4-f STATES IN INTERMEDIATE VALENCE COMPOUNDS
  M.D. Núñez Regueiro and M. Avignon

  MAGNETIC INTERACTION BETWEEN PAIRS OF INTERMEDIATE VALENCE Tm IMPURITIES
  C.R. Proetto and C.A. Balseiro

- "17th International Conference on Low Temperature Physics", Karlsruhe, Germany (1984):
  EFFECT OF DANGLING SUPERCONDUCTING BRANCHES ON THE CRITICAL CURRENT OF A THIN SC WIRE
  H. Fink and V. Grünfeld

- "International Workshop in Condensed Matter", ICTP, Trieste, Italy (1984):
  A REAL SPACE RENORMALIZATION GROUP DECIMATION FOR SPECTRA AND DENSITY OF STATES
  C. Wiecko

- "International Conference on Magnetism, San Francisco, U.S.A (1985):
  DENSITY OF 4-f STATES IN RARE-EARTH COMPOUNDS
  M.D. Núñez Regueiro and M. Avignon

- "International Workshop in Condensed Matter", ICTP, Trieste, Italy (1985):
  FRACTAL DIMENSIONS OF WAVE FUNCTIONS IN DISORDERED AND INCOMMENSURATE MODELS
  C. Wiecko

- "International Conference on Internal Friction and Ultrasonic Attenuation in Solids 8" (ICIFUAS 8), Urbana, Illinois, U.S.A. (3-7 July 1985):
  ANELASTIC BEHAVIOUR OF COLD ROLLED 304 L STAINLESS STEEL
  J. Quiroga, A. Ghilarducci, M. Mondino, A. Lamagna and A. Caro

- "Conference on Localization", Primorsko, Bulgaria (October 1985):
  LOCALIZATION PROPERTIES IN LINEAR MODELS THROUGH THE RENORMALIZATION GROUP DECIMATION TECHNIQUE.
  C. Wiecko.

- "IX SLAFES", Mar del Plata, Argentina (19-24 August 1985):

  CORRIENTES CRITICAS DE MICROCIRCUITOS SEMICONDUCTORES.
  H. Fink and A. López Dávalos

  FOTOEMISION 4f DE SISTEMAS DE TIERRAS RARAS.
  M.D. Núñez Regueiro and M. Avignon

EXCITACIONES DE SPIN EN REDES DE KONDO
R. Allub

TEMPERATURA CRITICA SUPERCONDUCTORA EN LAMINAS DELGADAS
J. Simonin

NEUTRAL-IONIC TRANSITION AND DIMERIZATION IN ORGANIC MIXED-STACK COMPOUNDS
M. Avignon, C.A. Balseiro, C.R. Proetto and B. Alascio

SEGREGACION Y ESTABILIDAD DE FORMA EN PARTICULAS METALICAS PEQUEÑAS
J.S. Morán López and C.A. Balseiro

4.1.b Local Conferences:

- "69a Reunión de la A.F.A.", Buenos Aires (1984):

ENERGIA LIBRE DE COMPUESTOS DE VALENCIA INTERMEDIA
A.A. Aligia and B. Alascio

ESTRUCTURA ELECTRONICA DE LOS COMPUESTOS DE Tm EN LA FASE ANTIFERROMAGNETICA
A.A. Aligia, C.A. Balseiro and B. Alascio

VARIACIONES DE LA TEMPERATURA CRITICA EN SUPERCONDUCTORES CON IMPUREZAS DE VALENCIA INTERMEDIA ENTRE DOS CONFIGURACIONES MAGNETICAS
R. Allub, M. Achterberg and B. Alascio

EFECTOS DE IMPUREZAS DE VALENCIA INTERMEDIA EN MATRIZ SUPERCONDUCTORA
C.R. Proetto and C.A. Balseiro

APLICACION DEL BETHE ANSATZ EN MAGNETISMO: SOLUCION EXACTA DE UN MODELO DE VALENCIA INTERMEDIA
C.R. Proetto, A.A. Aligia and C.A. Balseiro

DESARROLLO EN Z^{-1} PARA ALEACIONES BINARIAS DESORDENADAS EN REDES DE BETHE
J. Simonin and C.A. Balseiro

ESTRUCTURA ELECTRONICA EN SISTEMAS UNIDIMENSIONALES DESORDENADOS
M.E. García and C.A. Balseiro

CALCULO DE LA TENSION DE FLUENCIA DE UNA ALEACION BINARIA DESORDENADA MEDIANTE EL USO DE FUNCIONES DE GREEN DE FONONES
A. Caro

DINAMICA DE REDES DE SISTEMAS DE VALENCIA INTERMEDIA
G.M. Pastor, A. Caro and B. Alascio

- "70a. Reunión de la A.F.A.", Rosario (1985):

LOCALIZACION EN SISTEMAS DESORDENADOS CON CAMPO ELECTRICO
D. Castello and A. Caro

SOLUCION EXACTA DE UN MODELO PARA IMPUREZA DE VALENCIA INTERMEDIA CON DOS CONFIGURACIONES MAGNETICAS: SOLUCION NUMERICA DE LAS ECUACIONES TERMODINAMICAS
A.A. Aligia, C.A. Balseiro, C.R. Proetto and P. Schlottmann

ESCALERAS DE STARK EN SISTEMAS DESORDENADOS DE 1D
A. Caro

ESPECTRO DE FONONES IRRADIADO POR UNA DISLOCACION EN MOVIMIENTO EN UN CRISTAL
S. Ramos de Debiaggi and A. Caro

4.1.c Invited Talks:

- "IX SLAFES", Mar del Plata, Argentina (19-24 August 1985):

  REVISION DE LA TRANSICION α - γ DEL Ce
  B. Alascio

- "International Conference on Localization", Primorsko, Bulgaria (1985):

  REAL SPACE DECIMATION AND LOCALIZATION
  C. Wiecko

- Academia Nacional de Cienicas Exáctas, Físicas y Naturales, Buenos Aires, Argentina, receptor del premio "Teófilo Isnardi" (1985):
  VALENCIA INTERMEDIA: UN BANCO DE PRUEBAS PARA LA CIENCIA DE MATERIALES.
  B. Alascio

4.2 Seminars:

- "Workshop sobre Valencia Intermedia y Fermiones Pesados", Bariloche, (August 1985):

  FOTOEMISION 4-f DE SISTEMAS DE TIERRAS RARAS
  M.D. Núñez Regueiro

  SOLUCION EXACTA PARA UN MODELO CON DOS CONFIGURACIONES MAGNETICAS
  C.R. Proetto

4.3 Theses:

MODELO PERIODICO PARA FLUCTUACIONES DE VALENCIA ENTRE DOS CONFIGURACIONES MAGNETICAS
Armando A. Aligia - Directed by Prof. Blas Alascio

INTERACCIONES MAGNETICAS ENTRE IMPUREZAS DE VALENCIA INTERMEDIA.
César R. Proetto - Directed by Prof. Arturo López Dávalos

4.4 Publications:

RENORMALIZATION GROUP DECIMATION TECHNIQUE FOR DISORDERED BINARY HARMONIC CHAINS
C. Wiecko and E. Roman
Solid State Communications 50, 995 (1984)

EFFECT OF PRESSURE ON SUPERCONDUCTORS Pr_xLa_{1-x} AND Pr_xY_{1-x}: ZERO BAND WIDTH LIMIT
R. Allub, M. Achterberg and B. Alascio
Physical Review B 30, 5349 (1984)

MAGNETIC SUSCEPTIBILITY OF A MODEL FOR VALENCE FLUCTUATIONS BETWEEN TWO MAGNETIC CONFIGURATIONS: RENORMALIZATION GROUP APPROACH
R. Allub, H. Ceva and B. Alascio
Physical Review B 29, 3098 (1984)

MAGNETIC SUSCEPTIBILITY AND SPECIFIC HEAT OF INTERMEDIATE VALENCE Tm COMPOUNDS
B. Alascio and A.A. Aligia
Journal of Magnetism and Magnetic Materials 43, 119 (1984)

A LATTICE DYNAMICS MODEL OF THE INTERACTION OF A DISLOCATION WITH POINT DEFECTS
A. Caro and N. Glass
Journal de Physique 45, 1337 (1984)

THE FLUX DEPENDENCE OF INTERNAL FRICTION UNDER IRRADIATION
A. Caro, P.R. Bloch, J. de Miguel and W. Benoit
Journal of Physics F 14, 55 (1984)

RENORMALIZATION GROUP DECIMATION TECHNIQUE FOR SPECTRA, WAVE FUNCTIONS AND DENSITY OF STATES
C. Wiecko and E. Roman
Physical Review B 30, 1603 (1984)

EFFECT OF DANGLING SUPERCONDUCTING BRANCHES ON THE CRITICAL CURRENT OF A THIN SC WIRE.
H. Fink and V. Grünfeld
Proceedings of the International Conference on Low Temp. Physics, Ed. V. Eckern, A. Schmid, W Weber, H. Wühl (Elsevier Science Publishers B.V. 721 (1984)

MIXED-VALENCE IMPURITIES IN A SUPERCONDUCTING MATRIX: $1/N_f$ EXPANSION.
C. Proetto and C.A. Balseiro
Physical Review B, 31, 2847 (1985)

FRACTAL CHARACTER OF WAVE FUNCTIONS IN DISORDERED ANDERSON MODEL
C. Wiecko
Solid State Communications, 53, 603 (1985)

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Journal of Physics and Chemistry of Solids 46, 1339 (1985)

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ON THE INTEGRABILITY OF A GENERAL MODEL FOR INTERMEDIATE VALENCE
A.A. Aligia, C.A. Balseiro and C.R. Proetto
To be published in Physical Review B

POSSIBILITY OF CHARGE ORDERING IN INTERMEDIATE VALENCE SYSTEMS
M.D. Núñez Regueiro and M. Avignon
To be published in Journal of Physics F

INSTITUTO BALSEIRO

RELATIVITY

1. PERSONNEL

Scientists	Undergraduate IB Students
O.J. Bressan	J.A. Pullin

2. GENERAL DESCRIPTION

The group working on relativity, gravitation and unified theories at Instituto Balseiro is at its early stages. Its activity began in 1985 when Dr. Bressan who, until then had been working independently, agreed to take a student to complete his Master's Thesis with him. Another senior researcher and other students are expected to join the group.

3. RESEARCH PROGRAMS

The main line of work is on non-riemannian geometries. This subject became important immediately after the appearance of general relativity hoping to incorporate electromagnetic and other interactions through the extra degrees of freedom provided by these geometries.

Although this approach was later abandoned by most researchers, it reappeared in the 60's with the works of Sciama and Kibble on Gauge Theories of the Poincaré group, which required the presence of torsion in space time, and the works of Hehl, Kerlick and von der Heyde on hypermomentum that required the appearance of a segmental curvature.

The group has developed and is currently working on two unified theories, namely: Weyl and Friedmann-Schouten spacetimes. Work on possible experimental ways to test these theories is under way. In this respect neutron stars are being investigated in cooperation with the astronomer C. Lousto of the IAFE Gravitation group in Buenos Aires.

There is, at present, no other gravitation group in the country working on non-riemannian geometries.

4. CONFERENCES AND PUBLICATIONS

From 4-11 January 1985 the group organized SILARG V, Quinto Simposio Latinoamericano de Relatividad y Gravitación, under the joint sponsorship of the COLARG, Comité Latinoamericano de Relatividad y Gravitación, UNESCO, CONICET, CONICOR, CNEA and the Deutsche Forschungsgesellschaft.

4.1 Contributions to Conferences:

4.1.a International Conferences:

- SILARG V, Bariloche, Argentina (4-11 January, 1985):
  UNIFIED CLASSICAL PHYSICS ON A METRIC SPACE WITH TORSION
  O.J. Bressan

4.1.b. Local Conferences:

- "70a. Reunión de la A.F.A. and XIII Reunión Bianual de Relatividad y Gravitación", Rosario, (7-11 October, 1985):

  SIGNIFICADO FISICO DEL TRANSPORTE PARALELO DE UN VECTOR EN TRES TEORIAS UNITARIAS CLASICAS
  J.A. Pullin

  LA INFLUENCIA DE UN CAMPO GRAVITATORIO SOBRE UN CAMPO MAGNETICO: UN NUEVO TEST PARA LA RELATIVIDAD GENERAL
  O.J. Bressan and J.A. Pullin

  DESARROLLO DE UNA TEORIA UNITARIA CLASICA DEL ELECTROMAGNETISMO Y LA GRAVITACION EN UN ESPACIO DE WEYL
  J.A. Pullin and O.J. Bressan

4.4 Publications:

UNIFIED CLASSICAL PHYSICS ON A METRIC SPACE WITH TORSION
O.J. Bressan
Proceedings of the SILARG V, Bariloche, Argentina (January 1985), "Relativity, Supersymmetry and Cosmology", World Scientific, Singapore, 232 (1985).

CLASSICAL UNIFIED FIELDS: PHYSICAL SPACE
O.J. Bressan
To be published in General Relativity and Gravitation

THE PARALLEL TRANSPORT OF A VECTOR, ITS PHYSICAL MEANING IN THREE UNIFIED FIELD THEORIES
J.A. Pullin
To be published in General Relativity and Gravitation

APPENDIXES

APPENDIX

DEPARTAMENTAL PERSONNEL

DIVISION	Researchers CNEA	Researchers CONICET	Researchers other Inst.	Fellows CNEA	Fellows CONICET	Fellows IB	Technicians	Other Fellows	TOTAL
ATOMIC COLLISIONS	14	1	-	4	3	6	2	(x) 1	31
LOW TEMPERATURE PHYSICS	8	-	-	4	1	2	3	-	18
MAGNETIC RESONANCES	6	-	-	-	1	4	1	-	12
METALS PHYSICS	6	-	(#) 1	2	2	1	-	-	12
NEUTRONS AND REACTORS	7	-	(#) 1	2	-	1	2	-	13
THEORETICAL PHYSICS Elementary Particles	3	2	(+) 1	6	-	3	-	-	15
THEORETICAL PHYSICS Solid State	8	2	-	-	1	6	-	-	17
INSTITUTO BALSEIRO Relativity	1	-	-	-	-	1	-	-	2
TOTAL	(*) 53	5	3	18	8	24	8	1	120

APPENDIX I

References:

(*) 10 of these researchers are members or the Carrera del Investigador CONICET.

(#) Argentine Army

(+) Instituto Balseiro

(x) OAS

APPENDIX II

VISITING SCIENTISTS

DATE(1984)	NAME	INSTITUTION	INVITED BY
January	Dr. Pedro L. Mascheroni	Los Alamos Scientific Laboratory, New Mexico, USA	Basic Research Dept.
February	L. Civale & L. Juri	Laboratorio de Bajas Temperaturas, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina	Low Temperature Physics
February	Dr. Peter Morley	Universidad Técnica de Valparaíso, Chile	Theoretical Physics
March	Prof. Armando Riera	Depto. de Química Cuántica, Universidad de Madrid, Spain	Atomic Collisions
March	Prof. Herman Fink	Dept. of Electrical Engineering, University of California, Davis, USA	Theoretical Physics & Low Temperature Physics
March	Prof. José Luis Moran López	Centro de Investigación y Estudios Avanzados, Instituto Politécnico Nacional, Mexico	Theoretical Physics
April	Prof. Norberto Majlis	Instituto de Física, Universidade Federal Fluminense, Rio de Janeiro, Brazil	Theoretical Phys., Low Temp.Phys.& Atomic Coll
April	Prof. Rafael Montemayor di Blassi	Universidad Autónoma de México, Villa Obregon, Mexico	Theoretical Physics
July	Prof. Fernando Flores Sintas	Depto. de Física del Estado Sólido, Universidad Autónoma de Madrid, Spain	Atomic Collisions & Theoretical Physics
July	Prof. Eduardo Fradkin	Dept. of Physics, University of Illinois, Urbana, USA	Theoretical Physics
July	Prof. Bernard Giovannini	Dept. de Physique de la Matiere Condensée Université de Geneve, Geneva, Switzerland	Low Temp. Phys., Theoretical Phys & Magnetic Resonances

(1984)			
September	Prof. Herman Fink	Dept. of Electrical Engineering, University of California, Davis, USA	Theoretical Physics & Low Temp. Physics
September	Prof. Humer Fanchiotti	Depto. de Física, Universidad Nacional de La Plata, Argentina	Theoretical Physics
October	Prof. Ana Celia Mota	Lab. für Festkörperphysik, Zurich, Switzerland	Low Temperature Physics
November	Prof. Robert Gayet	Laboratoire des Collisiones Atomiques, Université de Bordeaux, France	Atomic Collisions
November	Dr. Patrick Smutek	ALCATEL, Paris, France	Low Temperature Physics
November	Prof. Manuel Menendez	Dept. of Physics, University of Georgia, Athens, USA	Atomic Collisions
November	Prof. Ivan Sellin & Prof. Terry Scott	Oak Ridge National Laboratory, University of Tennessee, USA	Atomic Collisions
November	Dr. Bernard Pannetier & Dr. Jean M.T. Mignot	Centre de Recherches sur les Tres Basses Températures, CNRS, Grenoble, France	Low Temperature Physics
(1985)			
January	Prof. Herman Fink	Dept. of Electrical Engineering, University of California, Davis, USA	Theoretical Physics & Low Temperature Physics
January	Prof. John Huber	Virginia Commonwealth University, Virginia, USA	Low Temperature Physics
January	Prof. Carlos Bollini	Depto. de Campos y Partículas, Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro, Brazil	Theoretical Physics
January	Prof. Gustaav Van Tendeloo	Rijksuniversiteit Antwerpen, Belgium	Metals Physics

(1985)

February	Prof. Ricardo Page	Universidad de Managua, Nicaragua	Theoretical Physics
February	Dr Henri Godfrin	Centre des Recherches sur les Tres Basses Températures, CNRS, Grenoble, France	Low Temperature Physics
February	Prof. José A. Grifols	Universidad Autónoma de Barcelona, Spain	Theoretical Physics
March	Prof. Francisco Alcaraz	Depto. de Física, Universidade Federal de Sao Carlos, Brazil	Theoretical Physics
March	Prof. Angelo Della Selva	Universita degli Studi, Napoli, Italy	Theoretical Physics
April	Prof. Mario Baibich	Instituto de Física, Universidade Federal de Rio Grande do Sul, Porto Alegre, Brazil	Low Temperature Physics
April	Dr, Peter Thieberger	Brookhaven National Laboratory, Upton, N.Y., USA	CAB
April	Prof. Vicente Torra Ferré	Universitá de Palma de Mallorca, Spain	Metals Physics
May	Prof. Dr. Abdus Salam	International Center for Theoretical Physics, Trieste, Italy	CAB
June	Dr. Robert Stokstad	Lawrence Radiation Laboratory, University of California, Berkeley, USA	Atomic Collisions Neutrons & Reactors
July	Dr. Jorge Ortin	Departamento de Física, Universitá de Palma de Mallorca, Spain	Metals Physics
July	Prof. Héctor José de Vega	Laboratoire de Physique Théorique et des Hautes Energiés, Université de Paris, France	Low Temperature Physic
August	Prof. Oscar E. Vilches	University of Washington, Seattle, USA	Low Temperature Physics
August	Prof. François L.P. Gautier	Université de Strasbourg, France	Theoretical Physics

(1985)			
August	Prof. Dieter K. Wohlleben	II Physikalisches Institut, Universität zu Köln, West Germany	Theoretical Physics
August	Prof. Didier R. de Fontaine	Dept. of Materials Science, University of California, Berkeley, USA	Metals Physics
August	Dr. Eduardo Román	Universität Konstanz, West Germany	Theoretical Physics
August	Prof. E. Fokener	Rheinische Friedrich-Wilhelms-Universität Bonn West Germany, and temporarily at the Universidad de la Plata, Argentina	Low Temperature Physics Magnetic Resonances
August	Prof. Gastón Barberis	Universidade Estadual de Campinas, Brazil	Low Temperature Physics
September	Prof. Herman Fink	Dept. of Electrical Engineering, University of California, Davis, USA	Low Temperature Physics Theoretical Physics
September	Dr. Anatole P. Nefedov Prof. Giorgi Vagradov	U.S.S.R	CAB
September	Dr. Rafael Calvo	Instituto de Desarrollo Tecnológico para la Industria Química (INTEC), Santa Fé, Argentina	Magnetic Resonances
October	Prof. Dr. Guido Beck	Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro, Brazil	CAB
October	Prof. Dr. Joachim Herzig	Institut für Metallforschung, Universitat de Munster, West Germany	Metals Physics
November	Dr. James L. Smith	Los Alamos National Laboratory, New Mexico, USA	Low Temperature Physics Theoretical Physics
November	Prof. Fernando Flores	Universidad Autónoma de Madrid, Spain	Atomic Collisions Theoretical Physics

(1985)			
November	Prof. Karl Bennemann	Freie Universität Berlin, West Germany	Theoretical Physics
November	Dr. Jan van Humbeeck & Dr. Lucas Delaey	Katholieke Universiteit Leuven, Belgium	Metals Physics
November	Dr. Michel Avignon	Laboratoire d'Etudes des Propietés Electronique des Solides, CNRS, Grenoble, France	Theoretical Physics
November	Prof. Jocelyn C.P. Hanssen	Laboratoire des Collisiones Atomiques, Université de Bordeaux, France	Atomic Gollisions
November	Dr. Marcel M. Locatelli	Centre d'Etudes Nucléaires, Grenoble, France	Low Temperature Physics
December	Dr. Oscar Reula	Max-Planck Institut, München, West Germany	I.B.
December	Ricardo Steinmann & Eng. Eduardo Pérez Wodtke	Depto. de Física, Universidad de Buenos Aires Argentina	Low Temperature Physics
December	Prof. Herman Fink	Dept. of Electrical Engineering, University of California, Davis, USA	Low Temperature Physics Theoretical Physics
December	Prof. Miguel Angel Virasoro	Universitá degli Studi, Roma, Italy	Theoretical Physics

GLOSSARY

A.A.T.N	: Asociación Argentina de Tecnología Nuclear
A.F.A.	: Asociación Física Argentina
APS	: American Physical Society
CAB	: Centro Atómico Bariloche
CNEA	: Comisión Nacional de Energía Atómica
CNRS	: Centre National de la Recherche Scientifique (Grenoble, France)
CONICET	: Consejo Nacional de Investigaciones Científicas y Técnicas
CRTBT	: Centre des Recherches sur les Très Basses Temperatures (Grenoble)
ELAF	: Escuela Latinoamericana de Física
IAEA	: International Atomic Energy Agency
IB	: Instituto Balseiro: Comisión Nacional de Energía Atómica and Universidad Nacional de Cuyo
ICTP	: International Centre for Theoretical Physics (Trieste)
IFIR	: Instituto de Física de Rosario (CONICET - UNR)
INTEC	: Instituto para el desarrollo Tecnológico de la Industria Química
INVAP S.E.	: Empresa de Investigación Aplicada, Sociedad del Estado
KfK	: Kernforschungzentrum Karlsruhe
NSF	: National Science Foundation
OAS	: Organization of American States
TANDAR	: Tandem Argentino (CNEA)
UN	: United Nations
UNAM	: Universidad Nacional Autónoma de México

IMPRESO EN CNEA