

# Abstracta

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## Trabalhos Publicados

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- P031-00 Structural effects in the EPR spectra of  $\text{Ni}^{3+}$  in  $\text{La}_2\text{NiO}_5\text{Li}_0.5\text{O}_4$ .
- P032-00 Topological quantization of the magnetic flux.

## Trabalhos aceitos para publicação em periódicos

### A 058-00 A kinetic theory for nonlinear quantum transport.

Clóves G. Rodrigues, Áurea R. Vasconcellos, and Roberto Luzzi.

It is described a kinetic theory providing bases for an analytical treatment of nonlinear quantum transport. It is founded on a nonequilibrium statistical ensemble formalism, which constitutes a soundly approach for the study of dissipative many-body systems driven arbitrarily away from equilibrium. This theory is applied to the study of transport of charge in *n*- and *p*- type doped polar semiconductors. Evolution of the carriers' quasitemperature and mobility as well as of the relaxation times for energy and momentum are derived. Some comparison with experimental data is done.

Journal of Transport Theory and Statistical Physics, accepted on November 2000.

### A 059-00 Laser reflectometry "in situ" monitoring structural and growth effects on the etching of $\text{In}_{0.49}\text{Ga}_{0.51}\text{P}$ layers in Al-free laser structures.

S. N. M. Mestanza and N. C. Frateschi

Electron Cyclotron Resonance (ECR) Plasma etching of *p* and *n*- $\text{In}_{0.49}\text{Ga}_{0.51}\text{P}$  layers in Al-free laser structures is studied based on  $\text{BCl}_3/\text{N}_2$  gas mixture. Laser reflectometry is used for the *in-situ* etching analysis. Strong etching rate discrepancies are found for the same material whether inserted in multi-layer laser structures or in single calibration layers. Strong etching dependence with growth conditions and beryllium concentration is found. Great reduction in etching rate is observed near *p*++GaAs/*p*++ $\text{In}_{0.49}\text{Ga}_{0.51}\text{P}$  interfaces depending on growth conditions. These results are explained by a 200 Å beryllium diffusion in the  $\text{In}_{0.49}\text{Ga}_{0.51}\text{P}$  material with subsequent formation of  $\text{Be}_3\text{P}_2$  clusters in *p*- $\text{In}_{0.49}\text{Ga}_{0.51}\text{P}$  during growth.

Journal of Vacuum Science Technology B, accepted on November 2000.

### A 060-00 ESR of $\text{Gd}^{3+}$ in $\text{Y}_{1-x}\text{Yb}_x\text{GdInNi}_4$

A.N.Medina, D.P.Rojas and F.G. Gandra

Electron Spin Resonance (ESR) results of  $\text{Gd}^{3+}$  diluted in  $(\text{Y}_{1-x}\text{Yb}_x)\text{InNi}_4$  for  $0 \leq x \leq 0.8$  are reported. It is found that for  $x = 0$  the linewidth present the usual temperature linear behavior and a negative *g*-shift. As *x* is increased the residual linewidth also increases, and a non-linear temperature dependence is observed. An additional relaxation channel through the RKKY interaction is suggested to explain the results. The Yb exchange parameter is determined as function of the concentration.

Journal of Magnetism and Magnetic Materials, accepted on November 2000.

### A 061-00 Transport and thermodynamic properties of $\text{YbInNi}_{4-x}\text{Cu}_x$ systems.

D. P. Rojas, A. N. Medina, F. G. Gandra and L.P. Cardoso.

We report on specific heat and resistivity results on  $\text{YbInNi}_{4-x}\text{Cu}_x$  with  $0 \leq x \leq 4$ . The magnetic resistivity for  $x \leq 1$  presents two temperature regions with a  $-\ln T$  dependence due to the crystal field (CF) and show that the splitting of the first excited state increases with the Cu concentration. The specific heat results are in agreement with resistivity and lead to the evaluation of the crystal field splitting for the first and second excited states. The energy level scheme remains unaltered when Cu replaces Ni. The unit cell volume increases linearly with *x* but the kondo temperature obtained from the specific heat does not change monotonously as expected for the whole series.

Journal of Magnetism and Magnetic Materials, accepted on November 2000.

### A 062-00 Fourier Analysis of Giant Magnetoimpedance in Soft Magnetic Amorphous Wires: Relationship Between the Fundamental Harmonic and the Rotational Magnetization Process.

C. Gómez-Polo, M. Vázquez e M. Knobel.

A method to investigate the Giant Magnetoimpedance (GMI) effect is introduced, based on Fourier analysis. The study is carried on a FeCoSiB amorphous wire with vanishing magnetostriction subjected to Joule heating (current annealing) treatment that induces an enhancement of circumferential magnetic anisotropy and modifies the Magneto-impedance response of the samples. Experimental results are interpreted within the framework of the classical electrodynamic model, where the circumferential permeability plays the dominant role in the field dependence of the complex impedance of the sample. A rotational magnetization model is employed to determine the circular magnetization process, and a mean value of the circumferential permeability is obtained through the first harmonic components obtained through Fourier analysis of the time derivative of the circular magnetization. This simple model is able to reproduce the observed experimental behavior, i.e. evolution of the field dependence of the complex impedance with annealings and the asymmetrical field dependence under a dc biased electrical current.

Applied Physics Letters, accepted on November 2000.

**A 063-00 Staircase-Type Magnetic Field Dependence of the Activation Energy of Josephson Interlayer Vortices in  $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ .**

J. C. P. Campoy, Y. Kopelevich, S. Moehlecke, and R. Ricardo da Silva.

The anomalous depinning of Josephson interlayer vortices in  $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$  high- $T_c$  superconductor occurring at nearly field-independent temperature  $T_x = 20 \text{ K} - 40 \text{ K}$  has been studied by means of ac susceptibility measurements with magnetic field applied parallel to  $\text{CuO}_2$  planes. From the frequency dependence  $T_x(n_m)$  we define the flux-creep activation energy for Josephson vortices  $U_{Jv}(H)$  which increases with field and shows well defined plateaus. In contrast, the activation energy of in-plane pancake vortices  $U_{pv}(H)$  decreases with field, i. e. demonstrates a qualitatively different behavior.

Physical Review B, accepted on November 2000.

**A 064-00 Non-resonant Microwave Absorption in Bi2212 Single Crystal: Second Peak and Microwave Power Dependence.**

V.V. Srinivasu, Ken-ichi Itoh, Akinori Hashizume, V. Sreedevi, Hideaki Kohmoto, Tamio Endo, R. Ricardo da Silva, Yakov Kopelevich, Sergio Moehlecke, Takami Masui and Kazuya Hayashi

Non-resonant microwave absorption (NMA) measurements were carried out at liquid nitrogen temperature on a high quality Bi2212 single crystal as a function of microwave power in three mutual orientations of crystal ab-plane, dc field ( $H_{dc}$ ) and microwave magnetic field ( $H_w$ ). NMA line shapes in Bi2212 crystal are complicated with a narrow peak ( $P_1$ -peak) located near zero field followed by a much broader second peak ( $P_2$ -peak) in the particular orientations. More excitingly, we show that the  $P_2$ -peak qualitatively evolves as a function of microwave power in the orientation of  $H_{dc} \wedge$  ab-plane;  $H_w //$  ab-plane and  $H_{dc} \wedge H_w$ . In this configuration, as the microwave power is progressively increased, the broad  $P_2$ -peak first gets smeared off and then a multiple peak structure appears which develops into another narrower second peak ( $P_s$ -peak) at high enough microwave powers. In the orientation of  $H_{dc} //$  ab-plane;  $H_w \wedge$  ab-plane and  $H_{dc} \wedge H_w$ , we report for the first time the appearance and disappearance of a new second peak ( $P_2$ -like peak) as a function of microwave power.

Journal of Superconductivity, accepted on October 2000.

## Trabalhos Publicados

**P 018-00 Comparison between Weber's electrodynamics and classical electrodynamics.**

Assis, A. K. T. and Silva, H. T.

We present the main aspects of Weber's electrodynamics and of Maxwell's equations. We discuss Maxwell's point of view related to Weber's electrodynamics. We compare Weber's force with Lorentz's force. We analyse the relation between Weber's law and Maxwell's equations. Finally, we discuss some experiments performed and proposed with which we can distinguish Weber's force from Lorentz's one.

Pramana-Journal of Physics 55[3], 393-404. 2000.

**P 019-00 Status of the solution to the solar neutrino problem based on nonstandard neutrino interactions - art. no. 073001.**

Bergmann, S., Guzzo, M. M., de Holanda, P. C., Krastev, P. I., and Nunokawa, H.

We analyze the current status of the solution to the solar neutrino problem based both on (a) nonstandard flavor-changing neutrino interactions (FCNI) and (b) nonuniversal flavor diagonal neutrino interactions (FDNI). We find that FCNI and FDNI with matter in the Sun as well as in the Earth provide a good fit not only to the total rate measured by all solar neutrino experiments but also to the day-night and seasonal variations of the event rate, as well as the recoil electron energy spectrum measured by the SuperKamiokande Collaboration. This solution does not require massive neutrinos and neutrino mixing in vacuum. Stringent experimental constraints on FCNI from bounds on lepton flavor violating decays and on FDNI from limits on lepton universality violation rule out  $\nu(e) \rightarrow \nu(\mu)$  transitions induced by new physics as a solution to the solar neutrino problem. However, a solution involving  $\nu(e) \rightarrow \nu(\tau)$  transitions is viable and could be tested independently by the upcoming B factories if flavor violating tan decays would be observed at a rate close to the present upper bounds.

Physical Review D 6207[7], 3001-+. 2000.

**P 020-00 Scattering map for two black holes.**

de Moura, A. P. S. and Letelier, P. S.

We study the motion of light in the gravitational field of two Schwarzschild black holes, making the approximation that they are far apart, so that the motion of light rays in the neighborhood of one black hole can be considered to be the result of the action of each black hole separately. Using this approximation, the dynamics is reduced to a two-dimensional map, which we study both numerically and analytically. The map is found to be chaotic, with a fractal basin boundary separating the possible outcomes of the orbits (escape or falling into one of the black holes). In the limit of large separation distances, the basin boundary becomes a self-similar Cantor set, and we find that the box-counting dimension decays slowly with the separation distance, following a logarithmic decay law.

Physical Review e 62[4], 4784-4791. 2000.

**P 021-00 Semi-empirical study of chain conformation and absorption spectra of polyanilines: size, solvent and disorder effects.**

de Oliveira, Z. T. and dos Santos, M. C.

In this paper, we present electronic structure calculations and conformational studies of polyaniline oligomers to investigate the influence of oligomer size, oxidation state and solvent effects in the UV-Vis absorption spectrum. Torsional barrier and solvent effect calculations are carried out within AM1 semi-empirical technique. Absorption spectra are simulated through ZINDO/S-CI calculations. Based on the analysis of the torsion potential curves, an interpretation is given for the diverse thermochromic behavior observed in insulating polyanilines as a function of oxidation state. Pernigraniline base, the fully oxidized form of polyaniline, has been reported to present an unusual redshift in its spectrum with increasing

temperature. The potential energy associated to ring twisting calculated for pernigraniline exhibits a double well shape, which is different from the potentials obtained for the other forms. We concluded that the chain flexibility depends strongly on the oxidation state and is the source of the diverse chromic behavior.

**Chemical Physics 260[1-2], 95-103. 2000.**

**P 022-00 Structure and property relationships of amorphous CN<sub>x</sub>: A joint experimental and theoretical study.**

dos Santos, M. C. and Alvarez, F.

Amorphous CN<sub>x</sub> and CN<sub>x</sub>:H have been prepared by the ion beam assisted deposition technique. Samples were characterized through X-ray and UV photoemission, IR absorption and Raman spectroscopies. These spectra have been interpreted with the aid of quantum chemical calculations based upon the Hartree-Fock theory on several molecular models. The understanding of the electronic and structural properties of the amorphous alloy as a function of nitrogen content could help in the task of synthesizing the metastable silicon-nitride like-phase beta-C<sub>3</sub>N<sub>4</sub>, a solid which has been predicted to be as hard as diamond. The physical picture emerging from the present study helps to clarify the difficulties in obtaining the crystalline phase of the material, suggesting new experimental directions for syntheses.

**Brazilian Journal of Physics 30[3], 499-507. 2000.**

**P 023-00 Periodic Anderson model from the atomic limit: The optical conductivity of FeSi.**

Foglio, M. E. and Figueira, M. S.

The optical conductivity  $\sigma(\omega, T)$  can be obtained with the same approximations employed in a previous work to calculate the static conductivity  $\alpha(T)$  and magnetic susceptibility  $\chi(T)$  of FeSi, a compound that behaves like a Kondo insulator with both quantities vanishing rapidly for  $T \rightarrow 0$ ; the periodic Anderson model (PAM) for  $U \rightarrow \infty$  was employed to model FeSi, assuming that the system is in the intermediate valence region. The same treatment is employed in the present paper to describe the three properties for the same compound, and a fairly good agreement with the experimental results is obtained. The sum rule of  $\sigma(\omega, T)$ , appropriate for the PAM, is well satisfied in the range of the experimentally measured temperatures. Some quantities derived from our results are of the same order of magnitude that was estimated from recent measurements of angle-resolved low-temperature photoemission in FeSi.

**Physical Review B 62[12], 7882-7891. 2000.**

**P 024-00 On positron radiation belt in the Earth's magnetosphere.**

Gusev, A. A., Jayanthi, U. B., Martin, I. M., Pugacheva, G. I., and Spjeldik, W. N.

The ratio of positron/electron fluxes originated in nuclear spallation reactions in the Earth's magnetosphere is considered. It is supposed that positrons as well as electrons are produced in the decay of charged pions ( $\pi^{+/-} \rightarrow \mu^{+/-} \rightarrow e^{+/-}$ ) born in nuclear collisions of trapped relativistic inner zone protons with the residual atmosphere. These positrons and electrons are captured in the

magnetosphere and create positron and electron radiation belts of nuclear origin. The positron/electron trapped magnetospheric fluxes formed with this mechanism are simulated and the resulting computed  $e^{+}/e^{-}$  flux ratio approximate to 4 appears in agreement with the recent observations. This ratio is significantly different from the ratio approximate to 1 obtained from the primary cosmic ray source through the same mechanism.

**Brazilian Journal of Physics 30[3], 590-593. 2000.**

**P 025-00 Cellulose aluminium oxide coated with organofunctional groups containing nitrogen donor atoms.**

Lazarin, A. M., Gushikem, Y., and de Castro, S. C.

A composite of cellulose and aluminium oxide, cel/Al<sub>2</sub>O<sub>3</sub>, was prepared and further modified with organofunctional groups by reacting with the coupling reagent (C<sub>2</sub>H<sub>5</sub>O)<sub>3</sub>SiL, where L represents -(CH<sub>2</sub>)<sub>3</sub>NH<sub>2</sub>, -(CH<sub>2</sub>)<sub>3</sub>NH(CH<sub>2</sub>)<sub>2</sub>NH<sub>2</sub>, -(CH<sub>2</sub>)<sub>3</sub>NH(CH<sub>2</sub>)<sub>2</sub>NH(CH<sub>2</sub>)<sub>2</sub>NH<sub>2</sub> or -(CH<sub>2</sub>)<sub>3</sub>N(C<sub>3</sub>H<sub>3</sub>)N [-N(C<sub>3</sub>H<sub>3</sub>)N = imidazolyl radical], abbreviated to ap, enp, dienp and imp, respectively. The experimental preparation procedures were very reproducible and resulted in the following values for the amount of organofunctional groups grafted on cel/Al<sub>2</sub>O<sub>3</sub> (average values in mmol g<sup>-1</sup>): cel/Al<sub>2</sub>O<sub>3</sub>/Si(ap) = 0.35; cel/Al<sub>2</sub>O<sub>3</sub>/Si(enp) = 0.30; cel/Al<sub>2</sub>O<sub>3</sub>/Si(dienp) = 0.25 and cel/Al<sub>2</sub>O<sub>3</sub>/Si(imp) = 1.0. The Al-27 MAS NMR spectra, which show an intensification of the area under the peak at 62 ppm due to Al in a tetrahedral environment, and the increase of the Al/C atomic ratios (determined from X-ray photoelectron spectra) after reaction with the coupling reagents indicate that Al atoms have migrated to the surface. This indicates that (C<sub>2</sub>H<sub>5</sub>O)<sub>3</sub>SiL is adsorbed on the matrix surface and reacts with the AlOH groups forming Al-O-Si bonds. The adsorption isotherms from ethanol solutions of FeCl<sub>3</sub>, CuCl<sub>2</sub> and ZnCl<sub>2</sub> were obtained at 298 K. The average stability constants were determined for each metal halide and the results indicated that the constants for the bi- and tridentate ligands, enp and dienp, are slightly higher than those for ap and imp, both monodentate ligands.

**Journal of Materials Chemistry 10[11], 2526-2531. 2000.**

**P 026-00 Hardness and stress of amorphous carbon films deposited by glow discharge and ion beam assisting deposition.**

Marques, F. C. and Lacerda, R. G.

The hardness and stress of amorphous carbon films prepared by glow discharge and by ion beam assisting deposition are investigated. Relatively hard and almost stress free amorphous carbon films were deposited by the glow discharge technique. On the other hand, by using the ion beam assisting deposition, hard films were also obtained with a stress of the same order of those found in tetrahedral amorphous carbon films. A structural analysis indicates that all films are composed of a sp<sup>2</sup>-rich network. These results contradict the currently accepted concept that both stress and hardness are only related to the concentration of sp<sup>3</sup> sites. Furthermore, the same results also indicate that the sp<sup>2</sup> sites may also contribute to the hardness of the films.

**Brazilian Journal of Physics 30[3], 527-532. 2000.**

**P 027-00 Unitary transformation approach for the trapped ion dynamics.**

Moya-Cessa, H., Vidiella-Barranco, A., Roversi, J. A., and Dutra, S. M.

We present a method of treating the problem of the interaction of a single trapped ion with laser beams based on successive applications of unitary transformations onto the Hamiltonian. This allows the diagonalization of the Hamiltonian, by means of recursive relations, without performing the Lamb-Dicke approximation.

*Journal of Optics B-Quantum and Semiclassical Optics* 2[1], 21-23. 2000.

**P 028-00 Considerations on nonequilibrium entropy and temperature.**

Ramos, J. G., Vasconcellos, A. R., and Luzzi, R.

Several aspects of the Thermodynamics of systems away from equilibrium are considered. Particular attention is given to the question of the concepts of entropy and temperature in arbitrary nonequilibrium conditions. Even though such state function and thermodynamic variable are elusive in such conditions, it is elaborated and discussed an approach to them that can be obtained in the framework of the so-called Informational Statistical Thermodynamics. This is the approach to Thermodynamics based on the statistical-mechanical foundations provided by a Gibbs ensemble-like algorithm in nonequilibrium situations. The resulting nonequilibrium temperature-like variable dubbed as quasitemperature - is shown to be a quantity measurable with appropriate "thermometric devices". A comparison of quasitemperatures that arise in different approximated nonequilibrium statistical-thermodynamic descriptions of the dissipative system is done. The validity of these different approximations is evaluated, and (in the framework of the theory) generalized Gibbs, Clausius, and Boltzmann's relations, as well as properties of the corresponding entropy-like function (or informational entropy in Jaynes-Shannon sense), that the theory introduces, are presented. Conceptual and physical aspects of the question are also discussed, and a partial comparison of these concepts with those arising in other approaches to irreversible thermodynamics is briefly attempted. This article is an enlargement of a paper in *Fortschritte der Physik/Progress of Physics*, 47, 9 (1999), where have been added extensive comments on the subject.

*Brazilian Journal of Physics* 30[3], 617-646. 2000.

**P 029-00 Effects of magnetohydrodynamics matter density fluctuations on the solar neutrino resonant spin-flavor precession.**

Reggiani, N., Guzzo, M. M., Colonia, J. H., and de Holanda, P. C.

Taking into account the stringent limits from helioseismology observations on possible matter density fluctuations described by magnetohydrodynamics theory, we find the corresponding time variations of solar neutrino survival probability due to the resonant spin-flavor precession phenomenon with amplitude of order  $O(10\%)$ . We discuss the physics potential of high statistics real time experiments, like as Superkamiokande, to observe the

effects of such magnetohydrodynamics fluctuations on their data. We conclude that these observations could be thought as a test of the resonant spin-flavor precession solution to the solar neutrino anomaly.

*Brazilian Journal of Physics* 30[3], 594-601. 2000.

**P 030-00 Magnetic-field effects on shallow impurities in semiconductor GaAs-(Ga,Al)As quantum wells and superlattices within a fractional-dimensional space approach.**

Reyes-Gomez, E., Perdomo-Leiva, C. A., Oliveira, L. E., and Dios-Leyva, M.

We have used the fractional-dimensional space approach to study the effects of applied magnetic fields on shallow-impurity states in GaAs-(Ga,Al)As quantum wells and superlattices. In this scheme, a semiconductor heterostructure is treated as isotropic in an effective fractional-dimensional space, and the value of the fractional dimension is associated to the degree of anisotropy introduced both by the heterostructure barrier potential and applied magnetic field. Theoretical fractional-dimensional calculations for shallow-impurity states in GaAs-(Ga,Al)As semiconductor quantum wells and superlattices, under magnetic fields applied along the growth direction, were shown to be in overall agreement with available experimental measurements and previous variational calculations.

*Physica e* 8[3], 239-247. 2000.

**P 031-00 Structural effects in the EPR spectra of Ni<sup>3+</sup> in La<sub>2</sub>Ni<sub>0.5</sub>Li<sub>0.5</sub>O<sub>4</sub>.**

Urbano, R. R., Garcia, A., Granado, E., Sanjurjo, J. A., Torriani, I., Rettori, C., Oseroff, S. B., Hassan, A., Martins, G. B., Fisk, Z., Pagliuso, P. G., Sarrao, J. L., and Caciuffo, R.

Electron paramagnetic resonance (EPR), Raman scattering, and neutron- and x-ray-diffraction experiments were performed in polycrystalline samples of La<sub>2</sub>Ni<sub>0.5</sub>Li<sub>0.5</sub>O<sub>4</sub> as a function of temperature. Structural studies confirm a partial cation ordering of Ni and Li at the metal sites. As the temperature decreases, EPR measurements show an increasing g-value anisotropy (g(perpendicular to)-g(parallel to)) and neutron and x-ray-diffraction experiments an increase of the c/a ratio. These results are interpreted in terms of the stabilization of the Ni<sup>3+</sup>(3d<sup>7</sup>)(2)A(1g) low-spin configuration in the NiO<sub>6</sub> Jahn-Teller distorted octahedra.

*Physical Review B* 62[14], 9593-9598. 2000.

**P 032-00 Topological quantization of the magnetic flux.**

Wisnivesky, D.

We discuss the quantum problem of a charged particle in a multiply connected region encircling a magnetic tube, using a theory in which space and internal coordinates are derived from the parameters of a linear group of transformations (group space quantum theory). Based only on symmetry considerations, we show that, the magnetic flux in the tube must be quantized in multiples of the Dirac monopole charge

*Modern Physics Letters A* 15[24], 1491-1495. 2000.

# Abstracta

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