Nathan Berkovits

2a. Project: ICTP South American Institute for Fundamental Research

2b. Project Coordinator: Nathan Jacob Berkovits

2c. Host Institution: Instituto de Física Teórica-UNESP

2.d Project Team

Professors

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Nathan Jacob Berkovits, Project Coordinator (20 hours), IFT-UNESP

Gustavo Burdman, Associate Researcher (4 hours), IF-USP

Hilda Cerdeira, Associate Researcher (4 hours), IFT-UNESP

Roberto André Kraenkel, Associate Researcher (4 hours), IFT-UNESP

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George E. A. Matsas, Associate Researcher (4 hours), IFT-UNESP

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Eduardo Pontón, Associate Researcher (4 hours), ICTP-SAIFR/IFT-UNESP

Paulo Inácio de Knegt López de Prado, Associate Researcher (4 hours), IB-USP

Victor Rivelles, Associate Researcher (4 hours), IF-USP

Rogerio Rosenfeld, Principal Investigator (20 hours), IFT-UNESP

Daniel Augusto Turolla Vanzella, Associate Researcher (4 hours), IFSC-USP

Postdoctorals associated to ICTP-SAIFR

Carlos Alfonso Ballon Bayona (CAPES)

Nicolás Bernal (FAPESP)

Oscar Chacaltana (CAPES)

Gero von Gersdorff (FAPESP)

Chrysostomos Kalousios (FAPESP)

Fabien Lacasa (FAPESP)

Saeed Mirshekari (FAPESP)

Luana Sucupira Pedroza (FAPESP)

Riccardo Sturani (Young Investigator – FAPESP)

Alberto Tonero (FAPESP)

Fabio Iocco (Young Investigator – FAPESP)

Administrative support

Danilo Rodrigues Ramos, Computer System Manager (40 hours), ICTP-SAIFR/UNESP

Lilia Faria, Financial Manager (40 hours), ICTP-SAIFR/UNESP

Nadia Rosa Roque, Executive Secretary (40 hours), ICTP-SAIFR/UNESP

Jandira Ferreira de Oliveira, Executive Manager (40 hours), ICTP-SAIFR/UNESP

2e. Fapesp Project Number: 2011/11973-4

2f. Project Period: 01/12/2011 – 30/11/2016

2g. Period covered by this Report: 31/12/2013 – 30/12/2014

3. Summary of the Project's main goals

Fundamental research in theoretical physics has historically led to developments in all areas of science. In addition to producing technological applications coming from a better understanding of the physical laws of the universe, fundamental research in theoretical physics has led to new methods of problem-solving which has revolutionized areas of mathematics, biology, computer science, economics, and other areas of study.

Throughout the world, the importance of fundamental research has led to the creation of theoretical physics institutes which focus on research, on the training of graduate students and post-docs, and on the organization of schools and workshops. Although these theoretical physics institutes have different structures and many are connected with public universities, they are all disconnected from undergraduate physics departments and have independent hiring policies and academic responsibilities from the rest of the university. Because of this autonomy, these theoretical physics institutes are able to attract the best researchers to their faculty. And because of the prestigious faculty and the organization of schools and workshops, these institutes are able to attract highly qualified graduate students and post-docs. As a result, the academic and research programs at these autonomous theoretical physics institutes increase the international impact of their host universities.

The establishment of a viable South American institute devoted to the fundamental aspects of theoretical physics is an urgent priority. One of the main roles of the International Center for Theoretical Physics (ICTP) in Italy is to promote scientific research in developing countries, and the establishment of such a center in South America has been promoted for several years by the ICTP leadership. In addition to promoting theoretical physics research in Brasil, this center would also have the responsibility of promoting research in less-developed countries of South America by hosting workshops and schools and having an active visiting program for students and researchers from other South American countries. In other words, this regional center would play the role of a mini-ICTP. In 2010, the new management of ICTP made the establishment of this South American regional center a high priority with the direct participation of the ICTP and named it the "ICTP South American Institute for Fundamental Research".

The association of the São Paulo State University (UNESP) with the International Center for Theoretical Physics (ICTP) to establish the ICTP South American Institute for Fundamental Research in São Paulo with funding from FAPESP has grown from the desire of UNESP to increase its international visibility and the ICTP desire to employ its expertise in the organization and running of this new South American regional center for theoretical physics.

The long-term goal for this new institute is to become a South American center of excellence in theoretical physics which will be comparable to theoretical physics institutes in the rest of the world and at the same level as the highly prestigious mathematics institute Instituto Nacional de Matematica Pura e Aplicada (IMPA) in Rio de Janeiro. Through an active visiting program involving Schools and Workshops, this center of excellence will elevate the level of theoretical physics in all of South America. With the assistance of the three institutions, namely ICTP, UNESP and FAPESP, the Steering Committee and Scientific Council and the Director will accomplish this mission through the following steps:

- Hiring five new permanent researchers with a reduced teaching load who will assist in the organization of the schools and workshops;
- Hiring a trained secretarial staff which will handle all non-scientific aspects;
- Supporting an active visiting program for South American students and researchers;
- Offering prestigious postdoctoral positions to highly qualified researchers;
- Organizing schools and workshops on focused topics throughout the year for South American students and researchers.

4. Accomplishments in the period

In this third year of the existence of the ICTP-SAIFR, the number of researchers, staff, visitors and activities was significantly increased. An agreement was signed in January 2014 with Simons Foundation (New York) to jointly fund with FAPESP two tenure-track fellowships. After reviewing the applications and interviewing 6 candidates, the ICTP-SAIFR International Search Committee selected Rafael Porto (IAS Princeton) and Fabio Iocco (IFT-Madrid) as recipients of these Simons-FAPESP tenure-track fellowships which will include a FAPESP Young Investigator position. Both candidates accepted the offer and arrived at the ICTP-SAIFR in December 2014. Fabio Iocco works in the field of Astroparticle Physics with applications to Dark Matter and Big Bang Nucleosynthesis, and Rafael Porto works in the field of Effective Field Theory approaches to cosmology and gravitational waves. The ICTP-SAIFR International Search Committee will decide within two years if permanent ICTP-SAIFR positions will be opened in the subareas of these two candidates.

In addition to these two new Young Investigator positions, the 6 current FAPESP postdoctoral positions were extended for a third year, and the 7th FAPESP postdoctoral position was filled with the selection of Luana Pedroza (Stony Brook). Luana Pedroza performs research in the field of condensed matter theory and her research project uses density functional theory (DFT) to investigate the out-of-equilibrium dynamics at the interface of liquids and solids. A new FAPESP fellowship in scientific journalism was awarded in November 2014 to Ricardo Aguiar who will write articles and an online blog for the general public on ICTP-SAIFR scientific activities. Furthermore, a new joint IMPA/ICTP-SAIFR postdoctoral position in mathematical physics was established with funding by CAPES and will begin in 2015.

In March 2014, UNESP agreed to hire a new executive manager for the ICTP-SAIFR to supervise all scientific activities. After an extensive search involving interviews with several candidates, Jandira Ferreira de Oliveira (Rio de Janeiro) was selected. Jandira Oliveira received her PhD in Biophysics in 2010 from CBPF and after working for four years in industry, joined the ICTP-SAIFR in June 2014. In July 2014, both Jandira Oliveira and Nadia Roque spent three weeks in ICTP Trieste where they received training in various administrative and scientific duties.

During 2014, the number of visitors, seminars, schools and workshops significantly increased. 92 visitors stayed for more than one week and more than 150 seminars and colloquia were presented. The ICTP-SAIFR organized activities in diverse areas of theoretical physics and complex systems. These activities included 6 international schools on mathematical biology, dynamical systems, few-body physics, electronic structure, random geometry, and observational cosmology, 8 workshops on theoretical cosmology, observational cosmology, complex systems, random geometry, spintronics, particle physics, non-perturbative QCD, and

quantum theory, and 3 minicourses on data analysis in cosmology, on QCD amplitudes, and on advanced quantum field theory. Also, 3 month-long programs were organized on Cosmology, on Nanophysics and Spintronics, and on Integrability, Holography and the Conformal Bootstrap. The first program was organized in February by Luca Amendola (Heidelberg), the second program was organized in March by Amnon Aharony (Tel Aviv), and the third program is being organized from November 2014 – February 2015 by Pedro Vieira (Perimeter). Finally, there were weekly meetings in 2014 of a colloquium and three separate ``journal clubs'' in the areas of string theory, particle physics and cosmology. These three journal clubs and colloquiua discussed current research problems at the frontiers of scientific knowledge and included the participation of students and researchers both from IFT-UNESP and from other nearby universities

In 2015, 9 international schools will be organized at ICTP-SAIFR on the topics of mathematical biology, pathogen dynamics, supersymmetric gauge theories, physics at the LHC, gravitational waves, neutrinos, complex networks, scientific programming and the biophysics of proteins. Also, two minicourses in 2015 are already confirmed on the topics of energy landscapes in biophysics by Jose Onuchic (Rice) and on numerical spectral methods by George Rawitscher (U. Of Connecticut). In addition, organizational support will be given to two schools on high-energy physics and string theory which will be held in Lima (Peru) and Mexico City, respectively.

In addition to the 5 permanent positions of ICTP-SAIFR, UNESP agreed in 2014 to hire three permanent researchers at IFT-UNESP over the next three years. Because of a temporary hiring freeze in 2014, these IFT-UNESP positions were not yet opened. However, it is expected that at least one position will be opened in early 2015 and the IFT council has determined that preference for this position will be in the area of complex systems.

Regarding the 5 permanent ICTP-SAIFR positions, the ICTP-SAIFR has filled one position in the area of particle physics (Eduardo Ponton) and has hired two tenure-track fellows in the areas of astrophysics and cosmology. There is a current search for candidates in the area of complex systems with biological applications, and it is hoped that the planned IFT-UNESP hiring in early 2015 will aid in this search. To attract possible candidates, various distinguished professors working in this field have been consulted and several activities have been organized and will be organized in the area of complex systems with biological applications.

In 2014, the ICTP-SAIFR appeared in the international media in print articles in Physics World (April 2014, Special Report on Brazil, "Sao Paulo realizes Salam's Dream") and Physics Today (October 2014, "From Beijing to Kigali, ICTP makes itself at home in the developing world"), and in the TV documentary film by Nicole Leghissa "From Theory to Reality: ICTP at 50" (October 2014).

The activities of ICTP-SAIFR in 2014 will be described below in more detail including:

(a) research related to publications;
(b) research related to visitors;
(c) organization of schools, workshops, minicourses, outreach activities, meetings and seminars.

a. Research related to publications

The research conducted at ICTP-SAIFR during this period includes diverse areas of theoretical physics, as indicated by the publication list in item 8. Among the different subjects are string theory, statistical mechanics, particle physics, cosmology, astrophysics, nonlinear systems, and mathematical biology. These publications involved research performed by associate researchers, postdoctoral fellows and visitors of ICTP-SAIFR and will be briefly described below.

a1. String theory

Although the conventional formalism for describing the superstring is the Ramond-Neveu-Schwarz (RNS) formalism developed in the 1970's, the RNS formalism is unable to describe backgrounds necessary for studying the AdS-CFT correspondence which relates weakly coupled gravity theories and strongly coupled gauge theories. For this background, one needs to use the pure spinor formalism for the superstring which contains manifest spacetime supersymmetry.

Since both the RNS and pure spinor formalism describe the same superstring, it is important to verify that they compute equivalent scattering amplitudes. In publication 8, an important step was taken in proving this equivalence by finding a covariant map between the RNS and pure spinor formalisms. Surprisingly, the covariant map gives a new description of fermionic states in the RNS formalism which does not involve spin fields. Instead of bosonizing the RNS worldsheet fermionic vectors to create spin fields, the fermionic states in this map are constructed by performing a twist using the pure spinor variables.

An alternative formalism for describing the superstring is the Green-Schwarz (GS) formalism, however, this formalism can only be quantized in light-cone gauge. In publication 11, a light-cone analysis was performed using the pure spinor formalism and it was proven that the light-cone pure spinor description is equivalent to the light-cone GS formalism by explciitly constructing DDF operators for the physical states.

In publication 9, the non-minimal version of the pure spinor formalism was developed for the heterotic superstring and the b ghost needed for computing loop amplitudes was explicitly constructed. An interesting test of the consistency of the pure spinor formalism is the computation of supersymmetry-breaking effects in this heterotic superstring. In publication 10, it was shown that these supersymmetry-breaking effects in the heterotic superstring are analogous to those computed using the RNS formalism. However, in the pure spinor formalism, these effects are much easier to compute and arise from BRST-invariant regulators.

In publication 7, this pure spinor formalism was used to describe the infinite tension limit of the superstring which computes the tree-level scattering amplitudes of d=10 super-Yang-Mills and supergravity states. Although one can also describe the infinite tension limit using the RNS formalism, the pure spinor formalism has the advantage of simplifying the amplitude expressions for external fermionic states.

In publication 37, the kinetic properties of these same tree-level scattering amplitudes of super-Yang-Mills and supergravity were studied. The formulae for these amplitudes can be expressed in a simple manner using Jacobi polynomials. An interpretation is given for the common reduced determinant appearing in the formulae as the product of squares of eigenfrequencies of small oscillations.

The infinite tension limit of the superstring is described by a spinning particle, and in publcation 34, the formulation of the spinning particle was used to study possible modifications to Lorentz Invariance coming from Very Special Relativity (VSR). The relativisitic BMT equations are modified by VSR and these modifications can be analyzed by studying the spinning particle.

a2. Statistical mechanics

The effect of quantum mechanics on dissipation and non-equilibrium systems is a difficult and long-standing problem. One approach involves Markovian and non-Markovian stochastic quantization methods applied to a complex action. Non-Markovian stochastic quantization introduces a memory kernel which has the effect of slowing down oscillations that arise in the Langevin-type evolution towards equilibrium. In publication 19, these Markovian and non-Markovian methods are analyzed for a model analogous to Maxwelll-Chern-Simons electrodynamics in Weyl gauge, and convergence to the correct equilibrium states is shown for both methods. And in publication 18, the non-Markovian Langevin evolution is analysed for a dissipative dynamical system interacting with a heat bath. After discussing the role of a frequency cutoff in the interaction between the system and the heat bath, an analytic expression is obtained for the exact non-Markovian dissipation kernel and the corresponding color noise that consistently incorporates non-local corrections.

a3. Particle Physics

Studying the strong interactions of QCD is important both for the theoretical goal of understanding a non-perturbative system and for the experimental goal of understanding the nature of matter inside the nucleus. In publication 17, an extension of the Julich meson-baryon model is used to study the production of charmed mesons in the annihilation of prótons and antiprotons close to reaction thresholds. And in publication 20, the couplings of charmed mesons to light mesons and nucleons was analyzed using a quark-pair creation model and a framework based on the Dyson-Schwinger equations. The results were compared with expectations from SU(4) flavor symmetry and produced predictions of SU(4) breaking.

In publication 21, the role of asymptotic freedom was discussed in the recent discrepancies between lattice QCD simulations and theoretical quark models regarding the behavior of the pseudocritical temperature for chiral symmetry restoration in the presence of a magnetic field. And in publication 22, the shear viscosity of a pion gas with vanishing chemical potential and the collisiional rate of pions is calcuated using effective interactions in the real-time formulation of finitetemperature field theory.

Another important area of research is the search for new phenomena beyond the Standard Model (SM). One clue may come from an explanation of the Higgs mass using a composite Higgs model in which the Higgs is a pseudo-Nambu-Goldstone boson arising from spontaneous breaking of an approximate global symmetry. In publication 29, this proposal was studied for the model in which the spontaneous symmetry breaking is SO(5) to SO(4) and its consequences for fermionic representations produced by the strong dynamics.

In publication 36, anomalous quartic photon couplings was suggested as a probe for new physics beyond the SM. By searching for these quartic photon couplings at the Large Hadron Collider (LHC), one could obtain a new window on extra dimensions and strongly interacting composite states. Another possible probe for new physics is anomalous couplings of the top quark to gauge bosons. In publication 53, current limits on these anomalous couplings was reviewed and updated. Improved limits of almost one order of magnitude are obtained in comparison with previous results and the analysis is extended to include four-quark operators. And in publication 54, these anomalous top quark couplings were used to put bounds on the coefficients of higher-dimensional top quark dipole operators using a Bayesian analysis.

a4. Cosmology

Although there is a rapidly increasing amount of observational cosmological data on our universe, the application of this observational data to testing current theoretical models is a challenging task. In publication 1, the characteristics of data on supernova from the upcoming Javalambre Physics Astrophysical Survey (J-PAS) is discussed. The J-PAS survey has the unique capability of obtaining distances and redshifts of supernova from a single experiment. Flux measurements, signal-to-noise ratios and other parameters are analyzed and strategies for optimizing the survey's outcome are presented.

Another important measurement in observational cosmology is the study of the cosmic infrared background (CIB). The main contribution to CIB comes from strongly clustered point sources and it is a challenge to construct models for this contribution. In publication 38, a fast estimator for the amplitude of the CIB spectrum coming from clustered point sourses is proposed and it is shown how this estimator can account for the cases of partial sky coverage and inhomogeneous noise. When used together with estimators for unclustered sources, this estimator can be used to impose robust constraints on theoretical models.

In publications 39 and 40, the non-Gaussianity of the CIB anisotropies were computed using a halo model that is fully parametric. A diagrammatic method is used to compute the CIB angular bispectrum at different wavelengths that traces the clustering of dirty star-forming galaxies. The CIB bispectrum is shown to be a strong contaminant of the Cosmic Microwave Background at certain wavelengths.

Surveys of large scale structure are important for determining the properties of our universe. Two such large-scale surveys probe the cluster number counts and galaxy 2-point functions. In publication 41, the halo model is used to model the cross-covariance of thes two probes and a diagrammatic method is introduced which can easily compute the relevant terms.

Another observational probe for obtaining cosmological data is gravitational waves which can give new information on very energetic objects in our universe such as black holes and cosmic strings. Although gravitational waves are predicted by general relativity, they have not yet been directly detected. However, the increased precision of the LIGO-Virgo experiment is expected to detect these waves within the next 5-10 years. In publications 42-47 and publications 49-52, various recent results of the LIGO-Virgo experiment have been described. Although this experiment has not yet identified any significant candidates for gravitational waves, the published results impose important constraints on the abundance and energy of possible cosmic strings and binary black hole systems in our universe. In publication 48, it is theoretically shown that the spin of a black hole in a binary system can be measured up to a few percent error using gravitational waves.

a5. Astrophysics

The source of dark matter in our universe is an unsolved mystery which needs to be urgently explained. In publication 35, it is argued using N-body simulations that the halos of dark matter in our universe are not spherical as is commonly assumed. This non-sphericity causes a systematic uncertainty in all dark matter searches, and the evaluation of these uncertainties is discussed.

Another unsolved mystery is the source of cosmic ray acceleration. Magnetic reconnection sites has been conjectured to be the source of this acceleration, and publications 27 and 28 discuss this possibility. By performing three-dimensional simulations with the injections of thousands of test particles, it is argued from the evolution of their energy spectrum that the particles can be efficiently accelerated by magnetic reconnection through a first-order Fermi process involving magnetic current sheets. And in publication 25, this magnetic reconnection is applied to the case of gamma-ray emission from microquasars and active galactic nuclei.

The amplification of magnetic fields in the intercluster medium can possibly be explained by turbulent dynamo action, however, this explanation is not well

understood. In publication 23, three-dimensional simulations were used to model the turbulent intercluster medium for different initial values of the magnetic field intensity. And in publication 24, models are tested using two-dimensional simulations for amplification of magnetic fields which are believed to cause the large synchrotron emission at the afterglow phase of gamma ray bursts.

In publication 26, the results of the Planck experiment on polarized thermal emission from galactic dust were presented.

a6. Dynamical and nonlinear systems

A general model of dynamic response under external perturbations is developed in publication 3, applied to a a wide range of systems out of equilibrium including Ising models of physical systems, social opinions, and population genetics.The distribution of states under perturbation and relaxation process reflects one regime driven by the external perturbation, and one driven by internal ordering. The results are extended to a wide range of network topologies by introducing an effective strength of external perturbation by analytic mean-field approximation.

The phenomenon of synchronization in chaotic systems has been well studied. Publication 9 investigates the possibility to achieve synchronization in finite time of two tunnel-diode based chaotic oscillators, considering the case of chaotic systems without and with delay (internal delay and multiple delay), based on Lyapunov and on Krasovskii-Lyapunov stability theories. Publication 12 aimed to investigate synchronization enhancement via an oscillatory bath in a network of coupled oscillators with free-end boundary conditions.

The electrical stimulation (ES) protocols have been applied either to induce neuronal activity or to disrupt pathological electrical activity patterns. In publication 10, computational simulations were used to study the interference of ES in the cellular excitability and the neuronal dynamics.Their results suggested that the variation of the the amplitude or duration of ES could trigger three different states of neuronal excitability, which changed the dynamics of neuronal electrical behaviour.

Publication 11 presents a theoretical description of a new physical principle to design a semiconductor device for amplication of a weak optical pulse where its multiplesequential amplications take place due to multiple avalanche processes happening in localized areas with high enough voltage, the Semiconductor Photoelectron Multiplier (SPEM). It consists of a multilayered semiconductor structure, where the necessary conditions for generation of photoelectrons are met, such that it enables sequential avalanche multiplication of electrons and holes inside two depletion slabs created around the p-n junctions of a reverse biased $pn - i - pn$ structure.

Publication 13 uses the Korteweg-de Vries-Burgers equation to study simultaneous competing effects of (weak) nonlinearity, dispersion and antidissipation of a soliton to give an accurate kinematic and dynamic description of the route towards breaking of solitary waves. Publication 15 describe the dynamics of monochromatic surface waves in deep water, deriving a nonlinear and dispersive system of equations for the free surface elevation and the free surface velocity from the Euler equations in infinite depth.

a7. Mathematical biology

Isolation by spatial distance and isolation mediated by genetic incompability are two forces that can cause speciation, even in the absence of natural selection. In publication 2 a population genetics theory for topopatric speciation considering the effect of assortative mating is constructed. In absence of mutations, evolution leads to the disappearance of one of the alleles. However, a particular combination of the allele frequencies at the two loci is maintained constant. It is shown that this

combination remains constant even when mutations are present, revealing the robustness of the epistatic correlation introduced by the non-random mating mechanism.

Natural landscapes have become increasingly fragmented due to natural disturbances or human activities. Understanding the effects that spatial heterogeneity can have on population dynamics has become therefore a central point in ecological research. Publication 14 provides a clear picture about the effects of finite habitat size on the dynamics of a predator–prey system. Species movement and growth are described through a reaction–diffusion model with Rosenzweig–MacArthur type local interactions. The reduction of habitat size, or increasing of species movement rates equivalently, has the potential to decrease the amplitude of oscillations and even bring the system to a steady coexistence equilibrium above a threshold. This trend is reversed when when species movement rates and response at patch boundaries interact to induce non-trivial patterns of species distributions. These distributions are characterized by anti-correlation between predator and prey, creating then spatial refugia for prey.

Ecological science contributes to solving a broad range of environmental problems. However, lack of ecological literacy in practice often limits application of this knowledge. Publication 30 highlights a critical but often overlooked demand on ecological literacy: to enable professionals of various careers to apply scientific knowledge when faced with environmental problems. The authors propose problem based learning to improve the understanding of ecological science and its usefulness for real-world environmental issues that professionals in several careers will address, enabling professionals in different fields to improve environmental decision-making processes.

Species abundance distributions (SADs) are one of the basic patterns of ecological communities. The empirical distributions are traditionally modelled through probability distributions. Hence, the maximum likelihood method can be used to fit and compare competing models for SADs. The package sads provides functions to fit the most used models to empirical SADs and also to evaluate fits and to compare competing models. The package also allows to simulate SADs expected from samples from communities, with and without aggregation of individuals of the same species.

Most models on the effects of habitat loss are stochastic, neutral theories that assume communities are mainly affected by ecological drift and random extinction. The results of publication 31 show the prevalence of deterministic, niche-based processes for community assembly following habitat loss. Besides, habitat loss simultaneously led to a strong within-landscape biotic homogenization, an abrupt change in community composition and a drastic decline in species richness. These results corroborate the importance of pro-active measures to prevent human-modified landscapes to go beyond these ecological thresholds, and on the limitations of ecological restoration in highly deforested landscapes.

Theoretical models predict that the net interactions between plants are affected by environmental conditions and that the importance and intensity of facilitation decreases as the conditions become less severe, a proposition known as the stress gradient hypothesis (SGH). In publication 32, transplant experiments along a natural stress gradient in coastal dunes from southeast Brazil were performed to test if shading is a facilitative mechanism that allows mature trees to provide a nurse effect, and if the net outcome of the nurse interaction and the shade-driven facilitation change along a natural gradient of environmental severity. This study highlighted the potential of nurse plants and artificial shade as techniques to improve the survival of transplanted seedlings used in the restoration of degraded shrubland coastal dunes.

Publication 33 proposes an explicit concept of specialisation that comprises affinities among resources as well as their co-occurrence with consumers. This concept is build on recent advances in ecophylogenetics and null model analysis and comprises. The purpose of this work is to enable a more rigorous deployment

of ecological specialisation in empirical and theoretical studies.

b. Research related to visitors

During 2014, the ICTP-SAIFR hosted 74 short-term visitors who stayed less than one week and 92 long-term visitors who stayed more than one week. The complete list of short-term and long-term visitors to ICTP-SAIFR can be found on the webpage http://www.ictp-saifr.org/?page_id=5262
The research of some of the long-term visitors is described below:

Fabio Iocco – OKC, Stockholm Univ. (2/13 – 2/22):
During my visit at ICTP-SAIFR I have had the possibility to get intense feedback over my activity in the field of nucleosynthesis in cosmological context, in the framework of the Cosmology workshop where I have presented and discussed my work on Lithium 7 and its non-primordial origin implications. Also, I have had stimulating conversations about my work on dynamical constraints on the dark matter content in our Galaxy, which has helped me to focus my research on the subject.

Ora Entin-Wohlman – Tel Aviv and Bem Gurion University (2/24 – 3/25)
During my stay in the Institute I carried out research on:
1. The efficiency of work/heat production in three-terminal electronic and thermal junctions;
2. Spin filtering in mesoscopic systems.
I also participate in the organizing of a workshop dedicated to spin effects in mesoscopic systems, delivered a lecture, participated in many scientific discussions with the participants. Part of the work developed during our visit to ICTP-SAIFR resulted in a paper entitled "Enhanced performance of joint cooling and energy production" (http://arxiv.org/pdf/1410.4880v1.pdf), submitted to Physical Review B.

Amnon Aharony – Tel Aviv and Bem Gurion University (2/24 – 3/25)
I worked on various topics related to spintronics. In particular this work dealt with spin filters, for quantum information storage. I was also busy with organizing the 2-day workshop on these topics.

Matheus Grasseli – UNICAMP (5/28 – 6/4)
The purpose of my visit was to interact with the Complex Systems and Econophysics groups. Over the past five years, my research focus has been mathematical modelling in macroeconomics, using both agent-based and dynamical systems methods. During my visit, I gave a 2-hour talk describing the many applications of dynamical systems to macroeconomics, including credit expansion and asset price bubbles, government intervention, and sectorial portfolio dynamics. I believe some of this work can be of interest to researchers at ICTP-SAIFR, in particular those familiar with dynamical systems techniques applied to biological and epidemiological problems. For example, my recent paper on government intervention uses persistence results first develop for applications in population dynamics.

Pau Amaro Seoane – Max Planck Institute for Gravitational Physics (7/21-25)
During my visit at the ICTP-SAIFR I discussed mostly with Riccardo Sturani about an old project on which I had been working for a long time, namely the role of eccentricity in the sources of gravitational radiation for ground-based detectors such as Advanced LIGO and Virgo. This is important, because due to the large number of free parameters to be explored when developing waveforms, some assumptions must be made to reduce the parameter space. Eccentricity has been systematically set to zero for all sources of radiation. While this is probably fine for

field binaries, the truth is that we know very little about them, and the event rate estimates fluctuate in up to three orders of magnitude. Binaries formed dynamically, though, are "clean" and easy to understand, because we have a good mathematical machinery to describe the process: Two body relaxation is a well-studied theory in stellar dynamics. Binaries formed dynamically are likely to have an important eccentricity when they are in the range of frequencies of relevance of the detectors and, hence, it cannot be omitted in the study. Moreover, Riccardo and I are organizing a 1-week workshop in Brazil next year. My visit was in this respect very useful to make progress.

Paper: The role of eccentricity in sources of gravitational radiation for ground-based detectors. Amaro-Seoane & Sturani. (work in progress)

Sylvain Fichet – UFRN (7/27– 8/17)
The visit to the IFT (ICTP-SAIFR) in Sao Paulo provided the opportunity to give a seminar (``light-by-light scattering from warped extra-dimensions'), participate to the ``Going on aftet the LHC8' Workshop and to make progress on the following project.

Papers: Towards higher-spin phenomenology, Fichet, Gersdorff (Work in progress); Light-by-light scattering with intact protons at the LHC: from Standard Model to New Physics, Sylvain Fichet, Gero von Gersdorff, Bruno Lenzi, Christophe Royon, Matthias Saimpert (arXiv:1411.6629v1, submitted on Nov. 24th)

Giácomo Cacciapaglia - Institut de Physique Nucleaire de Lion (8/11-18)
I participated to the Workshop GOAL8. During my visit I also started preliminary work on two projects. The first one is about the study of multi gauge boson production at the LHC in models where the Higgs couplings to the W and Z are reduced and Unitarisation of the scattering amplitudes is restored thanks to spin-1 resonances. The discussion involved Prof. R.Rosenfeld and A.Belyaev (participant to the workshop). I also started discussing about simple models for Dark Matter at the LHc with A.Belyaev. The development of the two projects is too premature to forecast the titles and authors of eventual publication; however I reckon that there will be at least two papers published in the near future.

David Kosower – Saclay (8/17-23)
I delivered a series of four lectures on on-shell methods for computing scattering amplitudes (see http://www.ictp-saifr.org/?page_id=6279). In addition, I gave the weekly colloquium, on Precision QCD at the LHC. I also discussed scattering equations and possible derivations of recursion relations with Dr. Kalousios of the IFT.

Arhrib Abdesslam – University Abdemalek Essaadi (8/1-29)
During My visit of 4 weeks, I make some progress on my ongoing research projet about type II seesaw model and also two Higgs doublet model. I also give 2 seminars: 1. phenomenology of type II seesaw model. 2. phenomenology of inert Higgs models I also discuss with Prof Juan Montero and V. Pleitez about possible collaboration. I also attended to the workshop "Going On After the LHC8 ''GOAL8'' organized at ICTP-SAIFR from 11th to 15th August 2014.

Enrique Gaztanaga - Instituto de Ciencias Del Espacio (IEEC-CSIC) (8/29 – 9/7)
I discuss with Rogerio Rosenfeld and Fabien Lacasa two research projects and explore the possibility of a follow up collaboration. First was about estimating the covariance of Cluster Abundance and galaxy clustering. The new idea here would be to use simulations to test the analytical work already done by Rogerio and Fabien. The other project is to measure the 3-point function of the Planck y-maps in real space and model this using halo model and SZ profiles.

Alejandro Ibarra – Technische Universitaet Muenchen (8/29 – 9/7)
I gave a seminar on 11.9 with title "Signatures of the Inert Doublet Dark Matter Model". I also had several discussions on dark matter phenomenology with Nicolas Bernal and Rogerio Rosenfeld.

Oscar Chalcatana – John Hopkins University (10/28 - 12/2)
I worked on my research project in collaboration with Jacques Distler and Anderson Trimm. I had research discussions with Nathan Berkovits and talked about a number of possible research projects. I also had discussions with David Simmons-Duffin on the conformal bootstrap, wiht Balt van Rees on chiral algebras, and with Sebastian Guttenberg on pure spinors. Finally, I attended the minicourse on Conformal Field Theory by Pedro Vieira.

João Penedones – U. Porto (11/1 - 12/9)
During my visit to ICTP-SAIFR, I explored new ideas to generalize the numerical methods successful in the conformal bootstrap to the case of S-matrix bootstrap. This was done in collaboration with Pedro Vieira and Balt van Rees. Unfortunately, our efforts have not been successful so far. I also continued to work on a project to determine recursion relations for conformal blocks for four point functions of conserved currents in 3 dimensions. This work should give rise to a publication in the near future and involves my student Emilio Trevisani and Masahito Yamazaki. During my visit, I also concluded a paper on the thermodynamics of the BMN matrix model at strong coupling. This was a collaboration with Miguel Costa, Jorge Santos e Lauren Greenspan that started 2 years ago.

Paper: Thermodynamics of the BMN matrix model at strong coupling. M.S. Costa, L.Greenspan, J. Penedones, J. Santos (work in progress).

David Simmons-Duffin – IAS Princeton (11/10-22)
At ICTP-SAIFR, I continued research on numerical methods for the conformal bootstrap and also singularities in CFT correlators in 2 dimensions. In addition, I discussed recursion relations for conformal blocks with Joao Penedones and Emilio Trevisani. ICTP-SAIFR provided a very stimulating environment for research. I enjoyed discussing physics with other members of the program on integrability and the conformal bootstrap. I also appreciated the excellent questions from audiences during the two seminars I gave.

Mateo García-Pepin – Institut de Fisica d´Altes Energies, Barcelona – (11/15 - 12/13)
I went to ICTP for a month as a visiting PhD student to work with my supervisor Mariano Quirós (IFAE, Barcelona), who is associated to ICTP SAIFR for at least 2 years, where he will spend at least two months per year. During my stay I worked on a project with him, Antonio Delgado and Bryan Ostdiek, from Notre Dame University. It examines the Dark Matter phenomenology of a new supersymmetric model previously introduced in: http://arxiv.org/abs/1308.4025 and, http://arxiv.org/abs/1409.5737 Probably, I will at some point start a project with permanent researchers at ICTP, I pretend to follow this project on a visit next year that will be funded by my home institution.

Paper: Dark Matter from the SCTM. A. Delgado, B. Ostdiek, M. Quirós, M.García-Pepin (work in progress)

Guillermo Ariel Silva – IFLP – UN La Plata (11/30 – 12/11)
I discussed about my research with various people at SAIFR: Nathan Berkovits, Balt Van rees and Joao Penedones. I finished a paper with Diego Correa an Jeremias Aguilera Damia and I gave a seminar at the DFMA, Institute of Physics, USP.

Paper to be submitted: Semiclassical partition function for strings dual to Wilson loops with small cusps in ABJM. D Correa, J Aguilera-Damia and G A Silva

Elisabetta Furlan – FERMILAB (11/30 – 12/11)
I came to collaborate with Eduardo Ponton on our project on double Higgs production in composite Higgs models. Before computing the double Higgs production rates, we want to understand if these models are compatible with electroweak symmetry breaking and the electroweak constraints. We focused on the latter and performed two independent calculations of the loop contribution to the Peskin-Takeuchi parameters from the extended fermionic sector. Our results agree. We also discussed the effects of nonlinearities in the quark-vector bosons couplings arising from integratingthe heavy vectors. We computed the contributions to the S and T parameters from the modification of the couplings of the electroweak gauge bosons with the Higgs. We discussed the additional contribution to T, and potentially to S, from the heavy vector bosons, and how we should account for them in the effective theory. On Dec 11 I presented a seminar on gluon-fusion Higgs production, at the level of an introduction to the techniques adopted in QCD to predict the cross section for this process at the highest accuracy.

Paper: Double Higgs production in composite Higgs models. M. Carena, L. da Rold, E. Furlan, E. Ponton (Work in progress)

Amit Sever – Tel Aviv University – (12/1-12)
During my visit I continued collaborating with Pedro Vieira on the problem of computing scattering amplitudes in planar N=4 SYM. I gave a talk about "Adjoint BFKL at finite coupling - a short-cut from the collinear limit".

c. Organization of activities

During the year of 2014, the ICTP-SAIFR organized six São Paulo International Schools for Theoretical Physics, eight workshops, three minicourses, three Programs, one outreach event, the annual meeting of the steering committee and scientific council, and weekly seminars, colloquia and journal clubs. The complete list of 2014 activities is on the webpage http://www.ictp-saifr.org/?page_id=4718, the list of weekly seminars and colloquia is on the webpage http://www.ictp-saifr.org/?page_id=5622, and the weekly journal clubs on particle physics and cosmology are on the webpages http://www.ift.unesp.br/users/matheus/partJC/ and https://sites.google.com/site/ictpsaifrjc/. Many of the activities were filmed using equipment donated by the ICTP in Trieste and the vídeos are available online on the associated webpages.

c1. São Paulo International Schools

The six São Paulo International Schools each lasted one to two weeks and were on the subjects of Mathematical Biology (February 3 - 15), Dynamical Systems in Biology (May 4 – 9), Random Geometry and Random Matrices (August 25 – September 2), Few-body Physics (October 6-10), Electronic Structure and Quantum Transport Methods (October 13- 24), Observational Cosmology (December 1-12).

The schools were for mostly masters and PhD students, and those students not from São Paulo where housed in a hotel in shared rooms. The students were asked to anonymously evaluate the schools, and the links to view their evaluations are
http://ictp-saifr.org/sis/mbIIIViewAvaliacao.php

http://ictp-saifr.org/sis/dsbViewAvaliacao.php
http://ictp-saifr.org/sis/randomViewAvaliacao.php
http://www.ictp-saifr.org/sis/few-bodyViewAvaliacao.php
http://ictp-saifr.org/sis/qtmViewAvaliacao.php
http://ictp-saifr.org/sis/observationalViewAvaliacao.php
All lectures of the schools were filmed and the videos are available online on the school webpage.

c1A. Mathematical Biology (February 3 - 15)

The III Southern-Summer School on Mathematical Biology is described on the webpage http://www.ictp-saifr.org/?page_id=4634, and involved 4 lecturers, 1 distinguished lecturer (Simon Levin from Princeton University) and 78 students. The school was aimed at graduate students in Physics, Mathematics, Ecology and Epidemiology, having at least a basic knowledge of calculus and differential equations. The first week was a basic course on population biology, which was strongly based on modelling exercises. The second week consisted of three advanced courses on up-to-date topics in ecology and epidemiology and a series of three seminars by Simon Levin
Topic and Lecturers:

- Roberto Kraenkel (IFT-UNESP, Brazil) – Introduction to Population Biology
- Robert Smith? (Univ. Ottawa, Canada) – Mathematical Modeling of Infectious Diseases.
- Otso Ovaskainen (Univ. Helsinki, Finland) – Spatial Ecology and Evolution: Integrating Theory and Data
- François Massol (CNRS, Montpellier, France) – Topics in Evolutionary Dynamics

c1B. Dynamical Systems in Biology (May 4 – 9)

The Minischool on Dynamical Systems in Biology is described on the webpage http://www.ictp-saifr.org/?page_id=5873 involved 4 lecturers and 42 participants. The school was aimed at students with a basic knowledge of calculus, linear algebra and differential equations. The course covered applications of methods developed in physics and mathematics to some leading-edge problems of biology.

Topics and Lecturers:

- Marcus A.M. de Aguiar (Unicamp, Brazil) – Population dynamics and speciation
- Roland Koberle (USP São Carlos, Brazil) – Real time vision
- Marcelo Magnasco (Rockefeller Univ., USA) – Critical dynamics in biological systems
- Gabriel Mindlin (Univ. de Buenos Aires, Argentina) – Birdsong as a model for learning

c1C. Random Geometry and Random Matrices (Aug. 25 – Sep. 2)

The School on Random Geometry and Random Matrices (August 25 – September 2) is described on the webpage http://www.ictp-saifr.org/?page_id=5949 and involved 5 lecturers and 55 participants. In this interdisciplinary school, an overview of applications of random geometry and random matrices was given. The school was intended for graduate students and researchers in the fields of high energy physics, statistical physics and probability theory. This event received support from the Nordic Institute for Theoretical Physics (Nordita) for the participation of Nordic scientists.

Topics and Lecturers:

- Jérémie Bouttier (Saclay, France) - Recent developments in random planar maps, or the virtue of discreteness
- Zdzislaw Burda (Krakow, Poland) - Products of random matrices and their applications
- François David (Saclay, France) - Liouville theory, KPZ and SLE
- Nadav Drukker (King's College, UK) - Matrix model for supersymmetric field theories
- Thordur Jonsson (Iceland) - Random tree ensembles and applications

c1D. Few-body Physics (October 6-10)

The Minischool on Few-body Physics is described on the webpage http://www.ictp-saifr.org/?page_id=6093 and involved 5 lecturers and 24 participants. In this one-week interdisciplinary school, lectures were presented on the correlated Gaussian method, a powerful tool used to solve quantum few-body systems in atomic and nuclear physics, and on the relevance of dimensionality in quantum few-body systems and quantum magnetism. Additionally, a review talk on universal behaviours was presented and there was daily sessions for resolving homework exercises. The school was aimed at graduate students and researchers in the fields of nuclear, atomic, molecular, condensed-matter, particle physics and quantum chemistry with a basic knowledge of quantum mechanics.

Topics and Lecturers:

- Dmitri Fedorov (Aarhus University/Denmark) – Correlated Gaussian method in quantum mechanics
- Tobias Frederico (Instituto Tecnológico da Aeronáutica / Brazil) – Strongly interacting two- and three-boson systems between two and three-dimensions
- Aksel Jensen (Aarhus University/Denmark) - Universal properties of few-body systems
- Alejandro Kievsky (Istituto Nazionale di Fisica Nucleare/Pisa) – Exploring universal behavior in few-body systems
- Nikolaj Zinner (Aarhus University/Denmark) – Few-body physics in different dimensions

c1E. Electronic Structure and QTM (October 13- 24)

The School on Electronic Structure and Quantum Transport Methods is described on the webpage http://www.ictp-saifr.org/?page_id=6103 and involved 5 lecturers and 46 participants. The first aim of this school was to introduce the theoretical framework of computational condensed matter physics through mini-courses taught by prominent researchers in their corresponding fields. The second aim was to introduce students to the available computational tools through hands-on tutorials provided by the developers of the computational codes. The third and final aim was to explain the current limitations of the tools available and to introduce through research seminars a number of state-of-the-art approaches to overcoming these limitations.

The school was intended for graduate students and young researchers in the fields of theoretical condensed matter physics and computational chemistry. A basic knowledge of condensed matter and/or atomic and molecular physics was preferred

Topics and Minicourse Lecturers:

- Ralph Gebauer (ICTP – Trieste / Italy) – Time-Dependent Density Functional Theory
- Caio Lewenkopf (UFF / Brazil) – Electronic Transport Theory: Equilibrium and Out-of-Equilibrium
- Caetano Rodrigues Miranda (UFABC / Brazil) – Multi-Scale Methods
- Mariana Rossi (Oxford University / United Kingdom) – Path Integrals applied to Quantum dynamics in molecules
- Ivan Rungger (Trinity College Dublin / Ireland) – Non-Equilibrium Transport in Density Functional Theory

Seminar Speakers:

- Alex Antonelli (UNICAMP / Brazil)
- Karen Hallberg (Centro Atómico Bariloche, Instituto Balseiro, Argentina)
- Belita Koiller (UFRJ / Brazil)
- Antônio José Roque da Silva (LNLS / Brazil)
- Kristian Sommer Thygesen (Technical University of Denmark)

Tutorials:

- Rodrigo Garcia Amorim (Uppsala University/ Sweden)
- Ralph Gebauer (ICTP – Trieste / Italy)
- Matheus P. Lima (USP-São Paulo / Brazil)
- Luana Sucupira Pedroza (ICTP-SAIFR / Brazil)
- Ivan Rungger (Trinity College Dublin / Ireland)

c1F. Observational Cosmology (December 1-12)

The Joint ICTP-Trieste/ICTP-SAIFR School on Observational Cosmology is described on the webpage http://www.ictp-saifr.org/?page_id=6046 and involved 7 lecturers and 60 participants. Cosmology has entered a precision era driven by numerous experiments. Large scale surveys of structures such as the Sloan Digital Sky Survey and the Dark Energy Survey, together with experiments designed to carefully measure the cosmic microwave background, such as the Planck satellite and BICEP2, continue to explore and reveal vital information about our universe. This School provided students with the necessary tools to use this multifold of data to test different cosmological models and determine their parameters. Pedagogical lectures providing the necessary theoretical background was followed by hands-on lectures focusing on the different cosmological probes that are currently used.
Topics and Lecturers:

- Philippe Brax (Saclay) – Beyond LCDM
- Paolo Creminelli (ICTP-Trieste) – Inflation
- Scott Dodelson (Fermilab & U. of Chicago) – Theory and Combined Probes
- Marcello Musso (U. de Louvain) – Large Scale Structure II
- Anais Rassat (EPFL-Lausanne) – Gravitational Lensing
- Ravi Sheth (ICTP-Trieste & U. of Pennsylvania) – Large Scale Structure I
- Joe Zuntz (U. of Manchester) – From Observations to Models (and back)
-

c2. Workshops

ICTP-SAIFR organized eight workshops in 2014 on the subjects of Cosmology (February 20-21), Nanophysics and Spintronics (March 13 – 14), Perspectives in Nonperturbative QCD (May 12 – 13), Going on After the LHC8 GOAL (August 11 – 15), Random Geometry and Random Matrices (September 3 - 4), Complex Systems (October 22 – 23), Foundations of Quantum Theory and Cosmology (November 3 – 7), Observational Cosmology (December 7). The purpose of these workshops was to discuss status, recent progress, perspectives in each of the fields mentioned.

c2A. Cosmology (February 20-21)

We had a 2-day gathering with several visitors and posdocs to discuss many

topics in Cosmology, such as Inflation, CMB, Dark Matter, Dark Energy and Gravitational Waves. In order to encourage discussions, we had short (~20 min) talks, followed by questions (~10 min), as well as extended free periods for open discussions.
The only exception was the opening talk by Luca Amendola. The webpage of the workshop is http://www.ictp-saifr.org/?page_id=5575 and speakers and topics included:

- Jailson Alcaniz (ON, Rio de Janeiro) - Testing the cosmic duality relation with galaxy clusters
- Luca Amendola (Univ. of Heidelberg) - Testing modified gravity: a unified approach
- Irène Balmès (USP Sao Paulo) - Imprints of structure formation history on dark matter halo profiles
- Nicolás Bernal (ICTP-SAIFR) - Systematic uncertainties in dark matter searches due to halo asphericity
- Fedor Bezrukov (Univ. of Connecticut) - Light Inflation – Reconciling φ4 Inflation with Planck and Experimental Prospects
- Julio Fabris (Univ. Fed. Espirito Santo) - Non-linear analysis of unified models of the dark sector
- Fabio Iocco (IFT Madrid) - The lithium problem, a phenomenologist's perspective.
- Gilberto Kremer (Univ. Fed. Parana) - Fermions as sources of accelerated regimes
- Fabien Lacasa (ICTP-SAIFR) - Non-Gaussianity of extragalactic foregrounds to the CMB with Planck
- Morgan Le Delliou (IFT-UNESP) - Separating expansion and collapse in general fluids: local conditions and spherically symmetric models
- Marcello Musso (Univ. Catholique de Louvain) - Halo statistics for cosmology: the excursion set approach with correlated steps
- Alessio Notari (Univ. Ferrara, Italy) - CMB anomalies and peculiarities
- Thiago Pereira (Univ. Estadual de Londrina) - Weak-lensing as a probe of the Universe's geometry
- Paulo Reimberg (USP Sao Paulo)
- Riccardo Sturani (ICTP-SAIFR) - Gravitational waves from coalescing binaries as testbeds of cosmology and fundamental physics
- Amol Upadhye (Ewha Univ., Seoul) – Modified gravity from the laboratory to the stars
- Ioav Waga (Univ. Fed. Rio de Janeiro) - f(R) gamma-gravity

c2B. Nanophysics and Spintronics (March 13 – 14)

A two-day workshop on nanophysics and spintronics was organized in the IFT-UNESP auditorium. The webpage of the workshop is http://www.ictp-saifr.org/?page_id=5440 and speakers and topics included:

- Amnon Aharony (BGU and TAU) - Spin filtering and mobile qubits
- Enrique V. Anda (PUC/Rio de Janeiro) - Correlation and spin effect in transport in nanosystems
- Carlos Balseiro (Centro Atómico Bariloche) - Floquet topological insulation in graphene
- Carlos Egues (USP Sâo Carlos)
- Ora Entin-Wohlman (BGU and TAU) - Thermopower in mesoscopic systems
- Gerson J. Ferreira (Univ. Fed. Uberlândia) - Magnetically defined qubits on 3D topological insulators
- Yara Galvao Gobato (Univ. Fed. São Carlos) - Spin injection in resonant tunneling diodes
- Belita Koiller (Univ. Fed. Rio de Janeiro) - Enhanced valley splitting towards spin qubits in silicon
- Caio Lewenkopf (Univ. Fed. Fluminese) - Mesoscopic electronic transport in graphene
- Gilmar Marques (Univ. Fed. São Carlos)

- Alexander Punnoose (IFT-UNESP) - Non-abelian spin-orbit gauge field: Localization and coulomb interaction effects
- Sergio Rezende (Univ. Fed. de Pernambuco) - Spin current phenomena: new impetus to spintronics
- Alexandre Rocha (IFT-UNESP) - Spin-orbit effects in graphene with density functional theory
- Luis Dias da Silva (USP São Paulo) - Kondo effect in disordered graphene
- Edson Vernek (Univ. Fed. Uberlândia) - Majorana fermions

c2C. Perspectives in Nonperturbative QCD (May 12 – 13)

This two-day workshop discussed status and perspectives on selected topics in nonperturbative QCD. Physics topics included:

- QCD vacuum
- Quark-gluon confinement
- Dynamical Chiral Symmetry Breaking
- Hadron structure & Hadron-hadron forces
- Quark-gluon plasma

These topics were discussed in the context of the nonperturbative methods of:

- Lattice QCD
- Effective field theories
- Dyson-Schwinger & Bethe-Salpeter equations
- QCD sum rules

The webpage of the workshop is http://www.ictp-saifr.org/?page_id=5924 and speakers included:

- Arlene C. Aguilar, UNICAMP (São Paulo) - Ghost-gluon vertex and the ghost Schwinger-Dyson equation
- Adnan Bashir, University of Michoacan (Mexico) - QCD critical point: a Schwinger-Dyson equations perspective
- Anthony W. Thomas, Adelaide (Australia)
- Craig D. Roberts, Argonne (USA) - Bound-state problem in continuum QCD
- Eduardo Rojas, Univ. Cruzeiro do Sul (São Paulo) - Mass generation under strong magnetic fields
- Giorgio Torrieri, UNICAMP (Campinas) - Large Nc at finite chemical potential
- Ian Cloët, Argonne (USA) - EMC effect: past, present and future
- Jorge Segovia, Argonne (USA) - Heavy quark phenomenology: a quark model perspective
- Peter Tandy, Kent State (USA) - Some chapters of the do-it-yourself hadron theory manual
- Raphael Albuquerque, IFT-UNESP (São Paulo) - Exotic states in charmonium spectroscopy
- Ricardo Farias, Univ. Federal de Santa Maria (Santa Maria) - Asymptotic freedom and the pseudocritical temperature of magnetized quark matter
- Sabyasachi Ghosh, IFT-UNESP (São Paulo) - Transport properties of a pion gas

c2D. Going on After the LHC8 GOAL (August 11 – 15)

The Large Hadron Collider at CERN has finished its first successful run in December 2012. The historical discovery of a Higgs boson started the exploration of the sector of the Standard Model responsible for the spontaneous breaking of the electroweak symmetry. Since no conclusive evidence for new physics beyond the SM has been found at the LHC so far, many theoretical ideas are now being put to stringent tests. The goal of this workshop was to bring together theorists to ponder on the progress that the flurry of data from LHC8 has brought to the field and

access future directions of research before the LHC is turned on again with almost its full design energy and higher luminosities. The webpage of the workshop is http://www.ictp-saifr.org/?page_id=5313 and speakers and topics included:

- Alex Azatov (CERN) - New Insights from Higgs Physics
- Yang Bai (University of Wisconsin/Madison) - Dips at the LHC
- Alexander Belyaev (University of Southampton) - Probing Higgs Physics with Vector-Boson Scattering
- Giacomo Cacciapaglia (IPNL/Lyon) - The Dynamics of Composite Pseudo-Goldstone Higgses
- Zackaria Chacko (U. of Maryland) - Colorless Top Partners in Light of the Higgs Discovery
- Leandro Da Rold (Centro Atómico Bariloche and Instituto Balseiro) - Anarchy and a PNGB Higgs
- Antonio Delgado (University of Notre Dame) - Generalized Focus Point in the MSSM
- Claudio Dib (U. Federico Santa María) - Linear Seesaw Neutrino Masses in B-L symmetry Breaking
- Oscar Éboli (IF-USP) – Higgs Couplings
- Christoph Englert (University of Glasgow) - Higgs under the Hood?
- Adam Falkowski (Orsay) - Nonstandard Higgs Discussion
- Marco Farina (Cornell University) - Baryogenesis through Split/High-Scale SUSY
- Claudia Frugiuele (Fermilab) - Dirac Gauginos, R-Symmetry and the 125 GeV Higgs
- Jamison Galloway (New York University) - Strong Dynamics and the Little Hierarchy
- Gero von Gersdorff (ICTP-SAIFR) - Higgs Couplings Discussion
- Roni Harnik (Fermilab) - Probes of a CP Violating Higgs
- José Juknevich (SISSA) - The Elusive Gluon
- Graham Kribs (University Oregon) - Dark Matter in Dileptons
- André Lessa (IFUSP) - SModelS: A Tool for Making Systematic Use of Simplified Models
- Ian Low (Argonne/Northwestern University) - Higgs Physics @ 100 TeV
- Adam Martin (University of Notre Dame) - New Physics in Higgs Kinematic Distributions
- Gilad Perez (CERN and Weizmann Institute) - Other BSM Discussion
- Erich Poppitz (University of Toronto) – Insightful supersymmetry
- Mariano Quirós (ICRA/IFAE) - EW Breaking and Supersymmetric Custodial Triplets
- Javi Serra (Cornell University) - Composite Higgs
- Witold Skiba (Yale University) - Scale Invariance and the EW Hierarchy
- Riccardo Torre (University of Padova) - Heavy Vectors at the LHC and Beyond
- Andreas Weiler (CERN) - SUSY status Discussion

c2E. Random Geometry and Random Matrices (September 3 - 4)

This two-day workshop hosted a series of talks on recent progress on research in random geometry and random matrices. The topics included applications to string theory and quantum gravity, statistical physics and probability theory. This event received support from the Nordic Institute for Theoretical Physics (Nordita) for the participation of Nordic scientists. The webpage of the workshop is http://www.ictp-saifr.org/?page_id=6267 and speakers and topics included:

- Jakob Björnberg (Uppsala) - Local limits of random bipartite planar maps and random trees
- Zdzislaw Burda (Krakow) - Universal distribution of Lyapunov exponents for products of Ginibre matrices
- Nadav Drukker (London) - Holography, integrability and the quark-antiquark potential in N=4 super-Yang-Mills theory
- Blai Garolera (Barcelona) - Applied localization
- João Gomes (Cambridge) - Quantum gravity and exact holography

- Andrzej Görlich (Copenhagen) - Simplicial quantum gravity in four dimensions
- Thordur Jonsson (Iceland)
- George Napolitano (Lund) - Ising model on random planar Lorentzian triangulation
- Andre Nock (Queen Mary, London) - Statistics of K-Matrices in Quantum Chaotic Scattering
- Ricardo Schiappa (Lisbon) - Touring the resurgent structure of random matrices and strings
- Thomas Vallier (Helsinki) - Bootstrap percolation on the random graph G_np
- Maria Eulalia Vares (Rio de Janeiro) - Phase transitions in layered systems
- Nicholas Simm (Queen Mary, London) - Mesoscopic spectral statistics and the fractional Brownian motion process with H=0

c2F. Complex Systems (October 22 – 23)

This two-day workshop on complex systems discussed applications of nonlinear dynamics to interdisciplinary research areas involving biology, ecology, economics, linguistics and physics. The webpage of the workshop is http://www.ictp-saifr.org/?page_id=6379 and speakers and topics included:

- Guillermo Abramson (Instituto Balseiro, Argentina) - Space use by foragers consuming renewable resources
- Eduardo Altmann (MPI for the Physics of Complex Systems, Germany) - A complex-systems view on language dynamics
- Jose Soares Andrade Jr. (Universidade Federal do Ceará, Brazil) - Robustness, transport and synchronization in complex networks
- Flora Bacelar (Universidade Federal da Bahia, Brazil) - Life history and mating systems select for male biased parasitism mediated through natural selection and ecological feedbacks
- Edgardo Brigatti (Universidade Federal do Rio de Janeiro, Brazil) - The Role of Neighbours Selection on Cohesion and Order of Swarms
- Yaneer Bar-Yam (New England Complex Systems Institute, USA) - Complex systems science and global crises
- Nestor Caticha (IF-USP, Brazil) - Cognitive limits, social interactions and the breakdown of the egalitarian society: an information theory approach
- Hilda Cerdeira (IFT-UNESP, Brazil) - Can we predict an epileptic seizure?
- Ronald Dickman (UFMG, Brazil) - Failure of Steady-State Thermodynamics
- Miguel Fuentes (Santa Fé Institute, USA) - Stochastic Path Perturbation Approach Applied to Non–Local Non-Linear Equations in Population Dynamics
- Marcos Gomes Eleutério da Luz (IF – UFPR, Brazil) - The Levy foraging theory and fragmented landscapes
- Renio dos S. Mendes (Universidade Estadual de Maringá, Brazil) - Violent conflicts and crime
- Jorge Pacheco (Universidade do Minho, Portugal) - Linking individual to collective behavior on complex networks
- Francisco Rodrigues (USP São Carlos, Brazil) - Centrality and dynamical processes on complex networks
- Renato Vicente (IME-USP, Brazil) - Evolution of altruism in group-structured populations

c2G. Foundations of Quantum Theory and Cosmology (Nov. 3 – 7)

The objective of this workshop was to bring together researchers working in the application of quantum theory to cosmology, and those working on foundational aspects of quantum theory. These two fields have a very important intersection, exemplified by the fact that many approaches that have been developed to deal with the conceptual difficulties, particularly with the so called "measurement problem" in quantum mechanics, become almost untenable in their application to cosmology. On the other hand, the views about the nature of quantum theory that are most popular amongst researchers working in modern cosmology are being

critically scrutinized within the foundational community.

This situation indicates that there is a very large potential for fruitful exchange and cross-fertilization of ideas among these two communities, which have not in the past had a strong interaction. The workshop was organized with emphasis on promoting interaction and discussion. There was a small number of formal presentations and a series of long discussion sessions with specific focus topics and whose titles are showed below:

1. Wave function of the Universe? Does it make sense?
2. Many Worlds Interpretations; Decoherence and their interconnection
3. Collapse Theories, de Broglie-Bohm theory, Lorentz Invariance and all that
4. Final analysis and conclusions

The webpage of the workshop is http://www.ictp-saifr.org/?page_id=5683 and speakers and topics included:

- David Albert (Columbia University) - On Primitive Ontology (by skype)
- George Ellis (Department of Mathematics, University of Cape Town) - Quantum mechanics, unitarity, and determinism: debatable issues and relations to cosmology (Colloquium); Quantum physics and the classical transition: back to fundamentals
- Rodolfo Gambini (Universidad de la Republica, Uruguay) - Quantum Gravity and the Montevideo Interpretation of Quantum Mechanics
- I. Gomez (IFIR, Rosário, Argentina) - Fundamendal graininess and statistical classical limit: compatibility of chaos with the Correspondence Principle (CP)
- Federico H. Holik (Universidad de La Plata, Argentina) - Generalizad probabilistic theories and the foundations of quantum mechanics
- Adrian Kent(DAMTP, University of Cambridge) - Quantum Reality, Generalizations of Quantum Theory and Cosmological Implications
- Susana Landau (University of Buenos Aires, Buenos Aires, Argentina) - Testing quantum collapse models with data from the Cosmic Microwave Background
- Marcelo A. Losada (Instituto de Física de Rosário, Argentina) - Quantum histories without contrary inferences
- Olimpia Lombardi (University of Buenos Aires, Buenos Aires, Argentina) - About the concept of quantum information
- Elias Okon(National Autonomous University of Mexico, Mexico D.F., Mexico) - Consistency of Consitent Histories
- Igor Peña (National Autonomous University of Mexico, Mexico D.F., Mexico) - Black Hole Information Loss and Collapse theories
- Nelson Pinto Neto (Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro, Brazil) - Quantum cosmology from the de Broglie–Bohm perspective
- Daniel Sudarksy (National Autonomous University of Mexico, Mexico D.F., Mexico) - Symmetry in Quantum theory in general and in the cosmological context in particular
- Roderich Tumulka (Rutgers University, USA) - Cosmological quantum fluctuations from the perspectives of Bohmian mechanics and collapse theories
- Antony Valentini (Clemson University, USA) - Primordial quantum non-equilibrium and large-scale cosmic anomalies
- Maurício Valenzuela (ICFM-UACH, Chile) - Space-time quantization and modified causality at Planck scales

C2H.Observational Cosmology (December 7)

In this workshop recent work on this field was presented. The webpage of the workshop is http://www.ictp-saifr.org/?page_id=6046 and speakers and topics included:

- Irène Balmès (USP Sao Paulo) - Dark matter halo profiles in modified gravity simulations
- Philippe Brax (Saclay) - K-mouflage
- Paolo Creminelli (ICTP-Trieste) – Cosmological consistency relations
- Saeed Mirshekari (ICTP-SAIFR): Astrophysics and Cosmology with Gravitational Waves
- Rafael Porto (ICTP-SAIFR) - Ideal (Theory) Targets for Cosmological Observations
- Miguel Quartin (UFRJ) - The CMB and our peculiar velocity
- Ravi Sheth (ICTP-Trieste & U. of Pennsylvania) – Voids: Much ado about nothing?
- Joe Zuntz (U. of Manchester) – Weak Lensing in the Dark Energy Survey: Early Results and Systematic Error Plans

c3. Minicourses

The ICTP-SAIFR organized three minicourses in 2014 with invited lectures on different topics including Bayesian Statistics and data analysis in cosmology, QCD amplitudes and Holography and Integrability. The topics, lecturers and webpages for these minicourses are:

1) January 27-31, Filipe Abdalla Minicourse on Data Analysis in Cosmology

   Filipe Abdalla (Univ. College, London)

   Title: Bayesian statistics and data analysis in cosmology

   http://www.ictp-saifr.org/?page_id=5386

2) August 18-22, Kosower Minicourse on QCD Amplitudes

   David Kosower (Saclay)

   Title: on-shell methods, amplitudes and collider physics

   http://www.ictp-saifr.org/?page_id=6279

3) November 5 – December 12, Advanced Quantum Field Theory: Holography and Integrability

   Pedro Vieira (Perimeter Institute)

   Title: Advanced Quantum Field Theory: Holography and Integrability

   http://www.ictp-saifr.org/?page_id=6944

c4. Programs

The ICTP-SAIFR organized three Programs in 2014. The first was the Program on Cosmology (http://www.ictp-saifr.org/?page_id=5480, February 11-21) organized by Prof. Luca Amendola (Heidelbert) and included visitors from several Universities worldwide which ended in a two-days workshop on Cosmology (February 20-21). The second was the Program on Nanophysics and Spintronics (http://www.ictp-saifr.org/?page_id=5440, February 24 – March 25) organized by Amnon Aharony and Ora Entin from the Ben Gurion University and Tel Aviv University and ended in a two-days workshop on a two-days workshop (March 13-

14). The third was the Program on Integrability, Holography and the Conformal Bootstrap (http://www.ictp-saifr.org/?page_id=6809, November 1, 2014 to February 28, 2015) organized by Pedro Vieira from the Perimeter Institute. Participants in the program include:

- Hrachya Babujian (Armenia and IIP Natal): Nov. 3-10
- Benjamin Basso (Perimeter Institute): Jan. 11 – Feb. 28
- Joao Caetano (Perimeter Institute): Jan. 4 – Feb. 28
- Eduardo Casali (Univ. of Cambridge): Dec. 11-19
- Lucia Cordova (Perimeter Institute): Nov. 4 – March 2
- Frank Coronado (Perimeter Institute): Nov. 4 – March 2
- Diego Correa (Univ. de La Plata): Jan. 25 – Feb. 5
- Nikolay Gromov (King's College, London): Feb. 1 – 28
- Romuald Janik (Jagiellonian U., Krakow): Jan. 19 – Feb. 2
- Vladimir Kazakov (ENS, Paris): Jan. 26 – Feb. 28
- Shota Komatsu (Perimeter Institute): Dec. 1 – Jan. 31
- Ivan Kostov (CEA, Paris): Feb. 15-28
- Martin Kruczenski (Univ. Purdue): Nov. 23-29
- Joao Penedones (Univ. Porto): Nov. 1 – Dec. 9
- Leonardo Rastelli (SUNY Stony Brook): Dec. 6-14
- Fidel I. Schaposnik (Unv. de La Plata): Jan. 5-31
- Didina Serban (CEA, Paris): Jan. 24 – Feb. 8
- Amit Sever (Tel Aviv Univ.): Dec. 1-12
- David Simmons-Duffin (IAS Princeton): Nov. 10-22
- Jon Toledo (Perimeter Institute): Jan. 5 – Feb. 28
- Emilio Trevisani (Univ. Porto): Nov. 3 – March 2
- Balt Van Rees (CERN): Dec. 1-14
- Matt Von Hippel (Perimeter Institute): Jan. 24 – Feb. 28

C5. Outreach activities

The ICTP-SAIFR organized one outreach event in 2014 in collaboration with IFT-UNESP: a competition for undergraduate physics students held on November 1 in which winners were determined by a 3-hour exam. The title of the competition is 2014 Premio IFT-ICTP para Jovens Físicos and the webpage with the names of the 5 winners is http://www.ictp-saifr.org/?page_id=3246

In December, the ICTP-SAIFR began a weekly online blog on its webpage with entries written by Ricardo Aguiar who has a FAPESP fellowship in scientific journalism.

Every three months, the ICTP-SAIFR sends out a scientific bulletin with general information about its activities. This scientific bulletin is also available on the ICTP-SAIFR webpage.

C6. Annual meeting of ICTP-SAIFR councils

The annual meeting of the ICTP-SAIFR Steering Committee and Scientific Council was held from February 17-19 and included closed meetings of the two councils as well as an invited seminar by Carlos Henrique de Brito Cruz (Scientific Director of FAPESP), "Science and Technology in São Paulo, Brazil".

The webpages of this meeting is http://www.ictp-saifr.org/?page_id=5321

The names of the members of these councils are

Members of the Steering Committee:

Fernando Quevedo (chair) - ICTP director
Julio Cezar Durigan - UNESP rector
Carlos Brito Cruz - FAPESP scientific director
Jacob Palis - Brazilian Academy of Science president
Juan Maldacena - Representing South America

Members of the Scientific Council:

Peter Goddard (chair) - IAS Princeton
Seifallah Randjbar-Daemi - ICTP vice-director
Rogério Rosenfeld - IFT-UNESP director
Marcela Carena - Fermilab, Batavia
Marcel Clerc - Univ. de Chile, Santiago
Belita Koiller - UFRJ, Rio de Janeiro
Daniel Sudarsky - UNAM, Mexico City
Matias Zaldarriaga - IAS, Princeton
Barton Zwiebach - MIT, Cambridge

In addition, there was a 2-hour telephone meeting of the ICTP-SAIFR International Search Committee on January 9 in which the short list of candidates for the two Simons-Fapesp tenure-track fellowships was selected.

Members of the International Selection Committee:

Marcela Carena - Fermilab, Batavia
David Gross - KITP, Santa Barbara
Leo Kadanoff - University of Chicago
Martin Rees - Cambridge University
Uros Seljak - University of California at Berkeley
Robert Wald - University of Chicago
Simon White - MPA, Garching
Edward Witten - IAS, Princeton
Matias Zaldarriaga - IAS, Princeton

C7. Weekly seminars, colloquia and journal clubs

During 2014, weekly seminars and colloquia were regularly organized. There were 151 seminars and colloquia in 2014 and the complete list is on the webpage http://www.ictp-saifr.org/?page_id=5622. There were also weekly journal club meetings in particle physics and in cosmology, and the webpages for these journal club meetings are http://www.ift.unesp.br/users/matheus/partJC/ and https://sites.google.com/site/ictpsaifrjc/

5. Description of Institutional Support

The ICTP-SAIFR received generous support from both the Instituto de Física Teórica (IFT) and from the Universidade Estadual Paulista (UNESP). All professors and secretarial staff of the IFT have been extremely supportive of all ICTP-SAIFR

activities, and the ICTP-SAIFR frequently uses the services of the IFT-UNESP driver and car. Also, one of the IFT-UNESP technical assistants, Jaqueline Santos Venturim, has been dedicated to filming ICTP-SAIFR activities. In 2014, part of the space obtained from IFT on the first floor was divided into four new visitor offices for ICTP-SAIFR which can host up to nine visitors.

The UNESP university is paying for four ICTP-SAIFR secretaries including our executive secretary, our accountant, our computer systems manager and a new executive manager who was hired in 2014. UNESP has also agreed to hire 5 permanent ICTP-SAIFR researchers and the first permanent researcher (Eduardo Ponton) was hired in 2013 at the top researcher level.

6. Activity plan for the next period

In 2015, the ICTP-SAIFR will evaluate the progress of the two newly hired tenure-track fellows in astrophysics and cosmology and will continue its search for a permanent researcher in the field of complex systems with biological applications. It also plans to fill the remaining two postdoctoral FAPESP fellowships approved on the grant, as well as hire a new joint IMPA/ICTP-SAIFR postdoctoral fellow in mathematical physics with funding from CAPES. Confirmed scientific activities in 2015 which will be organized by ICTP-SAIFR include international schools and workshops on various topics including gauge theory, mathematical biology, high-energy physics, biophysics, numerical spectral methods, advanced techniques for scientific programming, gravitational waves, particle physics, complex networks and neuroscience. Most of these schools will be organized by external researchers, and several of the topics are areas in which the ICTP-SAIFR would like to increase its research.

The list of 2015 activities confirmed up to now are on the webpage http://www.ictp-saifr.org/?page_id=6166 and include the activities:

São Paulo International Schools on Theoretical Physics

IV Southern-Summer School on Mathematical Biology
January 5-11, 2015
School on Pathogen Dynamics, Climate and Global Change
January 12-24, 2015
3rd Joint Dutch-Brazil School on Theoretical Physics
February 2-6, 2015
School on QCD and LHC Physics
July 22-31, 2015
School on Gravitational Waves: from data to theory and back
August 3-11, 2015
International Neutrino Summer School 2015
August 17-29, 2015
School on Complex Networks and Neuroscience
September 28 – October 16, 2015

Meetings/Programs/Workshops

Program on Integrability, Holography and the Conformal Bootstrap
November 1, 2014 – February 28, 2015
2015 Meeting of Scientific Council and Steering Committee
February 9-10, 2015

NCC/ICTP-SAIFR School and Workshop on Advanced Techniques for Scientific Programming
April 13-30, 2015
Workshop on Astrophysics and Relativity: Astro-GR 2015
August 11-15, 2015

Minicourses/Minischools

Onuchic Minicourse on Biophysics
March 8, 2015
Minischool on Biophysics of Protein Interactions
March 9-13, 2015
Rawitscher Minicourse on Numerical Spectral Methods
March 19 – April 14, 2015

Prize Competition

2015 Prêmio IFT/ICTP-SAIFR para Jovens Físicos
October 31, 2015

Besides these local activities, ICTP-SAIFR will give organizational support to the following External Activities: First Peruvian School on High-Energy Physics and Cosmology in Lima, Peru (June 22-26) and the 6th ICTP Latin-America String School in Mexico City (October 26 – November 6). The websites of these activities are http://www.ictp-saifr.org/?page_id=6617 and http://www.ictp-saifr.org/?page_id=6615, respectively.

7. Use of Reserva Tecnica and Benefícios Complementares Funds

In 2014, reserva técnica and benefícios complementares funds were used for the following purposes:

a) Advertisement of permanent and postdoctoral positions in specialized magazines (Physics Today - March, Physics World – May, Nature - August): 10,596.29 reais

b) Reform of first floor (4 new visitor rooms, office furniture, white board): 47,647.82 reais

c) Purchase of equipment (7 computers and 1 printer): 21,079.84 reais

d) Per diem, airfare and health insurance for training of ICTP-SAIFR staff members Nadia Roque and Jandira Oliveira to ICTP Trieste: 12,055.11 reais

e) Per diem and airfare for research visit of ICTP-SAIFR member Prof. Eduardo Pontón to FERMILAB: 14,257.86 reais

f) Airfare for visit of ICTP-SAIFR director Prof. Nathan Berkovits to ICTP-Trieste as invited speaker at 50th anniversary conference: 4,111.01 reais

g) Airfare for visit of ICTP-SAIFR director Prof. Nathan Berkovits to Caracas as invited speaker at conference CNF 2014: 3,566.61 reais

h) Per diem and airfare for conference SILAFAE of ICTP-SAIFR member Prof. Eduardo Pontón to Medellin (Colombia): 10,150.33 reais

8a. Articles in refereed scientific journals

8a1. Articles by ICTP-SAIFR Associate Researchers – they are presented following the order of the Project Team (item 2d)

1. Photometric type Ia supernova surveys in narrow band filters. Henrique S. Xavier, L. R. Abramo, M. Sako, N. Benítez, M. O. Calvão, A. Ederoclite, A. Marín-Franch, A. Molino, R. R. R. Reis, B. B. Siffert et al.. Dec 19, 2013. 19 pp. Published in Mon.Not.Roy.Astron.Soc. 444 (2014) 2313 DOI:10.1093/mnras/stu1611 e-Print:arXiv:1312.5706 [astro-ph.CO].

2. Toward a theory of topopatric speciation: the role of genetic assortative mating. D.M. Schneider, A. B. Martins, E. do Carmo, M.A.M. de Aguiar. Physica A 409 (2014) 35.

3.A dynamical analysis of allele frequencies in populations evolving under assortative mating and mutations. D.M. Schneider, E. do Carmo, M.A.M. de Aguiar. Physica A (2014), in press. doi:10.1016/j.physa.2014.11.030.

4.Infinite Tension Limit of the Pure Spinor Superstring. N. Berkovits. JHEP 1403 (2014) 017, arXiv: 1311.4156.

5.Covariant Map Between Ramond-Neveu-Schwarz and Pure Spinor Formalisms for the Superstring. N. Berkovits. JHEP 1404 (2014) 024, arXiv: 1312.0845.

6.Simplified Pure Spinor b Ghost in a Curved Heterotic Superstring Background. N. Berkovits, O. Chandia. JHEP 1406 (2014) 001, arXiv:1403.2429.

7. Supersymmetry Breaking E ects using the Pure Spinor Formalism of the Superstring. N. Berkovits, E. Witten. JHEP 1406 (2014) 127, arXiv:1404.5346.

8.Light-cone Analysis of the Pure Spinor Formalism for the Superstring. N. Berkovits and R. L. Jusinskas. JHEP 1408 (2014) 102, arXiv: 1406.2290.

9.Finite-time synchronization of tunnel-diode-based chaotic oscillators. P. Louodop, H. Fotsin, M. Kountchou, E. B. M. Ngouonkadi, H. A. Cerdeira and S.Bowong. Phys. Rev. E 89, 03291 (2014). http://dx.doi.org/10.1103/PhysRevE.89.032921.

10.Neuronal Excitability Level Transition Induced by Electrical Stimulation. G. Florence, J. Kurths, B. S. Machado, E. T.i Fono, H. A. Cerdeira, M. J.Teixeira, K.i Sameshima. To appear in European Physics Journal (2014).

11.Photoelectron multipliers based on avalanche pn-i-pn structures. K. A. Lukin, P. P. Maksymov, H. A. Cerdeira. To appear in European Physics Journal (2014).

12.Synchronization enhancement via an oscillatory bath in a network of self-excited cells. B. R. N. Nbendjo, H. G. E. Kadji, H. A. Cerdeira. To appear in Pramana (2015).

13.Finite time blow-up and breaking of solitary wind waves. M. A. Manna, P. Montalvo, R. A. Kraenkel. Physical Review. E, Statistical, Nonlinear, and Soft Matter Physics (Print), v. 90, p. 013006, 2014.

14. How population loss through habitat boundaries determines the dynamics of a predator-prey system. R. A. Kraenkel, G. A. Maciel. Ecological Complexity (Print), v. 20, p. 33-42, 2014.

15. An integrable evolution equation for surface waves in deep water. R. A. Kraenkel, H. Leblond, M. A. Manna. Journal of Physics A: Mathematical and Theoretical, v. 47, p. 025208, 2014.

16. Spatial Dynamics of a Population with Stage-Dependent Diffusion. F. Azevedo, R. M. Coutinho, R. A. Kraenkel. Communications in Nonlinear Science & Numerical Simulation, v. 22, p. 605-610, 2014.

17. Production of charmed pseudoscalar mesons in antiproton-proton annihilation. J. Haidenbauer, G. Krein. Physical Review. D. Particles, Fields, Gravitation, and Cosmology (Online), v. 89, p. 114003, 2014.

18. Non-Markovian expansion in quantum Brownian motion. E. S. FRAGA, G. Krein, L. F. PALHARES. Physica. A (Print), v. 393, p. 155-172, 2014.

19. Markovian versus non-Markovian stochastic quantization of a complex-action model. G. Krein, G. Menezes, N. F. Svaiter. International Journal of Modern Physics A, v. 29, p. 1450030, 2014.

20. Charmed hadrons in matter and SU(4) flavor symmetry. G. Krein. EPJ Web of Conferences, v. 73, p. 05001, 2014.

21. Importance of asymptotic freedom for the pseudocritical temperature in magnetized quark matter. R. L. S. Farias, K. P. Gomes, G. Krein, M. B. Pinto. Physical Review. C. Nuclear Physics (Print), v. 90, p. 025203, 2014.

22. Shear viscosity of a pion gas resulting from ρnn and. S. Ghosh, G. Krein, S. Sarkar. Physical Review. C. Nuclear Physics (Print), v. 89, p. 1-4, 2014.

23. Magnetic field amplification and evolution in turbulent collisionless magnetohydrodynamics: an application to the intracluster medium. R. Santos-Lima, E. M. de Gouveia Dal Pino, G. Kowal, D. Falceta-Gonçalves, A. Lazarian, M. S. Nakwacki. The Astrophysical Journal, v. 781, p. 84, 2014.

24. Ambient magnetic field amplification in shock fronts of relativistic jets: an application to GRB afterglows. G. R. da Silva, D. Falceta-Goncalves, G. Kowal, E. M. De Gouveia Dal Pino. Monthly Notices of the Royal Astronomical Society (Print), v. 446, p. 104-119, 2014.

25. The role of fast magnetic reconnection in the core region of black hole sources: effects of an MDAF accretion disk/corona. C. B. Singh, E. M. de Gouveia Dal Pino, L. H. S. Kadowaki. ApJ Letters, 2014 (accepted) (arXiv:1411.0883).

26. Planck intermediate results. XIX. An overview of the polarized thermal emission from Galactic dust.mPlanck Collaboration, P. A. R. Ade, N. Aghanim, E. M. de Gouveia Dal Pino, et al., Astronomy & Astrophysics, 2014, in press, (arXiv:1405.087)

27. Particle acceleration by magnetic reconnection. G. Kowal, E. M. Gouveia dal Pino. in Magnetic Fields in Diffuse Media, Astrophysics and Space Science Library 407, DOI 10.1007/978-3-662-44625-613 (arXiv:1302.4374)

28. Cosmic ray acceleration in magnetic reconnection sites. G. Kowal, E. M. Gouveia dal Pino, A. Lazarian. 8th International Conference of Numerical Modeling of Space Plasma Flows (ASTRONUM 2013), ASP Conference Series, Vol. 488, p.8, 2014 (arXiv:1401.4941) (REVIEW paper)

29. Minimal composite Higgs models at the LHC. M. Carena, L. da Rold, E. Pontón. J HIGH ENERGY PHYS, v. 2014, p. 159, 2014.

30. Ecological literacy and beyond: Problem-based learning for future professionals. T. M. Lewinsohn, J. L. Attayde, C. R. Fonseca, G. Ganade, L. R. Jorge, J. Kollmann, G. E. Overbeck, P. I. Prado et al. Ambio, 1-9, 2014.

31. Ecological filtering on random extinction? Beta-diversity patterns and the importance of niche-based and neutral process following habitat loss. T. Püttker, A. A. Bueno, P. I. Prado, R. Pardini. Oikos, 2014

32. Benefit of Shading by Nurse Plant Does Not change along a Stress Gradient in a Costal Dune. C. T. Castanho, P. I. Prado. PloS one, 9 (8) e105082, 2014.

33. An integrated framework to improve the concept of resource specialisation. L. R. Jorge, P. I. Prado, M. Almeida-Neto, T. M. Lewinsohn. Ecology letters 17 (11) 1341 – 1350, 2014.

34. Very special Relativity and Lorentz violating theories. J. Alfaro, V. O. Rivelles. Phys. Lett. B 239-244, 2014.

8a2. Articles by ICTP-SAIFR Postdoctoral Associates

35. Systematic uncertainties from halo asphericity in Dark Matter searchs. N. Bernal, J. Forero-Romero, R. Garani, S. Palomares-Ruiz. JCAP 1409 4.

36. Probing new physics in diphoton production with proton tagging at the Large Hadron Collider. S. Fichet, G. von Gersdorff, O. Kepka, B. Lenzi, C. Royon, M. Saimpert. Phys. Rev. D 89 (2014) 114004 [arXiv:1312.5153 [hep-ph]].

37. Massless scattering at special kinematics as Jacobi polynomials. C. Kalousios. J.Phys. A47 215402, 2014. arXiv:1312.7743 [hep-th]

38. Optimal estimator for the amplitude of the bispectrum from infrared clustered sources. F. Lacasa, N. Aghanim. A & A. vol. 569, 2014. doi: 10.1051/0004-6361/201220751, arXiv:1211.3902.

39.Non-Gaussianity of the cosmic infrared background anisotropies - I. Diagrammatic formalism and application to the angular bispectrum. F. Lacasa, A. Pénin, N. Aghanim. MNRAS vol. 439, 2014. doi: 10.1093/mnras/stt2373, arXiv:1312.1251.

40. Non-Gaussianity of the cosmic infrared background anisotropies - II. Predictions of the bispectrum and constraints forecast. A. Pénin, F. Lacasa, N. Aghanim. MNRAS vol. 439, 2014. doi:10.1093/mnras/stt2372, arXiv:1312.1252.

41. Combining cosmological constraints from cluster counts and galaxy clustering. F. Lacasa. Proceedings of IAUS 306: Statistical challenges in 21st Century Cosmology (SCCC 21), 2014. arXiv:1407.1247.

42. A directed search for continuous gravitational waves from the galactic center. LIGO Scientific and Virgo Collaborations: J. Aasi et al. – R. Sturani is included. Physical Review D 88.102002 DOI:10.1103.

43. Constraints on cosmic strings from the LIGO-Virgo gravitational-wave detectors The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. Physical Review D 112.131101 DOI:10.1103.

44. The NINJA-2 project: Detecting and characterizing gravitational waveforms modelled using numerical binary black hole simulations. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. DOI: 10.1088/0264-9381/31/11/115004.

45. Reconstruction of the gravitational wave signal $h(t)$ during the Virgo science runs and independent validation with a photon calibrator. The LIGO Scientific Collaboration, the Virgo Collaboration: T. Accadia et al. – R. Sturani is included. DOI: 10.1088/0264-9381/31/16/165013.

46. First Searches for Optical Counterparts to Gravitational-wave Candidate Events. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. The Astrophysical Journal Supplement Series211(1):25, 2014. DOI: 10.1088/0067-0049/211/1/7.

47. Implementation of an F-statistic all-sky search for continuous gravitational waves in Virgo VSR1 data. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. Classical and Quantum Gravity 31(16), 2014. DOI:10.1088/0264-9381/31/16/165014.

48. Measuring the spin of black holes in binary systems using gravitational waves. S. Vitale, R. Lynch, J. Veitch, V. Raymond, R. Sturani. Physical Review Letters 112(25), 2014. DOI:10.1103/PhysRevLett.112.251101.

49. Search for gravitational wave ringdowns from perturbed intermediate mass black holes in LIGO-Virgo data from 2005-2010. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. 2014. DOI: 10.1103/PhysRevD.89.102006.

50. Search for gravitational radiation from intermediate mass black hole binaries in data from the second LIGO-Virgo joint science run. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. 2014. DOI: 10.1103/Phys Rev D. 89.122003.

51. Methods and results of a search for gravitational waves associated with gamma-ray bursts using the GEO600, LIGO, and Virgo detectors. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. 2014. DOI: 10.1103/PhysRevD.89.122004.

52. Search for gravitational waves associated with gamma-ray bursts detected by the InterPlanetary Network. The LIGO Scientific Collaboration, the Virgo Collaboration: J. Aasi et al. – R. Sturani is included. Physical Review Letters 113(1):011102, 2014.

53. Limits on anomalous top quark gauge couplings from Tevatron and LHC data. M. Fabbrichesi, M. Pinamonti, A. Tonero. E-print arXiv:1406.5393 [hep-ph], accepted for publication in European Physics Journal C.

54. Dipole-induced anomalous top quark couplings at the LHC. A. Tonero, R. Rosenfeld. E-print arXiv:1404.2581 [hep-ph] Physical Review D, 90, 017701.

9. First page of publications

See two annexed files for publications of professors and postdocs on ICTP-SAIFR research team.

12. Scientific reports of postdocs

See annexed file for scientific reports of

Nicolás Bernal, Gero von Gersdorff, Chrysostomos Kalousios, Fabien Lacasa, Saeed Mirshekari, Luana Pedroza e Alberto Tonero.