PLENARY TALKS and SEMINARS

Group and Algebraic Methods and Hamiltonian Systems (Monday, 04/24)

Plenary Talks

- **Boris Dubrovin** (SISSA, Italy)

  Universality problems in Hamiltonian PDEs

  Certain properties of solutions to nonlinear PDEs turn out to be essentially independent on the choice of initial data; they also manifest remarkable stability with respect to small deformations of the PDE. Such properties were first discovered in the study of eigenvalue distributions in large N random matrices, they also appear in the Fermi - Pasta - Ulam numerical experiments and in the theory of weakly dispersive waves. In the talk it will be presented a general point of view on the universality phenomena using the theory of Hamiltonian perturbations of hyperbolic PDEs.

- **Robert Coquereaux** (CPT, Marseille, France)

  Quantum Symmetries of Graphs and Higher Coxeter-Dynkin Systems

  At the end of the eighties, it was shown by Cappelli, Itzykson, Zuber that conformal field theories like affine WZW models of type $SU(2)$ or minimal (Virasoro) models can be classified in terms of ADE Dynkin diagrams. A few years later, new kinds of diagrams have been introduced by Di Francesco and Zuber in order to classify conformal field theory models of type $SU(3)$. We describe quantum symmetries of Dynkin diagrams or of their higher analogues

by associating with every such graph a quantum groupoid (a weak Hopf algebra) and two algebras of characters: the first is related with the set of irreducible representations of quantum groups at roots of unity and the other with the so-called Ocneanu graph of quantum symmetries. To every such quantum groupoid correspond several sets of generalized Racah-Wigner coefficients (Ocneanu cells or generalized 6J symbols). Results can also be interpreted in terms of fusion categories. The aim of this seminar is to present a general introduction to the above ideas.

Seminars

- **Ademir Eugênio de Santana** (Instituto de Física, Universidade de Brasília, Brazil), in collaboration with J. A. Cardeal (1), M. de Montigny (2), F. C. Khanna (2,3) and T. M. Rocha Filho (4) ((1) UEFS, (2) Univ. Alberta, Canada, (3) TRIUMF, Canada, (4) UnB)

  Gauge Symmetries in Fokker-Planck Dynamics

  We use a covariant Galilean formalism, based in the light-cone of the (4+1) Minkowski space, to introduce a U(1)-gauge invariant Lagrangian written in Riemannian manifold, say R, such that, with a proper choice for the gauge condition, the Fokker-Planck equation is derived. The metric (and so the connection) in R is defined with the diffusion tensor, which is in turn investigated with Lie group methods applied to differential equations. Our main results include the extension of the formalism for non-abelian gauge groups, in particular considering the $SU(2)$ symmetry, and some analytical expressions derived for the drift and diffusion terms.

- **Anatol Odzijewicz** (University in Bialystok, Poland)

  Banach Lie-Poisson Spaces and Quantization

  The predual Banach space $\mathfrak{g}_*$ of Banach Lie algebra $\mathfrak{g}$ fulfilling the condition $\mathrm{ad}^*_x\mathfrak{g}_* \subset \mathfrak{g}_*$, for $x \in \mathfrak{g}$, has canonically defined Poisson bracket, i.e. it is Banach Lie-Poisson space. In particular the predual of W^*-algebra form the subcategory in the category of Banach Lie-Poisson spaces. We will present a method of quantization related to the above structures. Examples illustrating this method will be also presented. References 1. A . Odzijewicz, T. Ratiu, Banach Lie-Poisson spaces and reduction, Comm. Math. Ph. 243(1) 1-54 2003, http://arxiv.org/abs/math.SG/0210207 2. A . Odzijewicz, Coherent States and Geometric Quantization, Commun. Math. Phys. 150 385-413 1992

- **Ricardo Antonio Mosna** (IMECC - UNICAMP, Brazil), in collaboration with Marcos B. Jardim

  Nonsingular Solutions of Hitchin's Equations for Noncompact Gauge Groups

  Let G be a real form of the complex Lie group $SL(2, C)$. We consider a general ansatz for solving the 2-dimensional Hitchin's equations associated to G, which arise as dimensional reduction of the 4-dimensional anti-self-dual Yang-Mills equation, with remarkable integrability properties. For $G = SO(2, 1)$, the resulting field equations are shown to reduce to either the Liouville, elliptic sinh-Gordon or elliptic sine-Gordon equations. As opposed to the compact case, given by $G = SU(2)$, the field equations associated with the group $SO(2, 1)$ are shown to have nonsingular solutions with nondiverging actions. We conclude by discussing

some particular solutions, defined on R^2, S^2 and T^2, that come out of this ansatz.

Integrable Systems and Gauge Theories (Tuesday, 04/25)

Plenary Talks

- **Faqir Khanna** (Univ. of Alberta, Canada)

  Ward-Takahashi Relations: Longitudinal and Transverse

  Ward [1] wrote down a relation between the vertex and the electron propagator in Spinor QED in 1950. This was generalised to arbitrary fields by Takahashi [2] in 1957. These relations provided the only non-perturbative results for a Quantum Field Theory. These relations provided consistency conditions in solutions in Quantum Field Theory and Many-body Physics, where perturbative treatments were used. The results in perturbative treatment were required to satisfy the basic symmetry aspects in the problem. Use of Ward-Takahashi relations was crucial in getting results that satisfied the symmetry of the problem. However it was noticed soon that the results provided only a limitation on the longitudinal part of the vertex function. The transverse part was not constrained by these relations. In 1977, Takahashi [3] proposed as way out of this dilemma. Recently we have developed this technique that allows us to write down non-perturbative relations that restrict the transverse part of the vertex. Some recent results will be presented for a Fermion-Boson vertex at one loop order. This development makes the generalised Ward-Takahashi relations much more useful in the study of covariant Gauge theories.

References

[1] J. C. Ward, Phys. Rev. 78 (1950) 182. [2] Y. Takahashi, Nuovo Cimento 6 (1957) 370. [3] Y. Takahashi, Phys. Rev. D15 (1977) 1589.

Seminars

- **André Fonseca** (Departamento de Matemática, Faculdade de Engenharia Industrial - São Bernardo do Campo, Brazil)

  Solitons Bifurcations in Presence of Surface Tension

  In this work we apply a non pertubative approach to analyse solitons bifurcation in presence of surface tension, which is a reformulation of standard methods based on the reversibility proprieties of the system. The hypothesis are non restrictive and the results can be extended to a much wider variety of systems. The usual idea of tracking intersections of unstable manifolds with some invariant set is again used, but reversibility plays important role establishing in a geometrical point of view some kind of symmetry which, in a classical way, is unknown or non existent. Using a computer program we determine soliton solutions and also their bifurcations in the space of parameters giving a picture of the structural distribution to phase and amplitude shifts phenomena.

- **Dmitri Gitman** (Departamento de Física Nuclear - Universidade de São Paulo, Brazil), in collaboration with Igor Tyutin

  Symmetries and Constraint Structure of General Gauge Theory

The aim of the present work is to relate symmetries and constraint structure of a general gauge theory. To this end, we analyze a symmetry equation in a special orthogonal constraint basis and derive, thus, a general structure of symmetries of a general gauge theory. We construct a general expression for the gauge charge as a decomposition in the orthogonal constraint basis. These results allow us to identify physical functions defined as commuting with first-class constraints in the Hamiltonian formulation and defined as gauge invariant functions in the Lagrangian formulation. In particular, we prove the famous Dirac conjecture.

- **Johan Peter Goedbloed** (FOM - Institute for Plasma Physics 'Rijnhuizen', Netherlands)

  Magnetohydrodynamic Spectral Theory of Laboratory and Astrophysical Plasmas

  Spectral theory of linear waves and instabilities of magnetohydrodynamics (MHD) describes an enormous variety of plasma dynamics in the laboratory and in the Universe. The reason is the abundance of plasmas: more than 90% of visible matter in the Universe is plasma, whereas dark matter may have a substantial plasma component as well. The theoretical basis comes from the fact that MHD spectral theory can be cast in a completely analogous form to that of quantum mechanics: the MHD force operator is self-adjoint in the Hilbert space of plasma displacement vectors [1]. Nevertheless, MHD spectral theory is still very incomplete at present. In particular, group theoretical investigation of symmetry properties has hardly been undertaken.

Considering the central role plasmas are to play in a future model of the Universe, this calls for a major mathematical effort.

Probably, the complicating factor is the omni-presence of large background flows, which are often supersonic (surpass one the three critical MHD speeds), implying that the standard picture developed for static plasmas breaks down: Plasma dynamics is to be described by non-selfadjoint operators and the necessary background states are frequently transonic. The mathematical problems associated with these two features are enormous, but recently found monotonicity properties of the complex spectrum and singularities in the equilibrium flows provide confidence that a meaningful structure will eventually emerge.

This will be illustrated with recent results on the spectrum of accretion disks [2] and new instabilities driven by transonic transitions of the flow that involve singular trans-slow Alfven modes with a continuous spectrum [3]. Except that these instabilities appear to have exciting physical properties (facilitating accretion flows and jet formation), they have quite interesting geometrical properties as well since they live on the curved two-dimensional surfaces spanned by the plasma velocity and magnetic fields.

[1] J.P. Goedbloed and S. Poedts, Principles of Magnetohydrodynamics (Cambridge University Press, 2004); ISBN 0521626072.

[2] R. Keppens, F. Casse, and J.P. Goedbloed, Waves and instabilities in accretion disks: Magnetohydrodynamic spectroscopic analysis, Astrophys. J. 569, L121L126 (2002).

[3] J.P. Goedbloed, A.J.C. Beliën, B. van der Holst, and R. Keppens, Unstable continuous spectra of transonic axisymmetric plasmas, Phys. Plasmas 11, 2854 (2004).

Quantum Field Theory (Tuesday, 04/25)

Plenary Talks

- **Olivier Piguet** (UFES, Brazil)

  A Vector Supersymmetry Killing the Infrared Singularity of Gauge Theories in Noncommutative space

  We show that the "topological BF-type" term introduced by Slavnov in order to cure the infrared divergences of gauge theories in noncommutative space can be characterized as the consequence of a new symmetry. This symmetry is a supersymmetry, generated by vector charges,of the same type as the one encountered in Chern-Simons or BF topological theories (Work done in collaboration with Daniel N. Blaschke (Technische Universität Wien), François Gieres (Université de Lyon I) and Manfred Schweda (Technische Universität Wien)).

Seminars

- **Jorge M. C. Malbouisson** (Instituto de Física, Universidade Federal da Bahia, Brazil), in collaboration with F. C. Khanna, A. P. C. Malbouisson and A. E. Santana

  Compactified Large-N Gross-Neveu Model at Finite Temperature

  We consider the N-components D-dimensional Euclidean massive Gross-Neveu model, confined in a $(D-1)$-dimensi-

onal cubic box (edge L), at finite temperature (T). Using ζ-function analytical regularization, we determine the large-N effective coupling constant (g) as a function of L, T and the fixed coupling constant (λ), for the cases $D = 2, 3, 4$. In all cases, we find that g tends to 0 when L goes to 0 or T goes to infinity, corresponding to an "asymptotic freedom" type of behavior. For finite L and T, distinct behaviors appear depending on the value of λ. For small λ only "asymptotic freedom" occurs. However, for λ greater than a "critical" value (λ_c), starting from small values of L (and low enough temperatures), a divergence of g appears as L approaches a value $L_c(\lambda)$ which lies in a finite interval for $\lambda \geq \lambda_c$. Such behavior suggests that the system becomes spatially confined in a box of size $L_c(\lambda)$ if λ is large enough. If the temperature is raised, the divergence desappears at a temperature T_d which can be seen as a deconfining temperature. Taking the fermionic mass as the constituent quark mass, the confining length and the deconfining temperature obtained are comparable with the estimated values for hadrons.

- **Rubens Luis Pinto Gurgel do Amaral** (Instituto de Física, Universidade Federal Fluminense, Brazil), in collaboration with L. V. Belvedere and K. D. Rothe

  Bosonization within Thermofield Dynamics Approach

  We consider the two-dimensional free massless scalar field within the thermofield dynamics approach. The corresponding two-point function exhibits two infrared singularities, one similar to the zero temperature case and a new temperature dependent one, implying an indefinite-metric Hilbert

space on which the massless scalar thermofield acts. We show that one can nevertheless define positive definite Wick ordered exponentials of a massless scalar thermofield, provided we associate with them a conserved charge (superselection rule). We also consider the two-dimensional Fermi thermofield and compute the corresponding two-point function. We use the Wick-ordered exponentials of the free massless scalar thermofield as building blocks for the operator thermofield bosonization of the free massless Fermi field and show that the Fermi thermofield satisfies the correct statistics. We further compute the fermion thermofield current by a point-splitting limit and verify that the current satisfies the usual bosonization correspondence. We further illustrate the use of thermofield bosonization by solving the massless Thirring model at finite temperature.

Quantum Field Theory (Wednesday, 04/26)

Plenary Talks

- **Carmen Nuñez** (IABA, Argentina)

  Free fields for non-RCFT?

  The free field realization of rational conformal field theories has played a crucial role to determine the structure of minimal models and of WZW models on compact groups. In this talk we will discuss the possibility of extending the free field representation of RCFT to non RCFT. We will consider in particular the non compact $SL(2,R)$-WZW model and compare the exact results of correlation functions of primary fields with those computed in the free field approximation.

- **Floyd Leroy Williams** (Univ. of Massachussetts, EUA)

  Remarks on the BTZ Instanton with Conical Singularity

  We consider the topology,trace formula,effective action,and the Mann-Solodukhin quantum correction to the entropy of the BTZ instanton with a conical singularity at its horizon.The trace formula,in particular,provides for an alternate approach to the Patterson resolvent formula. The effective action and black hole entropy correction are expressed in terms of a suitable zeta function deformation.

Seminars

- **Antônio José Accioly** (LAFEX-CBPF and Instituto de Física Teórica - UNESP, Brazil), in collaboration with Marco Dias (IFT-UNESP)

  Boson-Boson Bound States in Higher-Derivative Electromagnetism Augmented by a Chern-Simons Term

  A rough comparison between the number of boson-boson bound states in the electromagnetic theories of Podolsky-Chern-Simons and Maxwell-Chern-Simons, is drawn appealling to Bargmann's condition. This approximate calculation shows that the higher-derivative terms are responsible for a remarkable increase in the number of bound states.

- **Aram Saharian** (Department of Physics, Yerevan State University, Armenia and Depto. de Física, Universidade Federal da Paraíba, Brazil)

  Generalized Abel-Plana Formula as a Renormalization Tool in Quantum Field Theory with Boundaries

  Applications of the generalized Abel-Plana formula are described for the evaluation of the vacuum expectation values

of the energy-momentum tensor in quantum field theory with boundaries. Various boundary geometries are considered.

- **Eugênio R. Bezerra de Mello** (Departamento de Física, Universidade Federal da Paraíba, Brazil)

  Vacuum Polarization Effects in Higher Dimensional Global Monopole Spacetime

  We analyse the vacuum polarization effects associated with a massless scalar field in a higher dimensional global monopole spacetime, admitting a non-vanishing curvature coupling between the field and the geometry. Specifically we calculate the renormalized vacuum expectation value of the square of the field. In order to develop this analysis we construct the general Euclidean Green function. We also investigate the general structure of the renormalized vacuum expectation value of the energy-momentum tensor.

- **Fabio Braghin** (Instituto de Física - Universidade de São Paulo, Brazil)

  Free Parameters in Quantum Theories: an Analysis with the Variational Approximation

  The usual renormalization procedure for the gaussian variational appoach for the $\lambda\phi^4$ model is reanalysed. Privileged values of the free parameters (mass and coupling constant) and the stability of the approximation is also investigated differently from done before. The minimization of the renormalized energy density with respect to the free parameters (bare or renormalized ones) is done and several results can be different from the same procedure for

the regularized theory. Some parameters are placed in the complex plane, in particular the physical mass. The behavior of the expected value of the field as an order parameter is investigated all along the work.

- **Jorge Gamboa** (Universidad de Santiago de Chile, Chile)

  Lorentz Invariance Violation and Neutrino Physics

  We propose that a tiny violation of Lorentz and CPT symmetry may be enough to explain the solar and atmospheric neutrino puzzle as well as the LSND anomaly. We present a toy model to support such an assertion. In this scenario neutrino oscillation can arise even for massless neutrinos (or neutrinos degenerate in mass).

- **Márcio José Martins** (Universidade Federal de São Carlos, Brazil)

  Integrable Lattice Models Based on Superalgebras

  In this talk we will discuss trigonometric vertex models associated with solutions of the Yang-Baxter equation which are invariant relative to q-deformed superalgebras. The associated R-matrices are presented in terms of the standard Weyl basis and novel solvable lattice models not predicted before are pointed out. This approach allowed us to formulate the quantum inverse scattering method for a large class of integrable models invariant by superalgebras from a unified point of view.

- **Silvio Paolo Sorella** (Universidade Estadual do Rio de Janeiro, Brazil), in collaboration with D. Dudal, M. Capri, J. Gracey, V. Lemes, R, Sobreiro, and H. Verschelde

Infrared behavior of the gluon and ghost propagators in Yang-Mills theories

Dimension two gauge condensates and their role for the infrared behavior of the gluon and ghost propagators in nonabelian gauge theories are reviewed. A few remarks on the issue of the gauge invariance of these condensates are presented.

Principles of Quantum Theory (Thursday, 04/27)

Plenary Talks

- **Jean Pierre Gazeau** (Univ. Paris VII, France)

  A Survey of Recent Results for Quantum Field Theory in de Sitter Space

  We present a survey of rigourous quantization results obtained in recent works on quantum free fields in de Sitter space-time. For the massive cases which are associated to principal series representations of the de Sitter group $SO_0(1,4)$, the construction is based on analyticity requirements on the Wightman two-point function. For the massless cases (e.g. minimally coupled or conformal), associated to the discrete series (and possibly to the complementary series), the quantization schemes are of the Gupta-Bleuler-Krein type. Some hints will be given on the question of interacting fields in de Sitter.

  References

  [1] R. Bousso, A. Maloney, A. Strominger, Phys. Rev. D 65, 104039 (2002). [2] R. Hollands, R. Wald, Commun. Math. Phys., 231, (2002). [3] P.Bartesaghi, J-P. Gazeau,

U. Moschella and M. V. Takook, Dirac fields and thermal effects in de Sitter universe, Class. Quant. Grav., 18, 4373 (2001). J-P. Gazeau and M. V. Takook, Massive vector fields in de Sitter space J. Math. Phys., 41, 5920 (2000) et J. Math. Phys., 43, 6379 (2002). T. Garidi, J-P. Gazeau and M. V. Takook, Massive spin-2 field in de Sitter space, J. Math. Phys., 44, 3938 (2003). [4] T. Garidi, J-P. Gazeau, and M. V. Takook, Massless vector field in de Sitter space, in preparation. [5] J-P. Gazeau, J. Renaud, M. V. Takook, Gupta-Bleuler Quantization for minimaly coupled Scalar Fields in de Sitter Space Class. Quant. Grav, 17, 1415 (2000). [6] T. Garidi, E. Huguet and J. Renaud, de Sitter waves and the zero curvature limit Phys. Rev. D., 67, 124028 (2003). [7] J. Bros, H. Epstein and U. Moschella, The asymptotic symmetry of de Sitter spacetime, Phys. Rev. D 65, 084012 (2002). [arXiv:hep-th/0107091].

Seminars

- **Bert Schroer** (TEO-CBPF, Brazil)

  Holography, its Bondy-Metzner-Sachs Symmetry Group and Localization-Entropy

  After briefly illustrating the holography (for a wedge region and a double cone) in case of a free field, I will explain how modular localization theory generalizes this in the presence of interactions. Here I will freely use the modular concepts which Jens Mund introduced in his prior talk on "Modular localization and string-localized quantum fields". The holographic projections have an easily recognizable infinite dimensional BMS-like symmetry group which in the case of double cone holography is actually identical to the classical

Bondi-Metzner-Sachs group in the Penrose setting. Holography is extremely useful to define and calculate localization entropy which turns out to have a surprising connection to the global heat bath entropy density of thermal QFT on the lightfront.

- **Jens Mund** (Departamento de Física, Universidade Federal de Juiz de Fora, Brazil), in collaboration with B. Schroer and J. Yngvason

  String-Localized Quantum Fields and Modular Localization

  The concept of modular localization introduced by Brunetti, Guido and Longo, and Schroer, can be used to construct quantum fields. I shall report on the construction of free fields which are localized in semi-infinite strings extending to spacelike infinity. Particular applications are - massless 'infinite spin' particles - Anyons in 2+1 dimensions - string-localized vector potential for photons.

Classical and Quantum Gravity and Cosmology (Thursday, 04/27)

Plenary Talks

- **Emilio Elizalde** (IEEC, Spain)

  On Zeta Regularization and Some of its Uses in Cosmology

  Zeta regularization has proved to be a powerful and reliable tool for the regularization of the vacuum energy density in ideal situations. With the additional help of the Hadamard calculus, it can been shown to provide finite (and meaningful) answers too in much involved cases, as when imposing

physical boundary conditions (BCs) in two– and higher–dimensional surfaces (being able to mimic in a very convenient way other ad hoc cut-offs, as non-zero depths). These recent developments will be described in the first part of the presentation. Recently, these techniques have been also used in calculations of the contribution of the vacuum energy of the quantum fields pervading the universe to the cosmological constant (cc). Naive calculations of the absolute contributions of all known fields lead to a value which is off by roughly 120 orders of magnitude, as compared with the results obtained from observational fits, what is known as the new cosmological constant problem. This is very difficult to solve and we are not going to address such issue directly.

What we will consider are the additional contributions to the cc that may come from the possibly non-trivial topology of space and from specific boundary conditions imposed on braneworld models (kind of Casimir effects at a cosmological scale). Assuming one will be able to prove (in the future) that the ground value of the cc is zero (as some have always suspected), we will then be left with this incremental value coming from the topology or Bcs. This value can be shown to acquire the correct order of magnitude – corresponding to the one coming from the observed acceleration in the expansion of our universe – in a number of reasonable situations involving small and large compactified scales and/or brane BCs.

- **Mário Novello** (ICRA/CBPF, Brazil)

  The Cosmological Constant and the Mass of the Graviton

Recently, a new formulation to deal with the consistency problem of both massive and massless spin-2 fields in arbitrary curved spacetime was presented. Using three-index tensor (Fierz-frame) to represent the spin-2 field it was shown how to avoid the arbitrariness and inconsistency that exist in the standard (Einstein-frame) formulation of a spin-2 field that deals with a second order symmetric tensor. As a consequence of this a relation between the fundamental (bare) cosmological constant and the mass of the graviton appears. As a by-product it is possible to associate the so called cosmological puzzle — i.e., the enormous value of the ratio $\rho_{\rm Planck}/\rho_{\rm vac} \approx 10^{120}$ - to the total number of gravitons in the observable universe.

Seminars

- **Henrique Pereira de Oliveira** (Instituto de Física, Universidade Estadual do Rio de Janeiro, Brazil)

  Spectral Methods in Gravitation and Cosmology

  General Relativity is a nonlinear field theory, and for this reason there are few relevant exact solutions of the field equations. Numerical techniques are possibly the only way of dealing with the intrinsic nonlinearities of the field equations. Therefore, we intend to present some interesting applications of the Galerkin and pseudospectral methods in problems of Gravitation and Cosmology, where minimum computational effort is usually sufficient for the knowledge of the basic physical aspects of the system under consideration.

- **Ilya Shapiro** (Departamento de Física, Universidade Federal de Juiz de Fora, Brazil)

Local Conformal Symmetry and its Fate at Quantum Level

The purpose of this talk is to present a short review of local conformal symmetry in curved 4d space-time. Furthermore we discuss the conformal anomaly and anomaly-induced effective actions. Despite the conformal symmetry is always broken at quantum level, it may be a basis of useful and interesting approximations for investigating quantum corrections.

- **Victor de Oliveira Rivelles** (Instituto de Física, Universidade de São Paulo, Brazil)

  Noncommutative Gravity

  We consider a gravity theory where the noncommutative parameter is a covariantly constant tensor so that it can be coupled to the geometric tensors in a natural way. We find that the theory is invariant under a restricted class of volume preserving transformations thus leading to unimodular gravity. The correction to the Newtonian potential is found. The Moyal product in curved spacetime is defined by replacing ordinary derivatives by covariant ones and becomes non-associative.

Strings, Branes and Supersymmetric Theories (Friday, 04/27)

Plenary Talks

- **Loriano Bonora** (SISSA, Italy)

  Gravitational Droplets and String Field Theory

  The talk concerns the analogy between a class of 1/2 BPS solutions of $N = 4$, $U(N)$, SYM theory in 4d and a parallel

class of solutions of vacuum bosonic string field theory. The correspondence is striking and is all but accidental. It stems from the possibility to represent 1/2 BPS states by means of fermionic systems and on a perfect isomorphism between systems of fermions and solutions of vacuum string field theory. The large N limit shapes these systems into droplets that are seen to describe to 1/2 BPS supergravity solutions. It is argued that this correspondence fits very well into open-closed string duality. The talk will also analyse the problem of finding analogous solutions in superstring field theory.

- **Nathan Jacob Berkovits** (IFT/UNESP, Brazil)

  On the Calculation of Superstring Multiloop Amplitudes

  In this talk, I will review the different methods for computing multiloop amplitudes in superstring theory. These methods include the light-cone Green-Schwarz formalism, the light-cone and covariant Ramond-Neveu-Schwarz formalism, and the covariant pure spinor formalism. The pure spinor formalism is the only method which preserves all symmetries of the target space, and is the most convenient method for analyzing the finiteness and duality properties of the scattering amplitudes.

Seminars

- **Edmundo Marinho do Monte** (Departamento de Física, Universidade Federal da Paraíba, Brazil)

  Change of the Bulk's Signature with Change of the Brane-World's Topology

In the present paper we make a brief review about the immersion problem in physics and prove that if we have $Y : (M^n, g) \longrightarrow (\bar{M}^D, \bar{g})$, a local isometric embedding, a topology τ'_η of $Y(W^n)$ different of the induced topology τ_η of the $Y(W^n)$ (W^n a neighborhood of $p \in M^n$), and the determinants of the metric tensor g_{ij} and $g'_{\mu\nu}$ are not equal in sign at a point, then there is a change of signature of the bulk, $(\bar{M}^D, \bar{g})$. We use the Schwarzschild space-time as a brane-world embedded in the six-dimensional bulk and a change of topology via Kruskal metric obtaining in this form a signature change that bulk.

- **Francesco Toppan** (TEO-CBPF, Brazil)

  New Results in Supersymmetric Quantum Mechanics

  Supersymmetric quantum mechanics was invented 25 years ago. We present now for the first time the classification of its irreducible representations. As a byproduct, new invariant off-shell actions and new non-linear on-shell actions are presented.

- **Gerardo Aldazabal** (Instituto Balseiro-C, Bariloche, Argentina)

  Particle Physics from D-Branes at Gepner Points

  The fact that gauge interactions are localized on D-branes world volumes opened new roads to establish a link between Particle Physics and String theory. Many interesting studies have been performed in this D-brane world scenario, mainly, in the framework of toroidal like compactifications. For instance, we know that D-branes intersecting at angles or D-branes stuck at orbifold singularities are needed

in order to obtain chiral spectra. Also, consistent D-brane configurations, leading to "close to Standard Model" models have been found.

We will discuss a generalization of these toroidal like scenarios to include internal manifolds described by rational conformal field theories, in particular by Gepner models. We will illustrate how these constructions can lead to appealing models, closed to the Standard Model or some of its extensions.

- **Henrique Boschi Filho** (Instituto de Física, Universidade Federal do Rio de Janeiro, Brazil), in collaboration with N. R. F. Braga (IF-UFRJ, Brazil)

  AdS/CFT Correspondence and Strong Interactions

  Inspired in the exact AdS/CFT duality we consider phenomenological models to describe strong interactions in terms of strings in a slice of an anti-de Sitter space. The size of the slice is related to an infrared cutoff of the boundary gauge theory. With this model we obtain masses of light hadrons and the static quark anti-quark phenomenological potential.

- **Ion Vasile Vancea** (Departamento de Física, Universidade Federal Rural do Rio de Janeiro, Brazil)

  Thermal D-branes States from Superstrings in Light-Cone Gauge

  We present the construction of the thermal D-brane states in TFD approach in the GS formulation of the superstring.

- **Jorge Stephany** (Universidad Simón Bolvar, Venezuela), in collaboration with N. Hatcher and A. Restuccia

On the Quantization of Massive Superparticles

We consider the action of the $D = 11$ supermembrane wrapping a compactified sector of the target space in such a way that a non trivial central charge in the SUSY algebra is induced. This corresponds to a superparticle in $D = 9$ with additional fermionic terms associated to the central charges. We perform the covariant quantization of this system. The resulting multiplet contains 2^8 states corresponding to a KKB ultrashort multiplet.

- **Ricardo Medina** (Universidade Federal de Itajubá, Brazil), in collaboration with L. A. Barreiro

  Higher N-Point Amplitudes in Open Superstring Theory

  Massless string scattering amplitudes are important as a tool to find the low energy effective lagrangian of the theory. For a long time it has been believed that these amplitudes can be used to find only the first (α') terms of it, since only 3 and 4-point amplitudes were possible to be computed in a closed form. We report on the progress done in recent years, where methods have been found to compute 5 and higher point amplitudes, for bosons, in a closed form.

POSTERS

(from Monday, 04/24, to Friday, 04/28)

1. **Alberto Saa** (IMECC - UNICAMP, Brazil), in collaboration with Luciana A. Elias

   Non-Minimally Coupled Cosmology as Geodesic Motion

Townsend and co-workers have recently shown that the equations of motion of homogeneous and isotropic cosmologies involving N minimally coupled scalar fields, with arbitrary potential, are equivalent to the geodesic equations of an extended space. For homogeneous and isotropic cosmologies with flat spatial sections ($\kappa = 0$), the extend space is $(N+1)$-dimensional and has $(1, N)$ signature, while for non-flat ($\kappa = \pm 1$) cosmologies, the extend space is $(N+2)$-dimensional and has signature $(1, N+1)$ for $\kappa = -1$ and $(2, N)$ for $\kappa = 1$. For all the cases, the geodesic are timelike if $V > 0$, null if $V = 0$ and spacelike if $V < 0$. This analysis is generalized here to include also non-minimally coupled scalar fields. These results can be useful to classify the asymptotic behavior of homogeneous and isotropic cosmological models, leading, for instance, to some geometrical criteria for the existence of accelerated expansion phases.

2. **Alexandre Carlos Tort** (Instituto de Física, Universidade Federal do Rio de Janeiro, Brazil), in collaboration with F. C. Santos (UFRJ) and E. Elizalde (IEEC/UB/UAB)

   Analytical Regularisation and Confined Quantum Fields

   A technique for evaluating the regularised vacuum energy stemming from non-trivial boundary conditions is reviewed and results for the Casimir energy of a massive fermionic field confined by a $d+1$ dimensional slab-bag and the effect of a uniform magnetic field on the vacuum energy of a confined massive bosonic and fermionic fields are presented. Results concerning the Casimir energy and the evaluation of the rate of quanta creation in κ-deformed theories are also discussed.

3. **Álvaro Gomes dos Santos Neto** (Instituto de Física, Universidade de Brasília, Brazil), in collaboration with A. G. Santos Neto and M. E. X. Guimaraes (UnB)

   Type-Like Vortices Solutions in Scalar-Tensor Gravities

   We analyze a vortex line model in the contexte of a class of scalar-tensor theories of gravity. We obtain exact solutions for the gravitational field of the vortex in the particular case of Brans-Dicke theory.

4. **André Luiz Naves de Oliveira** (Instituto de Física, Universidade de Brasília, Brazil), in collaboration with M. Leineker Costa and M.E.X. Guimaraes (UnB)

   On the Contributions from Dilatonic Strings to the Flat Behaviour of the Rotational Curves in Galaxies

   We analyse the flat behaviour of the rotational curves in same galaxies in the framework of a dilatonic, current-carrying string. We determine the expression of the tangential velocity of test objects following a stable circular equatorial orbit in this spacetime.

5. **Celso Melchiades Dória** (Universidade Federal de Santa Catarina, Brazil)

   Morse Theory Framework for the Seiberg-Witten Equations

   It is shown that the Seiberg-Witten equations are obtained from a variational formulation and that the functional satisfies the Palais-Smale condition. Consequently, the equations admit a solution for all spin^c structure. However, the solution may not be a Seiberg-Witten monopole but just a cohomology class in $H^1(X, R)$.

6. **Chrystian de Assis Siqueira** (Instituto de Física, Universidade de Brasília, Brazil), in collaboration with A. E. Santana (UnB)

   Thermofield Dynamics and Path-Integral Formalism

   Thermofield dynamics (TFD), a real-time formalism for thermal quantum field theory, is formulated in terms of a path-integral approach following the Weinberg procedure. In order to assure precise rules for the development, we use a representation for Lie-algebras such that the TFD algebraic ingredients are derived, including the tilde conjugation rules. The association with the canonical formalism is obtained, and for the case of bosons, we introduce the Feynman diagrams and derive the n-point functions.

7. **Cresus Godinho** (LAFEX-CBPF, Brazil), in collaboration with Martim Lourenço (Pontifícia Universidade Católica - RJ)

   Constraints on the Noncommutative Quantum Hall Efect

   We analyse the Classical and Quantum Hall Effect, based on the Noncommutative Schrödinger - Chern-Simons Action. The constraints are obtained by means of the Fadeev-Jackiw quantization Scheme and guide us to an interesting new corrected Hall conductivity expression.

8. **Cristine Nunes Ferreira** (CEFET-Campos, Brazil), in collaboration with José A. Helayël-Neto (LAFEX-CBPF)

   Supersymmetric Superfluid in a Lorentz-Violating Background

   This work presents a supersymmetric scenario for a global vortex with the superfluid behaviour. In our formulation,

the duality relation between the vortex configuration and a 2-form gauge field is the key-element. The Lorentz-breaking background is also suitably accomodated in a superfield and the duality between the vortex and the Kalb-Ramond field is duely formulated in the N=1-superspace. We then find that the embedding of the superfluid vortices in a supersymmetry model dictate the introduction of terms that softly break supersymmetry in an explicit way and an interpretation of the parameters that govern these SUSY breaking terms is found out in terms of the energy scales for the vortex formation.

9. **Daniel Heber Theodoro Franco** (Centro de Estudos de Física Teórica, Brazil), in collaboration with Luiz H. Renoldi

   Paley-Wiener-Schwartz Theorem and Microlocal Analysis of Singularities in Theory of Tempered Ultrahyperfunctions

   We study the Fourier-Laplace transform of tempered ultrahyperfunctions introduced by Sebastião e Silva and Hasumi. We establish a generalization of Paley-Wiener-Schwartz theorem for this setting. This theorem is interesting in connection with the microlocal analysis of singularities of tempered ultrahyperfunctions.

10. **Davi Cabral Rodrigues** (Instituto de Física, Universidade Federal do Rio de Janeiro, Brazil), in collaboration with Clóvis Wotzasek (IF-UFRJ , Brazil)

    Issues on 3D Noncommutative Electromagnetic Duality

    We extend the ordinary 3D electromagnetic duality to the noncommutative (NC) space-time through a Seiberg-Witten

map to second order in the noncommutativity parameter θ, defining a new scalar field model. There are similarities with the 4D NC duality, these are exploited to clarify properties of both cases. Up to second order in θ, we find duality interchanges the 2-form θ with its 1-form Hodge dual ${}^\star\theta$ times the gauge coupling constant, i.e., $\theta \to {}^\star\theta\ g^2$ (similar to the 4D NC electromagnetic duality). We prove that this property is false in the third order expansion in both 3D and 4D space-times. Starting from the third order expansion, θ cannot be rescaled to attain an S-duality; on the other hand, to any order in θ, it is possible to rescale the fields to obtain the same coupling constants in both dual descriptions. In addition to possible applications on effective models, the 3D space-time is useful for studying general properties of NC theories. In particular we show that many terms of the Seiberg-Witten mapped action in this dimension can be significantly simplified.

11. **Fábio Macêdo Mendes** (Instituto de Física, Universidade de Brasília, Brazil), in collaboration with Anníbal Dias Figueiredo Neto (UnB)

    Generalized Entropies in the Statistical Foundations of Thermodynamics

    We offer an alternative account for the so called generalized entropies which follows naturally from the ubiquitous Boltzmann's formula "$S = k \ln W$". Non-exponential laws would appear naturally in a unified framework where generalized entropies might follow either from ab initio counting procedures or as effective entropies that fits some unknown parameters of a physical process. We consider the impli-

cation of non-standard entropic forms to thermodynamics. Additionally, the relation between our formalism and Jaynes/Gibbs (MAXENT) inference procedure is explored. A generalization of the usual Darwin Fowler method to account non-standard entropic forms is thus employed.

12. **Fábio Pascoal dos Reis** (Instituto de Física, Universidade Federal do Rio de Janeiro, Brazil), in collaboration with C. Farina (IF-UFRJ, Brazil)

    On the Particle Creation in a Robertson-Walker Universe

    It's well know that nonstatic curved space-time can lead to the phenomenon of particle creation. The fist one to discuss this kind of problem was Schrödinger in 1939 [1]. In a recent work [2], the problem of particle creation in $3+1$ a spatially closed Robertson-Walker space-time is investigated. However we have found a little mistake in the total number of particles produced and in the total energy calculated by the author. In our work, we correct this mistake and also, analyze graphically how the parameters of the metric affect the total number of particles produced. [1] E. Schrödinger, Physica (Utrecht), **6**, 899, (1939). [2] M.R. Setare, Int.J.Theor.Phys. **43** 2237 (2004).

13. **Fabrício Augusto Barone Rangel** (DFQ-UNESP, Guaratinguetá, Brazil)

    Casimir Energy for Point-like Objects

    In this paper it is presented the calculus of the Casimir energy for point-like objects. Specifically, it is studied the Casimir energy of the scalar field interacting with two delta potentials localized at two distinct points. The limit of

strong coupling between the field and the potentials is equivalent to the situation where the field satisfies Dirichlet boundary condition on the points where the potentials are localized. For this case, the Casimir energy is inversely proportional to the distance between the points.

14. **Franciscus Jozef Vanhecke** (Instituto de Física, Universidade Federal do Rio de Janeiro, Brazil), in collaboration with A. R. da Silva and C. Sigaud

    Symmetries in Non Commutative Configuration Space

    A group G acting on a symplectic manifold M is a Symmetry Group if there is a group homomorphism :

    $$\phi : G \to \mathcal{S}p(M)$$

    where $\mathcal{S}p(M)$ is the group of diffeomorphisms conserving the symplectic two-form ω of M. The vector fields, generators of these transformations are *locally Hamiltonian* i.e. there is a Lie algebra homomorphism from the Lie algebra $\mathcal{G}$ to the locally Hamiltonian vector fields $Ham_0(M)$:

    $$\phi_* : \mathcal{G} \to Ham_0(M) : \mathbf{u} \to \mathbf{X}(\mathbf{u}) \; ; \;\; d(\imath_{\mathbf{X}(\mathbf{u})}\,\omega) = 0$$

    The action is called almost Hamiltonian if each generator $\mathbf{X}(\mathbf{u})$ is Hamiltonian ($\in Ham(M)$). This means that, for each $\mathbf{u} \in \mathcal{G}$, there exists a linear map $\mathbf{f} : \mathcal{G} \to \mathcal{F}(M) : \mathbf{u} \to f(\mathbf{u})$ on M such that $df(\mathbf{u}) = \imath_{\mathbf{X}(\mathbf{u})}\,\omega$.
    Let $\mathcal{F}(M)$ denote the Lie algebra of functions on M endowed with the Lie algebra of the Poisson structure associated to ω.
    There is an horizontal exact sequence of Lie algebra homo-

morphisms

$$\begin{array}{ccccccc} \{0\} \to & \mathbf{R} & \to \mathcal{F}(M) & \to Ham(M) & \to \{0\} \\ & & \nwarrow \mathbf{f} & \uparrow \phi_* & \\ & & & \mathcal{G} & \end{array}$$

When $\mathbf{f}$ is also a Lie algebra homomorphism, the action is said to be *strictly Hamiltonan* and allows a momentum map.

The group action on configuration space Q induces an action on a cotangent bundle $T^*(Q)$, which is strictly Hamiltonian on $T^*(Q)$ with its canonical symplectic structure $\omega_0 = dq^i \wedge dp_i$.

In this note, we examine what happens when $T*(Q)$ is endowed with a more general symplectic structure:

$$\omega = \omega_0 + 1/2\, F_{ij}\, dq^i \wedge dq^j + 1/2\, G^{kl}\, dp_k \wedge dp_l$$

with $d\omega = 0$, which generates a non commutative configuration space.

15. **Gabriel Santos Menezes** (ICRA-CBPF, Brazil), in collaboration with N. F. Svaiter (ICRA-CBPF, Brazil)

    Stochastic Quantization of Topological Field Theory: Generalized Langevin Equation with Memory Kernel

    We use the method of stochastic quantization in a topological field theory defined in an Euclidean space, assuming a Langevin equation with a memory kernel. We show that our procedure for the Abelian Chern-Simons theory converges regardless of the nature of the Chern-Simons coefficient.

16. **Humberto Belich Júnior** (Universidade Federal do Espírito Santo, Brazil), in collaboration with T. Costa-Soares, M. M. Ferreira Jr. and M.T.D. Orlando

    Bose-Einstein Condensates in a Lorentz Breaking Background

    This type of Lorentz and CPT symmetries breaking has appeared in the context of high energy physics. The well known Anderson-Higgs mechanism is generalized to a context of string theory in such way that we obtain a four vector background field. Recently, the proposal of the reminiscent effects of Lorentz and CPT breaking in non-relativistic quantum mechanics was investigated with the non-minimal coupling recipe. Such coupling presents a new type of phase generation and we can investigate the influences of this background in a variety of phase transitions. In the present work, we shall propose to reasses the Bose-Einstein Condensates (BEC) going from a Relativistic theory with this non-minimal coupling to a Lorentz and CPT breaking background to computing its non-relativistic limit and study the contribution of the background in the Gross-Pitevskii equation for the BEC. The non-minimal coupling was chosen to be the one that generates an Aharonov-Casher phase, in the sense that we would like to study circular states in this system.

17. **Jean Paulo Spinelly da Silva** (Universidade Estadual da Paraíba, Brazil), in collaboration with E. R. Bezerra de Mello

    Vacuum Polarization in the Presence of Magnetic Flux at Finite Temperature in the Cosmic String Background

In this paper we analyse the vacuum polarization effect associated with the charged massless scalar field, in the presence of magnetic flux at finite temperature, in the cosmic string background. We consider a spacetime of an idealized cosmic string which presents a magnetic field confined in a cylindrical tube of finite radius. Two situations are taken into account in our analysis: (i) a homogeneous field inside the tube and (ii) a magnetic field proportional to $1/r$. In these two cases, the axis of the infinitely long tube of radius R coincides with the cosmic string. Specifically, we calculate the effects produced by the temperature in the renormalized vacuum expectation value of the square of the charged massless scalar field, $\langle\hat{\phi}^*(x)\hat{\phi}(x)\rangle$. Therefore, in order to realize these analysis, we calculate the Euclidean Green function associated with this field in this background.

18. **Josefa Surek de Souza de Oliveira** (Departamento de Física, Universidade Estadual de Londrina, Brazil), in collaboration with Veríssimo Manoel de Aquino

    Approximate Solution of the Evolution Operator of the Neutrino System

    Neutrino flavor osccilations have been supposed as an explanation for neutrino discrepancies in varied contexts. One of them is the atmospheric neutrino problem. As a consequence of the spherical geometry of the neutrino source volume its predicted that atmospheric neutrino flux is up-down symmetric. If this symmetry is not observed then a possible explanation is neutrino oscillation. In this work the evolution operator of the neutrino system at variable

eletron density is computed as the product of infinitesimal operators in the context of existence of two neutrino flavors with extension for three flavors. The relations between survival probability and energy and mixing angles at vacuum are analysed. The up and down fluxs are calculated considering neutrino oscillation to energy 5 GeV for down neutrinos that cross the upper mantle.

19. **Julio Marny Hoff da Silva** (Instituto de Física Teórica - UNESP, Brazil), in collaboration with M. C. B. Abdalla and M. E. X. Guimarães

    Vortices Solutions in Chern-Simons-Maxwell-Higgs System

    In this work we analyse some characteristcs of Bogomol'nyis equations for abelian gauge theories with Chern-Simons-Maxwell-Higgs terms. We don't obtain the complete solution for the model, but we analyse the equations in a kind of weak field approximation instead of using a computational analysis. Our main idea is to get some intuition on the subject. Working with the equations in such approach we reproduce the accurate behavior next to the origin.

20. **Leonardo Paulo Guimarães de Assis** (LAFEX - CBPF, Brazil), in collaboration with J. A. Helayël-Neto (LAFEX - CBPF, Rio de Janeiro and GFT - JLL, Petrópolis) and F. Haas (UNISINOS, Sao Leopoldo) and Álvaro Luis Martins de Almeida Nogueira (DEPBG/DEPES/CEFET/RJ and GFT - JLL, Petrópolis)

    On the Stabiliser Rôle of the Critical Coupling of an $N = 2$ Maxwell-Chern-Simons-Higgs Mechanical Model

    We apply different integrability analysis procedures to a reduced (spatially homogeneous) mechanical system derived

from an off-shell non-minimally coupled $N = 2$ Maxwell-Chern-Simons-Higgs model that presents BPS topological vortex excitations, numerically obtained with an ansatz adopted in a special - critical coupling - parametric regime. As a counterpart of the regularity associated to the static soliton-like solution, we investigate the possibility of chaotic dynamics in the evolution of the spatially homogeneous reduced system, descendant from the full $N = 2$ model under consideration. The originally rich content of symmetries and interactions, $N = 2$ susy and non-minimal coupling, singles out the proposed model as an interesting framework for the investigation of the role played by (super-)symmetries and parametric domains in the triggering/control of chaotic behavior in gauge systems. After writing down effective Lagrangian and Hamiltonian functions, and establishing the corresponding canonical Hamilton equations, we apply global integrability Noether point symmetries and Painlevé property criteria to both the general and the critical coupling regimes. As a non-integrable character is detected by the pair of analytical criteria applied, we perform suitable numerical simulations, as we seek for chaotic patterns in the system evolution. Finally, we present some comments on the results and perspectives for further investigations and forthcoming communications.

21. **Marcelo Botta Cantcheff** (Instituto de Física Teórica - UNESP, Brazil)

    Lorentz Symetry Breaking in Gravity and Dimensional Reduction

    This is a work in progress where we propose a modification

of the standard Einstein Theory in four dimensions. A new topological term is introduced in the sector of coupling with matter and a Lorentz symmetry breakingis induced through a mechanism proposed in a recent paper (hep-th/0411254). An effective "planarity" may be observed in the resulting theory which resembles some aspects of holography.

22. **Marcelo Leineker Costa** (Instituto de Física, Universidade de Brasília, Brazil), in collaboration with A. L. Naves de Oliveira e M. E. X. Guimaraes

    On the Generalized Rainich Algebra in Scalar-Tensor Gravities

    We obtain exact solutions for a static and charged cosmic string in a Einstein-Maxwell-Dilaton theory of a scalar-tensor type in (3+1)-Dimensions. This theory is specified by the dilaton field ϕ, the graviton field $g_{\mu\nu}$ and the electromagnetic field $F_{\mu\nu}$, and one post-Newtonian parameter $\alpha(\phi)$. It contains three different cases, each of them corresponding to a particular solution of the Rainich algebra for the Ricci tensor.

23. **Rafael de Lima Rodrigues** (Universidade Federal de Campina Grande, Brazil), in collaboration with A. F. de Lima, E. R. Bezerra de Mello and V. B. Bezerra

    SUSY QM from Three Domain Walls in a Scalar Potential

    The soliton solutions have been investigated for field equations defined in a space-time of dimension equal or bigger than $1+1$. The kink solution of a field theory is an example of a soliton in $1+1$ dimensions. From field theoretic superpotential evaluated on the domain states the algebraic

framework of supersymmetry in quantum mechanics (SUSY QM), as formulated by Witten may be elaborated. The SUSY QM generalization of the harmonic oscillator raising and lowering operators has several applications. The generalization of SUSY QM for the case of matrix superpotential, is well known in the literature for a long time, for one-dimension systems about on non-relativistic quantum systems. In this work we construct a matrix general superpotential on a three-field potential model in $1 + 1$ dimentions. The classical configurations with domain wall solutions are bidimensional structures in 3+1 dimensions. They are static, non-singular, classically stable Bogomol'nyi and Prasad-Sommerfield (BPS) soliton (defect) configurations, with finite localized energy associated with a real scalar field potential model. Domain walls have several applications in condensed matter and cosmology. The BPS states are classical configurations that satisfy the first order differential equations and the second order differential equations (equations of motion). Domain walls have been recently exploited in a context that stresses their connection with BPS-bound states. While Rajaraman has applied the trial orbit method for the equation of motion, here one uses the trial orbit method for the first order differential equations associated to three real scalar fields. However, for solitons of three coupled scalar fields there are no general rules for finding analytic solutions since the nonlinearity in potential leads to enlarging of difficulties to solve the BPS equations and field equations.

24. **Rafael A. Vera** (Universidad de Concepcion, Chile)

    A Short-Cut to Non-Local Relativity, a General Theory Ba-

sed on Dual Properties of Light

This theory is based on another form of the equivalence principle found from fundamental experiments according to which uncharged particles and radiation in stationary state obey the same inertial and gravitational laws [1]. Effectively, the theoretical properties of a particle model (PM) made up of radiation in stationary state, derived from just dual properties of light, correspond with all of them: the Einsteins equivalence principle (EEP), special relativity, quantum mechanics, all of the traditional G tests, and recent astronomical observations [1][2][3]. Therefore this theory can be used to test the current hypotheses in physics. In the short cut done here it is proved that gravitation is an optical phenomenon produced by a gradient of the relative refraction index of the space with respect to any observer at rest in the field. During the free propagation of a body, to the contrary of current physics, its relative frequencies and mass-energy with respect to any observer at rest in the field are conserved. When the body stops in the field, the change of its relative mass-energy is just equal to the energy released. Thus, the G energy comes not from the G field but from a fraction of the mass-energy of the body. This result is in opposition with: a) the Einsteins G field energy hypothesis (GFEH) in that the G field gives up the energy for the G work and b) the classical hypothesis in that the relative rest-mass of a body with respect to the observer is independent on the difference of G potential between them. Thus the right predictions of GR for the conventional G tests would come from cancellations of errors of the same absolute value and opposite signs of

wrong hypotheses. Such errors stand out in more critical tests that are independent of such hypotheses. The relative changes occurring after changes of velocity, G potential and universe expansion, cannot be found from local measurements because everything changes in a common proportion and, therefore, every local ratio remains unchanged. The lack of energy of the G field is most important in universe evolution because the new kind of linear black hole without singularity, after a long period of radiation absorption, decays into primeval gas that can regenerate dead galaxies in relatively short periods. Thus galaxies should evolve in rather closed cycles with luminous and dark periods so that, in the average, the entropy in the universe can remain constant, indefinitely. This is consistent with all of them: the rather uniform distribution of elliptical galaxies, near us and in the deep field universe, the increasing proportion of dark matter in galaxies of smaller luminous sizes, the high proportion of dark matter between them, and the low temperature CMB[4]. References [1]. R. A. Vera. Proceedings of the Einstein Centennial Symposium on Fundamental Physics. eds. S. M. Moore et al, Universidad de Los Andes. Bogot, G. Violni, Universit di Roma, p. 597-625 (1981). http://www2.udec.cl/ rvera [2]. R. A. Vera. International Journal of Theoretical Physics. 20 p. 19-50 (1981) [3]. R. A. Vera. The New Universe Fixed by the Equivalence Principle and Properties of Light: (ed. R. Vera. Universidad de Concepcin. Concepcin. Chile. (1997). [4]. R. A. Vera. The Dark Matter and Radiation Backgrounds Predicted from a New Principle and a New Gravitational Theory. in Progress in Dark Matter Re-

search Ed. Blain, J. Val.(Nova Science Publishers, 2005), p 241-252.

25. **Renato Dória** (AprendaNet, Brazil)

    Ubiquous Lux

    Based on an Antireductionist Gauge Theory applied to U(l) group one develops new properties for light. They are a new dispersion relation yielding a group velocity bigger than c, self interacting photons, non-linear wave equations, photon quanta composed by fields. These new light properties are derived from an extension to Maxwell equations. This means that Maxwell is preserved as Newton to Einstein mechanics. This physics of light goes beyond the principle that light is derived from electric charges. It says that light anteceeds electric charge. Being the only one absolute that physics detects in Nature, light should be considered something special. Besides turning the others physical entities as relative, it should also to become ubiquous. Thus one interprets that light should interact simultaneously with a set of fields. In terms of gauge theory be a genuine gauge field while others are potential fields. New aspects are derived from this physics of light. Maxwell equations are extended and a new expression for force just depending on fields is obtained.

26. **Ricardo M. Bentin** (Universidade Estadual de Santa Cruz, Brazil)

    An Attempt of Construction for the Grassmann Numbers

    We will pursue a way of building up an algebraic structure that involves, in a mathematical abstract way, the well

known Grassmann variables. The problem arises when we tried to understand the grassmannian polynomial expansion on the scope of ring theory. The formalization of this kind of variables and its properties will help us to have a better idea of some algebraic structures and the way they are implemented in models concerning theoretical physics.

27. **Roldão da Rocha** (Instituto de Física, UNICAMP, Brazil), in collaboration with Carlos H. Coimbra-Araújo

    Physical Effects of Extra Dimension and Concomitant Map between Photons and Gravitons in RS Brane-World Scenario

    We show how the existence of an extra dimension in Randall-Sundrum brane-world model can estimate the correction in the horizon of Schwarzschild, Reissner-Nordstrm and Kerr black holes, and consequently the measurability of physical effects due to extra dimensions endowing the geometry of a brane-world scenario in an AdS_5 bulk. We also investigate the mutual transformation of photons and gravitons in the field of a charged black hole in a brane-world Randall-Sundrum scenario. Also, we show the number of gravitons and photons are not conserved on the brane due to a source term coming from Maxwell-Einstein field equations on the brane. It can be explained in terms of the leaking of gravitons out of the brane into the AdS bulk

28. **Sergio de Oliveira Vellozo** (Centro Tecnolgico do Exército (CTEx) and LAFEX-CBPF, Brazil), in collaboration with José Abdalla Helayël Neto, Alexander William Smith and Leonardo Paulo Guimarães de Assis

Born-Infeld Magnetostatic Field from Electrical Point-like Charge at Rest in an Inertial Frame

Born-Infeld non-linear Abelian classical electrodynamics has a non-polynomial Lagrangian with no derivative and interative terms. Therefore the canonical equations have the same features. In this work we employed this non-linear Lagrangian to investigate the static electric and magnetic fields generated by a point-like charge at rest in an inertial frame. Associated with usual Maxwell differential equations we arrived on an system of equations and the solution are real and non singular. Speculative remarks on a semiclassical model are proposed.

29. **Thiago Gilberto do Prado** (Universidade Estadual de Londrina, Brazil), in collaboration with A. E. Gonçalves

The Aplication of the Cardy-Verlinde Formula in BTZ Black Hole

The fascinating properties of the classical, and especially quantum, black holes, have long made it desirable to have avaliable a lower dimensional analog which could exhibit the key features without the usual complications. M. Baados, C. Teitelboim and J. Zanelli have proposed a interesting lower dimensional black hole with a negative cosmological constant, known as BTZ black hole. Starting from the holografic principle in the context of closed $(n+1)$-dimensional Friedman-Robertson-Walker universe in the radiation dominated era, E. Verlinde had proposed an interesting formula that expresses the entropy of a Conformal Field Theory (CFT) in terms of the Casimir energy via a universal Cardy formula that is valid for space with

an arbitrary number of dimensions. The main objective of the present work is the aplication of the Cardy-Verlinde formula in order to study the AdS/CFT correspondence, where AdS, for BTZ black holes.