ICTP Instituto Sul-Americano para Pesquisa Fundamental: um Centro Regional para Física Teórica

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Host Institution: Instituto de Física Teórica-UNESP

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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 this 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.

To fulfill the need for such a theoretical physics institute in South America, the ICTP South American Institute for Fundamental Research (ICTP-SAIFR) was created in 2011 in Sao Paulo as a collaboration between the Sao Paulo Research Funding Agency (FAPESP), the International Centre for Theoretical Physics (ICTP-Trieste) - a category 1 institute of UNESCO, the Sao Paulo State University (UNESP), and the Instituto de Fisica Teórica (IFT-UNESP) in whose building it is located. The ICTP- SAIFR in South America was the first regional center of ICTP created outside of Trieste, and because of its success, the ICTP-Trieste has now created regional centers in the continents of Central America (Mexico), Africa (Ruanda), and Asia (China).

In this UNESP-ICTP-FAPESP collaboration, the role of UNESP is to provide

the infrastructure of the IFT-UNESP building including an auditorium, a computer lab, and first floor office space, as well as provide the salaries of their two secretaries, one accountant, one computer technician, and up to five tenured research professors. The role of ICTP-Trieste is to provide organizational support to the secretaries, and financial support for visitors from other South American countries. And the role of FAPESP is to provide financial support for visitors, postdocs, and Young Investigators, and for the organization of schools and workshops.

Despite its brief existence, the ICTP-SAIFR has already established itself as a leading institute for theoretical physics. With the help of a world-class scientific council and international search committee, ICTP-SAIFR has been able to sign exchange agreements with the other leading theoretical physics institutes around the world and attract the top candidates for its faculty and postdoctoral positions. Its single tenured faculty member is Eduardo Ponton, a particle physicist who held a tenure-track position at Columbia University and received a competing offer from CEA-Saclay in Paris, and its current two tenure-track faculty members are Aline Ramires (condensed matter physicist from Zurich) and Fabio Iocco (astrophysicist from Stockholm) who are funded by a donation of the Simons Foundation (New York) together with a Young Investigator grant from FAPESP. A second tenured ICTP-SAIFR faculty member will soon be hired through a joint agreement signed by Perimeter Institute (Waterloo) and UNESP in which the faculty member will spend 8 months/year at ICTP-SAIFR and 4 months/year at Perimeter and will coordinate a joint masters program for outstanding students from Latin America. Furthermore, ICTP-SAIFR has obtained a private donation called the "Isaias Raw Chair" which will supplement the salary of a future professor, and a donation from the Instituto Serrapilheira to finance outreach activities and two outreach coordinators.

Its postdocs and Young Investigators are selected from thousands of applications received through an online application process. Almost all received their PhD's at institutions outside Brazil, and many of these postdocs have already secured permanent faculty positions at other Brazilian institutions. So ICTP-SAIFR has been very successful at reversing the "brain drain" and attracting talented young physicists to Brazil. The main role of a theoretical physics institute is to foster the interchange of information between visiting and local researchers, and the ICTP-SAIFR has an active visiting program with over 150 visitors per year spending between one week and two months at the institute. There are weekly seminars and journal clubs in various subareas of theoretical physics, and the complete list of visitors and research seminars can be found on the ICTP-SAIFR webpage www.ictp-saifr.org. Research seminars are frequently recorded and made available online using equipment installed with the guidance of the Perimeter Institute and ICTP Trieste audiovisual departments.

In addition to the research conducted by its members and visitors, the ICTP-SAIFR regularly organizes schools, minicourses, workshops and programs for doctoral students and researchers in all areas of theoretical physics. The success of these activities has allowed the IFT-UNESP masters and doctoral programs to attract the top students in theoretical physics from all of South America, and to receive the top ranking of Brazilian graduate physics programs since 2011.

During the next five-year period, the ICTP-SAIFR intends to build on these recent accomplishments and continue to improve its research and organizational activities. Through its new agreement with Perimeter Institute involving a joint faculty member and a joint masters program, these activities will have an expanding impact and include outreach activities for high-school students and teachers, as well as for the general public. In addition to the support it receives from public institutions such as FAPESP and UNESP, ICTP-SAIFR is actively pursuing

support from private institutions to consolidate its status as the premier theoretical physics institute in South America.

4. Accomplishments in the period

The number of current ICTP-SAIFR researchers is relatively small and concentrated in areas of fundamental physics such as cosmology, particle physics and string theory, with connections to both cutting-edge theoretical developments and large-scale experiments such as LIGO, the Dark Energy Survey and the LHC. But the goal of ICTP-SAIFR is to gradually expand to include research in all subareas of theoretical physics. Although the current economic crisis has made it difficult for UNESP to open new permanent positions, the large number of visitors and associated researchers at ICTP-SAIFR allows it to organize activities and conduct research in a growing number of subareas. Furthermore, the tenure-track Simons-FAPESP Young Investigator fellowships have been awarded to promising young physicists to start research groups in new areas.

The two permanent ICTP-SAIFR researchers are Pedro Vieira and Eduardo Ponton. In 2018, Pedro Vieira continued his research in integrability and quantum field theory with partial funding from a Simons Institute grant, and was awarded in March 2018 the prestigious Sackler International Prize in Physics by Tel Aviv University for his groundbreaking work. In late 2017, Eduardo Ponton was unfortunately diagnosed with a serious illness which required several months of hospitalization but he was able to return in August 2018 to his research activities in particle physics.

In 2018, Aline Ramires was hired as a tenure-track Simons-FAPESP fellow following an international search led by Peter Goddard (IAS Princeton ex-director) with committee members Juan Maldacena (IAS Princeton), David Gross (KITP Santa Barbara, 2004 Nobel Laureate) and Belita Koiller (UFRJ). Aline Ramires is an extremely promising young Brazilian condensed matter physicist working in superconductivity whose most recent paper was chosen as the cover article of the October 1 issue of Physical Review Letters.

Also in 2018, a search for the second tenure-track Simons-FAPESP fellow was initiated in the interdisciplinary area of physics with relation to biology. Six candidates were interviewed in January 2018 by the search committee including William Bialek (Princeton), Simon Levin (Princeton) and Marcus Aguiar (Unicamp), but none were selected. A new search was opened in August 2018, and a second set of Simons-FAPESP candidates are expected to be interviewed in January 2019. In this important interdisciplinary area, ICTP-SAIFR initiated in 2018 a collaboration with the new Center for the Physics of Biological Function at Princeton University. This NSF-funded center is directed by William Bialek, and will accept one student per year from ICTP-SAIFR to visit and collaborate with members of the Center. In addition, Professor José Nelson Onuchic, co-director of the NSF Center for Theoretical Biological Physics, is planning to spend six months at ICTP-SAIFR during the period of October 2019 – March 2020.

In 2018, ICTP-SAIFR also invited several visitors and organized several activities in the rapidly growing areas of quantum information and machine learning. Professor Mario Leandro Aolita (UFRJ) spent several months in 2018 at ICTP-SAIFR as a visiting fellow to perform research in quantum entanglement, and a postdoc, Leandro Guerini de Souza, was hired by ICTP-SAIFR to work with him in this research field. In August 2018, Professor Fernando Brandão (Caltech) presented a one-week minicourse on quantum entanglement, and in October 2018, Professor

Aolita organized a minicourse on quantum computation and simulability. And in December 2018, Juan Carrasquilla (Vector Institute, Toronto) will be visiting ICTP-SAIFR to collaborate with Professor Aolita on applications involving machine learning.

In addition to these research activities, ICTP-SAIFR continued in 2018 its previous outreach activities including monthly informal discussions in a bar called "Papos de Física" and distinguished public lectures by internationally recognized physicists, as well as initiating several new outreach activities with partial support from the private foundation Instituto Serrapilheira. One such new activity is a collaboration with the Instituto Moreira Salles museum in downtown São Paulo involving monthly discussions between a physicist and an artist in the museum on a topic of common interest called "Ciência em Diálogo".

A second outreach activity initiated in 2018 in partnership with the Perimeter Institute educational outreach department is the translation into Portuguese of pedagogical material prepared for high-school physics teachers to use in their classrooms. Several volumes of this material were translated in 2018, and two workshops for high-school teachers on how to use this classroom material were organized by ICTP-SAIFR in September and November 2018.

A third outreach activity in 2018 included Saturday morning lectures for high-school students on advanced physics topics by ICTP-SAIFR faculty, followed on Saturday afternoons by discussions on the lectures with a high-school teacher. And a fourth outreach activity initiated in 2018 involves monthly visits of ICTP-SAIFR faculty to different public high schools in São Paulo to discuss with students the research and career choices of a physicist.

Finally, through its extensive program of schools, workshops and minicourses, ICTP-SAIFR expanded in 2018 its training of students and young researchers. In July 2018, ICTP-SAIFR organized the third version of Journeys in Theoretical Physics for the top 100 undergraduate students from Latin America. At the end of this one-week minischool, the top-scoring students in an exam are invited to participate in a joint Masters' program with one year at ICTP-SAIFR/IFT-UNESP and one year at either Perimeter Institute or the Princeton/CUNY Center for the Physics of Biological Function. The four students accepted in 2016 to the first version of this mnischool have just finished this 2-year joint Masters' program, and two of them have already been accepted to the PhD program at Caltech.

Between December 2017 and November 2018, the number of ICTP-SAIFR schools, workshops and minicourses increased over the previous years. The ICTP-SAIFR organized activities including 9 international schools on the topics of data science, mathematical biology, physics applications in biology, nonlinear time series analysis and complex networks, particle physics, integrability, dark matter and neutrino detection, entrepreneurship and gravitational waves, 11 workshops on general relativity, solitons, dark matter, cosmology and gravitation, Cherenkov Telescope Array, quantum field theory and quantum gravity, cosmology and astrophysics, density functional theory and quantum information theory, condensed matter physics as well as 5 minicourses on gravitational waves, field theory amplitudes, quantum entanglement, quantum computation and simulability and dark matter. Finally, there were weekly meetings in 2018 of a colloquium and four separate "journal clubs'' in the areas of string theory, particle physics, integrability and cosmology. These four journal clubs and colloquia 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 its February 2018 meeting, the ICTP-SAIFR scientific council approved 9

international schools to be held in 2019 on the topics of mathematical biology, models of evolution, theoretical physics, statistical physics, observational cosmology, high energy astrophysics, cold atoms, high performance computing, data science and machine learning. In addition, 8 workshops in 2019 were approved by the council on the topics of QCD, nonlinear dynamics, American monsoons, particle physics, gender, mathematical physics and cosmology. On the ICTP-SAIFR scientific council, the term of council member Matias Zaldarriaga (IAS Princeton, cosmology) expired in 2018, and the new council member in 2019 will be Gabriela Gonzalez (LIGO and Louisiana State U., gravitational waves).

The activities of ICTP-SAIFR in 2018 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, field theory, integrability, condensed matter, particle physics, cosmology, general relativity, astrophysics, complex systems, and mathematical biology. These publications involved research performed by associate researchers, postdoctoral fellows and visitors of ICTP-SAIFR. Researchers of ICTP-SAIFR are members of important, state-of-the-art international collaborations, such as the CMS detector at the LHC, the LIGO and the Dark Energy Survey collaborations. In this period we had 25 high impact publications in Physical Review Letters from a total of 227 publications involving our associates. A few of them will be highlighted below.

a1. String theory, Field Theory and Integrability

Pure spinor formalism has been applied in many theories, such as supersymmetric Yang-Mills, supergravity and superstring theories. Ref.[72] constructs a minimalistic pure spinor action for the sigma model in AdS_5XS^5. Ref.[12] shows that BRST-invariant actions proposed in the literature using pure spinors correctly describes a supergravity theory in D=11 dimensions and a super-Born-Infeld theory in D=10 dimensions. In [13] the spectrum of ambitwistor string field theory is shown to contain non-unitary states that provides consistency checks for 1-loop computations.

The background solutions obtained by applying abelian and non-abelian T-duality on in AdS_5XS^5 are used to quantize weakly coupled type IIA string theory in [74].

The somewhat surprising fact that pure electromagnetism, which is a free theory, can have topological solutions called Maxwell knots is investigated in detail in [76], where these solutions are quantized.

a2. Condensed Matter

Graphene is a new material with great prospects for applications. The intriguing possibility of using graphene in DNA sequencing is explored in [213] and in gas sensing in [217]. The quantum Hall effect in graphene is computed in [214].

In some condensed matter systems the ideas of gauge theories are becoming a useful tool to explore some physical properties. In [211], published in PRL, it is shown that the twisted bilayer graphene is such a system, where artificial

gauge fields help to understand the density of states.

a3. Particle and Astroparticle Physics

The Standard Model (SM) of elementary particles and is being tested at the LHC and several possible extensions, such as the minimal supersymmetric SM, are being constrained by new experimental searches. SAIFR researchers participate in the CMS experiment, which has produced several important results during this last year. Here we cite a few that were published in PRL: first observation of the Higgs boson decay into bottom quarks [83], detection of new meson states containing bottom quarks [89], searches for narrow dijet resonances with a tagged bottom quark [96], search for new heavy neutral leptons [98], search for physics beyond the SM in events with high-momentum Higgs bosons and missing transverse momentum [119], the search for pair-produced new resonances with their subsequent decay in multi-quark states [143] and the first observation Higgs boson production in association with a top-anti-top pair [159].

On the theoretical side the effects of new physics represented by higher dimension fermionic operators were studied in [20], whereas the possible consequences of a new hidden sector in addition to the SM were considered in [14]. The prospects for new physics in the muon anomalous magnetic moment and lepton flavor violation was discussed in a Physics Reports publication [200].

Research related to hadron physics was also pursued by SAIFR members. In [26] an effective field theory for the nucleon-quarkonium interaction was developed and the nuclear-bound quarkonia and heavy-flavor hadronic states were studied in [31].

The universe has a significant component in the form of dark matter, most possible a still unknown stable and electrically neutral new particle. Ref.[203] presents a review of the most popular candidate for dark matter, the so-called weakly interacting massive particle (wimp). The indirect search for dark matter in different experiments was discussed in [202]. The possibility to detect dark matter at the LHC was discussed in [201].

a4. Cosmology and Gravity

SAIFR researchers are working in important international efforts such as the Laser Interferometer Gravitational-wave Observatory (LIGO) and the Dark Energy Survey (DES) collaborations.

LIGO has revolutionized the field of gravitational physics with the first direct detection of a binary black hole merger which was recognized with a Nobel prize in 2017. This has opened a new window to the universe. Another spectacular first detection was done by LIGO: the merger of two neutron stars. Differently from the case of black hole mergers, neutron star mergers also emit light and hence one can have the detection in gravitational **and** electromagnetic waves. This "multi-messenger" detection allowed to place a very strong bound on the speed of propagation of gravitational waves – it can depart from the speed of light at most one part in 10^{15}! In the PRL papers this event was used to put constraints in the radii of neutron star and the equation of state of the nuclear matter from which they are composed [227] and to study the gravitational wave background produced by this type of events [219]. Also, in two additional PRL publications, searched for tensor, vector, and scalar polarizations in the stochastic gravitational-wave background [223] and conducted the first search for non-tensorial gravitational waves from known pulsars [221].

DES is a 570 Mpixel digital camera mounted on a 4-meter telescope in Chile that takes pictures of the universe in 5 optical filters. It is interesting that there was a joint paper involving DES and LIGO in the multi-messenger detection of the binary neutron star merger [229].

DES has finished the analysis of the first year of data. The main result was presented in [41], which built from many different results published in separate papers: a joint analysis of the clustering of galaxies and weak gravitational lensing,

the first of its kind in a single experiment. For the first time the constraints on some cosmological parameters obtained from large galaxy surveys were comparable to the ones obtained from the cosmic microwave background. The analysis, when combined with external data sets, provided the most precise determination of the equation-of-state for dark energy, which confirms the standard LCDM model as the best description of our universe.

a5. Astrophysics

Dark matter has a significant role in the dynamics of galaxies. Rotational curves in galaxies have been a tell-tale signal for the presence of dark matter. In [235] the rotational curves of dwarf galaxies, which are dark matter rich, were studied and a universal form was found. The possibility of indirect detection of dark matter through its annihilation in dwarf galaxies into gamma rays was the subject of [236].

Magnetic fields play an important role in high-energy astrophysical events, such as jets. In particular, magnetic reconnection is a physical process occurring in highly conducting plasmas in which the magnetic topology is rearranged and magnetic energy is converted to kinetic energy, thermal energy, and particle acceleration. Magnetic reconnection was studied around rotating black holes [19] and in accretion disks [17].

a6. Complex Systems

Chaotic systems can exhibit interesting phenomena. One example, the synchronization of time evolution of the components of a system, was the subject of [15]. Solutions of nonlinear equations usually lead to complex behavior. One such equation, relevant to describe the dynamics of surface wind waves, was studied in [22].

The use of networks to model complex systems such as the banking system, electricity power grids and the internet has been greatly developed in the past decade. An interesting application to football is described in [232].

a7. Mathematical Biology

Understanding the emergence of biodiversity patterns in nature is a central problem in biology. The mechanisms responsible for the origin of species, called speciation, is not yet understood. Theoretical models of speciation have addressed this question in the macroecological scale, but little has been investigated in the macroevolutionary context. Knowledge of the evolutionary history is important since it allows the study of patterns underlying the processes considered in these models. Two algorithms to record the evolutionary history of populations were considered in [7].

Mathematical models have provided useful insights into the population persistence in cases where species are subject to isolated habitats surrounded by unfavorable regions. In [21] a reaction-diffusion system was used to investigate the dynamics of a sex-structured population in a single semipermeable patch.

a8. Quantum information

The possibility of using properties of quantum mechanics, such as entanglement, as a tool to transmit information by either teleportation or using cryptography is an important and active area of research in the recent years. Three high impact publications in PRL were produced in this period. Ref.[9] explores the concept of contextuality, a fundamental feature of quantum theory and necessary for quantum computation and communication. It can be seen as a generalization of

Bell nonlocality. In [10] it was predicted theoretically and tested with entangled photons that outcome communication is not enough for hidden-state models to reproduce quantum steering. A method to check for the certification of quantum simulations was developed in [11].

b. Research related to visitors

Between December 2017 and November 2018, the ICTP-SAIFR hosted 77 short-term visitors who stayed less than four days, 190 middle-term visitors who stayed between five and fourteen days, and 15 long-term visitors who stayed more than two weeks. The complete list of visitors to ICTP-SAIFR can be found on the webpage http://www.ictp-saifr.org/ictp-saifr-visitors-2018/
The research of some of the visitors is briefly described below, and the research of the ICTP-SAIFR visiting fellows has been annexed because of lack of space here:

Thales Azevedo – Uppsala University (01/10-15/2018)

My ICTP-SAIFR visit at the end of 2017 and beginning of 2018 was a very good opportunity to get in touch with the string-theory community there, especially Prof. Nathan Berkovits and Prof. Andrei Mikhailov, as well as some of their students. On that occasion, I had the chance to give a talk about my recent work, and was also able to discuss new possible directions during more informal meetings. In particular, we have discussed the possibility of connecting the Berkovits-Witten twistor string with the heterotic version of the ambitwistor string introduced by Mason and Skinner. The main goal of this project is to understand to which extent one can regard the latter string model as an arbitrary-dimensional generalization of the former. In that sense, I feel that my visit was beneficial not only to me but also to the ICTP-SAIFR community, and I look forward to visiting the Institute again.

Jonathan Toledo – EPFL Lausanne (02/17-03/04/2018)

We derived bounds on coupling constants in gapped QFT by bootstrapping S-matrix elements based on Analyticity, Crossing and Unitarity.

João Penedones– EPFL Lausanne (02/15-03/03/2018)

During my visit, I worked with Pedro Vieira and Jon Toledo on our ongoing project about the S-matrix Bootstrap. We are extending our approach to multiple scattering amplitudes involving the two lightest particles of a relativistic Quantum Field Theory in 1+1 dimensions.

Juan Villareal – IMPA (03/1-31/2018)

During my visit to ICTP-SAIFR my research was related to understand the construction of sheaves of vertex algebras on some manifolds. Until now, we have a mathematically well understood case (of sheaves of vertex algebras) called Chiral de Rham. The motivation of my research is to construct other sheaves of vertex algebras, if they exists these sheaves will allow us to explain naturally some objects associate to manifolds (elliptic genera, some co-homologies ...). The first object to consider is a vector bundle (space of states). I consider some vector bundles from the physics literature like: N=1 (for example, Witten-Dirac index on loop manifolds) and N=2 (for example Lerche, Vafa, Warner chiral rings in N=2 superconformal) Then, I want to associated fields to these states and consider later sheaves of vertex algebras. During my visit on ICTP I realized two different problems if we want to build these sheaves 1- All the construction now will depend of a metric (this doesnt happened with Chiral de Rham). 2- If I want to define some fields on the manifold for example as T(z) (virasoro field), then the spaces of states is even more restricted. It is a problem related with the infinite dimension of the vector spaces and the metric. These two conditions restrict the definition of space of states, I am thinking now as a possible solution to work with vielbein, and associate fields to these vielbein. And later try to continue the construction in this way. This is a work in progress.

Marzieh Zare – University of Tehran (02/07-04/10/2018)

Our research at the institute focuses on understanding the underlying dynamics of epilepsy, using advanced statistical analysis methods, including complexity, Hurst exponent, and entropy. We are using a data set already available online at Physionet data bank. In particular, we are interested in to detect irregularities during epileptic seizures and also detecting the channels responsible for epileptic seizures. Therefore, our analysis is three folded in line with the already mentioned techniques. As of know, we have been able to detect the specific channels responsible for the seizures using Entropy and Hurst exponent, however, we need to deploy more analysis to come to a conclusion. There are also two more future works that will be done on the same data: One will be Phase-Amplitude Coupling analysis on the

Local Field Potentials of the data. This technique will reveal the underlying dynamics of the epileptic seizures and may show the time evolution of the seizure. The next work will be network analysis of the data, with which we will be able to detect the channels responsible for the seizure and monitor network topology during a seizure. The results of the current research may be applied in clinic on detecting channels responsible for epileptic seizures where the surgery is an option to improve a patient's quality of life.

Ellis Ye Yuan – IAS-Princeton (05/05-09/2018)

In this visit I delivered a mini-course on the scattering equations and the Cachazo-He-Yuan formalism for scattering of massless particles. Together with Pedro Vieira and his collaborators we also had many discussions on the Witten diagrams and Mellin amplitudes that I have been working on very recently. We were trying to figure out how to use the results there to address some of the puzzles regarding the flat space limit of scattering in AdS, especially in understanding how various new poles and branch cuts could emerge in the limit.

Ariel Bendersky – Univ. Buenos Aires (05/21-26/2018)

During my brief visit to ICTP-SAIFR, other than giving a colloquium, I used the opportunity to discuss several topics related to quantum non-locality with Leandro Aolita and Leonardo Guerini. In particular, we discussed topics on causal networks and how they can benefit from our knowledge on algorithmic randomness. Hopefully, this will be the starting point for a fruitful collaboration.

Yifei He – Purdue University (05/06-19/2018)

During my visit I presented my work on 2d O(N) bosonic S-matrix bootstrap and discussed related topics with researchers at ICTP-SAIFR. SPRINT project: 2017/50402-9

Dimitry Melnikov – UFRN (08/09-17/2018)

I have participated in the workshop on Mathematical Physics, where I have delivered a talk entitled "Topological Theories and Quantum Computing". I have also gave a seminar "Modular invariance beyond CFT" for the members of the string theory group. During my stay I have discussed my research with members and visitors of the ICTP/SAIFR and IFT. I have attended the IFT colloquium and a couple of talks of the workshop "Workshop on Strong Electron Correlations in Quantum Materials: Inhomogeneities, Frustration and Topology". During my stay I have worked on completion of my paper "Studies of Boundary Entropy in AdS/BCFT", which will appear soon. Discussions at the ICTP/SAIFR helped me to clarify certain questions related to the CFT interpretation of the considered geometric construction. The support of the ICTP/SAIFR will be acknowledged in the paper.

Nandadulal Bairagi – Jadavpur University (08/09-17/2018)

During my visit at ICTP SAIFR from 9th August to 17th August 2018, I have discussed with Prof. Roberto Kraenkel about our common research fields of interest. I have also delivered a lecture on mathematical ecology. We had a good discussion on other fields of mathematical biology. Hopefully, we will be able to submit a joint research project in near future and establish fruitful collaboration.

Kostas Skenderis – University of Southampton (09/05-20/2018)

During this visit I had discussions with Horatiu Nastase about holographic cosmology. I expect at least one paper (and most likely several) to result for these discussions.

Bahati Mukeru – University of South Africa (09/06-30/2018)

During my visit at ICTP-SAIFR, I performed different nuclear reaction calculations. In articular, I considered the breakups of 8B and 8Li proton and neutron rich nuclei. The main objective was to study the differences and similarities between proton-and neutron rich nuclei as far as breakup dynamics are concerned. I also studied the breakup of a 10B, which is a tightly bound nuclei and which is commonly regarded as a cluster of 6Li and 4He nuclei. The main goal was to investigate whether there are similarities between breakups of loosely bound and tightly bound nuclei. Finally we worked on the universality in three-halo nuclei. This project is still ongoing as we need to perform calculations in configuration space. I am now busy preparing manuscripts for publications.

c. Organization of activities

Between December 2017 and November 2018, the ICTP-SAIFR organized nine São Paulo International Schools for Theoretical Physics, one flash-school, eleven workshops, four minicourses, thirteen outreach events, and weekly seminars, colloquia and journal clubs. The complete list of 2018 activities is on the

webpage http://www.ictp-saifr.org/2018-activities/, the list of weekly seminars, colloquia and journal clubs is on the webpage http://www.ictp-saifr.org/2018-research-seminars-and-activities/. Activities, seminars and colloquia of december 2017 are described on "Past research seminars and activities" at http://www.ictp-saifr.org/other-years-research-seminars-and-activities/. Many of the activities were filmed using equipment donated by the ICTP in Trieste and the videos are available online on the associated webpages.

c1. São Paulo International Schools

The nine São Paulo International Schools were on the subjects of data science (Dec. 4-15, 2017), mathematical biology (Jan. 15-21), physics applications in biology (Jan. 22-27), nonlinear time series analysis and complex networks (Feb. 19 - March 2), particle physics (June 18-29), integrability (July 2-14), dark matter and neutrino detection (july 23 – aug. 3), entrepreneurship (Oct 15-19) and gravitational waves (Nov. 26-Dec. 14). The schools were for mostly masters and PhD students, and those students not from São Paulo were 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/surveys/datasci2017/view.php
http://ictp-saifr.org/surveys/mathbio7/view.php
http://ictp-saifr.org/surveys/bioapp2018/view.php
http://ictp-saifr.org/surveys/nonlinear18/view.php
http://ictp-saifr.org/surveys/particle18/view.php
http://ictp-saifr.org/surveys/integrability18/view.php
http://ictp-saifr.org/surveys/dmneutrino18/view.php
http://ictp-saifr.org/surveys/entrepreneurship18/view.php
http://ictp-saifr.org/surveys/gw2018/view.php

All lectures of the schools were filmed and the videos are available online on the school webpage.

c1A. CODATA-RDA School of Research Data Science (Dec. 4-15, 2017)

The International School on Data Science (Dec. 4-15) is described on the webpage http://www.ictp-saifr.org/datasci2017 and involved 10 lecturers and 30 students. This activity covered topics on principles and practice of Open Science, research data management and curation, use of a range of research compute infrastructures, large scale analysis, statistics, visualization and modeling techniques, automation and scripting.

Lecturers:

- Raphael Cobe (NCC, Brazil)
- Steve Diggs (University of California, USA)
- Filipe Fernandes (USP & Software Carpentry, Brazil)
- Sarah Jones (Digital Curation Centre, University of Glasgow, UK)
- Beraldo Leal (NCC, Brazil)
- Fernando de Pol Mayer (UFPR & Software Carpentry, Brazil)
- Robert E Quick (Indiana University, USA)
- Hugh Shanahan (Royal Holloway, University of London, UK)
- William Sherman (Indiana University, USA)

- Abel Soares Siqueira (UFPR & Software Carpentry, Brazil)

c1B. Mathematical Biology (January 15 - 21)

The VII Southern-Summer School on Mathematical Biology (January 15 – 21) is described on the webpage http://www.ictp-saifr.org/mathbio7 and involved 1 lecturer and 64 students. The school was aimed at students in Physics, Mathematics, Ecology and Epidemiology, having at least a basic knowledge of calculus and differential equations. Lectures covered the basics of population dynamics and are supplemented with modelling exercises addressing mainly problems in ecology, epidemiology and evolution.

Lecturers and Topics:

- **Roberto Kraenkel** (IFT-UNESP, Brazil): Introduction to Population Biology

c1C. School on Physics Applications in Biology (Jan. 22 – 27)

The School on Physics Applications in Biology (Jan. 22-27) is described on the webpage http://www.ictp-saifr.org/bioapp18 and involved 3 lecturers, 4 speakers and 66 participants. This activity included minicourses, discussion sessions and group exercises on topics including neuroscience, evolutionary dynamics, time-series analysis applied to ecology and epidemiology, collective behavior, and optimization.

Lecturers and Topics:

- **William Bialek** (Princeton University, USA): Statistical mechanics for networks of real neurons (or, Thinking about a thousand neurons) & Coding and information flow in a small genetic network
- **Andrea Cavagna** (Roma ISC-Sapienza, Italy): The physics of flocking: correlation as a compass from experiments to theory
- **George Sugihara** (UC San Diego, USA): An Introduction to Empirical Dynamics: Equation-Free (Minimalist) Nonlinear Mathematics for a Data-driven Understanding of Nature — Transforming Observations to Insights

Speakers and Topics:

- **André Barato** (Max-Planck Institute-Dresden): Cost and precision in stochastic thermodynamics
- **Flávia Marquiti** (UNICAMP): Spicing complexity on evolutionary games
- **Danielle DeMartino** (Institute of Science and Technology Austria): Statistical mechanics of metabolic networks
- **Fernando Peruani** (Universite Nice Sophia Antipolis): Collective motion across scales in biology: a statistical physics perspective

c1D. School on Nonlinear Time Series Analysis and Complex Networks in the Big Data Era (Feb. 19 – March 2)

The School on Nonlinear Time Series Analysis and Complex Networks in the Big Data Era (Feb. 19 – March 2) is described on the webpage and involved 7 lecturers and 83 participants. This school provided students a broad overview of the state-of-the-art in the field of Big Data analysis tools, including the most recent advances in complex networks and methods for the analysis of large time series

and datasets, focusing on nonlinear dynamics and network science.

Lecturers and Topics:

- **Alex Arenas** (Universitat Rovira i Virgili, Spain): Big Data Analysis
- **Murilo Baptista** (University of Aberdeen, UK): A fast-track glimpse to the life cycle of modelling complex systems
- **Ernesto Estrada** (University of Strathclyde, UK): Network analytics: Traditional vs. modern approaches.
- **Jesús Gomez-Gardenes** (University of Zaragoza, Spain): Metapopulation dynamics: Linking Human mobility and contagion processes.
- **Marta Gonzalez** (MIT, U.S.A.): Computational Urban Science
- **Cristina Masoller** (Universitat Politecnica de Catalunya-Terrassa, Spain): Introduction to nonlinear time series analysis tools
- **Osvaldo Rosso** (Universidade Federal de Alagoas, Brazil & CONICET, Argentina): Time series characterization by information theory based quantifiers

c1E. First Joint ICTP-Trieste/ICTP-SAIFR School on Particle Physics (June 18-29)

The First Joint ICTP-Trieste/ICTP-SAIFR School on Particle Physics (June 18-29) is described on the webpage http://www.ictp-saifr.org/first-joint-ictp-triesteictp-saifr-school-on-particle-physics/ and involved 6 lecturers and 80 participants. The school aimed at giving a detailed overview of particle physics, and covering important areas where recent progress has been made in the field.

Lecturers and Topics:

- **Laura Covi** (Institute for Theoretical Physics – Göttingen, Germany): Particle Physics and the Early Universe Lectures on the Standard Model: Benjamin Grinstein (UCSD, USA)
- **Giulia Zanderighi** (University of Oxford, UK): Practical QCD at Colliders
- **Gustaaf Brooijmans** (Columbia University, USA): Experimental Elements for Theorists: A Roadmap to the Future
- **Paddy Fox** (FERMILAB, USA): Dark Matter and Particle Physics
- **Alex Pomarol** (UAB & IFAE, Spain): Lectures on Beyond the Standard Model Physics

c1F. School on Integrable Models: From Quantum Spin Chains and Vertex Models to AdS/CFT (July 2-6)

The School on Integrable Models: From Quantum Spin Chains and Vertex Models to AdS/CFT (July 2-14) is described on the webpage http://www.ictp-saifr.org/integrable-models-from-quantum-spin-chains-and-vertex-models-to-adscft/ and involved 4 lecturers and 41 participants. Topics included applications of integrability in statistical physics, condensed matter physics, gauge and string theory and mathematics.

Lecturers and Topics:

- **Shota Komatsu** (IAS-Princeton, USA): Integrability in four-dimensional gauge theories: beyond spectral problem
- **Vladimir Korepin** (State University of New York at Stony Brook, USA): Quantum Inverse Scattering Method
- **Márcio José Martins** (UFSCar, Brazil): Integrable Lattice Models and Algebraic Geometry

- **Konstantin Zarembo** (NORDITA, Sweden): Origins of AdS/CFT integrability

c1G. School on Dark Matter and Neutrino Detection (July 23 – Aug. 3)

The School on on Dark Matter and Neutrino Detection (July 23 – Aug. 3) is described on the http://www.ictp-saifr.org/school-on-dark-matter-and-neutrino-detection/ and involved 14 lecturers, 10 experiments and 51 participants. The first week of the school featured theoretical courses on neutrinos and dark matter, and the second week consisted of experimental courses distributed through ten different laboratory sessions.

Courses:

- **Andre de Gouvea** (Northwestern Univ., USA): Neutrinos
- **Fabio Iocco** (ICTP-SAIFR/IFT-UNESP, Brazil) & **Farinaldo Queiroz** (II-P Natal/ICTP-SAIFR visitor fellow, Brazil): Dark Matter
- **Stefan Soldner-Rembolt** (Manchester U., UK): Neutrino Detection
- **Enectali Figueroa-Feliciano** (Northwestern Univ., USA): Dark Matter Detection

Lectures:

- **Eduardo Pontón** (ICTP-SAIFR/IFT-UNESP, Brazil): Dark Matter in colliders
- **Orlando Peres** (UNICAMP, Brazil): Sterile neutrinos
- **Pedro de Holanda** (UNICAMP, Brazil): Non standard neutrinos & Neutrinos in Astrophysics
- **Juan Estrada** (Fermilab, USA): CCD detection technology for dark matter and neutrinos
- **Ettore Segreto** (UNICAMP, Brazil): TPC detection technology for neutrinos and dark matter
- **Carla Bonifazi** (IF/UFRJ, Brazil): Coherent neutrinos
- **Xavier Bertou** (CAB/CNEA, Argentina): The ANDES Underground Laboratory
- **Marcelle Soares-Santos** (Brandeis, USA): Multi-messenger astronomy with gravitational waves and the Dark Energy Camera
- **Andrew Sonnenschein** (Fermilab, USA): WIMP DM with Bubble Chambers & Axion Dark Matter Search

Experiments:

- **Characterization of Gamma background with inorganic scintillators**: Federico Izraelevitch (Instituto Dan Beninson/UNSAM/CNEA – CONICET, Argentina)
- **EL TPCito – Illustration of Time Projection Chamber**: Franciole Marinho (UFSCAr, Brazil), Laura Paulucci (UFABC, Brazil), Gustavo Valdiviesso (UFA, Brazil)
- **Particle detection with CCDs**: Guillermo Moroni, Javier Tiffenberg, Juan Estrada (Fermilab, USA), Aldo Rosado Fernandes (CEFET/RJ, Brazil)
- **Cosmic ray detection through their Extensive Air Shower**: the original Pierre Auger measurement: Xavier Bertou (CAB/CONICET, Argentina)
- **SiPM: a novel photon detector becoming a classic**: Horacio Arnaldi (CAB/CNEA, Argentina)
- **ARAPUCA effect: trapping light inside a reflective box**: Ana Amelia Machado (UFABC, Brazil) & Ettore Segreto (UNICAMP, Brazil)
- **High-speed data acquisition and optimal filtering based on programmable logic for single-photoelectron (SPE) measurement setup**: Herman Pessoa Lima Júnior (CBPF, Brazil) & Rafael Antunes Nobrega (UFJF, Brazil)

- **Proof of principle of a Neutrino mass measurement**: Kazu Akiba & Victor Gollo (Instituto de Física – UFRJ, Brazil)
- **Measurement of the muon decay time**: Gaston Gutierrez (Fermilab, USA), Irina Nasteva (IF/UFRJ, Brazil) & Carla Bonifazi (IF/UFRJ, Brazil)
- **Analysis of Fermi LAT gamma-ray observations**: Rodrigo Nemmen (IAG-USP, Brazil)

c1H. Entrepreneurship School for Scientists and Engineers (Oct. 15-19)

The Entrepreneurship School for Scientists and Engineers (Oct. 15-19) is described on the webpage http://www.ictp-saifr.org/entrepreneurship-school-for-scientists-and-engineers/ and involved 8 lecturers and 51 participants. The school aimed at students studying a STEM subject, and those who were interested in gaining entrepreneurial skills with the view to commercialize scientific ideas or inventions.

Lecturers:

- **Surya Raghu** (ET-CUBE, USA)
- **Richard Brooks** (FD Solutions, UK)
- **Rodrigo Marques** (IQ-UNESP, Brazil)
- **Luciano Avallone Bueno** (CECS-UFABC, Brazil)
- **Luciana Bueno** (Clinical Nutrition Science, Brazil)
- **Leticia Khater Covesi** (I9PI, Brazil)
- **Paulo Afonso Granjeiro** (UFSJ, Brazil)
- **Thalita Paes** (PatentAbilit, Brazil)

c1I. The Sound of Space-time: The Dawn of Gravitational Wave Science (Nov. 26 – Dec. 14, 2018)

The School "The Sound of Space-time: the Dawn of Gravitational Wave Science (Nov. 26 – Dec. 14) is described on the webpage http://www.ictp-saifr.org/the-sound-of-space-time-the-dawn-of-gravitational-wave-science/ and involved 8 lecturers and 45 participants. The school offered a unique opportunity to train the new generation of researchers in this incipient field. The first week developed the theoretical background, the second week more advanced topics were discussed and the third week contemplated astrophysics of sources and possible electromagnetic counterparts.

Lecturers and Topics:

- **Adam Pound** (U. of Southampton, UK): Modeling of extreme mass ratio in spirals
- **Luc Blanchet** (IAP Paris, France): Introduction to the post-Newtonian expansion of General Relativity and analytic modeling of gravitational waves
- **Sascha Husa** (U. of Balearic Islands, Las Palmas, Spain): Numerical Relativity
- **Rodrigo Nemmen** (IAG-USP, Brazil): Radiative processes in astrophysics and black hole accretion physics
- **Walter Del Pozzo** (U. of Pisa, Italy): Gravitational waves data analysis
- **Daniel Siegel** (Columbia University, USA): Multimessenger astronomy

- **Jan Steinhoff** (AEI Potsdam, Germany): An introductory course on Effective-One-Body formalism and gravitational waveform construction
- **Sylvia Zhu** (AEI Hannover, Germany): Continous and transient gravitational wave sources

c2. Workshops

ICTP-SAIFR organized 11 workshops on the subjects of general relativity, solitons, dark matter, cosmology and gravitation, Cherenkov Telescope Array, quantum field theory and quantum gravity, cosmology and astrophysics, density functional theory and quantum information theory, condensed matter physics. The purpose of these workshops was to discuss status, recent progress and perspectives in each of the fields mentioned.

c2A. CTA Temático Workshop (March 5-6)

The workshop brought together the members of the CTA FAPESP Tematico, in order to share scientific and technical knowledge. A general overview of the experiment status were presented and the future activities of the group planned. The webpage of the workshop is http://www.ictp-saifr.org/cta-tematico-workshop/ and speakers included:

- Rita de Cássia dos Anjos (UFPR)
- Luan Bonneau Arbeletche (Instituto de Física de São Carlos/IFSC/USP)
- Fernando Catalani (Escola de Engenharia de Lorena/EEL/USP)
- María Benito (IFT-UNESP)
- Humberto Martínez Huerta (Instituto de Física de São Carlos/IFSC/USP)
- Fabio Iocco (ICTP-SAIFR/IFT-UNESP)
- Danielle Kaori Nakashima (Instituto de Física de São Carlos/IFSC/USP)
- Ekaterina Karukes (ICTP-SAIFR/IFT-UNESP)
- Rodrigo Guedes Lang (Instituto de Física de São Carlos/IFSC/USP)
- Marcelo Augusto Leigui de Oliveira (Centro de Ciências Naturais e Humanas/CCNH/UFABC)
- Carlos Jose Todero Peixoto (Escola de Engenharia de Lorena/EEL/USP)
- Douglas Roberto de Matos Pimentel (Instituto de Física/IF/USP)
- Gustavo de Araujo Rojas (Reitoria/REIT/UFSCAR)
- Edivaldo Moura Santos (Instituto de Física/IF/USP)
- Cibelle Celestino Silva (Instituto de Física de São Carlos/IFSC/USP)
- Luiz Vitor de Souza Filho (Instituto de Física de São Carlos/IFSC/USP)
- Aion da Escóssia Melo Viana (Instituto de Física de São Carlos/IFSC/USP)

c2B. Workshop on Spatial and Temporal Dynamics of Ecological Networks (May 14-18)

During the workshop participants developed working hypotheses for factors driving network dynamics based on empirical patterns; explored case studies of variation across space or time in ecological networks; developed new models of network dynamics incorporating coevolution and community ecology; developed models to link ecology to macroevolutionary processes. The webpage of the workshop is http://www.ictp-saifr.org/workshop-on-spatial-and-temporal-dynamics-of-ecological-networks/ and speakers included:

- **Laura Burkle** (Montana State University, USA)
- **Cecilia Diaz Castelazo** (CONACYT, Mexico)
- **Marie-Josée Fortin** (University of Toronto, Canada)
- **Paulo R. Guimaraes Jr.** (University Sao Paulo, Brazil)
- **Dominique Gravel** (University of Quebec, Canada)
- **Thilo Gross** (University of Bristol, UK)
- **David Hembr**y (University of Arizona, USA)
- **Ulrich Mueller** (Johns Hopkins University, USA)

- **Erica Newman** (School of Natural Resources and the Environment, University of Arizona, USA)
- **James O'Donnell** (University of Washington, USA**Mathias Pires** (UNICAMP, Brazil)
- **Timothee Poisot** (University of Quebec, Canada)

c2C. Workshop on Long-range Interactions and Synchronization (May 28-31)

This workshop aims to bring together statistical physicists and dynamical physicists to discuss common aspects of long-range and synchronizing systems, addressing both fundamental techniques (large deviations theory, kinetic theory, dimensional reduction, equilibrium and nonequilibrium statistical physical aspects, etc) and applications (networks, light-matter interactions, etc). The webpage of the workshop is http://www.ictp-saifr.org/workshop-on-long-range-interactions-and-synchronization/ and speakers and topics included:

- Celia Anteneodo (PUC-Rio, Brazil): Synchronization: interplay between range of the interactions and time delay
- Mustansir Barma (TCIS, India): Stochastic Evolution of Interacting Particle Systems
- Julien Barré (Université d'Orléans, France): Large Deviations, long-range interactions and synchronization
- Alessandro Campa (ISS, Italy): The derivation of kinetic equations: main physical aspects
- Shamik Gupta (Ramakrishna Mission Vivekananda University, India): Equilibrium statistical mechanics
- Michael Kastner (Stellenbosch University, South Africa): Quantum long-range systems
- Arkady Pikovsky (University of Potsdam, Germany): Hierarchy of synchronization models
- Tarcisio M. Rocha Filho (University of Brasilia, Brazil): Simulating long-range systems on a GPU
- Stefano Ruffo (SISSA, Italy): Long-range interacting systems (IFT-Colloquium), Systems with long-range interactions: equilibrium properties (talk1), Systems with long-range interactions: dynamical properties
- Romain Bachelard (Universidade Federal de São Carlos, Brazil): Long-range interactions in light scattering
- Hugues Chaté (CEA, France): Synchronization and long-range interactions in dense bacterial suspensions
- Robin Kaiser (University of Nice, France): Long range dipole dipole coupling in cold atoms: from Anderson Localisation to Dicke subradiance and back
- Erik A. Martens (Technical University of Denmark): Chimera states in modular networks
- Giovanna Morigi (Saarland University, Germany): Collective dynamics of atomic ensembles due to long-range optomechanical forces
- Oleh Omel'chenko (WIAS, Berlin, Germany): Chimera states in spatially extended systems with nonlocal coupling
- Antonio Politi (University of Aberdeen, UK): Chaotic collective dynamics in the presence of long-range interactions
- Ram Ramaswamy (JNU, India): Patterns of synchrony in modular networks of coupled oscillators
- Ricardo Viana (Universidade Federal do Paraná, Brazil): Synchronization in populations of oscillators with coupling mediated by the diffusion of a chemical substance
- Anna Zakharova (Technische Universität Berlin, Germany): Chimera patterns: interplay of dynamics, structure, noise, and delay

c2D. Latin-American Workshop on Gravity and Holography (June 4-8)

This workshop aimed to bring together the Latin American and international community to promote scientific collaboration, and to contribute in the training of young researchers. The webpage of the workshop is http://www.ictp-saifr.org/latin-american-workshop-on-gravity-and-holography/ and speakers and topics included:

- Tomas Andrade (University of Barcelona, Spain): Applications of AdS/CFT
- Damian Galante + Juan Pedraza (University of Amsterdam, The Netherlands): HEE
- Pedro Vieira (Perimeter Institute & ICTP-SAIFR): S-matrix Bootstrap
- Elena Caceres (University of Texas at Austin, USA): Rotating Traversable Wormholes
- Cristóbal Corral (UNAM, Mexico): Unimodular Einstein–Cartan gravity: Dynamics and

conservation laws
- Diego Correa (Universidad de La Plata, Argentina): Wilson loop correlators
- Alberto Faraggi (Universidad Andres Bello, Chile): Functional Determinants in AdS_2
- Nicolas Grandi (Universidad Nacional de La Plata, Argentina): Fermions at finite doping in AdS/CMT
- Alberto Guijosa (UNAM, Mexico): Living on the Wedge: Rindler Reconstruction and Entanglement of Purification
- Betti Hartmann (USP – Sao Carlos, Brazil): Strings with excited condensates
- Edel Efraín García Hernández (UNAM, Mexico): Matter contributions to holographic entanglement entropy
- Martin Kruczenski (Purdue U., USA): S-matrix bootstrap applied to the 2d bosonic O(N) model
- Bertha Cuadros Melgar (USP – Lorena, Brazil): Stability of galileon black holes under spinorial perturbations
- Olivera Miskovic (PUC Valparaiso, Chile): Phase transitions of extremal black holes
- Horatiu Nastase (IFT-UNESP, Brazil): TBA
- Julio Oliva (Universidad de Concepcion, Chile): Black strings in higher curvature gravity
- Juan Pedraza (University of Amsterdam, The Netherlands): Chaotic strings in AdS/CFT
- Ignacio Araya Quezada (Universidad Andrés Bello, Chile): Renormalization of Entanglement Entropy from topological terms
- Cesar Agon Quintero (Stony Brook University, USA): Subsystem complexity and Holography
- Adolfo Cisterna Roa (Universidad Central de Chile): Axionic black branes with conformal coupling
- Fábio de Novaes Santos (IIP – Natal): Non-Relativistic Boundary Conditions of AdS3 Gravity and Microstate Counting
- Guillermo Silva (Universidad de La Plata, Argentina): Wilson Loops and precision tests
- Omar Valdivia (Universidad Arturo Prat, Chile): Nonminimal couplings, gravitational waves, and torsion in Horndeski's theory
- Edoardo Vescovi (University of São Paulo, Brazil): Deformations of the circular Wilson loop and spectral independence
- Julio Virrueta (Stony Brook University): Entanglement Dynamic in the Scaling Limit
- Leopoldo Pando Zayas (University of Michigan, USA): Microstate Counting of AdS_4 Black Hole Entropy

c2E. Workshop on Integrable Models: from quantum spin chains and vertex models to AdS/CFT (July 9 – 14)

Topics of this workshop included applications of integrability in statistical physics, condensed matter physics, gauge and string theory and mathematics. The webpage of the workshop is http://www.ictp-saifr.org/integrable-models-from-quantum-spin-chains-and-vertex-models-to-adscft/ and participants included:

- Frank Coronado (Perimeter Institute, Canada): The simplest four-point correlator in planar N=4 SYM
- Patrick Dorey (Durham University, UK)
- Vladimir Kazakov (Laboratoire de Physique Théorique École Normale Supérieure, France): Conformal fishnet theory
- Ivan Kostov (Université Paris Saclay, France): Boundary TBA, trees and loops
- Luis M. Kruckzenski (Purdue U., USA): The S-matrix Bootstrap for the 2d O(N) bosonic model
- Ivar Lyberg (IIP-UFRN, Brazil): The six vertex model with various boundary conditions
- Pramod Padmanabhan (Institute for Basic Science – Daejeon, South Korea): Semigroup Quantum Spin Chains
- Alexander B. Zamolodchikov (Rutgers University, USA): ${\bar T}$ flow, partition function, and universal contact terms.
- Deliang Zhong (Le Laboratoire de Physique Théorique de l'Ecole Normale Supérieure, France): Continuum limit of fishnet graphs and AdS sigma model
- Gwenaël Ferrando (l'Ecole Normale Supérieure, France): Conformal dimensions in the fishnet theory
- Rodrigo Alves Pimenta (UFSCar, Brazil): A tale of two Bethe ansätze
- Tarun Sharma (University of the Witwatersrand, South Africa): Hint of Integrability in Chern Simons vector models

c2F. Sixth International Workshop for the Design of the ANDES Underground Laboratory (Aug. 4 – 6)

The workshop was devoted to the structure of the international consortium to be built to run ANDES, on the latin-american and international participation, with a specific focus on the role for the local brazilian groups. The webpage of the workshop is http://www.ictp-saifr.org/sixth-international-workshop-for-the-design-of-the-andes-underground-laboratory/ and speakers and topics included:

- Osvaldo Civitarese (Universidad de La Plata, Argentina): Organizing ANDES: present status and prospects / ANDES: a survey of the physics related to underground labs
- Felix Napoleao Diaz Desposorio (PUC, Peru): Quantum Decoherence and CPT Violation at DUNE
- Claudio Dib (Universidad Técnica Federico Santa María, Chile): ANDES Status and Update
- Juan Estrada (FERMILAB, USA): DAMIC-SENSEI, looking for DM with CCD
- Ran Itay (Weizmann Institute of Science): Results from a tonne-year exposure with XENON1T
- Sergey Kuleshov (Universidad Técnica Federico Santa María, Chile): CTVAL/UTFSM Detector Laboratory
- Maximo David Ave Pernas (IF-USP, Brazil): New Physics Results from Darkside-50
- Loaiza Pia (CNRS/ Univ. Paris Saclay, France): The CUPID-Mo experiment
- Andreas Rietbrock (KIT Karlsruhe Institute of Technology, Germany): ANDES-GEO: current design considerations
- Boris Alejandro Panes Saavedra (IF-USP, Brazil): A simple simulation of the IceCube neutrino telescope
- Zehra Sayers (SESAME organization): SESAME, an example to follow for ANDES?
- Emanuel Arthur Ydrefors (ITA, Brazil): Theoretical calculations of neutrino-nucleus scattering for supernova neutrinos

c2G. Workshop on Mathematical Physics (Aug. 10 - 13)

The Workshop will focus on different aspects and applications of vertex algebras and infinite dimensional Lie algebras to representation theory and conformal field theory. The webpage of the workshop is http://www.ictp-saifr.org/workshop-on-mathematical-physics-2018/ and speakers and topics included:

- Marco Aldi (Virginia Commonwealth University, USA): Generalized CRF-structures and Spinors
- Tomoyuki Arakawa (Rims-Kyoto, Japan): Higgs branch conjecture for class S theory
- Wolfgang Bock (TU Kaiserlautern, Germany): Some new ideas of continuum graded Lie algebras
- Jethro van Ekeren (Universidade Federal Fluminense, Brazil): Rationality and Fusion Rules of Affine W-Algebras
- Anne Moreau (University of Lille, France): Chiral symplectic leaves and arc spaces of Slodowy slices
- Andrei Okounkov (Columbia University, USA): Enumerative symplectic duality
- Vera Serganova (University of California-Berkeley, USA): Categorification constructions involving superalgebras on the example of the periplectic case.
- Mathew Szczesny (Boston University, USA): Factorization algebras from fibrations and toroidal vertex algebras
- Vladimir Sokolov (UFABC, Brazil): Integrable systems and non-associative algebraic structures
- Geordie Williamson (University of Sydney, Australia): Characters in the modular representation theory of algebraic groups
- Hiroyuki Yamane (University of Toyama, Japan): Representation theory using Coxeter groupoids

c2H. Workshop on Strong Electron Correlations in Quantum Materials: Inhomogeneities, Frustration and Topology (Aug. 14-18)

Topics of the workshop included disordered metals and insulators, frustrated magnets, spin liquids and topological insulators, and correlated and topological superconductors. The webpage of the workshop is http://www.ictp-saifr.org/workshop-on-strong-electron-correlations-in-quantum-materials-inhomogeneities-frustration-and-topology/ and speakers included:

- **Gabriel Aeppli** (Paul Scherrer Institute, Switzerland) Many-body localization in a dense interacting quantum system

- **Maria Carolina Aguiar** (UFMG, Brazil) Correlation-Driven Lifshitz Transition at the Emergence of the Pseudogap Phase in the Two-Dimensional Hubbard Model
- **Eric Andrade** (IFSC-USP, Brazil): Cluster-glass phase in disordered XY antiferromagnets pyrochlores
- **Marcos Avila** (UFABC, Brazil) Magnetism and superconductivity in the intermetallic series RNiSi3 (R=Y,Gd-Lu)
- **Marcello Civelli** (Université Paris-Sud, France) Unconventional high-energy Cooper pairing in cuprates: a Cluster Dnamical Mean Field Theory Perspective
- **Natanael de Carvalho Costa** (IF-UFRJ, Brazil): The nature of charge-density wave: A Quantum Monte Carlo Study
- **Vlad Dobrosavljević**(National High Magnetic Field Lab & Florida State University, USA): Approaching Disorder-Driven Metal-Insulator Transitions in Deformable Lattices: the Mystery of Mooij Correlations
- **Carlos Fiore**(IF-USP, Brazil): Temporal disorder in discontinuous non-equilibrium phase transitions: general results
- **Fernando Garcia** (USP, Brazil): The disordered double perovskite BaTi1/2Mn1/2O3 as new Spin Liquid candidate: results from heat capacity and μSR experiments
- **Amit Ghosal** (Indian Institute of Science Education and Research Kolkata, India) Superconductivity in a disordered vortex lattice
- **Eduardo Granado** (UNICAMP, Brazil) Electronic nematic order and fluctuations in Fe pnictides: a Raman scattering and synchrotron x-ray diffraction study
- **Wei Ku** (Shanghai Jiao Tong University, China) Non-Fermi liquid scattering against emergent Bose liquid: manifestations in the kink and other exotic quasiparticle behaviors in the normal-state cuprate superconductors
- **Eduardo Marino** (UFRJ, Brazil) The Superconducting Phase Diagram of High-Tc Cuprates
- **Tobias Micklitz** (CBPF, Brazil) Quantum critical walk at a topological Anderson localization transition
- **Eduardo Miranda** (UNICAMP, Brazil) Emergent symmetry and transport in disordered quantum chains
- **Rajesh Narayanan** (Indian Institute of Technology Madras, Chennai, India) Spin selective Metal-Insulator transition in two dimensions.
- **Thereza Paiva** (UFRJ, Brazil) Spatial Charge and Spin Correlations in the 2D Fermi-Hubbard Model including a Zeeman field
- **Rodrigo Pereira** (International Institute of Physics-UFRN, Brazil) Quantum spin-orbital liquids in j=3/2 systems
- **Dragana Popovic** (National High Magnetic Field Laboratory, USA) {Phase diagram of underdoped cuprates in a magnetic field: A unified perspective
- **Louk Rademaker** (Perimeter Institute, Canada) Charge-transfer insulation in twisted bilayer graphene
- **Raimundo R. Santos** (UFRJ, Brazil) Mott phase in the dipolar extended Hubbard model on a square optical lattice
- **Cristiane Morais Smith** (Utrecht University, The Netherlands) Thermodynamic description of topological insulators: the search for universal behaviour
- **Oskar Vafek** (National High Magnetic Field Laboratory, USA): Symmetry, maximally localized Wannier states, and low energy model for the twisted bilayer graphene narrow bands
- **Andre P. Vieira** (USP, Brazil): Many-body localization and emergent dimerization in disordered quantum systems
- **Thomas Vojta** (Missouri University of Science and Technology, USA) Fate of the Amplitude (Higgs) Mode at a Disordered Quantum Phase Transition
- **Stephen Rowley** (Cavendish Laboratory, University of Cambridge, UK) Ultra-strong electron pairing by hybrid polar modes in ferroelectric superconductors

c2I. Mini-workshop on Mathematical Modeling of Infectious Disease Dynamics (Aug. 21)

One-day seminars on biomathematics and in particular of epidemic modeling. The webpage of the workshop is http://www.ictp-saifr.org/workshop-on-mathematical-modeling-of-infectious-disease-dynamics/ and speakers and topics included:

- Lora Billings (Montclair State University, USA): Using stochastic models in epidemiology
- Sara Del Valle (Los Alamos National Laboratory, USA): Real-time heterogeneous data fusion approaches to predict dengue in Brazil
- Shweta Bansal (Georgetown University, USA): *From Social Behavior to Disease Transmission, Surveillance & Modeling*
- Roberto André Kraenkel (IFT-UNESP, Brazil): Causal links between climate and malaria in Northern Argentina

c2J. Condensed Matter Theory in the Metropolis (Nov. 12-13)

Two-day seminars on condensed matter physics intended to promote collaborations and exchanges between the groups working on hard condensed matter theory in the city of São Paulo and nearby scientific poles, such as Campinas and São Carlos. The webpage of the workshop is http://www.ictp-saifr.org/condensed-matter-theory-in-the-metropolis/ and speakers and topics included:

- Andre de Pinho Vieira (USP São Paulo): Emergent dimerization and localization in disordered quantum chains
- Belita Koiller (UFRJ): Atomically placed P in Si as quantum simulators and transport-based devices
- Caetano Rodrigues Miranda (USP São Paulo): Nano-confined water in interfaces: a fresh and sonic molecular look
- Caio Lewenkopf (UFF): Quantum thermodynamics: Entropy evolution in strongly coupled mesoscopic systems
- Cedric Leão (UFABC): Homojunctions and heterojunctions in 2D materials
- Edison Zacarias das Silva (UNICAMP): Double Rainbow and the Physics of Clusters: Computer Simulations Meets Experiments
- Eduardo Miranda (UNICAMP): Abandoned by Bloch: the dominance of disorder
- Eric Andrade (USP São Carlos): Uncovering novel phases in j=3/2 Mott insulators
- Francisco Rouxinol (UNICAMP): Quantum Information and Quantum Sensing Applications using Macroscopic Scale Elements
- Helena Petrilli (USP São Paulo): Computer simulations of materials through ab-initio electronic structure calculations performed at IF-USP
- Jose Abel Hoyos (USP São Carlos): Cluster-glass phase in pyrochlore XY antiferromagnets with quenched disorder
- Jose Carlos Egues (USP São Carlos): Topological and non-topological edge states in quantum dots and Chern Insulators
- Juarez L. F. Da Silva (USP São Carlos): First-Principles Investigation of Chalcogenides Materials: From Nanoflakes to 2D Solids
- Kaline Rabelo Coutinho (USP São Paulo):
- Leandro Seixas (Mackenzie): Phase transitions and covalent functionalization in two-dimensional transition metal dichalcogenides
- Luana Sucupira Pedroza (UFABC): Water-solid interfaces
- Luis Gregorio Dias (USP São Paulo): Detection and manipulation of Majorana zero modes in mesoscopic systems
- Marcio Varella (USP São Paulo): Positronic Molecules
- Maurice de Koning (UNICAMP): Glassy Dynamics at Pre-melted Grain Boundaries in Ice Ih
- Tobias Micklitz (CBPF): On localization in Fock-space

c2K. II South American Dark Matter Workshop (Nov. 21-23)

The goal of this international workshop was to explore the state of the art of the Dark Matter field, discussing the latest developments in all branches: theoretical, collider, direct and indirect, and astro. The webpage of the workshop is http://www.ictp-saifr.org/dark-matter-flash-school/ and speakers included:

- Pier Stefano Corasaniti (Observatoire de Paris, France)
- Francesco D'Eramo (Università di Padova, Italy)
- Arman Esmaili (PUC-Rio de Janeiro, Brazil)
- Azadeh Fattahi (Durham University, UK)
- Daniel Lopez-Fogliani (Universidad de Buenos Aires, Argentina)
- Christopher McCabe (King's College London, UK)
- Ruth Pottgen (Lund University, Sweden)
- Farinaldo Queiroz (IIP Natal, Brazil)
- Davi Rodrigues (UFES, Vitoria, Brazil)
- Cecilia Scannapieco (Universidad de Buenos Aires, Argentina)

c3. Minicourses

The ICTP-SAIFR organized five minicourses in 2018, on gravitational waves, field theory amplitudes, quantum entanglement, quantum computation and simulability and dark matter. The topics, lecturers and webpages for these minicourses are:

1) March 5-9 - Gravitational Waves for Field Theorists

Rafael Porto (visitor fellow at ICTP-SAIFR)

This course provided an introduction to the new field of gravitational wave (GW) science oriented towards theory students.

http://www.ictp-saifr.org/gravitational-waves-for-field-theorists/

2) May 7-9 - CHY: a Stringy View of Field Theory Amplitudes

Ellis Ye Yuan (IAS-Princeton, USA)

This minicourse was devoted to a brief introduction of Cachazo-He-Yuan (CHY) formalism, which is a universal method for modeling perturbative S-matrix of massless particles, based on an underlying "world-sheet" (instead of the traditional Feynman diagrams).

http://www.ictp-saifr.org/chy-a-stringy-view-of-field-theory-amplitudes/

3) August 20-24 - Minicourse on Quantum Entanglement

Lecturers: Fernando Brandão (Caltech, USA), Burak Sahinoglu (Caltech, USA)

The basics of the theory of quantum entanglement theory was covered, and then recent applications of the theory of entanglement to other branches of physics, from condensed matter physics and statistical mechanics to high energy physics.

http://www.ictp-saifr.org/brandao-minicourse-on-quantum-information/

4) October 15-19 - Introduction to quantum computation and simulability

Lecturers: Leandro Aolita (IF-UFRJ, Rio de Janeiro & ICTP/SAIFR, São Paulo), Daniel J. Brod (UFF, Niterói), Ernesto F. Galvão (UFF, Niterói)

The essentials of the fascinating field of quantum computation and its (classical) simulability was introduced.

http://www.ictp-saifr.org/introduction-to-quantum-computing-and-simulability/

5) Nov. 19 - Dark Matter Flash-School (Nov. 19)

Lecturers: Fabio Iocco (ICTP-SAIFR/IFT-UNESP), Raul Abramo (IF-USP), Azadeh Fattahi (Durham University) and Enrico Bertuzzo (USP)

The minicourse had introductory classes on different aspects of the Dark Matter Problem.

http://www.ictp-saifr.org/dark-matter-flash-school/

c4. Outreach events

The ICTP-SAIFR organized eight outreach events in 2018 aiming at different audiences. The format, topics and webpages for these events are:

1) Papos de Física

Papos de Fisica is a monthly outreach program of ICTP-SAIFR introducing current topics in theoretical physics to the general public in an informal setting. The webpage for this program is http://www.ictp-saifr.org/papos16. Topics covered during these meetings included:

- 8 de novembro - Luana Sucupira Pedroza (UFABC) - Física da água
- 04 de Outubro, 2018 - Beatriz Leonor Silveira Barbuy (IAG-USP) - O bojo da nossa galáxia
- 13 de Setembro, 2018 - Marina Nielsen (IF-USP) - Essa tal de Física Quântica
- 02 de Agosto, 2018 - Diego Trancanelli (IF-USP) - Simetria e Escala: dos átomos às galáxias
- 07 de Junho, 2018 - Adriano Natale - IFT-UNESP - A ciência do videogame
- 14-16 de Maio, 2018 - Papos de Física no Pint of Science Brasil 2018
- 05 de Abril, 2018 - Ivone Albuquerque (IF-USP) - Em busca do lado escuro do Universo
- 01 de Março, 2018 - Leandro Aolita (IF-UFRJ) - Informação quântica ou como tirar vantagem dos paradoxos da teoria quântica

2) Ciência em Diálogo no IMS: Física e Arte

This outreach program involves a monthly series of presentations at the IMS featuring one scientist and one non-scientist who discuss a topic of common interest. The webpage for the program is http://outreach.ictp-saifr.org/dialogo/. Topics covered during these meetings included:

- 9 de novembro: *Matéria*, com Aline Ramires e Laerte Ramos (escultor)
- 5 de outubro: *Luz*, com Pedro Vieira e Millard Schisler (fotógrafo)
- 14 de setembro: *Tempo*, com Nathan Berkovits e John Boudler (músico)
- 3 de agosto: *Gênese*, com Raul Abramo e Betty Mindlin (antropóloga).
- 8 de junho: *A noção de beleza*, com Pedro Vieira e Sônia Salzstein (filósofa)
- 4 de maio: *Ficção científica*, com Rodrigo Nemmen e Antônio Xerxenesky (escritor)
- 6 de abril: *Fotografia espacial*, com Luis Raul Abramo e Cristina Bonfiglioli (fotógrafa)
- 2 de março: *Música e som*, com Nathan Berkovits e Flo Menezes (músico)

3) ICTP-SAIFR distinguished Public Lectures:

The goal of this program is to bring outstanding scientists to give talks to the general public on relevant topics in physics. Topics covered in 2018 included neutrinos & dark matter and the simultaneous detection of light and gravitational waves in 2017:

- July 27: Marcelle Soares-Santos (Brandeis U.) - Collisões cósmicas: o impacto científico da primeira detecção de ondas gravitacionais e luz
- February 4: André Luiz De Gouvêa (Northwestern U.) - O que a gente sabe que não sabe: neutrinos, matéria escura e outros fenômenos fantasmagóricos

4) 3rd IFT-Perimeter-SAIFR Journeys into Theoretical Physics (July 16 – 22)

The 3rd journeys is described on the webpage http://www.ictp-saifr.org/journeys and involved 5 lecturers and 82 participants. The top students in this school were accepted to a joint master`s program where they will spend one year at Perimeter Institute (Waterloo) or at CUNY/Princeton Center for the Physics of Biological Function and one year at ICTP-SAIFR/IFT-UNESP. The students accepted to the joint program include Otavio Luiz Canton (IMECC, Unicamp), Bruno de Souza Leão Torres (Univ. Fed. Pernambuco), Tales Rick Perche (IMECC,

Unicamp) and Iván Mauricio Burbano Aldana (Univ. dos Andes, Bogotá).

Lecturers and Topics included:

- **Kevin Costello** (Perimeter) – An introduction to topology for physicists
- **Gastão Krein** (IFT-UNESP) – Effective quantum field theory
- **Aline Ramires** (ETH Zurich/ICTP-SAIFR/IFT-UNESP/MPI-PKS) – Aspects of Superconductivity
- **David Schwab** (CUNY/Princeton) – Current theoretical problems in biophysics
- **Kendrick Smith** (Perimeter) – Physics of the Early Universe

5) Minicourses for High-School Students:

This program involves several minicourses on topics of modern physics to high-school Students. The webpage for the minicourses is http://outreach.ictp-saifr.org/ensino-medio/minicurso/ and topics covered include:

- April 7-28 – A física do Universo: Cosmologia – Rogério Rosenfeld (ICTP-SAIFR/IFT-UNESP
- May 26 – June 9 – Relatividade e Gravitação – Pedro Vieira (Perimeter I/ICTP-SAIFR/IFT-UNESP)
- September 15-29 – Mecânica Quântica - Pedro Vieira (Perimeter I/ICTP-SAIFR/IFT-UNESP)
- September 15 – October 13 – Aulas de acompanhamento – Lucas David (outreach coordinator)
- October 6-13 – Ondas – Nathan Berkovits (ICTP-SAIFR/IFT-UNESP)

6) Workshops for High-School Teachers

This program presents classroom methods for teaching modern physics concepts to high-school teachers. In 2018 ICTP-SAIFR organized two editions of this activity:

- Sept. 29-30 - Cutting-edge In-class Physics Resources - Gregory Dick (Perimeter I.) and Dave Fish (Perimeter I.)
- Nov. 24-25 – Física Moderna para professors do ensino médio – Ana Luiza Sério e Lucas David, outreach coordinators

7) Physicists at the school

This new outreach program involves visits of physicists to public high schools to discuss their research with the students and to answer questions about careers in physics. The webpage of the program is http://outreach.ictp-saifr.org/fisicos-na-escola/ and three visits were organized this semester:

- **19/09/2018:** ETEC Guaracy Silveira (R. Ferreira de Araújo, 527 – Pinheiros, São Paulo)

  Physicist: Nathan Berkovits (ICTP-SAIFR / IFT-UNESP)

- **27/09/2018:** ETEC Getúlio Vargas (R. Clóvis Bueno de Azevedo, 70 – Ipiranga, São Paulo)

Lecturers: physicist Pedro Vieira (ICTP-SAIFR/IFT-UNESP & Perimeter Institute, Canadá) , Greg Dick (Perimeter Institute, Canadá) e Dave Fish (Perimeter Institute, Canadá)

- **29/10/2018:** ETEC Mandaqui (R. Dr. Luís Lustosa da Silva, 303 – Mandaqui, São Paulo)

Physicist: Aline Ramires (ICTP-SAIFR / IFT-UNESP)

c5. Weekly seminars, colloquia and journal clubs

Between December 2017 and November 2018, weekly seminars and colloquia were regularly organized. There were 130 seminars and colloquia and the complete list is on the webpage http://www.ictp-saifr.org/2018-research-seminars-and-activities/ . The list of the seminars of December 2017 are shown at http://www.ictp-saifr.org/other-years-research-seminars-and-activities/. There were also weekly

journal club meetings in string theory, particle physics and cosmology.

c6. Annual meeting of Steering Committee and Scientific Council

On February 5-6, 2018, the ICTP-SAIFR steering committee and scientific council met to evaluate the activities of 2017 and to discuss the future plans and activities for 2019. The program is on the webpage http://www.ictp-saifr.org/2018-meeting-of-scientific-council-and-steering-committee/ and the council members are listed on the webpages http://www.ictp-saifr.org/steering-committee/ and http://www.ictp-saifr.org/scientific-council/ .

5. Description of Institutional Support

The ICTP-SAIFR received 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.

The UNESP university is providing the salary for four ICTP-SAIFR secretaries including an executive secretary, an accountant, a computer systems manager and an executive manager. In April 2018, our previous executive secretary Vvian Vidal moved to Italy, and our new executive secretary Vanessa Ferreira was hired and in June replaced by Humberto Neto. 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.

Part of the institutional reserve técnica was used in 2018 to substantially upgrade the recording equipment in the IFT-UNESP auditorium following the guidance of the Perimeter Institute audiovisual department.

6. Activity Plan for 2019

In 2019, the ICTP-SAIFR will continue and expand its research, outreach and training activities in all areas of theoretical physics. Confirmed scientific activities in 2019 which will be organized by ICTP-SAIFR include international schools and workshops on topics including mathematical biology, mathematical models of evolution, theoretical physics, statistical physics, observational cosmology, high energy astrophysics, light interactions with cold atoms, high performance computing and data science and machine learning. The list of 2019 activities confirmed up to now are on the webpage http://www.ictp-saifr.org/2019-activities/ and include the activities:

São Paulo International Schools on Theoretical Physics

VIII Southern-Summer School on Mathematical Biology
January 14-20, 2019

Joint ICTP-SAIFR/ICTP-Trieste School on Mathematical Models of Evolution
January 21-26, 2019

4th Joint Dutch-Brazil School on Theoretical Physics
February 11-15, 2019

Preparatory School for StatPhys 2019
July 1-6, 2019

Joint ICTP-Trieste/ICTP-SAIFR School on Observational Cosmology
July 22 – August 2, 2019

School on High Energy Astrophysics
August 5-16, 2019

School on Light Interactions with Cold Atoms
September 16-27, 2019

School on Parallel Programming for High Performance Computing
December 2-13, 2019

School on Data Science and Machine Learning
December 16-20, 2019

Meetings/Programs/Workshops

2019 Meeting of Scientific Council and Steering Committee
February 4-5, 2019

ICTP-SAIFR/FAIR Workshop on Mass Generation in QCD
February 25 – March 1, 2019

2019 Workshop on Perspectives in Nonlinear Dynamics
July 15-19, 2019

Workshop on American Monsoons
August 19-24, 2019

ICTP-SAIFR Program on Particle Physics
September 30 – November 30, 2019

Workshop on Determination of Fundamental QCD Parameters
September 30 – October 4, 2019

Workshop on Skills for Young Scientists/Increasing Diversity in Physics
October 7-11, 2019

Workshop on conformal field theories, tensor categories and Nichols algebras
October 16-18, 2019

Dark Universe Workshop – Early Universe Cosmology, Baryogenesis and Dark Matter
October 21-25, 2019

Outreach

Ciência em Diálogo: Física e Arte
March – November, 2019

Papos de Física
March – November, 2019

2019 IFT-Perimeter-SAIFR Journeys into Theoretical Physics
July 8-14, 2019

2019 ICTP-SAIFR Competition for Young Physicists
July 13, 2019

7. Use of Reserva Tecnica Funds

Between December 2017 and November 2018, the part of the reserva tecnica funds related to "Custos de Infraestrutura Direta do Projeto" was used for the following purposes:

a) Advertisement of postdoctoral and tenure-track fellowships at Academic Jobs Online: R$ 2.411,11

b) Advertisement of postdoctoral and tenure-track fellowships at Science Careers: R$ 2.508,29

c) Advertisement of postdoctoral and tenure-track fellowships at Physics Today Jobs: R$ 4.169,27

d) School/Workshop Posters design and printing for announcement of activities: R$ 12.974,50

e) Post office expenses – delivery of School/Workshop posters: R$ 25.671,00

f) Installation and purchase of air conditioners: R$ 12.660,00

g) Online advertisement of ICTP-SAIFR activities: R$ 79,34

h) Purchase of table and cabinet: R$1.346,08

i) Purchase of security cabinet: R$1.094,16

j) Purchase of projector lamp: R$ 1.680,00

k) Purchase of display board for advertising ICTP-SAIFR activities: R$585,08

l) Per diem for scientific visit and participation in the Workshop "PhenoExp 2018: LHC Physics and beyond" (May 9-11) of ICTP-SAIFR associate member Ricardo Matheus. Ricardo participated in work groups and roundtables: R$ 2.784,16.

m) Airfare for scientific visit at DESY Zeuthen (Berlin) of ICTP-SAIFR associate member Fabio Iocco. Fabio will participate in meetings and collaborations of the Cherenkov Telescope Array on the determination of roadmap for the Consortium paper on the Large Magellanic Cloud: R$ 2.932,89.

n) Partitions and electrical installations for research offices: R$ 6.124,00

o) Installation of HDMI adapters for ICTP-SAIFR presentations: R$1.450,00

And the part of the reserva tecnica funds related to "Benefícios Complementares" was used for the following purposes:

a) Airfare for ICTP-SAIFR director Nathan Berkovits to Toronto (Canada) to present a talk with the title "On pure spinor superfield actions in 10 and 11 dimensions" at the meeting New directions in conventional and ambitwistor string theories (April 16-20) at Perimeter Institute

(Waterloo): R$ 3.374,02

b) Airfare for ICTP-SAIFR director Nathan Berkovits to Cidade do México (México) to present a talk with the title "The South American regional center ICTP-SAIFR and its activities" at the meeting Fifth Latin-American Congress of Physics (Oct 7-9, Puebla-Mexico): R$ 3.668,20

c) Airfare for ICTP-SAIFR director Nathan Berkovits to Lima (Peru) to present a talk with the title "Twistors and the Superstring" at the XII Latin-American Symposium on High-Energy Physics (Nov. 26-30): R$ 3.274,11

d) Airfare and per diem for scientific visit and participation in the Workshop "PhenoExp 2018: LHC Physics and beyond" (May 9-11) of ICTP-SAIFR vice-director Rogério Rosenfeld to Buenos Aires, Argentina: R$ 2.611,01

e) Airfare and per diem for participation in the Workshop "Cosmo@Arg" (Oct. 12) of ICTP-SAIFR vice-director Rogério Rosenfeld in Buenos Aires, Argentina. Rogério presented a talk entitled "If the universe is the answer what is the question?": R$ 2.176,51

f) Airfare and per diem for participation in the XII Latin-American Symposium on High-Energy Physics (Nov. 26-30) of ICTP-SAIFR vice-director Rogério Rosenfeld to Lima, Peru. Rogério presented a talk entitled "Cosmology": R$ 2.073,60.

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] R. C. C. Lopes, R. Voivodic, L. R. Abramo, and L. S. Jr, "Turnaround radius in f (R) model," *J. Cosmol. Astropart. Phys.*, vol. 2018, no. 09, p. 010, 2018.

[2] S. Gautam and S. K. Adhikari, "Three-dimensional vortex-bright solitons in a spin-orbit-coupled spin-1 condensate," *Phys. Rev. A*, vol. 97, no. 1, p. 013629, Jan. 2018.

[3] R. A. Sultanov, D. Guster, and S. K. Adhikari, "Influence of the $\bar{p}$-p Nuclear Interaction on the Rate of the Low-Energy $p^- + H\,\mu \rightarrow (p^- p)\,\alpha + \mu -$ Reaction," *Atoms*, vol. 6, no. 2, p. 18, Apr. 2018.

[4] S. K. Adhikari and L. Salasnich, "Vortex lattice in the crossover of a Bose gas from weak coupling to unitarity," *Scientific Reports*, vol. 8, no. 1, p. 8825, Jun. 2018.

[5] S. K. Adhikari, "A self-bound matter-wave boson–fermion quantum ball," *Laser Phys. Lett.*, vol. 15, no. 9, p. 095501, 2018.

[6] S. K. Adhikari, "Improved effective-range expansions for small and large values of scattering length," *Eur. J. Phys.*, vol. 39, no. 5, p. 055403, 2018.

[7] C. L. N. Costa *et al. including* M. A. M. de Aguiar, "Registering the evolutionary history in individual-based models of speciation," *Physica A: Statistical Mechanics and its Applications*, vol. 510, pp. 1–14, Nov. 2018.

[8] A. Ketterer, A. Laversanne-Finot, L. Aolita, "Continuous-variable supraquantum nonlocality," *Phys. Rev. A*, vol. 97, no. 1, 2018.

[9] B. Amaral, A. Cabello, M. T. Cunha, L. Aolita, "Noncontextual Wirings," *Phys. Rev. Lett.*, vol. 120, no. 13, 2018.

[10] R. V. Nery, M. M. Taddei, R. Chaves, L. Aolita, "Quantum Steering Beyond Instrumental Causal Networks," *Phys. Rev. Lett.*, vol. 120, no. 14, 2018.

[11] M. Gluza, M. Kliesch, J. Eisert, L. Aolita, "Fidelity Witnesses for Fermionic Quantum Simulations," *Phys. Rev. Lett.*, vol. 120, no. 19, 2018.

[12] N. Berkovits and M. Guillen, "Equations of motion from Cederwall's pure spinor superspace actions," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 33, Aug. 2018.

[13] N. Berkovits and M. Lize, "Field theory actions for ambitwistor string and superstring," *J. High Energ. Phys.*, vol. 2018, no. 9, p. 97, Sep. 2018.

[14] G. Burdman and G. Lichtenstein, "Displaced vertices from hidden glue," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 146, Aug. 2018.

[15] P. Louodop, E. B. M. Ngouonkadi, P. Muruganandam, and H. A. Cerdeira, "Synchronization Dynamics of Modified Relay-coupled Chaotic Systems," *Journal of Applied Nonlinear Dynamics*, vol. 7, no. 1, pp. 11–24, Mar. 2018.

[16] P. Kushwaha *et al. including* E. M. de Gouveia Dal Pino, "Multiwavelength temporal and spectral variability of the blazar OJ 287 during and after the 2015 December flare: a major accretion disc contribution," *Mon Not R Astron Soc*, vol. 473, no. 1, pp. 1145–1156, Jan. 2018.

[17] L. H. S. Kadowaki, E. M. de Gouveia Dal Pino, and J. M. Stone, "MHD Instabilities in Accretion Disks and Their Implications in Driving Fast Magnetic Reconnection," *ApJ*, vol. 864, no. 1, p. 52, 2018.

[18] P. Kushwaha *et al. including* E. M. de Gouveia Dal Pino, "The ever-surprising blazar OJ 287: multiwavelength study and appearance of a new component in X-rays," *Mon Not R Astron Soc*, vol. 479, no. 2, pp. 1672–1684, Sep. 2018.

[19] C. B. Singh, D. Garofalo, and E. M. de Gouveia Dal Pino, "Magnetic reconnection and Blandford–Znajek process around rotating black holes," *Mon Not R Astron Soc*, vol. 478, no. 4, pp. 5404–5409, Aug. 2018.

[20] A. Alves, N. R. Agostinho, O. J. P. Eboli, M. C. Gonzalez-García, "Effect of fermionic operators on the gauge legacy of the LHC Run I," *Phys. Rev. D*, vol. 98, no. 1, 2018.

[21] G. A. Maciel, R. M. Coutinho, R. A. Kraenkel, "Critical patch-size for two-sex populations," *Mathematical Biosciences*, vol. 300, pp. 138–144, Jun. 2018.

[22] M. A. Manna, A. Latifi, and R. A. Kraenkel, "Green–Naghdi dynamics of surface wind waves in finite depth," *Fluid Dyn. Res.*, vol. 50, no. 2, p. 025514, 2018.

[23] N. Brambilla, G. Krein, J. T. Castella, An. Vairo, "Born-Oppenheimer approximation in an effective field theory language," *Phys. Rev. D*, vol. 97,

no. 1, 2018.

[24] D. S. Rosa, T. Frederico, G. Krein, M. T. Yamashita, "Efimov effect in D spatial dimensions in AAB systems," *Phys. Rev. A*, vol. 97, no. 5, 2018.

[25] R. Leme, O. Oliveira, and G. Krein, "Approximate dual representation for Yang–Mills SU(2) gauge theory," *Eur. Phys. J. C*, vol. 78, no. 8, p. 656, Aug. 2018.

[26] J. Tarrús Castellà, G. Krein, "Effective field theory for the nucleon-quarkonium interaction," *Phys. Rev. D*, vol. 98, no. 1, 2018.

[27] J. P. Carlomagno, G. Krein, "Time-dependent Ginzburg-Landau approach to the dynamics of inhomogeneous chiral condensates in a nonlocal Nambu–Jona-Lasinio model," *Phys. Rev. D*, vol. 98, no. 1, 2018.

[28] J. P. Carlomagno, G. Krein, D. Kroff, and T. Peixoto, "Dynamics of inhomogeneous chiral condensates," *EPJ Web of Conferences*, vol. 172, p. 03005, 2018.

[29] R. A. Diaz, N. F. Svaiter, G. Krein, C. A. D. Zarro, "Disordered lj^4+rj^6 Landau-Ginzburg model," *Phys. Rev. D*, vol. 97, no. 6, 2018.

[30] C. E. Fontoura, F. Krmpotić, A. P. Galeão, C. D. Conti, and G. Krein, "Nonmesonic weak decay of charmed hypernuclei," *J. Phys. G: Nucl. Part. Phys.*, vol. 45, no. 1, p. 015101, 2018.

[31] G. Krein, A. W. Thomas, K. Tsushima"Nuclear-bound quarkonia and heavy-flavor hadrons," *Progress in Particle and Nuclear Physics*, vol. 100, pp. 161–210, May 2018.

[32] J. Prat *et al. including* M. Lima, "Galaxy bias from galaxy–galaxy lensing in the DES science verification data," *Mon Not R Astron Soc*, vol. 473, no. 2, pp. 1667–1684, Jan. 2018.

[33] M. Garcia-Fernandez *et al. including* M. Lima, "Weak lensing magnification in the Dark Energy Survey Science Verification data," *Mon Not R Astron Soc*, vol. 476, no. 1, pp. 1071–1085, May 2018.

[34] F. Lacasa, M. Lima, and M. Aguena, "Super-sample covariance approximations and partial sky coverage," *A&A*, vol. 611, p. A83, Mar. 2018.

[35] M. Klein *et al. including* M. Lima, "A multicomponent matched filter cluster confirmation tool for eROSITA: initial application to the RASS and DES-SV data sets," *Mon Not R Astron Soc*, vol. 474, no. 3, pp. 3324–3343, Mar. 2018.

[36] N. Rumbaugh *et al including* M. Lima., "Extreme Variability Quasars from the Sloan Digital Sky Survey and the Dark Energy Survey," *ApJ*, vol. 854, no. 2, p. 160, 2018.

[37] F. Courbin *et al. including* M. Lima, "COSMOGRAIL: the COSmological MOnitoring of GRAvItational Lenses: XVI. Time delays for the quadruply imaged quasar DES J0408−5354 with high-cadence photometric monitoring⋆," *Astronomy & Astrophysics*, vol. 609, p. A71, Jan. 2018.

[38] C. Davis *et al. including* M. Lima, "Cross-correlation redshift calibration

without spectroscopic calibration samples in DES Science Verification Data," *Mon Not R Astron Soc*, vol. 477, no. 2, pp. 2196–2208, Jun. 2018.

[39] B. Abolfathi *et al. including* M. Lima, "The Fourteenth Data Release of the Sloan Digital Sky Survey: First Spectroscopic Data from the Extended Baryon Oscillation Spectroscopic Survey and from the Second Phase of the Apache Point Observatory Galactic Evolution Experiment," *ApJS*, vol. 235, no. 2, p. 42, 2018.

[40] E. J. Baxter *et al. including* M. Lima, "A measurement of CMB cluster lensing with SPT and DES year 1 data," *Mon Not R Astron Soc*, vol. 476, no. 2, pp. 2674–2688, May 2018.

[41] Dark Energy Survey Collaboration *et al. including* M. Lima and R. Rosenfeld, "Dark Energy Survey Year 1 results: Cosmological constraints from galaxy clustering and weak lensing," *Phys. Rev. D*, vol. 98, no. 4, p. 043526, Aug. 2018.

[42] A. Drlica-Wagner *et al. including* M. Lima, "Dark Energy Survey Year 1 Results: The Photometric Data Set for Cosmology," *ApJS*, vol. 235, no. 2, p. 33, 2018.

[43] B. Hoyle *et al. including* M. Lima, "Dark Energy Survey Year 1 Results: redshift distributions of the weak-lensing source galaxies," *Mon Not R Astron Soc*, vol. 478, no. 1, pp. 592–610, Jul. 2018.

[44] J. Zuntz *et al including* M. Lima., "Dark Energy Survey Year 1 results: weak lensing shape catalogues," *Mon Not R Astron Soc*, vol. 481, no. 1, pp. 1149–1182, Nov. 2018.

[45] S. Samuroff *et al. including* M. Lima, "Dark Energy Survey Year 1 results: the impact of galaxy neighbours on weak lensing cosmology with im3shape," *Mon Not R Astron Soc*, vol. 475, no. 4, pp. 4524–4543, Apr. 2018.

[46] C. Chang *et al. including* M. Lima, "Dark Energy Survey Year 1 results: curved-sky weak lensing mass map," *Mon Not R Astron Soc*, vol. 475, no. 3, pp. 3165–3190, Apr. 2018.

[47] Dark Energy Survey Collaboration *et al including* M. Lima., "Dark Energy Survey year 1 results: Galaxy clustering for combined probes," *Phys. Rev. D*, vol. 98, no. 4, p. 042006, Aug. 2018.

[48] Dark Energy Survey Collaboration *et al. including* M. Lima, "Dark Energy Survey year 1 results: Galaxy-galaxy lensing," *Phys. Rev. D*, vol. 98, no. 4, p. 042005, Aug. 2018.

[49] Dark Energy Survey Collaboration *et al. including* M. Lima, "Dark Energy Survey Year 1 results: Cosmological constraints from cosmic shear," *Phys. Rev. D*, vol. 98, no. 4, p. 043528, Aug. 2018.

[50] M. Gatti *et al. including* M. Lima, "Dark Energy Survey Year 1 results: cross-correlation redshifts – methods and systematics characterization," *Mon Not R Astron Soc*, vol. 477, no. 2, pp. 1664–1682, Jun. 2018.

[51] DES Collaboration *et al. including* M. Lima, "Density split statistics: Cosmological constraints from counts and lensing in cells in DES Y1 and SDSS data," *Phys. Rev. D*, vol. 98, no. 2, p. 023507, Jul. 2018.

[52] DES Collaboration *et al. including* M. Lima, "Density split statistics: Joint model of counts and lensing in cells," *Phys. Rev. D*, vol. 98, no. 2, p. 023508, Jul. 2018.

[53] D. Scolnic *et al. including* M. Lima, "How Many Kilonovae Can Be Found in Past, Present, and Future Survey Data Sets?," *ApJL*, vol. 852, no. 1, p. L3, 2018.

[54] C. Chang *et al. including* M. Lima, "The Splashback Feature around DES Galaxy Clusters: Galaxy Density and Weak Lensing Profiles," *ApJ*, vol. 864, no. 1, p. 83, 2018.

[55] T. M. C. Abbott *et al including* M. Lima., "Dark Energy Survey Year 1 Results: A Precise H0 Estimate from DES Y1, BAO, and D/H Data," *Mon Not R Astron Soc*, vol. 480, no. 3, pp. 3879–3888, Nov. 2018.

[56] I. Chiu *et al. including* M. Lima, "Baryon content in a sample of 91 galaxy clusters selected by the South Pole Telescope at 0.2," *Mon Not R Astron Soc*, vol. 478, no. 3, pp. 3072–3099, Aug. 2018.

[57] A. Agnello *et al including* M. Lima, "DES meets Gaia: discovery of strongly lensed quasars from a multiplet search," *Mon Not R Astron Soc*, vol. 479, no. 4, pp. 4345–4354, Oct. 2018.

[58] D. Mudd *et al. including* M. Lima, "Quasar Accretion Disk Sizes from Continuum Reverberation Mapping from the Dark Energy Survey," *ApJ*, vol. 862, no. 2, p. 123, 2018.

[59] M. Smith *et al. including* M. Lima, "Studying the Ultraviolet Spectrum of the First Spectroscopically Confirmed Supernova at Redshift Two," *ApJ*, vol. 854, no. 1, p. 37, 2018.

[60] S. Avila *et al. including* M. Lima and R. Rosenfeld, "Dark Energy Survey Year-1 results: galaxy mock catalogues for BAO," *Mon Not R Astron Soc*, vol. 479, no. 1, pp. 94–110, Sep. 2018.

[61] C. F. Wethers *et al. including* M. Lima, "UV-luminous, star-forming hosts of z ~ 2 reddened quasars in the Dark Energy Survey," *Mon Not R Astron Soc*, vol. 475, no. 3, pp. 3682–3699, Apr. 2018.

[62] K. C. Chan *et al. including* M. Lima and R. Rosenfeld, "BAO from angular clustering: optimization and mitigation of theoretical systematics," *Mon Not R Astron Soc*, vol. 480, no. 3, pp. 3031–3051, Nov. 2018.

[63] N. Jeffrey *et al. including* M. Lima, "Improving weak lensing mass map reconstructions using Gaussian and sparsity priors: application to DES SV," *Mon Not R Astron Soc*, vol. 479, no. 3, pp. 2871–2888, Sep. 2018.

[64] P. Aguirre *et al. including* M. Lima, "The LABOCA/ACT survey of clusters at all redshifts: multiwavelength analysis of background submillimeter galaxies" *Astrophys. J.*, vol. 855, no. 26, pp. 1–30, March 2018.

[65] N. MacCrann *et al including* M. Lima, "DES Y1 Results: validating cosmological parameter estimation using simulated Dark Energy Surveys," *Mon Not R Astron Soc*, vol. 480, no. 4, pp. 4614–4635, Nov. 2018.

[66] M. A. Troxel *et al. including* M. Lima, "Survey geometry and the internal consistency of recent cosmic shear measurements," *Mon Not R Astron Soc*, vol. 479, no. 4, pp. 4998–5004, Oct. 2018.

[67] T. Treu *et al. including* M. Lima, "The STRong lensing Insights into the Dark Energy Survey (STRIDES) 2016 follow-up campaign – I. Overview and classification of candidates selected by two techniques," *Mon Not R Astron Soc*, vol. 481, no. 1, pp. 1041–1054, Nov. 2018.

[68] T. Anguita *et al. including* M. Lima, "The STRong lensing Insights into the Dark Energy Survey (STRIDES) 2016 follow-up campaign – II. New quasar lenses from double component fitting," *Mon Not R Astron Soc*, vol. 480, no. 4, pp. 5017–5028, Nov. 2018.

[69] J. Gschwend *et al including* M. Lima., "DES science portal: Computing photometric redshifts," *Astronomy and Computing*, vol. 25, pp. 58–80, Oct. 2018.

[70] A. Fausti Neto *et al. including* M. Lima, "DES science portal: Creating science-ready catalogs," *Astronomy and Computing*, vol. 24, pp. 52–69, Jul. 2018.

[71] J. Marques L., S. H. Lee, A. Park, R. D. Matheus, and K. S. Jeong, "QCD sum rules for the $\mathrm{\ensuremath{\Delta}}$ isobar in neutron matter," *Phys. Rev. C*, vol. 98, no. 2, p. 025206, Aug. 2018.

[72] A. Mikhailov, "A minimalistic pure spinor sigma-model in AdS," *J. High Energ. Phys.*, vol. 2018, no. 7, p. 155, Jul. 2018.

[73] A. Mikhailov, "Integration over families of Lagrangian submanifolds in BV formalism," *Nuclear Physics B*, vol. 928, pp. 107–159, Mar. 2018.

[74] G. Itsios, H. Nastase, C. Núñez, K. Sfetsos, and S. Zacarías, "Penrose limits of Abelian and non-Abelian T-duals of AdS5 × S5 and their field theory duals," *J. High Energ. Phys.*, vol. 2018, no. 1, p. 71, Jan. 2018.

[75] H. Nastase and C. Núñez, "Deriving three-dimensional bosonization and the duality web," *Physics Letters B*, vol. 776, pp. 145–149, Jan. 2018.

[76] H. Nastase and J. Sonnenschein, "Lagrangian Formulation, Generalizations and Quantization of Null Maxwell's Knots," *Fortschritte der Physik*, vol. 66, no. 8–9, p. 1800042, Aug. 2018.

[77] I. Almeida, R. Nemmen, K.-W. Wong, Q. Wu, and J. A. Irwin, "The multiwavelength spectrum of NGC 3115: hot accretion flow properties," *Mon Not R Astron Soc*, vol. 475, no. 4, pp. 5398–5402, Apr. 2018.

[78] CMS Collaboration *et al. including* S. Novaes, "Elliptic Flow of Charm and Strange Hadrons in High-Multiplicity $p+\mathrm{Pb}$ Collisions at $\sqrt{{s}_{\mathrm{NN}}}=8.16\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 121, no. 8, p. 082301, Aug. 2018.

[79] A. M. Sirunyan *et al. including* S. Novaes, "Search for excited quarks of light and heavy flavor in γ + jet final states in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 781, pp. 390–411, Jun. 2018.

[80] A. M. Sirunyan *et al. including* S. Novaes, "Azimuthal anisotropy of charged particles with transverse momentum up to 100 GeV/c in PbPb collisions at

sNN=5.02 TeV," *Physics Letters B*, vol. 776, pp. 195–216, Jan. 2018.

[81] A. M. Sirunyan *et al. including* S. Novaes, "Azimuthal correlations for inclusive 2-jet, 3-jet, and 4-jet events in pp collisions at $$\sqrt{s}= 13~\hbox {TeV}$$s=13TeV," *Eur. Phys. J. C*, vol. 78, no. 7, p. 566, Jul. 2018.

[82] A. M. Sirunyan *et al. including* S. Novaes, "Charged-particle nuclear modification factors in XeXe collisions at sNN=5.44$$ \sqrt{s_{\mathrm{NN}}} = 5.44 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 10, p. 138, Oct. 2018.

[83] CMS Collaboration *et al. including* S. Novaes, "Observation of Higgs Boson Decay to Bottom Quarks," *Phys. Rev. Lett.*, vol. 121, no. 12, p. 121801, Sep. 2018.

[84] A. M. Sirunyan *et al. including* S. Novaes, "Search for resonant pair production of Higgs bosons decaying to bottom quark-antiquark pairs in proton-proton collisions at 13 TeV," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 152, Aug. 2018.

[85] A. M. Sirunyan *et al. including* S. Novaes, "Search for a singly produced third-generation scalar leptoquark decaying to a τ lepton and a bottom quark in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 7, p. 115, Jul. 2018.

[86] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the weak mixing angle using the forward–backward asymmetry of Drell–Yan events in $$\mathrm {p}\mathrm {p}$$ppcollisions at 8$$\,\text {TeV}$$TeV," *Eur. Phys. J. C*, vol. 78, no. 9, p. 701, Sep. 2018.

[87] A. M. Sirunyan *et al. including* S. Novaes, "Search for narrow and broad dijet resonances in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV and constraints on dark matter mediators and other new particles," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 130, Aug. 2018.

[88] A. M. Sirunyan *et al. including* S. Novaes, "Search for beyond the standard model Higgs bosons decaying into a bb¯$$ \mathrm{b}\overline{\mathrm{b}} $$pair in pp collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 113, Aug. 2018.

[89] CMS Collaboration *et al. including* S. Novaes, "Observation of the ${\ensuremath{\chi}}_{b1}(3P)$ and ${\ensuremath{\chi}}_{b2}(3P)$ and Measurement of their Masses," *Phys. Rev. Lett.*, vol. 121, no. 9, p. 092002, Aug. 2018.

[90] A. M. Sirunyan *et al. including* S. Novaes, "Search for an exotic decay of the Higgs boson to a pair of light pseudoscalars in the final state with two b quarks and two τ leptons in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 785, pp. 462–488, Oct. 2018.

[91] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the production cross section for single top quarks in association with W bosons in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 10, p. 117, Oct. 2018.

[92] A. M. Sirunyan *et al. including* S. Novaes, "Search for top squarks decaying via four-body or chargino-mediated modes in single-lepton final states in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 9, p. 65, Sep. 2018.

[93] A. M. Sirunyan *et al. including* S. Novaes, "Search for a new scalar resonance decaying to a pair of Z bosons in proton-proton collisions at s=13$$ sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 127, Jun. 2018.

[94] A. M. Sirunyan *et al. including* S. Novaes, "Jet properties in PbPb and pp collisions at sNN=5.02$$ \sqrt{s_{\mathrm{N}\;\mathrm{N}}}=5.02 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 5, p. 6, May 2018.

[95] A. M. Sirunyan *et al. including* S. Novaes, "Search for a heavy resonance decaying to a pair of vector bosons in the lepton plus merged jet final state at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 5, p. 88, May 2018.

[96] CMS Collaboration *et al. including* S. Novaes, "Search for Narrow Resonances in the b-Tagged Dijet Mass Spectrum in Proton-Proton Collisions at $\sqrt{s}=8\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 20, p. 201801, May 2018.

[97] CMS Collaboration *et al. including* S. Novaes, "Measurement of the ${\mathrm{\ensuremath{\Lambda}}}_{b}$ polarization and angular parameters in ${\mathrm{\ensuremath{\Lambda}}}_{b}\ensuremath{\rightarrow}J/\ensuremath{\psi}\mathrm{\ensuremath{\Lambda}}$ decays from pp collisions at $\sqrt{s}=7$ and 8 TeV," *Phys. Rev. D*, vol. 97, no. 7, p. 072010, Apr. 2018.

[98] CMS Collaboration *et al. including* S. Novaes, "Search for Heavy Neutral Leptons in Events with Three Charged Leptons in Proton-Proton Collisions at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 22, p. 221801, May 2018.

[99] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the inelastic proton-proton cross section at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 7, p. 161, Jul. 2018.

[100] A. M. Sirunyan *et al. including* S. Novaes, "Search for single production of vector-like quarks decaying to a b quark and a Higgs boson," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 31, Jun. 2018.

[101] A. M. Sirunyan *et al.*, "Search for lepton-flavor violating decays of heavy resonances and quantum black holes to eμ final states in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 4, p. 73, Apr. 2018.

[102] A. M. Sirunyan *et al. including* S. Novaes, "Comparing transverse momentum balance of b jet pairs in pp and PbPb collisions at sNN=5.02$$ \sqrt{s_{\mathrm{NN}}}=5.02 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 181, Mar. 2018.

[103] A. M. Sirunyan *et al. including* S. Novaes, "Search for dark matter in events with energetic, hadronically decaying top quarks and missing transverse

momentum at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 27, Jun. 2018.

[104] A. M. Sirunyan *et al.including* S. Novaes, "Combined search for electroweak production of charginos and neutralinos in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 160, Mar. 2018.

[105] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the $$\mathrm {Z}/\gamma ^{*} \rightarrow \tau \tau $$Z/γ∗→ττcross section in pp collisions at $$\sqrt{s} = 13 \hbox { TeV}$$s=13TeVand validation of $$\tau $$τlepton analysis techniques," *Eur. Phys. J. C*, vol. 78, no. 9, p. 708, Sep. 2018.

[106] A. M. Sirunyan *et al. including* S. Novaes, "Search for new physics in events with two soft oppositely charged leptons and missing transverse momentum in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 782, pp. 440–467, Jul. 2018.

[107] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the groomed jet mass in PbPb and pp collisions at sNN=5.02$$ \sqrt{s_{\mathrm{NN}}}=5.02 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 10, p. 161, Oct. 2018.

[108] A. M. Sirunyan *et al. including* S. Novaes, "Search for vector-like T and B quark pairs in final states with leptons at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 177, Aug. 2018.

[109] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the top quark mass with lepton+jets final states using $$\mathrm {p}$$p$$\mathrm {p}$$pcollisions at $$\sqrt{s}=13\,\text {TeV} $$s=13TeV," *Eur. Phys. J. C*, vol. 78, no. 11, p. 891, Nov. 2018.

[110] A. M. Sirunyan *et al. including* S. Novaes, "Performance of the CMS muon detector and muon reconstruction with proton-proton collisions at √ s =13 TeV," *J. Inst.*, vol. 13, no. 06, p. P06015, 2018.

[111] A. M. Sirunyan *et al. including* S. Novaes, "Search for pair production of excited top quarks in the lepton+jets final state," *Physics Letters B*, vol. 778, pp. 349–370, Mar. 2018.

[112] A. M. Sirunyan *et al. including* S. Novaes, "Search for a heavy resonance decaying into a Z boson and a Z or W boson in 2ℓ2q final states at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 9, p. 101, Sep. 2018.

[113] A. M. Sirunyan *et al. including* S. Novaes, "Search for new long-lived particles at s=13 TeV," *Physics Letters B*, vol. 780, pp. 432–454, May 2018.

[114] A. M. Sirunyan *et al. including* S. Novaes, "Search for gauge-mediated supersymmetry in events with at least one photon and missing transverse momentum in pp collisions at s=13TeV," *Physics Letters B*, vol. 780, pp. 118–143, May 2018.

[115] A. M. Sirunyan *et al. including* S. Novaes, "Search for tt¯H$$ \mathrm{t}\overline{\mathrm{t}}\mathrm{H} $$production in the all-jet final state in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High*

Energ. Phys., vol. 2018, no. 6, p. 101, Jun. 2018.

[116] A. M. Sirunyan *et al. including* S. Novaes, "Search for natural and split supersymmetry in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV in final states with jets and missing transverse momentum," *J. High Energ. Phys.*, vol. 2018, no. 5, p. 25, May 2018.

[117] A. M. Sirunyan *et al. including* S. Novaes, "Search for decays of stopped exotic long-lived particles produced in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 5, p. 127, May 2018.

[118] A. M. Sirunyan *et al. including* S. Novaes, "Electroweak production of two jets in association with a Z boson in proton–proton collisions at $$\sqrt{s}= $$s=13$$\,\text {TeV}$$TeV," *Eur. Phys. J. C*, vol. 78, no. 7, p. 589, Jul. 2018.

[119] CMS Collaboration *et al. including* S. Novaes, "Search for Physics Beyond the Standard Model in Events with High-Momentum Higgs Bosons and Missing Transverse Momentum in Proton-Proton Collisions at 13 TeV," *Phys. Rev. Lett.*, vol. 120, no. 24, p. 241801, Jun. 2018.

[120] A. M. Sirunyan *et al. including* S. Novaes, "Search for lepton flavour violating decays of the Higgs boson to μτ and eτ in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 1, Jun. 2018.

[121] CMS Collaboration *et al. including* S. Novaes, "Search for the $X(5568)$ State Decaying into ${B}_{s}^{0}{\ensuremath{\pi}}^{\ifmmode\pm\else\textpm\fi{}}$ in Proton-Proton Collisions at $\sqrt{s}=8\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 20, p. 202005, May 2018.

[122] A. M. Sirunyan *et al. including* S. Novaes, "Search for Zγ resonances using leptonic and hadronic final states in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 9, p. 148, Sep. 2018.

[123] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the associated production of a single top quark and a Z boson in pp collisions at s=13TeV," *Physics Letters B*, vol. 779, pp. 358–384, Apr. 2018.

[124] CMS Collaboration *et al. including* S. Novaes, "Search for new physics in final states with an energetic jet or a hadronically decaying W or Z boson and transverse momentum imbalance at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. D*, vol. 97, no. 9, p. 092005, May 2018.

[125] A. M. Sirunyan *et al. including* S. Novaes, "Search for additional neutral MSSM Higgs bosons in the τ τ final state in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 9, p. 7, Sep. 2018.

[126] A. M. Sirunyan *et al. including* S. Novaes, "Search for high-mass resonances in dilepton final states in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 120, Jun. 2018.

[127] A. M. Sirunyan *et al. including* S. Novaes, "Evidence for associated production of a Higgs boson with a top quark pair in final states with electrons, muons,

and hadronically decaying τ leptons at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 66, Aug. 2018.

[128] A. M. Sirunyan *et al. including* S. Novaes, "Observation of proton-tagged, central (semi)exclusive production of high-mass lepton pairs in pp collisions at 13 TeV with the CMS-TOTEM precision proton spectrometer," *J. High Energ. Phys.*, vol. 2018, no. 7, p. 153, Jul. 2018.

[129] A. M. Sirunyan *et al. including* S. Novaes, "Measurements of differential cross sections of top quark pair production as a function of kinematic event variables in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 2, Jun. 2018.

[130] A. M. Sirunyan *et al. including* S. Novaes, "Search for a heavy resonance decaying into a Z boson and a vector boson in the νν¯qq¯$$ \nu \overline{\nu}\mathrm{q}\overline{\mathrm{q}} $$final state," *J. High Energ. Phys.*, vol. 2018, no. 7, p. 75, Jul. 2018.

[131] A. M. Sirunyan *et al. including* S. Novaes, "Search for third-generation scalar leptoquarks decaying to a top quark and a $$\tau $$ lepton at $$\sqrt{s}=13\,\text {Te}\text {V} $$s=13Te," *Eur. Phys. J. C*, vol. 78, no. 9, p. 707, Sep. 2018.

[132] CMS Collaboration *et al. including* S. Novaes, "Bose-Einstein correlations in $pp, p\mathrm{Pb}$, and PbPb collisions at $\sqrt{{s}_{NN}}=0.9--7$ TeV," *Phys. Rev. C*, vol. 97, no. 6, p. 064912, Jun. 2018.

[133] A. M. Sirunyan *et al. including* S. Novaes, "Performance of reconstruction and identification of τ leptons decaying to hadrons and ν τ in pp collisions at √ s =13 TeV," *J. Inst.*, vol. 13, no. 10, p. P10005, 2018.

[134] CMS Collaboration *et al.*, "Search for physics beyond the standard model in high-mass diphoton events from proton-proton collisions at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. D*, vol. 98, no. 9, p. 092001, Nov. 2018.

[135] M. Aaboud *et al. including* S. Novaes, "Combination of inclusive and differential tt¯$$ \mathrm{t}\overline{\mathrm{t}} $$charge asymmetry measurements using ATLAS and CMS data at s=7$$ \sqrt{s}=7 $$and 8 TeV," *J. High Energ. Phys.*, vol. 2018, no. 4, p. 33, Apr. 2018.

[136] CMS Collaboration *et al. including* S. Novaes, "Constraints on the chiral magnetic effect using charge-dependent azimuthal correlations in $p\mathrm{Pb}$ and PbPb collisions at the CERN Large Hadron Collider," *Phys. Rev. C*, vol. 97, no. 4, p. 044912, Apr. 2018.

[137] A. M. Sirunyan *et al. including* S. Novaes, "Precision measurement of the structure of the CMS inner tracking system using nuclear interactions," *J. Inst.*, vol. 13, no. 10, p. P10034, 2018.

[138] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of charged particle spectra in minimum-bias events from proton–proton collisions at $$\sqrt{s}=13\,\text {TeV} $$s=13TeV," *Eur. Phys. J. C*, vol. 78, no. 9, p. 697, Aug. 2018.

[139] A. M. Sirunyan *et al. including* S. Novaes, "Search for dark matter produced in association with a Higgs boson decaying to γγ or τ +τ − at s=13$$

\sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 9, p. 46, Sep. 2018.

[140] CMS Collaboration 1 *et al. including* S. Novaes, "Observation of the $Z\ensuremath{\rightarrow}\ensuremath{\psi}{\ensuremath{\ell}}^{+}{\ ensuremath{\ell}}^{\ensuremath{-}}$ Decay in pp Collisions at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 121, no. 14, p. 141801, Oct. 2018.

[141] A. M. Sirunyan *et al. including* S. Novaes, "Constraints on the double-parton scattering cross section from same-sign W boson pair production in proton-proton collisions at s=8$$ \sqrt{s}=8 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 2, p. 32, Feb. 2018.

[142] A. M. Sirunyan *et al. including* S. Novaes, "Identification of heavy-flavour jets with the CMS detector in pp collisions at 13 TeV," *J. Inst.*, vol. 13, no. 05, p. P05011, 2018.

[143] CMS Collaboration 1 *et al. including* S. Novaes, "Search for Pair-Produced Resonances Each Decaying into at Least Four Quarks in Proton-Proton Collisions at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 121, no. 14, p. 141802, Oct. 2018.

[144] CMS Collaboration *et al. including* S. Novaes, "Inclusive Search for a Highly Boosted Higgs Boson Decaying to a Bottom Quark-Antiquark Pair," *Phys. Rev. Lett.*, vol. 120, no. 7, p. 071802, Feb. 2018.

[145] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of angular parameters from the decay B0 → K∗0μ+μ− in proton–proton collisions at s=8TeV," *Physics Letters B*, vol. 781, pp. 517–541, Jun. 2018.

[146] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of associated Z + charm production in proton–proton collisions at $$\sqrt{s} = 8$$s=8$$\,\text {TeV}$$TeV," *Eur. Phys. J. C*, vol. 78, no. 4, p. 287, Apr. 2018.

[147] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of differential cross sections in the kinematic angular variable ϕ* for inclusive Z boson production in pp collisions at s=8$$ \sqrt{s}=8 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 172, Mar. 2018.

[148] CMS Collaboration *et al. including* S. Novaes, "Constraints on models of scalar and vector leptoquarks decaying to a quark and a neutrino at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. D*, vol. 98, no. 3, p. 032005, Aug. 2018.

[149] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of normalized differential $\mathrm{t}\overline{\mathrm{t}}$ $$cross sections in the dilepton channel from pp collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 4, p. 60, Apr. 2018.

[150] CMS Collaboration *et al. including* S. Novaes, "Measurement of Prompt ${D}^{0}$ Meson Azimuthal Anisotropy in Pb-Pb Collisions at $\sqrt{{s}_{NN}}=5.02\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 20, p. 202301, May 2018.

[151] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of prompt and

nonprompt charmonium suppression in $$\text {PbPb}$$PbPbcollisions at 5.02$$\,\text {Te}\text {V}$$TeV," *Eur. Phys. J. C*, vol. 78, no. 6, p. 509, Jun. 2018.

[152] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of quarkonium production cross sections in pp collisions at s=13TeV," *Physics Letters B*, vol. 780, pp. 251–272, May 2018.

[153] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the cross section for top quark pair production in association with a W or Z boson in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 11, Aug. 2018.

[154] CMS Collaboration *et al. including* S. Novaes, "Constraining Gluon Distributions in Nuclei Using Dijets in Proton-Proton and Proton-Lead Collisions at $\sqrt{{s}_{\mathrm{NN}}}=5.02\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 121, no. 6, p. 062002, Aug. 2018.

[155] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the inclusive $\mathrm{t}\overline{\mathrm{t}}$ cross section in pp collisions at s=5.02$$ \sqrt{s}=5.02 $$TeV using final states with at least one charged lepton," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 115, Mar. 2018.

[156] CMS Collaboration *et al. including* S. Novaes, "Measurement of the Splitting Function in pp and Pb-Pb Collisions at $\sqrt{{s}_{NN}}=5.02\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 14, p. 142302, Apr. 2018.

[157] A. M. Sirunyan *et al. including* S. Novaes, "Search for disappearing tracks as a signature of new long-lived particles in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 8, p. 16, Aug. 2018.

[158] A. M. Sirunyan *et al. including* S. Novaes, "Measurement of the underlying event activity in inclusive Z boson production in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 7, p. 32, Jul. 2018.

[159] CMS Collaboration *et al. including* S. Novaes, "Observation of $t\overline{t}H$ Production," *Phys. Rev. Lett.*, vol. 120, no. 23, p. 231801, Jun. 2018.

[160] A. M. Sirunyan *et al. including* S. Novaes, "Measurements of $\mathrm{t}\overline{\mathrm{t}}$ cross sections in association with b jets and inclusive jets and their ratio using dilepton final states in pp collisions at s=13TeV," *Physics Letters B*, vol. 776, pp. 355–378, Jan. 2018.

[161] A. M. Sirunyan *et al. including* S. Novaes, "Search for high-mass resonances in final states with a lepton and missing transverse momentum at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 128, Jun. 2018.

[162] A. M. Sirunyan *et al. including* S. Novaes, "Search for a heavy right-handed W boson and a heavy neutrino in events with two same-flavor leptons and two jets at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 5, p. 148, May 2018.

[163] A. M. Sirunyan *et al. including* S. Novaes, "Nuclear modification factor of D0 mesons in PbPb collisions at sNN=5.02TeV," *Physics Letters B*, vol. 782, pp. 474–496, Jul. 2018.

[164] CMS Collaboration *et al. including* S. Novaes, "Measurement of differential cross sections for the production of top quark pairs and of additional jets in $\mathrm{lepton}+\text{jets}$ events from pp collisions at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. D*, vol. 97, no. 11, p. 112003, Jun. 2018.

[165] A. M. Sirunyan *et al. including* S. Novaes, "Search for new physics in dijet angular distributions using proton–proton collisions at $$\sqrt{s}=13\hbox {TeV}$$s=13TeVand constraints on dark matter and other models," *Eur. Phys. J. C*, vol. 78, no. 9, p. 789, Sep. 2018.

[166] CMS Collaboration *et al. including* S. Novaes, "Observation of Correlated Azimuthal Anisotropy Fourier Harmonics in pp and $p+\mathrm{Pb}$ Collisions at the LHC," *Phys. Rev. Lett.*, vol. 120, no. 9, p. 092301, Feb. 2018.

[167] CMS Collaboration *et al. including* S. Novaes, "Observation of Electroweak Production of Same-Sign W Boson Pairs in the Two Jet and Two Same-Sign Lepton Final State in Proton-Proton Collisions at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 8, p. 081801, Feb. 2018.

[168] A. M. Sirunyan *et al. including* S. Novaes, "Observation of the Higgs boson decay to a pair of τ leptons with the CMS detector," *Physics Letters B*, vol. 779, pp. 283–316, Apr. 2018.

[169] CMS Collaboration *et al. including* S. Novaes, "Pseudorapidity and transverse momentum dependence of flow harmonics in $p\mathrm{Pb}$ and PbPb collisions," *Phys. Rev. C*, vol. 98, no. 4, p. 044902, Oct. 2018.

[170] A. M. Sirunyan *et al. including* S. Novaes, "Pseudorapidity distributions of charged hadrons in proton-lead collisions at sNN=5.02$$ \sqrt{s_{\mathrm{NN}}}=5.02 $$and 8.16 TeV," *J. High Energ. Phys.*, vol. 2018, no. 1, p. 45, Jan. 2018.

[171] A. M. Sirunyan *et al. including* S. Novaes, "Search for a massive resonance decaying to a pair of Higgs bosons in the four b quark final state in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 781, pp. 244–269, Jun. 2018.

[172] A. M. Sirunyan *et al. including* S. Novaes, "Search for electroweak production of charginos and neutralinos in multilepton final states in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 166, Mar. 2018.

[173] A. M. Sirunyan *et al. including* S. Novaes, "Search for heavy resonances decaying to a top quark and a bottom quark in the lepton+jets final state in proton–proton collisions at 13 TeV," *Physics Letters B*, vol. 777, pp. 39–63, Feb. 2018.

[174] A. M. Sirunyan *et al. including* S. Novaes, "Search for Higgs boson pair production in events with two bottom quarks and two tau leptons in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 778, pp. 101–127, Mar. 2018.

[175] A. M. Sirunyan *et al. including* S. Novaes, "Search for low mass vector resonances decaying into quark-antiquark pairs in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 1, p. 97, Jan. 2018.

[176] CMS Collaboration *et al. including* S. Novaes, "Search for massive resonances decaying into WW, WZ, ZZ, qW, and qZ with dijet final states at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. D*, vol. 97, no. 7, p. 072006, Apr. 2018.

[177] A. M. Sirunyan *et al. including* S. Novaes, "Search for natural supersymmetry in events with top quark pairs and photons in pp collisions at s=8$$ \sqrt{s}=8 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 167, Mar. 2018.

[178] A. M. Sirunyan *et al. including* S. Novaes, "Search for new phenomena in final states with two opposite-charge, same-flavor leptons, jets, and missing transverse momentum in pp collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 76, Mar. 2018.

[179] A. M. Sirunyan *et al. including* S. Novaes, "Search for new physics in events with a leptonically decaying Z boson and a large transverse momentum imbalance in proton–proton collisions at $$\sqrt{s} $$s= 13$$\,\text {TeV}$$TeV," *Eur. Phys. J. C*, vol. 78, no. 4, p. 291, Apr. 2018.

[180] A. M. Sirunyan *et al. including* S. Novaes, "Search for pair production of vector-like quarks in the bWb¯W channel from proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 779, pp. 82–106, Apr. 2018.

[181] A. M. Sirunyan *et al. including* S. Novaes, "Search for R-parity violating supersymmetry in pp collisions at s=13TeV using b jets in a final state with a single lepton, many jets, and high sum of large-radius jet masses," *Physics Letters B*, vol. 783, pp. 114–139, Aug. 2018.

[182] A. M. Sirunyan *et al. including* S. Novaes, "Search for single production of a vector-like T quark decaying to a Z boson and a top quark in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 781, pp. 574–600, Jun. 2018.

[183] A. M. Sirunyan *et al. including* S. Novaes, "Search for standard model production of four top quarks with same-sign and multilepton final states in proton–proton collisions at $$\sqrt{s} = 13\,\text {TeV} $$s=13TeV," *Eur. Phys. J. C*, vol. 78, no. 2, p. 140, Feb. 2018.

[184] A. M. Sirunyan *et al. including* S. Novaes, "Search for supersymmetry in events with at least three electrons or muons, jets, and missing transverse momentum in proton-proton collisions at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 2, p. 67, Feb. 2018.

[185] A. M. Sirunyan *et al. including* S. Novaes, "Search for supersymmetry in events with one lepton and multiple jets exploiting the angular correlation between the lepton and the missing transverse momentum in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 780, pp. 384–409, May 2018.

[186] CMS Collaboration *et al. including* S. Novaes, "Search for supersymmetry in proton-proton collisions at 13 TeV using identified top quarks," *Phys. Rev. D*, vol. 97, no. 1, p. 012007, Jan. 2018.

[187] A. M. Sirunyan *et al. including* S. Novaes, "Search for supersymmetry with Higgs boson to diphoton decays using the razor variables at s=13TeV," *Physics Letters B*, vol. 779, pp. 166–190, Apr. 2018.

[188] A. M. Sirunyan *et al. including* S. Novaes, "Search for the flavor-changing neutral current interactions of the top quark and the Higgs boson which decays into a pair of b quarks at s=13$$ \sqrt{s}=13 $$TeV," *J. High Energ. Phys.*, vol. 2018, no. 6, p. 102, Jun. 2018.

[189] A. M. Sirunyan *et al. including* S. Novaes, "Search for the pair production of third-generation squarks with two-body decays to a bottom or charm quark and a neutralino in proton–proton collisions at s=13TeV," *Physics Letters B*, vol. 778, pp. 263–291, Mar. 2018.

[190] CMS Collaboration *et al. including* S. Novaes, "Search for top squarks and dark matter particles in opposite-charge dilepton final states at $\sqrt{s}=13\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. D*, vol. 97, no. 3, p. 032009, Feb. 2018.

[191] A. M. Sirunyan *et al. including* S. Novaes, "Search for ZZ resonances in the 2ℓ2v final state in proton-proton collisions at 13 TeV," *J. High Energ. Phys.*, vol. 2018, no. 3, p. 3, Mar. 2018.

[192] A. M. Sirunyan *et al. including* S. Novaes, "Study of dijet events with a large rapidity gap between the two leading jets in pp collisions at $$\sqrt{s}=7$$s=7$$\,\text {TeV}$$TeV," *Eur. Phys. J. C*, vol. 78, no. 3, p. 242, Mar. 2018.

[193] A. M. Sirunyan *et al. including* S. Novaes, "Study of jet quenching with isolated-photon+jet correlations in PbPb and pp collisions at sNN=5.02 TeV," *Physics Letters B*, vol. 785, pp. 14–39, Oct. 2018.

[194] CMS Collaboration et al. including S. Novaes, "Studies of B∗s2(5840)0 and Bs1(5830)0 mesons including the observation of the B∗s2(5840)0→ B0K0S decay in proton-proton collisions at s√= 8 TeV," Eur. Phys. J., vol. C78 (2018) no.11, p. 939-976

[195] CMS Collaboration *et al. including* S. Novaes, "Suppression of Excited $\mathrm{\ensuremath{\Upsilon}}$ States Relative to the Ground State in Pb-Pb Collisions at ${\sqrt{s}}_{\mathrm{NN}}=5.02\text{ }\text{ }\mathrm{TeV}$," *Phys. Rev. Lett.*, vol. 120, no. 14, p. 142301, Apr. 2018.

[196] CMS Collaboration *et al. including* S. Novaes, "Search for a new scalar resonance decaying to a pair of Z bosons in proton-proton collisions at p s = 13 TeV", *J. High Energy Phys*., vol. 127 , no.06, p. 1-54.

[197] CMS Collaboration *et al. including* S. Novaes, "Search for resonant and nonresonant Higgs boson pair production in the bblvlv final state in proton-proton collisions at (s)1/2 = 13 TeV," *J. High Energy Phys*., vol. 01 , no.54, p. 1-42.

[198] R. C. Rodrigues and P. I. Prado, "Sampling methods affect observed response of bird species richness to vegetation structure in Brazilian savannas," *The Condor*, vol. 120, no. 2, pp. 402–413, May 2018.

[199] D. A. Camargo, Y. Mambrini, and F. S. Queiroz, "XENON1T takes a razor to a

dark E6-inspired model," *Physics Letters B*, vol. 786, pp. 337–341, Nov. 2018.

[200] M. Lindner, M. Platscher, and F. S. Queiroz, "A call for new physics: The muon anomalous magnetic moment and lepton flavor violation," *Physics Reports*, vol. 731, pp. 1–82, Feb. 2018.

[201] G. Arcadi, M. D. Campos, M. Lindner, A. Masiero, and F. S. Queiroz, "Dark sequential $Z\ensuremath{'}$ portal: Collider and direct detection experiments," *Phys. Rev. D*, vol. 97, no. 4, p. 043009, Feb. 2018.

[202] S. Profumo, F. S. Queiroz, J. Silk, and C. Siqueira, "Searching for secluded dark matter with H.E.S.S., Fermi-LAT, and Planck," *J. Cosmol. Astropart. Phys.*, vol. 2018, no. 03, p. 010, 2018.

[203] G. Arcadi *et al. including* F. S. Queiroz, "The waning of the WIMP? A review of models, searches, and constraints," *Eur. Phys. J. C*, vol. 78, no. 3, p. 203, Mar. 2018.

[204] G. Arcadi, M. Lindner, F. S. Queiroz, W. Rodejohann, and S. Vogl, "Pseudoscalar mediators: a WIMP model at the neutrino floor," *J. Cosmol. Astropart. Phys.*, vol. 2018, no. 03, p. 042, 2018.

[205] G. Arcadi, C. P. Ferreira, F. Goertz, M. M. Guzzo, F. S. Queiroz, and A. C. O. Santos, "Lepton flavor violation induced by dark matter," *Phys. Rev. D*, vol. 97, no. 7, p. 075022, Apr. 2018.

[206] M. Dutra, M. Lindner, S. Profumo, F. S. Queiroz, W. Rodejohann, and C. Siqueira, "MeV dark matter complementarity and the dark photon portal," *J. Cosmol. Astropart. Phys.*, vol. 2018, no. 03, p. 037, 2018.

[207] P. V. Dong, D. T. Huong, F. S. Queiroz, J. W. F. Valle, and C. A. Vaquera-Araujo, "The dark side of flipped trinification," *J. High Energ. Phys.*, vol. 2018, no. 4, p. 143, Apr. 2018.

[208] M. Lindner, F. S. Queiroz, W. Rodejohann, and X.-J. Xu, "Neutrino-electron scattering: general constraints on Z′ and dark photon models," *J. High Energ. Phys.*, vol. 2018, no. 5, p. 98, May 2018.

[209] G. Arcadi, T. Hugle, and F. S. Queiroz, "The dark $L_\mu - L_\tau$ rises via kinetic mixing," *Physics Letters B*, vol. 784, pp. 151–158, Sep. 2018.

[210] A. Ramires, D. F. Agterberg, and M. Sigrist, "Tailoring ${T}_{c}$ by symmetry principles: The concept of superconducting fitness," *Phys. Rev. B*, vol. 98, no. 2, p. 024501, Jul. 2018.

[211] A. Ramires and J. L. Lado, "Electrically Tunable Gauge Fields in Tiny-Angle Twisted Bilayer Graphene," *Phys. Rev. Lett.*, vol. 121, no. 14, p. 146801, Oct. 2018.

[212] R. Negrón and V. O. Rivelles, "Yang-Baxter deformations of the $AdS4 \times \mathbb{CP}3$ superstring sigma model," *J. High Energ. Phys.*, vol. 2018, no. 11, p. 43, Nov. 2018.

[213] J. Prasongkit *et al. including* A. R. Rocha, "Topological Line Defects Around Graphene Nanopores for DNA Sequencing," *J. Phys. Chem. C*, vol. 122, no. 13, pp. 7094–7099, Apr. 2018.

[214] T. P. Cysne, J. H. Garcia, A. R. Rocha, and T. G. Rappoport, "Quantum Hall effect in graphene with interface-induced spin-orbit coupling," *Phys. Rev. B*, vol. 97, no. 8, p. 085413, Feb. 2018.

[215] L. S. Pedroza, P. Brandimarte, A. R. Rocha, and M.-V. Fernández-Serra, "Bias-dependent local structure of water molecules at a metallic interface," *Chem. Sci.*, vol. 9, no. 1, pp. 62–69, Dec. 2017.

[216] C. Gong *et al.including* A. R. Rocha, "Band Structure Engineering by Alloying for Photonics," *Advanced Optical Materials*, vol. 6, no. 17, p. 1800218, Sep. 2018.

[217] F. A. L. de Souza, R. G. Amorim, J. Prasongkit, W. L. Scopel, R. H. Scheicher, and A. R. Rocha, "Topological line defects in graphene for applications in gas sensing," *Carbon*, vol. 129, pp. 803–808, Apr. 2018.

[218] J. S. Martins, R. Rosenfeld, and F. Sobreira, "Forecasts for warm dark matter from photometric galaxy surveys," *Mon Not R Astron Soc*, vol. 481, no. 1, pp. 1290–1299, Nov. 2018.

[219] LIGO Scientific Collaboration and Virgo Collaboration *et al. including* R. Sturani, "GW170817: Implications for the Stochastic Gravitational-Wave Background from Compact Binary Coalescences," *Phys. Rev. Lett.*, vol. 120, no. 9, p. 091101, Feb. 2018.

[220] B. P. Abbott *et al including* R. Sturani., "Effects of data quality vetoes on a search for compact binary coalescences in Advanced LIGO's first observing run," *Class. Quantum Grav.*, vol. 35, no. 6, p. 065010, 2018.

[221] LIGO Scientific Collaboration and Virgo Collaboration *et al. including* R. Sturani, "First Search for Nontensorial Gravitational Waves from Known Pulsars," *Phys. Rev. Lett.*, vol. 120, no. 3, p. 031104, Jan. 2018.

[222] A. Parisi and R. Sturani, "Gravitational waves from neutron star excitations in a binary inspiral," *Phys. Rev. D*, vol. 97, no. 4, p. 043015, Feb. 2018.

[223] LIGO Scientific Collaboration and Virgo Collaboration *et al. including* R. Sturani, "Search for Tensor, Vector, and Scalar Polarizations in the Stochastic Gravitational-Wave Background," *Phys. Rev. Lett.*, vol. 120, no. 20, p. 201102, May 2018.

[224] LIGO Scientific Collaboration and Virgo Collaboration *et al. including* R. Sturani, "Full band all-sky search for periodic gravitational waves in the O1 LIGO data," *Phys. Rev. D*, vol. 97, no. 10, p. 102003, May 2018.

[225] LIGO Scientific Collaboration and Virgo Collaboration *et al. including* R. Sturani, "Constraints on cosmic strings using data from the first Advanced LIGO observing run," *Phys. Rev. D*, vol. 97, no. 10, p. 102002, May 2018.

[226] B. P. Abbott *et al. including* R. Sturani, "All-sky search for long-duration gravitational wave transients in the first Advanced LIGO observing run," *Class. Quantum Grav.*, vol. 35, no. 6, p. 065009, 2018.

[227] The LIGO Scientific Collaboration and the Virgo Collaboration *et al. including* R. Sturani, "GW170817: Measurements of Neutron Star Radii and Equation of State," *Phys. Rev. Lett.*, vol. 121, no. 16, p. 161101, Oct. 2018.

[228] C. Bercini and D. Trancanelli, "Supersymmetric integrable theories without particle production," *Phys. Rev. D*, vol. 97, no. 10, p. 105013, May 2018.

[229] The LIGO Scientific Collaboration *et al. including* M. Lima and R. Sturani,"Multi-messenger Observations of a Binary Neutron Star Merger," Astrophys. J. Lett., vol. 848, no L12, p. 1-59

[230] T. Bargheer, J. Caetano, T. Fleury, S. Komatsu, P. Vieira, "Handling handles. Part II. Stratification and data Analysis," *JHEP, vol. 11, no 95*, Nov. 2018.

8a2. Articles by ICTP-SAIFR Postdoctoral Associates

[231] C. Echeverria, J. L. Herrera, O. Alvarez-Llamoza, M. Morales, and K. Tucci, "Damping and clustering into crowded environment of catalytic chemical oscillators," *Physica A: Statistical Mechanics and its Applications*, Nov. 2018.

[232] J. M. Buldú *et al.including* J. L. Herrera, "Using Network Science to Analyse Football Passing Networks: Dynamics, Space, Time, and the Multilayer Nature of the Game," *Front. Psychol.*, vol. 9, 2018.

[233] B. Jain, S. J. Lee, and M. Son, "Validity of the effective potential and the precision of Higgs field self-couplings," *Phys. Rev. D*, vol. 98, no. 7, p. 075002, Oct. 2018.

[234] A. S. Belyaev, T. Flacke, B. Jain, and P. B. Schaefers, "LHC dark matter signals from vector resonances and top partners," *Phys. Rev. D*, vol. 98, no. 3, p. 035019, Aug. 2018.

[235] E. V. Karukes and P. Salucci, "The universal rotation curve of dwarf disc galaxies," *Mon Not R Astron Soc*, vol. 465, no. 4, pp. 4703–4722, Mar. 2017.

[236] V. Gammaldi, E. Karukes, and P. Salucci, "Theoretical predictions for dark matter detection in dwarf irregular galaxies with gamma rays," *Phys. Rev. D*, vol. 98, no. 8, p. 083008, Oct. 2018.

[237] L. Guerini and M. Terra Cunha, "Uniqueness of the joint measurement and the structure of the set of compatible quantum measurements," *Journal of Mathematical Physics*, vol. 59, no. 4, p. 042106, Apr. 2018.

8. First page of publications

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

9. Scientific reports of postdocs

See annexed file for scientific reports of

Jose Luis Herrera Diestra, Andrea Guerrieri, Leonardo Guerini, Bithika Jain, Ekaterina Karukes, Antonino Troja

10. Scientific reports of TT1 and JC-2

See annexed file for scientific reports of Ivan Nery Cardoso, Malena Stariolo, Jaqueline Venturim and Isabela Pereira

11. Scientific reports of visiting fellows

See annexed file for scientific reports of Leandro Aolita, Rafael Porto, Farinaldo Queiroz and Riccardo Sturani