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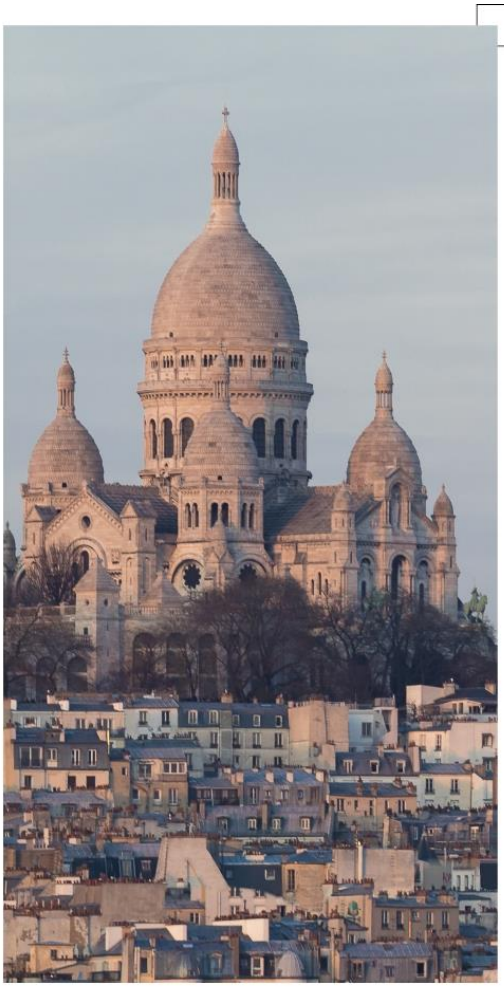
INSTITUTO DE MATEMÁTICA PURA E APLICADA

1ST JOINT MEETING BRAZIL-FRANCE IN MATHEMATICS

IMPA, Rio de Janeiro, July 15 – 19, 2019



Plenary Talks

Artur Avila, IMPA / Universität Zürich
Serge Cantat, Université Rennes 1
Hugo Duminil-Copin, IHES
Olivier Mathieu, Université de Lyon
Gregory Miermont, ENS-Lyon
Benoît Perthame, Université Paris 6
Ivan Shestakov, Universidade de São Paulo
Antoine Song, Princeton University
Augusto Teixeira, IMPA
Maria Eulalia Vares, Universidade Federal do Rio de Janeiro

Lectures Series

Etienne Ghys, ENS-Lyon

Special Sessions

There will be 25 sessions; programs can be consulted at: http://bit.ly/br-fr_specialsessions

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organizing

SBM Sociedade Brasileira de Matemática
SBMAC Sociedade Brasileira de Matemática Aplicada e Computacional
SMAI
Société Mathématique de France SMF

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1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

Program

Time	Monday, 15	Tuesday, 16	Wednesday, 17	Thursday, 18	Friday, 19
08:00 - 09:30	Registration				
09:30 - 10:30	**Lectures Series - Geometry from A to... B** by **Etienne Ghys** (ENS-Lyon) *5 of my favorite geometry papers*				
	1- Monge and optimal transport (1776)	*2- Gauss and cartography (1825)*	*3- Hadamard and geodesics of negatively curved surfaces (1898)*	*4- Poincaré and geodesics of positively curves surfaces (1905)*	*5- Birkhoff and the ergodic theorem (1931)*
10:30 - 11:00	**Coffee Break**				
11:00 - 12:00	**Augusto Teixeira** (IMPA) *Random walk on the simple symmetric exclusion process*	**Hugo Duminil-Copin** (IHES) *A New Link Between Bernoulli Percolation and the Gaussian Free Field*	**Antoine Song** (Princeton University) *Abundance of minimal hypersurfaces in closed manifolds*	**Jorge Vitório Pereira** (IMPA) *Codimension one foliations on projective manifolds*	**Maria Eulalia Vares** (UFRJ) *Metastability for stochastic dynamics: a quick review and some new results*
12:00 - 13:00	**Artur Avila** (IMPA / Universität Zürich) *Renormalization of one-frequency cocycles with values on compact Lie groups*	**Serge Cantat** (U Rennes 1) *The geometric Bogomolov conjecture*	**Gregory Miermont** (ENS- Lyon) *Brownian surfaces*	**Benoît Perthame** (U Paris 6) *Some Equations of Mathematical Biology*	**Olivier Mathieu** (U Lyon) *Self Similarity of groups*
13:00 - 14:30	**Lunch**				
14:30 - 16:30	***14:30 - 15:20*** ***Special Sessions*** 11, 13, 20, 21, 24, 25 ***15:30 - 16:30*** **João Candido Portinari** (PUC-Rio) *"The Portinari Project: Science and Art Team Up Together to Help Cultural Projects"*	***Special Sessions*** 2, 5, 7, 13, 14, 16, 17, 19, 21, 22, 23, 24	***Special Sessions*** 2, 4, 5, 7, 13, 14, 16, 17, 19, 21, 22, 23	***Special Sessions*** 1, 3, 4, 6, 8, 9,10, 11, 12, 15, 18, 20, 25	***Special Sessions*** 1, 3, 6, 8, 9,10, 11, 12, 15, 18, 20, 24, 25
16:30 - 16:45	**Coffee**				
16:45 - 18:45	**17:00 - 18:00** **Opening**	***Special Sessions*** 2, 5, 7, 13, 14, 16, 17, 19, 21, 22, 23, 24	***Special Sessions*** 2, 4, 5, 7, 13, 14, 16, 17, 19, 21, 22, 23	***Special Sessions*** 1, 3, 4, 6, 8, 9,10, 11, 12, 15, 18, 20, 25	***Special Sessions*** 1, 3, 6, 8, 9,10, 11, 12, 15, 18, 20, 24, 25
18:00 - 20:00	**Cocktail**				

Book of abstracts

Plenary Talks

Renormalization of one-frequency cocycles with values on compact Lie groups
Artur Avila (IMPA / Universität Zürich – Dynamical Systems)

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The geometric Bogomolov conjecture
La conjecture de Bogomolov géométrique

Serge Cantat[1]

[1] U Rennes 1

The Bogomolov conjecture concerns Diophantine geometry on a specific type of algebraic varieties, namely abelian varieties. I will explain how its geometric version is related to foliations, monodromy, and dynamical systems.

La conjecture de Bogomolov concerne la géométrie diophantienne sur un type particulier de variétés algébriques : les variétés abéliennes. J'expliquerai comment sa version géométrique fait apparaitre feuilletages, monodromies et systèmes dynamiques.

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A New Link Between Bernoulli Percolation and the Gaussian Free Field

Hugo Duminil-Copin[1]

[1] IHES, Phase Transitions

Percolation is a probabilistic model defined on infinite graphs that describes the inside of a porous material. The model emerged timidly in the middle of the twentieth century before becoming one of the major examples of a statistical physics model undergoing a phase transition. In this talk, we will explore some of the techniques enabling one to prove the existence of such a phase transition. In particular, we will discuss the connection between the existence of a phase transition and the geometry of the graph (for instance the isoperimetric dimension). To illustrate this last claim, we will explain how one can prove that Bernoulli percolation on super-linear growth Cayley graphs undergoes a non-trivial phase transition by exhibiting a new link between Bernoulli percolation and another classical model of statistical physics called the Gaussian Free Field (GFF). The talk requires no prior knowledge of probability theory.

Metastability for stochastic dynamics: a quick review and some new results

Maria Eulália Vares

Universidade Federal do Rio de Janeiro

Abstract:
As an interesting and rather common phenomenon in nature, metastability has been studied from multiple viewpoints, with different goals and big variety of tools. Its modeling has been object of many mathematical studies. In this lecture, I plan to start by revisiting some aspects of the metastable behavior in the frame of stochastic dynamics, hoping to discuss some of the basic motivations and to quickly review some of known mathematical results, through a class of concrete (somehow generic) examples. Finally, I should focus on more recent results applicable to the stochastic Ising model in the two-dimensional lattice, obtained in collaboration with Alexandre Gaudillière and Paolo Milanesi, both from Université Aix-Marseille.

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Self Similarity of groups
Olivier Mathieu (U Lyon – Representation Theory & Lie Algebras)

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Brownian Surfaces

Grégory Miermont[1], Jérémie Bettinelli[2]

[1] ÉNS de Lyon

[2] École Polytechnique

We show that large uniform random quadrangulations of a given compact orientable surface S, possibly with boundaries, converges in the appropriate scaling limit to a "canonical" random metric space that we call the *Brownian surface* with topology given by S. We will see that this random space is indeed a.s. homeomorphic to S, although it bears fractal properties, and we will explain in which sense we can view this random space as canonical.

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Codimension one foliations on projective manifolds

Jorge Vitório Pereira[1]

[1] IMPA

Review of old and new results on the global structure of singular holomorphic foliations on projective manifolds and their moduli spaces. A substantial portion of the theory under review is the fruit of French-Brazilian collaborations.

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Some Equations of Mathematical Biology

Benoît Perthame[1]

[1] Laboratoire J.-L. Lions, Sorbonne-Université

CNRS/UPD/INRIA

Equations of mathematical physics are numerous and define many basic principles of physics. The most famous being the Fundamental Principle of Dynamics described by the Newton equations. The Maxwell, Boltzmann or Schroedinger equations illustrate the fundamental principles of electromagnetism, rarefied flows, quantum world.

Through some equations, we are going to ilustrate several topics from biology: ecology, neuroscience, cell movement, dynamics of tissue growth

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Abundance of minimal hypersurfaces in closed manifolds

Antoine Song[1]

[1] Princeton University

Minimal surfaces, which are critical points of the area functional, are in general hard to construct. Recently, questions about their existence in closed Riemannian manifolds enjoyed important developments thanks to the work of F. C. Marques and A. Neves, and others. I will introduce some ideas behind the variational theory for minimal surfaces, and survey results revolving around a conjecture of S.-T. Yau which predicted the existence of infinitely many minimal surfaces in any closed 3-manifold.

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Random walk on the simple symmetric exclusion process

Augusto Teixeira[1]

[1] IMPA

In this talk we will discuss some of the history of random walks on dynamical random environments and we will present a recent result where the environment is given by a simple symmetric exclusion process. For this model, we are able to prove a law of large numbers for the displacement of the walk (for all but two densities of the underlying particle system) as well as a central limit theorem throughout its ballistic regimes. The main technique that we employ is a renormalization scheme that brings its inspiration from percolation theory.

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Lectures Series

Five of my favorite geometry papers
Geometry from A to... B !

Étienne Ghys[1]

[1] ENS-Lyon

These talks are not intended to geometers. There will be no attempt to provide any global view of geometry today. My intention is to present five old papers which have been influential in the later development of geometry. In each case, I'll try to focus on the motivations of these pioneers which are almost always related to applied mathematics : a reminder for contemporary geometers? In each case, I'll try to mention a few forgotten problems which might be relevant today. These five talks will be completely independent and hopefully elementary.

1- Monge and optimal transport (1776)
2- Gauss and cartography (1825)
3- Hadamard and geodesics of negatively curved surfaces (1898)
4- Poincaré and geodesics of positively curves surfaces (1905)
5- Birkhoff and the ergodic theorem (1931)

Special Lecture

The Portinari Project: Science and Art Team Up Together to Help Cultural Projects

Joao Candido Portinari[1]

[1] Pontifícia Universidade Católica do Rio de Janeiro

Candido Portinari (1903-1962) is the most famous Brazilian painter, whose production of more than 5,400 works is spread all over the world. The son of poor italian immigrants, he was born in a coffee plantation, near the small village of Brodowski, in the inlands of the State of São Paulo. He lived in a period of time which was very significant in the development of modern Brazilian culture. His work and interaction with other artists, poets, writers, architects, journalists, educators and politicians reflect the essence of the aesthetical, artistic, cultural, social and political concerns of 20th-century Brazil.

The Portinari Project - PP is a 40-year effort, always busy assembling the far-flung pieces of Portinari's oeuvre, life and times, to make it by all possible means accessible to researchers, students, and the public at large. In this process the Portinari Project published the first Catalogue *Raisonné* of the complete works of a latin american painter, and undertook the "War and Peace Project", in which the monumental "War and Peace" murals that stand at the entrance hall of the delegates to the General-Assembly room at the United Nations headquarters in New York, were brought to Brazil to be restored and shown in Brazil and at the *Salon d'Honneur of the Grand Palais*, in Paris, among many other achievements.

The 'War and Peace Project' is summarized in:
https://vimeo.com/142678776

The PP was born in the Mathematics Department at the Pontifical Catholic University of Rio de Janeiro, and throughout its development always maintained strong ties to the work of colleagues endeavoring scientific and technological activities. The most recent paper along these venues was submitted by Prof Nivio Ziviani, of the Computer Science Dept. of the Federal University of Minas Gerais, to **SPIRE 2019**, the 26th International Symposium on String Processing and Information Retrieval, with the title *Improving the Search for Painting Artworks with Tags Extracted from Diachronic Descriptions*. Its most recent development is its partnership with the Google Arts & Culture Program, as can be seen in:

https://artsandculture.google.com/project/portinari?hl=eng and in:

http://tiny.cc/ne888y

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Special Sessions

1 – Algebraic Representation Theory and Applications (ART) – *Auditorium 1*

1st Joint Meeting Brazil-France in Mathematics
IMPA, Rio de Janeiro, July 15 – 19, 2019

1 – Algebraic Representation Theory and Applications (ART) - Auditorium 1

Time	Thursday, 18	Friday, 19
14:30 - 15:10	**Reimundo Heluani** (IMPA) *The first chiral homology group*	**Marc Rosso** (Université Paris Diderot) *Quantum shuffles at roots of unity*
15:10 - 15:50	**Anne-Marie Aubert** (Institut de Mathématiques de Jussieu-Paris Rive Gauche) *Representations of Hecke algebras and enhanced Langlands parameters for p-adic reductive groups*	**Adriano Moura** (Universidade Estadual de Campinas) *Towards the Classification of Prime Simple Modules for Quantum Affine Algebras*
15:50 - 16:30	**Bertrand Remy** (Centre de Mathématiques Laurent Schwartz) *Topological generation of simple non-archimedean groups*	**Eric Ragoucy** (Annecy Laboratory for Theoretical Physics) *On elliptic deformation of W_N algebras*
16:30 - 17:00	Coffee	
17:00 - 17:40	**Phillipe Gille** (CNRS, Institut Camille Jordan) *On the Kaplansky construction for composition of quadratic forms*	**Abdenacer Makhlouf** (University of Haute Alsace) *Representations of n-Lie algebras and twisted algebraic structures*
17:40 - 18:20	**Jethro van Ekeren** (Universidade Federal Fluminense) *Orbifolds and the Very Strange Formula*	**Luis Enrique Ramirez** (Universidade Federal do ABC) *Explicit construction of Gelfand-Tsetlin gl(n)-modules*

The first chiral homology group

Reimundo Heluani [1],

[1] IMPA

Let V be a vertex algebra, M its irreducible module and E a self extension of M. We construct flat sections of the dual of the bundle of first chiral homology groups on the moduli space of elliptic curves associated to this datum. Joint work with Jethro van Ekeren.

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Representations of Hecke algebras and enhanced Langlands parameters for p-adic reductive groups

Anne-Marie Aubert [1], Ahmed Moussaoui[2], Maarten Solleveld[3]

[1] Institut de Mathématiques de Jussieu-Paris Rive Gauche, C.N.R.S, Sorbonne Université, Université de Paris

[2] Laboratoire de Mathématiques de Versailles, Université de Versailles Saint-Quentin-en-Yvelines

[3] Institute for Mathematics, Astrophysics and Particle Physics, Radboud Universiteit Nijmegen

The goal of the talk is to describe the parametrization in [3] of the enhanced Langlands parameters (ϕ, ρ) for the group G of F-points of a connected reductive group over a non-archimedean local fiel F by simple modules of generalized affine Hecke algebras. Here ϕ is an admissible morphism from the absolute Weil-Deligne of F to the L-group of G and ρ an irreducible representation of a certain finite group attached to ϕ. The parametrization relies on the notion of cuspidal support from [1] and uses as a crucial intermediate step the development of the representation theory of generalized graded Hecke algebras done in [2].

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Topological generation of simple non-archimedean groups

Bertrand Rémy [1]

[1] Centre de Mathématiques Laurent Schwartz, UMR 7640, CNRS-École polytechnique, France

We will deal with the problem of counting the minimal number of topological generators for simple algebraic groups over local fields. We have almost complete answers in the split case. The proofs make use of notions from profinite groups and the Bruhat-Tits theory of reductive groups over local fields, and uses arguments from finite simple group theory. This is joint work with Inna Capdeboscq (Warwick University).

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On the Kaplansky construction for composition of quadratic forms

Philippe GILLE

[1] CNRS, Institut Camille Jordan, Université Claude Bernard (Lyon 1)

This is a report on joint work in progress with Erhard Neher (University of Ottawa). The classical Kaplansky construction works over fields and associates a composition algebra with a composition of quadratic forms. We shall explain how this construction extends to the setting of rings and relate it to torsors.

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Orbifolds and the Very Strange Formula

Jethro van Ekeren [1]

[1] Universidade Federal Fluminense

A vertex algebra is called holomorphic if has no irreducible modules other than itself. It is well known that the rank of such a vertex algebra can only be a multiple of 8, and that there is one example of rank 8 (related to the E_8 lattice) and two examples of rank 16. It has essentially been proved that there are 71 examples of rank 24, but the proof of this classification result is heavily computational and is spread across many articles written over a period of decades. In this talk I will describe work in which we find a surprisingly simple proof that the 71 holomorphic vertex algebras of rank 24 may be obtained uniformly as orbifolds of the Leech lattice. (Joint work with Ching-Hung Lam, Sven Moeller, and Hiroki Shimakura.)

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Quantum shuffles at roots of unity

Marc Rosso [1],

[1] Université Paris Diderot

We consider quantum groups at a root of unity, in the Lusztig's finite dimensional version, from the quantum shuffle algebra approach. This provides a construction of irreducible finite dimensional modules, and an another way to look at the quantum Frobenius in characteristic zero.

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Towards the Classification of Prime Simple Modules for Quantum Affine Algebras

Adriano Moura, Clayton Silva

Universidade Estadual de Campinas

It is well-known that the tensor products of two simple finite-dimensional representations for the quantum affine algebras are almost always irreducible. Thus, it is natural to to seek for the classification of the simple prime modules, i.e., those which cannot be expressed as a non trivial tensor product of other simple modules. The classification is known only in the case the underlying simple Lie algebra is of rank one. In higher rank, only a few families of prime modules are known, such as the minimal affinizations (including the Kirillov-Reshetikhin modules), the minimal affinizations by parts, the prime snake modules introduced by Mukhin and Young, and a list of primes in type A_2 described by Chari and Pressley.

One important development in the area was the discovery by Hernandez and Leclerc that certain small subcategories of that of finite-dimensional representations provide a monoidal categorification of certain cluster algebras and the prime modules correspond to the cluster variables.

In this talk, based on an ongoing joint work with Clayton Silva, I will report on our progress towards the classification of simple prime modules.

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On elliptic deformation of W_N algebras

E. Ragoucy [1], J. Avan[2], L. Frappat[1]

[1] LAPTh (Annecy Laboratory for Theoretical Physics), CNRS-USMB, 74000 Annecy, France

[2] LPTM, University of Cergy-Pontoise

We revisit the construction of deformed Virasoro algebras from elliptic quantum algebras of vertex type, generalizing the bilinear trace procedure proposed in the 90's. It allows us to make contact with the vertex operator techniques that were introduced separately at the same period by Jimbo et al. The case of dynamical elliptic quantum algebras is also studied.

Then, we extend our method to q-deformations of quantum W_N algebras with elliptic structure functions. Their generators of spin k+1 are built from $2k$ products of the Lax matrix generators of $A_{q,p}(gl(N)_c)$). The closure of the algebras is insured by a critical surface condition relating the parameters p, q and the central charge c. Further abelianity conditions are determined, either as $c = -N$ or as a second condition on p, q, c. When abelianity is achieved, a Poisson bracket can be defined, that we determine explicitly. One connects these structures with previously built classical q-deformed W_N algebras and quantum $W_{q,p}(sl_N)$.

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Representations of n-Lie algebras and twisted algebraic structures

Abdenacer Makhlouf [1],

[1] University of Haute Alsace, Mulhouse, France

The notion of n-Lie algebra was introduced by Filippov in [2]. Ternary Lie algebras are related to Nambu mechanics [6], generalizing Hamiltonian mechanics by using more than one hamiltonian. The algebraic formulation of this theory is due to Takhtajan [7]. Moreover, 3-Lie algebras appeared in String Theory, Fuzzy sphere (noncommutative space)and in the context of Bagger-Lambert-Gustavsson model of multiple M2-branes.

In this talk, we discuss a new approach to representation theory of 3-Lie algebras. We define generalized representations of a 3-Lie algebra $\mathfrak{g}$ on a vector space V via canonical structures in the differential graded Lie algebra associated to $\mathfrak{g} \oplus V$. We show that they lead also to a new 3-Lie algebra, which we call a generalized semidirect product. We also develop the corresponding cohomology theory. As application, we study abelian extensions of 3-Lie algebras and provide several examples. If time allows, we will also discuss twisted n-Lie algebras and their representations.

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Explicit construction of Gelfand-Tsetlin $\mathfrak{gl}(n)$-modules

Luis Enrique Ramirez [1], V. Futorny[2], J. Zhang[3]

[1] Universidade Federal do ABC

[2] Universidade de São Paulo

[3] Universidade de São Paulo

The main idea of the talk is to describe a effective method of constructing explicitly Gelfand -Tsetlin modules for $\mathfrak{gl}_n$ (relation modules). We obtain a large family of simple modules that have a basis consisting of Gelfand-Tsetlin tableaux, the action of the Lie algebra is given by the Gelfand-Tsetlin formulas.

1st Joint Meeting Brazil-France in Mathematics

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2 – Combinatoire, Théorie des Nombres et Systèmes Dynamiques - Auditorium 1

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:10	**Fabio Brochero** (UFMG) *Problemas de Suma Zero*	**Davi Lima** (UFAL) *On the Topology of Classical and Dynamical Markov and Lagrange Spectra*
15:10 - 15:50	**Lucas Reis** (USP) *On the dynamics of the α-map over residually finite Dedekind Domains*	**André Contiero** (UFMG) *On Totients*
15:50 - 16:30	**Martine Queffélec** (Université de Lille) *Singular functions arising from numerations*	**Sávio Ribas** (UFOP) *On extremal product-one free sequences over nonabelian groups and weighted Davenport constants*
16:30 - 16:45	Coffee	
16:45 - 17:25	**Aihua Fan** (Université de Picardie & Central China Normal University) *Bohr chaoticity of topological dynamical systems*	**Ana Paula Chaves** (UFG) *On Mahler's U_m-numbers*
17:25 - 18:05	**Marco Aymone** (UFMG) *The Erdös discrepancy problem for multiplicative functions supported on the squarefree integers*	**Ramon Nunes** (UFC) *Reciprocity formulae via integral representations*
18:05 - 18:45	**Oleksiy Klurman** (Royal Institute of Technology) *The Erdös discrepancy problem over the function fields*	**Olivier Ramaré** (CNRS & Aix Marseille Université) *Products of primes in arithmetic progressions and similar questions*

PROBLEMAS DE SUMA ZERO

F. E. BROCHERO MARTÍNEZ AND SÁVIO RIBAS

Em 1961,Erdös Ginzburg e Ziv provaram que dados $2n-1$ inteiros, é possível escolher n tal que sua soma seja divisível por n. É fácil ver que este número $2n-1$ é mínimo com esta propriedade. Em geral dado um grupo abeliano $(G,+)$, a constante de Erdös Ginzburg e Ziv (EGZ) é definida com o mínimo k tal que qualquer sequencia de elementos de G com k elementos, é possível escolher $\exp(G)$ elementos com "soma" zero. Em particular temos que $EGZ(\mathbb{Z}_n) = 2n-1$. Esta mesma constante pode ser também definida para grupos não abelianos. Outro exemplo de problema de soma zero é a constante de Davenport, onde a diferencia com a constante é que não é fixado o tamanho do conjunto com soma zero.

Em 2007, Reiher [2] provou que $EGZ(\mathbb{Z}_n^2) = 4n-3$. É problema aberto que determinar a constante EGZ para $\mathbb{Z}_n^d$ para $d \geq 3$, mas conjectura-se que $EGZ(Z_n^3) = \begin{cases} 9n-8 & \text{se } n \text{ é ímpar} \\ 8n-7 & \text{se } n \text{ é par} \end{cases}$

Neste trabalho, seguindo as mesma tecnicas de Alon e Dubiner [1], mas aprimorando as constantes, provamos que $EGZ(\mathbb{Z}_p^3) < 870p$.

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On the dynamics of the a-map over residually finite Dedekind Domains

Lucas Reis [1], Claudio Qureshi[2]

[1] USP

[2] Universidad de la Republica

Let $\mathcal{D}$ be a residually finite Dedekind Domain, $a \in \mathcal{D}$ and $\mathfrak{n}$ a nonzero ideal of $\mathcal{D}$. In this talk, we discuss the dynamics of the a-map

$$\Gamma_a : x \mapsto a \cdot x \pmod{\mathfrak{n}}$$

over the quotient ring $\mathcal{D}/\mathfrak{n}$. We focus on the proof of the main result in [1], that provides the complete description of the so called *functional graph* associated to Γ_a over $\mathcal{D}/\mathfrak{n}$. If time permits, we present a nice application.

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Singular functions arising from numerations

Martine Queffélec

University of LILLE– France

Numerations provide a mean of representing numbers by finite or infinite words. Singular functions (with derivative vanishing almost everywhere) arise naturally by exchanging two different numerations, the most famous such example given by the Cantor-Lebesgue function. Not surprisingly, differentiability at some x and diophantine approximation or normality of x appear to be closely related. We focus on the Minkowski question mark function ?, strictly increasing however still singular, and present recent results and open questions, with the goal to highlight some aspects in dynamical systems, combinatorics, number theory and fractal harmonic analysis.

Bohr chaoticity of topological dynamical systems

Aihua FAN [1]

[1] Université de Picardie/Central China Normal University

We introduce the notion of Bohr chaoticity [2], which is a topological invariant, and is opposite to the property required by Sarnak's conjecture. Such a system is by definition never orthogonal to any non-trivial weight and it must be of positive entropy. But having positive entropy is not sufficient to ensure the Bohr chaoticity [1]. Using Riesz products we prove the Bohr chaoticity for the following systems when they have positive entropy: endomorphisms on tori, subshifts of finite type, β-shifts, principal algebraic $\mathbb{Z}^d$-actions on the torus [2, 3]. These are joint works with Shilei FAN, Wexiao SHEN, Klaus SCHMIDT, Evgeny VERBITSKIY.

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The Erdős discrepancy problem for multiplicative functions supported on the squarefree integers

Marco Aymone [1]

[1] UFMG

Let f be an arithmetic function assuming only ± 1 values. For non-negative integers d and x, let $S(x;d) = |f(d) + f(2d) + \cdots + f(xd)|$. A question of Erdős, known as the Erdős discrepancy problem, asks if the sup of $S(x;d)$ over all x and d is infinite. This has became a Theorem by T. Tao in 2015. As a consequence, if f is a completely multiplicative function assuming only ± 1 values, then f has unbounded partial sums. In this talk I will consider similar questions for multiplicative functions supported on the squarefree integers.

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The Erdős discrepancy problem over the function fields

Oleksiy Klurman [1]

[1] KTH (Royal Institute of Technology, Stockholm)

The famous Erdős discrepancy problem (now theorem due to Tao) asserts that for any sequence $\{a_n\}_{n\geq 1} = \{-1, 1\}^{\mathbb{N}}$,

$$\sup_{n,d} |\sum_{k=1}^{n} a_{kd}| = \infty.$$

It was observed during the Polymath5 project (run by Gowers), that the analog of this statement over the polynomial ring $\mathbb{F}_q$ is false. In this talk, we discuss "corrected" form of EDP over $\mathbb{F}_q[x]$ explaining some features that are not present in the number field setting. The talk is based on work in progress which is joint with A. Mangerel (CRM) and J. Teravainen (Oxford).

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ON THE TOPOLOGY OF CLASSICAL AND DYNAMICAL MARKOV AND LAGRANGE SPECTRA

DAVI LIMA - UNIVERSIDADE FEDERAL DE ALAGOAS

The classical Lagrange and Markov spectra are closed subsets of the real line consisting of the best constants of Diophantine approximations of certain irrational numbers and indefinite binary quadratic forms. The Lagrange and Markov dynamical spectra, was introduced by Moreira and share several geometric and topological aspects with the classical ones.

In this talk, we will present recent results on the topological structure of both spectra in the classical and dynamical forms. In particular, we will give some evidence that the set $M \setminus L$ is not closed, see [1]. This is a joint work with **C. Matheus, C. G. Moreira and S. Vieira.**

Finally, we will present Phase Transition theorems for the Markov and Lagrange dynamical spectra which allows us to conjecture a strong statement for the classical spectra, see [2]. This was obtained in a collaboration with **C. G. Moreira.**

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On totients

André Contiero [1] and Davi Lima[2]

[1] UFMG - Brasil

[2] UFAL - Brasil

abstract: Given a positive integer k, the distribution of totients in residue class 2^k mod 2^{k+1} will be discussed. While is completely easy to determine the asymptotic behaviour of the magnitude of totients 2 module 4, that is half of the number of prime numbers, the cases $k > 1$ are far from being easy. For this cases will be provided conditional results on the multiplicities of such totients, and also some natural questions that we are unable to answer yet. This is a working in progress joint with Davi Lima (UFAL).

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On extremal product-one free sequences over non-abelian groups and weighted Davenport constants

Sávio Ribas[1], F.E. Brochero Martínez[2]

[1] Universidade Federal de Ouro Preto

[2] Universidade Federal de Minas Gerais

Let G be a multiplicative finite group. The *small Davenport constant* of G is the smallest $\mathsf{d}(G) \in \mathbb{Z}_+^*$ such that every sequence over G with $\mathsf{d}(G)$ elements has a non-empty subsequence whose product, in some order, is 1. If G is abelian and $A \subset \mathbb{Z}$, the *A-weighted Davenport constant* of G is the smallest $\mathsf{D}_A(G) \in \mathbb{Z}_+^*$ such that every sequence $(x_1, \ldots, x_{\mathsf{D}_A(G)})$ over G has a non-empty subsequence $(x_{j_i})_i$ such that $\prod_{i=1}^{t} x_{j_i}^{\varepsilon_i} = 1$ for some $\varepsilon_i \in A$. Bass [1] and Zhuang & Gao [5] found $\mathsf{d}(G)$ for some types of (non-abelian) metacyclic groups G. For these groups, the authors [2, 3, 4] characterized explicitly the sequences of length $\mathsf{d}(G)-1$ which are free of product-1 subsequences. During the talk, we will present the main ideas for these characterizations and the relations with some weighted problems.

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On Mahler's U_m-numbers

Ana Paula Chaves [1], Diego Marques[2]

[1] Universidade Federal de Goiás

[2] Universidade de Brasília

The genesis of transcendental number theory, took place in 1844 with Liouville's result on the "bad" approximation of algebraic numbers by rationals. More precisely, if α is an algebraic number of degree $n > 1$, then there exists a positive constant C, such that $|\alpha - p/q| > Cq^{-n}$, for all $p/q \in \mathbb{Q}^*$. Using this remarkable fact, he was able to build a non-enumerable set of transcendental numbers called *Liouville numbers*. Since then, several classifications of transcendental numbers have been developed, one of them proposed by Kurt Mahler in 1932. He splited the set of transcendental numbers on three disjoint sets:$S-$,$T-$ and $U-$numbers. In a certain sense, $U-$numbers generalize the concept of Liouville numbers. Yet, the set of $U-$numbers can be splited into U_m-numbers, that are numbers "rapidly" approximable by algebraic numbers of degree m.

On this series of lectures, the following result, made in cooperation with D. Marques, will be proved:

Theorem: Let $\vartheta : \mathbb{N} \to \mathbb{N}$, such that $\omega_n := \vartheta(n+1)/\vartheta(n) \to \infty$, as $n \to \infty$. Let $\xi \in \mathbb{R}$, such that there exists an infinite sequence of rational numbers $(p_n/q_n)_n$, satisfying

$$\left|\xi - \frac{p_n}{q_n}\right| < H\left(\frac{p_n}{q_n}\right)^{-\vartheta(n)},$$

where $H(p_{n+1}/q_{n+1}) \leq H(p_n/q_n)^{O(\vartheta(n))}$.

Now, take $\alpha_0, \ldots, \alpha_l, \beta_0, \ldots, \beta_r \in \overline{\mathbb{Q}}$, with $\beta_r = 1$ and $\alpha_l \neq 0$, such that $[\mathbb{Q}(\alpha_0, \ldots, \alpha_l, \beta_0, \ldots, \beta_r) : \mathbb{Q}] = m$. Then, for $P(z), Q(z) \in \overline{\mathbb{Q}}[z]$, given by $P(z) = \alpha_0 + \alpha_1 z + \cdots + \alpha_l z^l$ and $Q(z) = \beta_0 + \beta_1 z + \cdots + \beta_r z^r$, $P(\xi)/Q(\xi)$ is a U_m-number.

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Reciprocity formulae via integral representations

Ramon M. Nunes [1]

[1] Universidade Federal do Ceará

In the past few years, some attention has been given to reciprocity formulae. There are two main reasons that help understand this recent interest. The main one is that they give a somewhat conceptual way of summarizing a technique often used in dealing with problems on families of GL2 L-functions in which one uses the Kuznetsov formula on both directions in order to estimate a moment of these L-functions. The second comes from their satisfying intrisical nature relating object that have no a priori reason to be linked. The first versions of these formulae used Classical techniques such as the Voronoi summation formula and the Kuznetsov formula. Starting from work of Zacharias, it became clear that an adelic and representation-theoretic approach could be of interest. Not only this has the advantage of getting the generalization to number fields almost immediate, it can also avoid some of the combinatorial difficulties appearing when applying the Voronoi formula.

In this lecture we discuss a version of a reciprocity formula by Blomer and Khan that is valid on general number fields using the language of automorphic representations. We will sketch our method and will describe as much as possible, the analogies between the two approaches.

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Products of primes in arithmetic progressions and similar questions

Olivier Ramaré [1],

[1] CNRS / Institut de Mathématiques de Marseille, Aix Marseille Université

We present the problem of finding products of three primes in some very large arithmetic progression as well as the results we have obtained so far with Aled Walker, Priyamvads Srivastav and R. Balasubramanian. We shall also present an extension to number fields and ray class-groups.

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

3 – Commutative Algebra, Number Theory and Algebraic Geometry - Auditorium 3

Time	Thursday, 18	Friday, 19
14:30 - 15:20	**Marc Chardin** (Sorbonne Université) *The (ir)regularity of Tor and Ext*	**Fabien Pazuki** (University of Copenhagen) *Regulators of number fields and elliptic curves*
15:30 - 16:20	**Alessandro Chiodo** (Sorbonne Université) *Mirror symmetry and automorphisms*	**Hamid Hassanzadeh** (Sorbonne Université) *Bounds on vector fields: degrees and generators*
16:20 - 16:45	Coffee	
16:45 - 17:35	**Aron Simis** (UFPE) *Specialization results with applications*	**Carolina Araujo** (IMPA) *Gale duality, blowups and moduli spaces*
17:45 - 18:35	**Marco Pacini** (UFF) *The stratification of the moduli space of spin curves*	**Marc Hindry** (Université Paris Diderot) *Analogues of the Brauer-Siegel theorem in arithmetic geometry*

The (ir)regularity of Tor and Ext

Marc Chardin [1], Dipankar Ghosh[2], Navid Nemati[3]

[1] Sorbonne Université

[2] IIT Hyderabad

[3] Sorbonne Université

We investigated the asymptotic behavior of Castelnuovo-Mumford regularity of Ext and Tor, with respect to the homological degree, over complete intersection rings. We derive from a theorem of Gulliksen a linearity result for the regularity of Ext modules in high homological degrees. We show a similar result for Tor, under the additional hypothesis that high enough Tor modules are supported in dimension at most one; we then provide examples showing that the behavior could be pretty hectic when the latter condition is not satisfied.

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Mirror symmetry and autormorphisms

Alessandro Chiodo

Sorbonne Université

I will speak about work in progress with Elana Kalashnikov and a previous work with her and Davide Cesare Veniani. It will illustrate the behavior of cohomological mirror symmetry in the presence of an automorphism operating on the two sides of a mirror pair of Calabi-Yaus constructed using the setup of Berglund and Hübsch. Some of the most striking statements we provide are cohomological invariants showing a mirror behaviour relating the fixed loci on the two sides (an interesting aspect is that clearly these are not Calabi–Yau orbifolds). The proof is also very simple and hopefully inspiring. It recasts important dualities through which mirror symmetry can be stated as an explicit automorphim. Namely, we use the crepant resolution conjecture relating cohomology of orbifolds and that of the resolutions of their coarse spaces, we rephrase it in terms of Landau-Ginzburg model, finally we obtain the desired statement from mirror symmetry of An singularities.

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Specialization results with applications

Aron Simis [1], Yairon Cid-Ruiz[2]

[1] UFPE, Recife, Brazil

[2] Universidad de Barcelona, Spain

[3] Institute of ...

This is joint work with Y. Cid-Ruiz. I will review the classical idea of specialization and bring in some further developments, including the idea of specializing modules and their powers (symmetric ones or in the sense of Rees). Some of it is inspired from previous results by Eisenbud–Huneke and Kennedy–Simis–Ulrich. Applications are given to the generic stability of the degree of a rational map and of a projectively embedded variety.

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The stratification of the moduli space of spin curves

Marco Pacini [1], Lucia Caporaso[2], Margarida Melo[3]

[1] Universidade Federal Fluminense (Brazil)

[2] Roma 3 (Italy)

[3] Roma 3 (Italy)

In the last few years, the problem of describing the tropicalization of moduli spaces asked for a deeper understanding of combinatorial aspects of moduli spaces and in particular of their stratifications. In a recent paper in collaboration with Lucia Caporaso and Margarida Melo, we study the tropicalization of Cornalba's moduli space of spin curves. In this talk we will describe the stratification needed to tropicalize this space. We will discuss some applications both in algebraic and tropical geometry.

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Regulators of number fields and elliptic curves

Fabien Pazuki [1]

[1] University of Copenhagen, Denmark, and Université de Bordeaux, France

We will start with a couple of interesting lower bounds for the regulator of number fields coming from earlier works of Friedman and Silverman, and explain a finiteness property we derive from it. We then report on a recent collaboration with Autissier and Hindry: we prove that up to isomorphisms, there are at most finitely many elliptic curves defined over a fixed number field, with Mordell-Weil rank and regulator bounded from above, when the rank is at least 4. We will explain where the result comes from, and discuss links with the Birch and Swinnerton-Dyer conjecture and with asymptotics on the number of rational points of bounded height on elliptic curves.

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Bounds on vector fields: degrees and generators

M. Chardin[1], **S. Hamid Hassanzadeh** [2], C. Polini[3] , A. Simis[4], B. Ulrich[5]

[1] Sorbonne University

[2] Federal University of Rio de Janeiro

[3] University of Notre-Dame

[4] Federal University of Pernambuco

[4] Purdue University

Finding algebraic integrals of a vector field is a fascinating question. Over a century ago Poincare had been interested in this question. Besides this fact, it is not clear what he might have asked about the algebraic integrals! The question of finding the minimum degree of a vector field which leaves a variety invariant has had significant progress in the recent years. In this talk which is a report on ongoing work, we present a Commutative Algebraic point of view to the object. We show that the a-invariant of a ring is the numerical invariant which can unify and explain several previous results such as some in [1, 2, 3, 4]. We determine lower bounds, upper bounds and bounds on the number of the generators of the module of non-trivial vector fields which leave a curve invariant.

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Gale duality, blowups and moduli spaces

Carolina Araujo

IMPA

Gale correspondence provides a duality between sets of n points in projective spaces $\mathbb{P}^s$ and $\mathbb{P}^r$ when $n = r + s + 2$. For small values of s, this duality has a remarkable geometric manifestation: the blowup of $\mathbb{P}^r$ at n points can be realized as a moduli space of vector bundles on the blowup of $\mathbb{P}^s$ at the Gale dual points. We explore this realization to describe the birational geometry of blowups of projective spaces at points in very general position.

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Analogues of the Brauer-Siegel theorem in arithmetic geometry

Marc Hindry

[1] Université Paris Diderot, Institut de mathématiques Jussieu – Paris Rive Gauche

We will explain analogies between the classical Brauer-Siegel theorem, a statement relating asymptotically the class number, regulator of units and discriminant of a number field, and similar statement involving arithmetic invariants of algebraic varieties over a finite or global field. We present precisely the analogy for surfaces over a finite field and for abelian varieties over a global field (i.e. a number field or the function field of a cuve over a finite field), surveying some recent results [1, 2, 3, 4]. The proof of Brauer-Siegel theorem relies on the class number formula and analytical estimates for the Dedekind zeta function, the analogy draws on formulae predicted by the Birch & Swinnerton-Dyer conjecture, (resp. Artin-Tate conjecture) and analytical estimates for the relevant L-series. If time permits, we will also formulate a quite general question along these lines, for algebraic varieties over a global field, and develop the case of projective hypersurfaces.

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4 – Control and Stabilization for Partial Differential Equations - Room 232

Time	Wednesday, 17	Thursday, 18
14:30 - 15:10	**Vincent Perrollaz** (Université de Tours) *Stabilization techniques for 1st order hyperbolic equations*	**Marcelo Moreira Cavalcanti** (UEM) *Exponential stability for the nonlinear Schrödinger equation with locally distributed damping*
15:10 - 15:50	**Maurício Cardoso Santos** (Federal University of Paraíba) Boundary Null Controllability as the Limit of Internal Controllability: the Heat Case	**Arnaud Münch** (Université Clermont Auvergne) *Control of PDEs involving boundary layers phenomena*
15:50 - 16:30	**Diego Araújo de Souza** (Federal University of Pernambuco) *Non null controllability of Stokes equations with memory*	**Felipe Chaves Silva** (Universidade Federal da Paraíba) *Controllability of parabolic PDE's with large parameters*
16:30 - 16:45	Coffee	
16:45 - 17:25	**Pierre Lissy** (Université Paris-Dauphine) *Bilinear local controllability to the trajectories of the Fokker-Planck equation with a localized control*	**Roberto de Almeida Capistrano Filho** (UFPE) *Controllability and Stabilization For a Family of Dispersive Systems*
17:25 - 18:05		**Vilmos Komornik** (Université de Strasbourg) *Simultaneous observability of infinitely many strings and beams*

Stabilization techniques for 1st order hyperbolic equations.

Vincent Perrollaz [1],

[1] Université de Tours, France

In this talk we will try to show how one can use families of Lyapunov functional to get asymptotic stabilization results, robustness estimates and in some cases exact controllability results. We will demonstrate the techniques for conservation laws in various functional framework.

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Boundary Null Controllability as the Limit of Internal Controllability: the Heat Case

Maurício C. Santos [1], Felipe W. Chaves-Silva[2], Jean -P. Puel[3]

[1] Federal University of Paraíba - Brazil

[2] Federal University of Paraíba - Brazil

[3] Université de Versailles St Quentin - France

It is well known that, for the heat equation with Dirichlet boundary condition, both internal and boundary null controllability hold with controls applied to any open subset of the domain and any open subset of the boundary, respectively. The purpose of this talk, is to show that for the heat equation the boundary null controllability can be obtained as the limit of distributed null controllability.

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Non null controllability of Stokes equations with memory

Diego A. Souza[1]

[1]Federal University of Pernambuco

Stokes equations have been studied since many years and its understanding is very relevant from the mathematical and physical viewpoint. In this talk, we will consider the Stokes equations in the presence of an integro-differential term (integral in time and differential in space) called *memory term*. We will study the boundary null controllability problem (to steer the flow to the rest at an arbitrarily small time) for the Stokes equations with memory in two and three dimensional cases. Precisely, we will construct explicitly initial conditions such that the null controllability does not hold even if the controls act on the whole boundary. Moreover, we also prove that this negative result holds for distributed controls. Finally, we will present some issues which remain open.

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Bilinear local controllability to the trajectories of the Fokker-Planck equation with a localized control

Pierre Lissy [1], Michel Duprez[2],

[1] CEREMADE, Université Paris-Dauphine

[2] LJLL, Université Sorbonne Université

We will present a new result on the control of the Fokker-Planck equation, posed on a bounded domain of $\mathbb{R}^d$ ($d \geqslant 1$). More precisely, the control is the drift force, localized on a small open subset. We prove that this system is locally null controllable to regular nonzero trajectories. The results are obtained thanks to a linearization method based on a standard inverse mapping procedure and the fictitious control method. The main novelties of the present article are twofold. Firstly, we propose an alternative strategy to the standard fictitious control method: the algebraic solvability is performed and used directly on the adjoint problem. Secondly, we prove a new Carleman inequality for the heat equation with one order space-varying coefficients: the right-hand side is the gradient of the solution localized on a subset (rather than the solution itself), and the left-hand side can contain arbitrary high derivatives of the solution. This is a joint work with Michel Duprez.

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Exponential stability for the nonlinear Schrödinger equation with locally distributed damping

Marcelo M. Cavalcanti [1], Wellington J. Corrêa[2], Turker Özsarı[3], Mauricio Sepúlveda[4], Rodrigo Véjar Asem[5]

[1] State University of Maringá, Brazil

[2] Federal Technological University of Paraná, Brazil

[3] Izmir Institute of Technology, Turkey

[4] Universidad de Concepción, Chile

[5] Universidad de Concepción, Chile

This talk is concerned with the defocusing nonlinear Schrödinger equation with a locally distributed damping on a smooth bounded domain. We first construct approximate solutions for this model by using the theory of monotone operators. We show that these approximate solutions decay exponentially fast in the L^2-sense by using the multiplier technique and a unique continuation property. Then, we prove the global existence as well as the L^2-decay of solutions for the original model by passing to the limit and using a weak lower semicontinuity argument, respectively. Finally, we implement a precise and efficient algorithm for studying the exponential decay established in the first part of the paper numerically. Our simulations illustrate the efficacy of the proposed control design.

Control of PDEs involving boundary layers phenomena

Arnaud Münch [1]

[1] Clermont-Auvergne University, France

We consider the controllability of some linear PDEs of the form

$$y_t^\varepsilon + Ay^\varepsilon + \varepsilon By^\varepsilon = 0, \quad \varepsilon > 0$$

where B is an operator with higher order than A. As ε goes to zero, the solution y^ε exhibits singular layers (boundary or internal) which may destroy the underlying controllability property. The main aim of the talk is to discuss the influence of singular phenomena on controllability properties. We shall notably discuss the system

$$\begin{cases} y_{tt}^\varepsilon + \varepsilon y_{xxxx}^\varepsilon - y_{xx}^\varepsilon = 0, & (x,t) \in (0,1)\times(0,T), \\ y^\varepsilon(0,\cdot) = y^\varepsilon(1,\cdot) = y_x^\varepsilon(0,\cdot) = 0, y_x^\varepsilon(1,\cdot) = v^\varepsilon, & t \in (0,T), \\ (y^\varepsilon(\cdot,0), y_t^\varepsilon(\cdot,0)) = (y^0, y^1), & x \in (0,1). \end{cases}$$

(which models the transversal displacement of an homogeneous beam with cross section ε) and determine rigorously an expansion of the null control v^ε of minimal $L^2(0,T)$ norm as follows:

$$v^\varepsilon = \varepsilon^{-1/2} v^0 + v^1 + \varepsilon^{1/2} v^2 + \cdots$$

in term of Dirichlet control functions v^i for nonhomogeneous wave equations.

Controllability of parabolic PDE's with large parameters

Felipe W. Chaves-Silva [1], Nicolas Carreño[2],

[1] Universidade Federal da Paraíba

[2] Universidad Técnica Federico Santa Maria

We consider a family of linear parabolic equations depending on a parameter which goes to infinity and we show that it is possible to control the family in a uniform way. Moreover, we also extend this result locally for nonlinear systems. Our strategy is based on spectral inequalities and a precise knowledge of the cost of controllability.

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Controllability and Stabilization For a Family of Dispersive Systens

Roberto de Almeida Capistrano Filho [1]

[1] Universidade Federal de Pernambuco

In this talk we will present recent results of controllability and stabilization for a family of dispersive systems in a bounded domain. More precisely, we study the control properties of a class of dispersive systems, namely,

$$\begin{cases} u_t + u_{xxx} + f(u,v)_x = 0 \\ v_t + v_{xxx} + g(u,v)_x = 0, \end{cases} \tag{1}$$

with two sets of boundary conditions (Dirichlet–Neumann and Neumann boundary conditions. In some situations controllability and stabilization of the system (1) generates the existence of the so-called *critical length phenomenon.*

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Simultaneous observability of infinitely many strings and beams

Vilmos Komornik [1], Anna Chiara Lai[2], Paola Loreti[3]

[1] Université de Strasbourg

[2] Sapienza Università di Roma

[3] Sapienza Università di Roma

We investigate the simultaneous observability of infinite systems of vibrating strings or beams having a common endpoint where the observation is taking place. Our results are new even for finite systems because we allow the vibrations to take place in independent directions. Our main tool is a vectorial generalization of some classical theorems of Ingham, Beurling and Kahane in nonharmonic analysis.

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5 – Delay and functional differential equations and applications - Room 347

Time	Tuesday, 16	Wednesday, 17
14:45 - 15:15	**Jaqueline Mesquita** (UNB) *Linearized instability for neutral functional differential equations with state–dependent delays*	**Guilherme Mazanti** (Université Paris-Sud) *Controllability of difference equations*
15:15 - 15:45	**Yacine Chitour** (Université Paris Saclay) *Stability of non-autonomous difference equations with applications to transport and wave propagation on networks*	**Valéria Cavalcanti** (Universidade Estadual de Maringá) *Exponential stability of a transmission problem for a viscoelastic wave equation*
15:45 - 16:15	**Cristina Pignotti** (Università degli Studi dell'Aquila) *Convergence to consensus of a Cucker-Smale model with time delay*	**Delphine Bresch-Pietri** (Centre Automatique et Systèmes MINES ParisTech) *Control with a non First-In/First-Out delay*
16:15 - 16:45	Coffee	
16:45 - 17:15	**Islam Boussaada** (IPSA) *Coalescence and Splitting Mechanisms of TimeDelay Systems' Spectral Values and their Effect on Stability*	**Márcia Federson** (USP) *New results in generalized ODEs*
17:15 - 17:45	**Rosane Ushirobira** (Inria Lille – Nord Europe) *On the Ore extension ring of differential timevarying delay operators*	

Linearized instability for neutral functional differential equations with state–dependent delays

Jaqueline G. Mesquita[1], Bernhard Lani-Wayda[2], Hans-Otto Walther[3]

[1] Universidade de Brasília, Brasília, Brazil

[2] Justus-Liebig Universität, Giessen, Germany

[3] Justus-Liebig Universität, Giessen, Germany

In this talk, the goal is to introduce a class of equations called *neutral functional differential equations with state–dependent delays* as well as to discuss about linearized instability results for these equations.

Stability of non-autonomous difference equations with applications to transport and wave propagation on networks

Yacine Chitour [1]

[1] Université Paris Saclay, CentraleSupélec, CNRS

In this talk, we address the stability of non-autonomous linear difference equations of the type

$$x(t) = \sum_{i=1}^{m} A_i(t)x(t - L_i), \quad x \in \mathbb{R}^n, \tag{NO-LDE}$$

where the L_i's are the (positive) delays and the matrix-valued functions $A_i(\cdot)$'s are measurable and take values in a bounded set $\mathcal{A}$. We aim at characterizing the asymptotic behavior of solutions of (NO-LDE) in terms of the L_i's and $\mathcal{A}$. We first provide a suitable representation of the solutions in terms of their initial conditions and some time-dependent matrix coefficients. As a consequence, we obtain necessary and sufficient stability criteria for (NO-LDE). In the case of difference equations with arbitrary switching, we obtain a delay-independent generalization of the well-known criterion for autonomous systems due to Hale and Silkowski. We then apply these findings to transport systems and wave propagation on networks with time-varying parameters. We get the following two results: (a) exponential stability of transport systems and wave propagation on networks is robust with respect to variations of the lengths of the edges of the network preserving their rational dependence structure; (b) the wave equation on a network with arbitrarily switching damping at external vertices is exponentially stable if and only if the network is a tree and the damping is bounded away from zero at all external vertices but at most one.
This is a joint work with G. Mazanti and M. Sigalotti.

Convergence to consensus of a Cucker-Smale model with time delay

Cristina Pignotti [1], Young-Pil Choi[2],

[1] University of L'Aquila, Italy

[2] Inha University, Republic of Korea

We describe a Cucker-Smale model with normalized communication weights and distributed time delay. By means of a Lyapunov functional approach we deduce asymptotic flocking estimates. Then, we show that as the number of individuals N tends to infinity, the N-particle system can be well approximated by a delayed Vlasov alignment equation. Moreover, we establish the global existence of measure-valued solutions for the delayed Vlasov alignment equation and analyze its large-time asymptotic behavior.

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Coalescence and Splitting Mechanisms of Time-Delay Systems' Spectral Values and their Effect on Stability

Islam Boussaada [1], Silviu-Iulian Niculescu[2],

[1] Inria Saclay, Equipe DISCO & DRII-IPSA & Laboratoire des Signaux et Systèmes (L2S), CNRS-CentraleSupelec-Université Paris Sud, Université Paris Saclay

[2] Laboratoire des Signaux et Systèmes (L2S), CNRS-CentraleSupelec-Université Paris Sud, Université Paris Saclay & Inria Saclay, Equipe DISCO

For linear delay-differential equations, a question of ongoing interest is to determine conditions on the equation parameters that guarantee exponential stability of solutions. The starting point of this talk shall be a recent result showing a link between the stable manifold and the manifold corresponding to a given multiplicity of a spectral value hence enabling a spectral abscissa assignment. After a motivation of the tracking of multiple spectral values for analysis/control perspectives, some existing links between Birkhoff's interpolation problem and a result due to Pólya and Szegő on the number of quasipolynomial's roots in some horizontal strip shall be revisited. Later, some ideas of analytic proofs of the dominancy of the quasipolynomial's root will be presented, setting up a reduced-complexity delayed stabilizing design. Sensitivity of the control design with respect to the parameters variation will be discussed. Finally, various reduced order examples will illustrate the applicative perspectives of the proposed control approach.

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On the Ore extension ring of differential time-varying delay operators

Rosane Ushirobira [1], Alban Quadrat[1]

[1] Inria, France

In this talk, I will present an algebraic method to study linear differential time-varying delay (DTVD) systems. The goal is to have an effective construction of the ring of DTVD operators as an Ore extension, thanks to the concept of skew polynomial rings. Some algebraic properties of the DTVD operators ring will be shown, such as its Noetherianity, its homological and Krull dimensions and the existence of Gröbner bases, all given in terms of the time-varying delay function. The algebraic analysis framework for linear systems theory allows us to study linear DTVD systems and important properties, such as the controllability and flatness, using module theory, homological algebra and constructive algebra.

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Controllability of difference equations

Guilherme Mazanti[1]

[1] Laboratoire de Mathématiques d'Orsay, Université Paris-Sud, France

Difference equations are useful tools in the analysis of some hyperbolic PDEs, in particular systems of PDEs on networks, since they provide a handy representation of some simple dynamics. In this talk, we analyze the controllability of a linear difference equation with finitely many delays.

Three notions of controllability are considered: relative, approximate, and exact. After providing the corresponding definitions, we start by presenting a relative controllability criterion expressed in terms of some coefficients computed inductively from the matrices defining the system. Issues such as the minimal controllability time and the effects of the rational dependence relations of the delays are also discussed.

We then provide a complete characterization of approximate and exact controllability in L^2 for 2-dimensional systems with two delays and a scalar control, which corresponds to the first non-trivial situation. It illustrates most difficulties in the analysis and the subtleties of the controllability criterion one obtains. We also relate these controllability properties to approximate and exact controllability to constants.

Our approach relies on a suitable representation formula for solutions, which had already been used in a previous work in the stability analysis of difference equations. Part of the results of this talk were obtained in collaboration with Y. Chitour and M. Sigalotti.

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Exponential stability of a transmission problem for a viscoelastic wave equation

Valéria N. Domingos Cavalcanti [1], Marcelo M. Cavalcanti[2], Emanuela R. de Sousa Coelho.[3]

[1] Universidade Estadual de Maringá

[2] Universidade Estadual de Maringá

[3] UniversidadeEstadual da Paraíba

We discuss the asymptotic stability as well as the well-posedness of a transmission problem in bounded domains with dissipative internal conditions. The proof of the exponential stability result combines energy estimates and results on microlocal defect measures.

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Control with a non First-In/First-Out delay

D. Bresch-Pietri [1], F. Mazenc [2], N. Petit[1]

[1] MINES ParisTech, PSL Research University, CAS - Centre Automatique et Systèmes, 60 bd St Michel 75006 Paris, FRANCE.

[2] EPI DISCO Inria-Saclay, L2S, CNRS CentraleSupelec, 3 rue Joliot Curie, 91192 Gif-sur-Yvette, FRANCE.

This talks focuses on a specific class of time-varying delays, which violates the First-In/First-Out (FIFO) principle, i.e., the delay D is such that $\dot{D}(t) \geq 1$ for some time instants and can jump. This means that the delayed signal can be reordered. We present the control challenges that arise in this context, and draw some perspectives of control design. Namely, in the case of an input-delay, we propose sufficient conditions of asymptotic stabilization using a prediction-based controller. The stability analysis grounds on a Partial Differential Equation representation of the delay and an extension of Halanay inequality in a hybrid framework.

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New results in generalized ODEs

Márcia Federson [1], Everaldo M. Bonotto[2], Rodolfo Collegari[3], Marta C. Gadotti[4]

[1] Universidade de São Paulo

[2] Universidade de São Paulo

[3] Universidade Federal de Uberlândia

[4] Universidade Estadual Paulista

We present new results within the theory of generalized ordinary differential equations based on the non-absolute integral of Jaroslav Kurzweil which enables one to handle functions with of unbounded variation and many discontinuities which, in turn, provide a good environment for models involving highly oscillating phenomena with many jumps.

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1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

6 – Derivations in Algebra and Geometry - Room 228

Time	Thursday, 18	Time	Friday, 19
14:30 - 15:45	**Gene Freudenburg** (Western Michigan University) *Locally Nilpotent Derivations*	14:30 - 15:20	**Severino Collier Coutinho** (UFRJ) *Simple derivations and foliations with one singularity*
		15:25 - 15:55	**Kevin Langlois** (Heinrich Heine Universität Düsseldorf) *Some results about the classification of algebraic group actions in characteristic p*
16:00 - 16:30	**Alvaro Liendo** (Universidad de Talca) *Integration of rational derivations on algebraic varieties*	16:00 - 16:30	**Pierre-Marie Poloni** (Universität Basel) *Embedding some open Riemann surfaces into the complex plane*
16:20 - 16:45	Coffee		
16:45 - 17:10	**Marcelo Oliveira Veloso** (UFSJ) *Rings of constants of linear derivations on Fermat rings*	16:45 - 17:35	**Sabrina Pauli** (University of Oslo) $\mathbb{A}^1$*-homotopy theory and affine algebraic geometry*
17:15 - 17:40	**Roberto Carlos Díaz Vivanco** (University of Talca) *Pro-Locally Nilpotent Derivations*		
17:45 - 18:15	**Lucy Moser-Jauslin** (Université de Bourgogne) *Examples of $\mathbb{G}_a$-actions on cylinders over Danielewski hypersurfaces*	17:40 - 18:45	**Open Table**
18:20 - 18:45	**Charlie Petitjean** (Université de Bourgogne) *Automorphism Groups Of Koras-Russell Threefolds*		

Locally Nilpotent Derivations

Gene Freudenburg

Western Michigan University, Kalamazoo, Michigan, 49008 USA

This talk will provide a brief introduction and overview for locally nilpotent derivations (LNDs) of integral domains over a field k of characteristic zero. For rings that are finitely generated over k, there is a correspondence between LNDs and algebraic actions of the additive group $(k, +)$ on the corresponding algebraic k-varieties. This is one of the main reasons that LNDs are of interest. Indeed, LNDs can be seen to play a role in many fundamental problems of algebraic geometry, including Hilbert's Fourteenth Problem, the Embedding Problem and Cancelation Problem for Affine Spaces, the Jacobian Conjecture, and the Dolgachev-Weisfeiler Conjecture. We will survey known results and highlight recent developments in this area.

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Integration of rational derivations on algebraic varieties

Alvaro Liendo

Universidad de Talca, Chile

In this talk we show a classification of rational actions of the additive and the multiplicative group on algebraic varieties that generalizes the usual description of regular actions of the additive and the multiplicative group on affine varieties in terms of derivations.

As a corollary, we provide a characterization of regular actions of the additive and the multiplicative group on the class of varieties that are proper over the spectrum of its ring of global regular functions. This class of varieties include affine varieties, complete varieties and their blowups.

Different parts of this talk are issued from joint works with L. Cid and A. Dubouloz, respectively.

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Rings of constants of linear derivations on Fermat rings

Marcelo Oliveira Veloso

[1] UFSJ, Ouro Branco - Brazil

It is well known how hard is to describe the ring of constants of an arbitrary derivation as well to decide if the ring of constants of a derivation is trivial. In this talk we deal with $\mathbb{C}$-derivations of a ***Fermat ring***

$$B_n^m = \frac{\mathbb{C}[X_1, \ldots, X_n]}{(X_1^{m_1} + \cdots + X_n^{m_n})},$$

where $\mathbb{C}[X_1, \ldots, X_n]$ is the polynomial ring in n variables over the complex numbers $\mathbb{C}$, $n \geq 3$, $m = (m_1, \ldots, m_n) \in \mathbb{Z}^n$, and $m_i \geq 2$ for $i = 1, \ldots, n$. Specifically, we study the ring of constants of linear derivations on Fermat rings and its locally nilpotent derivations. We present a description of all the linear $\mathbb{C}$-derivations and provide examples of linear derivations with trival ring constants for certain Fermat rings.

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Pro-Locally Nilpotent Derivations

Roberto Díaz[1], Adrien Dubouloz[2], Alvaro Liendo[1]

[1] University of Talca, Chile

[2] University of Bourgogne, France

Let V be an affine algebraic variety on $\mathbb{C}$ and $\mathcal{O}(V)$ its ring of regular functions, a known result is the correspondence between the actions of the additive group $\mathbb{G}_a$ on V and the locally nilpotent derivations on $\mathcal{O}(V)$. For the case of an affine ind-variety $\mathcal{V}$ and its ring of regular functions $\mathcal{O}(\mathcal{V})$ we can also associate each action of the additive group $\mathbb{G}_a$ on $\mathcal{V}$, in the category of ind-varieties, a continuous derivation on its ring of regular functions $\mathcal{O}(\mathcal{V})$. However, this derivation is not necessarily locally nilpotent. In this talk I describe a particular type of derivations, the "Pro-Locally Nilpotent Derivations", and I show some principles that make possible the correspondence between the actions of the additive group $\mathbb{G}_a$ on an affine ind-variety $\mathcal{V}$ and the pro-locally nilpotent derivations of its ring of regular functions $\mathcal{O}(\mathcal{V})$.

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Examples of $\mathbb{G}_a$-actions on cylinders over Danielewski hypersurfaces

Lucy Moser-Jauslin

Université de Bourgogne, Dijon, France

Given a polynomial of the form $P_n = x^n z - y^2 + 1$, consider the affine hypersurface S_n in affine complex three-space defined by $P_n = 0$. It is well-known that the cylinders of these hypersurfaces are all isomorphic. In particular they have many $\mathbb{G}_a$-actions. Consider the cylinder on the hypersurface S defined by the equation $x^2 z - y^2 + x = 0$. We will use explicit examples of $\mathbb{G}_a$-actions on the cylinder over S_2 to describe several $\mathbb{G}_a$-actions on S with particular properties. We will also discuss the question of extensions of $\mathbb{G}_a$-actions on a hypersurface to $\mathbb{G}_a$-actions on the ambient space.

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AUTOMORPHISM GROUPS OF KORAS-RUSSELL THREEFOLDS

Petitjean Charlie

Université de Bourgogne, France

The Koras–Russel threefolds are smooth contractible rational affine varieties, they can be described as hypersurfaces in $\mathbb{A}^4_{\mathbb{C}}$ [1]. Although close to $\mathbb{A}^3_{\mathbb{C}}$ these varieties are not isomorphic to $\mathbb{A}^3_{\mathbb{C}}$, this has been demonstrated using the Makar-Limanov invariant [2].
A first part will focus on the construction of these varieties, a second on the study of the automorphism groups using their Makar-Limanov invariants [3, 4], that is, considering additive group actions on them. The third part will be about rational properties related to torus actions on these threefolds.

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Simple derivations and foliations with one singularity

S. C. Coutinho[1], **Filipe Ramos Ferreira**[1],

[1] Departamento de Ciência da Computação, Instituto de Matemática, UFRJ

A number of results, in recent years, have been concerned with foliations with one singularity on the complex projective plane. Thus, [1] presents a classification of foliations of degree 2 with one singularity, while [2, Theorem 1, p. 192] introduces a family of foliations with one singularity of algebraic multiplicity one. In this talk I will present a new family of foliations of degree $d \geq 4$ whose unique singularity has multiplicity $d - 1$. The generic foliations in this family have trivial isotropy groups and a unique invariant algebraic curve, thus giving rise to a new family of simple derivations of the affine plane.

Some results about the classification of algebraic group actions in characteristic p

Kevin Langlois

Heinrich Heine Universität Düsseldorf, Germany

One of the great achievements of the Lie theory is to have created many beautiful and important relationships between algebraic and geometric objects dependent on continuous parameters and discrete objects of combinatorial nature. This fundamental picture is illustrated in the classification of Chevalley groups in terms of root systems. From this perspective, one may ask to describe not only the group object itself but its transformations on geometric spaces. In the case of reductive group actions, the Luna-Vust theory (1983) gives an answer in the situation that the equivariant birational type is known. A more mysterious issue to elucidate is thereby the case of *actions of non-reductive groups*, where the first prototype to look at is the additive group $\mathbb{G}_a = (k, +)$ of the ground field k. While the abundancy of the $\mathbb{G}_a$-actions for a given finite type scheme plays a key role in affine geometry, in order to have a Lie type correspondence, one needs to rigidify those actions by adding some geometric constraints. A natural condition that appears many times in practice is to consider somehow the $\mathbb{G}_a$-actions that are 'homogeneous' with respect to the grading provided by the action of an algebraic torus. For instance, this recently intervened in the *non-reductive geometric invariant theory* due to Bérczi, Doran, Hawes and Kirwan (2007-2017). A leading and pioneering work that reflects this idea is the one of M. Demazure (1970) who described the automorphism groups of smooth complete toric varieties in terms of the so called *Demazure roots*. In 2003, H. Flenner and M. Zaidenberg classified all the $\mathbb{G}_a$-actions on complex normal affine $\mathbb{C}^*$-surfaces that are normalized by the $\mathbb{C}^*$-actions. This latter classification has been extended in higher dimension by A. Liendo (2010) for torus actions with general orbits of codimension one. In this talk, we will present the classification of such $\mathbb{G}_a$-actions over an arbitrary ground field by emphasizing the difference between characteristic 0 and characteristic p and the interaction with the objects of combinatorial nature. This is joint work with A. Liendo.

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Embedding some open Riemann surfaces into the complex plane

Pierre-Marie Poloni

Universität Basel, Switzerland

It is a long-standing open problem whether every open Riemann surface (i.e. every one-dimensional Stein manifold) admits a proper holomorphic embedding into the complex plane.

In this talk, we enlarge the class of examples for which a positive answer is known. More precisely, we will show that the Riemann sphere, with a non-empty countable closed subset containing at most two accumulation points removed, as well as any compact Riemann surface of genus one, with a non-empty countable closed subset containing at most one accumulation point removed, are all embeddable into the plane.

Our construction is inspired by a result of Sathaye stating that every smooth affine algebraic curve of genus one is a plane algebraic curve.

This is joint work with Frank Kutzschebauch.

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$\mathbb{A}^1$-homotopy theory and affine algebraic geometry

Sabrina Pauli

University of Oslo, Norway

In $\mathbb{A}^1$-homotopy theory we apply techniques from algebraic topology to algebraic varieties. The affine line $\mathbb{A}^1$ plays the role of the unit interval. $\mathbb{A}^1$-homotopy theory provides many new applications, also in affine algebraic geometry. Notrivial affine $\mathbb{A}^1$-contractible varieties serve as potential counter examples to the Zaraski cancellation problem which is still unsolved in dimension greater or equal to 3 and characteristic 0. In my talk I will give an introduction to $\mathbb{A}^1$-homotopy theory. In particular, I will try to provide tools that can be useful in affine algebraic geometry.

1st Joint Meeting Brazil-France in Mathematics

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7 – Dynamical Systems and Ergodic Theory - Ricardo Mañé Auditorium

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:25	**Sylvain Crovissier** (Université Paris - Sud) *About the C1-Density of ergodic symplectomorphisms*	**Ali Tahzibi** (University of São Paulo) *Measures of maximal entropy for diffeomorphisms close to Anosov flow*
15:35 - 16:30	**Karina Marin** (Universidade Federal de Minas Gerais) *Stability of hyperbolic measures*	**Patricia Cirilo** (Universidade Federal de São Paulo) *Generalized hyperbolicity for linear operators*
16:30 - 16:45	Coffee	
16:45 - 17:40	**Bassam Fayad** (Institut de Mathématiques de Jussieu) *Instabilities for elliptic points and quasi-periodic tori in real analytic Hamiltonian dynamics*	**Carlos Gustavo Moreira** (IMPA) *Fractal geometry of the Markov and Lagrange spectra and their set difference*
17:50 - 18:40		**Patrice Le Calvez** (Sorbonne Université & Institut Universitaire de France) *Homoclinic intersections for area preserving diffeomorphisms of surfaces*

About the C1-Density of ergodic symplectomorphisms

Sylvain Crovisier [1],

[1] Université Paris - Sud

In the space of volume-preserving diffeomorphisms, it is known that the C1-generic systems with positive entropy are ergodic and non-uniformly hyperbolic.

In that talk we will discuss how this result can be extended to symplectic diffeomorphisms: the non-uniform hyperbolicity may fail, however the ergodicity still holds. This can be obtained by an approach which is different from the volume-preserving case and which uses a local version of the accessibility property. This is a joint work with A. Avila and A. Wilkinson.

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Stability of hyperbolic measures

Karina Marin [1]

[1] Universidade Federal de Minas Gerais (UFMG)

For most partially hyperbolic diffeomorphism having 1-dimensional center bundle and center foliation that forms a circle bundle A. Tahzibi and J. Yang proved that ergodic measures with large entropy are hyperbolic.

In this talk we will discuss a partial extension of their result to partially hyperbolic diffeomorphisms with 2-dimensional center bundle. The main tool is the study of u-states associated to the derivative cocycle through a characterization that involves the entropy along the expanding foliation. This is a joint work with Chao Liang (CUFE) and Jiagang Yang (UFF).

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Instabilities for elliptic points and quasi-periodic tori in real analytic Hamiltonian dynamics

Bassam Fayad [1],

[1] Institut de Mathématiques de Jussieu, France

We study the stability of elliptic points and quasi-periodic tori in real analytic Hamiltonian dynamics, from 3 points of view : topologic, metric, and effective. We introduce in particular new diffusion mechanisms that yield the first examples of unstable non resonant elliptic fixed points and quasi-periodic tori. The Birkhoff normal forms at the fixed points are divergent while the BNF at the tori can be chosen to be divergent or convergent.

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Measures of maximal entropy for diffeomorphisms close to Anosov flow

Ali Tahzibi [1], Jérôme Buzzi[2], Todd Fisher[3]

[1] University of São Paulo at São Carlos

[2] University of Paris-Sud

[3] Brigham Young University

We extend the construction of maximal entropy measure due to Margulis for Anosov flows to the diffeomorphisms which are C^1- close to time one map of Anosov flows and have minimal strong foliations. We prove a dichotomy for the measures of maximal entropy of such diffeomorphisms: for the measures of maximal entropy of such diffeomorphisms: Either all maximal entropy measures have vanishing central Lyapunov exponent or there exist exactly two measures of maximal entropy, both are hyperbolic with opposite sign of central Lyapunov exponent.

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Generalized hyperbolicity for linear operators.

Patricia Cirilo [1], B. Gollobit[2], E. Pujals[3]

[1] Universidade Federal de São Paulo

[2] Graduate Center/CUNY

[3] Graduate Center/CUNY

It is introduced an open class of linear operators on Banach and Hilbert spaces such that their non-wandering set is an infinite dimensional topologically mixing subspace. In certain cases, it coincides with the whole space. One of the most interesting dynamical consequences is that for that class of operators the non-wandering set is an infinite dimensional robustly transitive set.

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Fractal geometry of the Markov and Lagrange spectra and their set difference

Carlos Gustavo Moreira [1]

[1] IMPA, Rio de Janeiro

We will discuss some recent results on the fractal geometry of the Markov and Lagrange spectra from Diophantine approximations, and their set difference - in particular we show, in collaboration with Carlos Matheus, that their set difference $M \setminus L$ has Hausdorff dimension strictly between 0 and 1 (more precisely between 0.531 and 0.888), and has elements larger than 3.7, disproving a conjecture by Cusick. We will relate these results to symbolic dynamics, continued fractions and to the study of the fractal geometry of arithmetic sums of regular Cantor sets, a subject also related to homoclinic bifurcations in Dynamical Systems.

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Homoclinic intersections for area preserving diffeomorphisms of surfaces

Patrice Le Calvez [1], Martín Sambarino[2],
[1] Sorbonne Université et Institut Universitaire de France, [2] Universidad de la República, Montevideo

We prove that if S is a smooth compact boundaryless orientable surface of genus g, furnished with a smooth area form ω and $\mathrm{Diff}^r_\omega(S)$, $1 \leq r \leq +\infty$, is the space of C^r diffeomorphisms of S, endowed with the C^r topology, then there exists a residual set $\mathcal{R} \subset \mathrm{Diff}^r_\omega(S)$, such that every $f \in \mathcal{R}$ has hyperbolic periodic points and all these points have a transverse homoclinic intersection. Consequently the topological entropy is positive on an open and dense subset of $\mathrm{Diff}^r_\omega(S)$.

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8 – Geometric Flows and Einstein Manifolds - Room 347

Time	Thursday, 18	Friday, 19
14:30 - 15:20	**Ernani Ribeiro Junior** (Universidade Federal do Ceará) *Geometric inequality for critical metrics of the volume functional*	**Alix Deruelle** (Université de Bordeaux) *On the regularity of Ricci flows coming out of metric spaces*
15:30 - 16:20	**Laurent Bessières** (Université de Bordeaux) *Deforming 3-Manifolds with Bounded Geometry and Uniformly Positive Scalar Curvature*	**Eleonora Di Nezza** (Sorbonne Université) *Monge and Ampère : waiting for pluripotential theory*
16:30 - 17:20	**Xu Cheng** (IME - USP) *Spectral properties and rigidity for self-expanding solutions of the mean curvature flows*	**Ezequiel Barbosa** (Universidade Federal de Minas Gerais) *Classification results on free boundary CMC hypersurfaces*

Geometric inequality for critical metrics of the volume functional

Ernani Ribeiro Jr [1]

[1] Universidade Federal do Ceará - UFC, Brazil.

In this talk we discuss the modified (variational) problem of finding critical points for the volume functional on compact manifolds with boundary. This subject is related to the general question of finding canonical metrics on manifolds with boundary (possibly disconnected). Firstly, we will present an isoperimetric inequality for critical metrics of the volume functional. Moreover, we will establish sharp estimates to the mean curvature and area of the boundary components of critical metrics of the volume functional on a compact manifold. In addition, a localized version estimates to the mean curvature and area of the boundary of critical metrics will be also discussed.

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Deforming 3-Manifolds with Bounded Geometry and Uniformly Positive Scalar Curvature

Laurent Bessières[1]

[1] Université de Bordeaux

We prove that the moduli space of complete metrics with bounded geometry and uniformly positive scalar curvature of a given 3-manifol is path-connected, generalizing Marques theorem for compact manifolds.

This is a joint work with G. Besson, S. Maillot and F.C. Marques.

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Spectral properties and rigidity for self-expanding solutions of the mean curvature flows

Xu Cheng[1]

[1] Instituto de Matemática e Estatística, Universidade Federal Fluminense

In this talk, we discuss self-expanders which are the self-expanding solutions of the mean curvature flows. We give a universal lower bound of the bottom of the spectrum of the drifted Laplacian on a self-expander and prove an inequality between the bottom of the spectrum of the drifted Laplacian and the bottom of the spectrum of weighted stability operator. Also we prove some uniqueness properties of hyperplane for mean convex self-expanders. This is a joint work with D. Zhou.

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On the regularity of Ricci flows coming out of metric spaces

Alix Deruelle[1]

[1] Université de Bordeaux

We focus on the smoothing effect of the Ricci flow when it starts from a metric space whose metric is induced by a smooth Riemannian metric. We assume the convergence at the initial time to hold in the Gromov-Hausdorff sense. The main question we address is: under which conditions on the curvature are these Ricci flows attaining their initial conditions in a smooth way ?

This is a joint work with Felix Schulze and Miles Simon.

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Monge and Ampère : waiting for pluripotential theory

Eleonora Di Nezza[1], Tamás Darvas[2], Chinh Lu[3]

[1] Laboratoire IMJ-PRG, Sorbonne Université, Paris, France

[2] Department of Mathematics, University of Maryland, College Park, MD, United States

[3] Laboratoire de Mathématiques d'Orsay, Universiteé Paris-Saclay, Orsay, France

A fondamental problem in Kähler geometry is to look for canonical metrics on a Kähler manifold, where the word "canonical" means that the metric satisfies a curvature condition. Such geometric problem boils down to a complex non-linear PDE of Monge-Ampère type. In the last 50 years the study of the regularity of solutions of such equations (elliptic and parabolic) has motivated a lot of works. I will give a survey of what is known in this direction (also in singular settings), emphasising how the developments in pluripotential theory were crucial in order to treat (singular) complex Monge-Ampère equations.

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Classification results on free boundary CMC hypersurfaces

Ezequiel Barbosa [1]

[1] Universidade Federal de Minas Gerais

In this talk, we will present some recent classification results on free-boundary cmc hypersurfaces. We will show that if a free boundary constant mean curvature surface in an Euclidean 3-ball satisfies a pinching condition on the length of traceless second fundamental tensor, then either the surface is a totally umbilical disk or an annulus of revolution. The pinching is sharp since there are portions of some Delaunay surfaces inside in the unit Euclidean 3-ball which are free boundary and satisfy such pinching condition. Moreover, we will discuss how to apply a Hardy-type inequality to characterise free-boundary minimal hypersurfaces in Hadamard spaces. In particular, we will prove that a flat free-boundary minimal n-disk, $n \geq 3$, in the unit Euclidean ball B^{n+1}, is the unique compact free-boundary minimal hypersurface in the unit Euclidean ball which the squared norm of the second fundamental form is less than either $\frac{n^2}{4}$ or $\frac{(n-2)^2}{4|x|^2}$. Those results can be found in joint works with Celso Viana, Edno Pereira, Marcos Cavalcante and Rosivaldo Gonçalves.

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9 – Geometry and Dynamical Systems - Ricardo Mañé Auditorium

Time	Thursday, 18	Friday, 19
14:30 - 15:00	**Remi Langevin** (Université de Bourgogne) *Lenses on very curved zones of a singular line field of $\mathbb{C}^2$ or of a singular plane field of $\mathbb{C}^3$*	**Alain Jacquemard** (Université de Bourgogne) *Effective issues in Non-Smooth System*
15:10 - 15:40	**Marc Soret** (Université F. Rabelais) *An adjunction formula for surfaces in the 4-ball*	**Daniel Panazzolo** (Université de Strasbourg) *Discontinuous vector fields: regularization and versatility*
15:50 - 16:20	**Marina Ville** (Université F. Rabelais) *Local and global topology of minimal surfaces in $\mathbb{R}^4$*	**Gioia Vago** (Université de Bourgogne) *On the Ogasa number*
16:20 - 16:45	Coffee	
16:45 - 17:15	**Ronaldo Garcia** (UFG) *Darboux curves on surfaces*	**Andre Belotto da Silva** (Université d'Aix-Marseille) *Singular foliations in sub-Riemannian geometry and the Strong Sard Conjecture*
17:25 - 17:55	**Marcos Craizer** (PUC-Rio) *Quadratic Points in Projective 3-Space*	***Problem and discussion session***
18:05 - 18:35	**Jorge Sotomayor** (Universidade de São Paulo) *Principal curvature configurations on surfaces and hypersurfaces in Euclidean spaces*	

Lenses on very curved zones of a singular line field of $\mathbb{C}^2$ or of a singular plane field of $\mathbb{C}^3$

Rémi Langevin

[1] Université de Bourgogne-Franche Comté

[3] Institut de Mathématiques de Bourgogne

We renormalize, using suitable lenses, small domains of a singular holomorphic line field of $\mathbb{C}^2$ or plane field of $\mathbb{C}^3$ where the curvature of a plane-field is concentrated. At a proper scale the field is almost invariant by translations. When the field is integrable, the leaves are locally almost translates of a surface that we will call *profile*. We also generalize a result of Merle ([Me]) concerning the contact order of generic polar curves with the singular level $f = 0$ when $\omega = df$. On the way we obtain some classical results (Lê's carousels) on the knot $K = (\{f = 0\} \cap B_\epsilon(0, 0, 0))$ in dimension 2 an a maybe less classical ones in dimension 3 .

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Marc Soret [1]

[1] Université de Tours CNRS-UMR 7350

Title : An adjunction formula for surfaces in the 4-ball

We prove an adjunction formula for a surface in ball of $\mathbb{R}^4$ whose boundary lies in the boundary of the ball and we give some applications.

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Local and global topology of minimal surfaces in $\mathbb{R}^4$

Marina Ville [1]

[1] Institut Denis Poisson, University of Tours, France

The talk is about local and global topological aspects of minimal surfaces in $\mathbb{R}^4$ (I will recall the definitions and basic facts). I will discuss their branch points, the knots these define and their desingularization by immersed minimal disks. I will then move on to global minimal surfaces, mention one or two open problems and explain how knots appear also in this context. I will compare and contrast with local and global complex curves in $\mathbb{C}^2$. Time permitting, I may say a word about symplectic minimal surfaces. Partly joint work with Marc Soret.

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Darboux curves on surfaces

Ronaldo Garcia [1]

[1] Universidade Federal de Goiás

Instituto de Matemática e Estatística

In this talk it will ve considered the dynamical aspects of Darboux lines near Darbouxian umbilic points of surfaces. Also, it will be discussed other kind of curves on surfaces which are defined as critical points of variational problems. See [1, 2].

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Quadratic Points in Projective 3-Space

Marcos Craizer [1],

[1] Departamento de Matemática, Pontifícia Universidade Católica do Rio de Janeiro.

Quadratic points of a surface in the projective 3-space are the points which can be exceptionally well approximated by a quadric. They are also singularities of a 3-web in the elliptic part and of a line field in the hyperbolic part of the surface. We show that generically the index of the 3-web at a quadratic point is $\pm 1/3$, while the index of the line field is ± 1. From the above local results we can conclude some global results: A generic compact elliptic surface has at least 6 quadratic points, a compact elliptic surfaces with semi-homogeneous cubic forms has at least 2 quadratic points and the number of quadratic points in a hyperbolic disc is odd. This is a joint work with Ronaldo A.Garcia.

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Principal curvature configurations on surfaces and hypersurfaces in Euclidean spaces.

Jorge Sotomayor[1]

[1] Universidade de São Paulo, Instituto de Matemática e Estatística

We depart from an appropriate reformulation of classical results of G. Monge and G. Darboux, which, after a suitable elaboration, led to the study of a class Σ of immersions of a compact oriented surface M^2 into $\mathbb{R}^3$ with the property that they are structurally stable with respect to their principal curvature configurations. This configuration consisists of the umbilic points, as singularities, and of the pair of principal curvature families of curves defined on the complement of such points.
The work of Gutiérrez and Sotomayor established that in the space of immersions C^4 smooth, the class Σ is open in class C^3 and dense in class C^2. See [1], [2] and [3]. The class Σ is reminiscent of the class of Andronov - Pontrjagin and Peixoto flows on surfaces.
In the present lecture will be reported recent developments and inquieries focusing the structural stability and genericity of principal curvature configurations increasing the dimensions of the target space and of the domain space.

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Effective issues in Non-Smooth Systems

Alain JACQUEMARD [1]

[1] IMB - Université Bourgogne Franche-Comté

The scientific modeling of certain physical phenomena naturally requires the introduction of abrupt variations of the parameters values. Many examples of non-smooth dynamical systems arise this way. This field, which has a theoretical frame of its own, keeps developing and growing, both because of its applications and because of its intrinsic mathematical interest. A challenge is to study new structural questions arising in this setting by means of algorithmic methods and to express their invariants in terms of explicit and optimal expressions.

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Discontinuous vector fields: regularization and versality

Daniel Panazzolo [1],

[1] Université de Haute-Alsace.

A classic procedure for defining the solutions curves of a discontinuous vector X (let's say locally integrable) consists of constructing a sequence of approximations by smooth fields via the convolution product $X_\varepsilon = X * f_\varepsilon$, where f_ε is a *ε-molliffier* (positive and smooth function with support in the ball of radius ε). The dynamics of X_ε may depend on the choice of f_ε. In this lecture, we will discuss a geometric approach to construct a versal regularization of X, whose dynamic contains (modulo topological equivalence) all possible regularizations.

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On the Ogasa number

Gioia M. VAGO [1]

[1] IMB - Université Bourgogne Franche-Comté

Given a manifold M, we look for the Morse functions with the "simplest" regular levels, where the complexity of a level is the sum of its Betti numbers. The Ogasa number $\nu(M)$ is the integer such that any Morse function on M has at least a level of complexity $\nu(M)$, while M admits a Morse function whose regular levels have at most complexity $\nu(M)$.

In dimension 3, with Michel Boileau (AMU, Marseille, France) we have understood what this dynamical invariant measures, and we have shown how it is related to other topological, geometric and algebraic invariants of the underlying manifold.

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Singular foliations in sub-Riemannian geometry and the Strong Sard Conjecture

André Belotto da Silva[1], Alessio Figalli[2], Adam Parusiński[3], Ludovic Rifford[3]

[1] Aix-Marseille Université

[2] ETH Zurich, Department of Mathematics

[3] Université Côte d'Azur

Given a totally nonholonomic distribution of rank two Δ on a three-dimensional manifold M, it is natural to investigate the size of the set of points $\mathcal{X}^x$ that can be reached by singular horizontal paths starting from a same point $x \in M$. In this setting, the Sard conjecture states that $\mathcal{X}^x$ should be a subset of the so-called Martinet surface of 2-dimensional Hausdorff measure zero.

I will present a reformulation of the conjecture in terms of the behavior of a (real) singular foliation. Next, I will present a recent work [2] in collaboration with A. Figalli, L. Rifford and A. Parusinski, where we show that the (strong version of the) conjecture holds in the analytic category and in dimension 3. Our methods rely on resolution of singularities of surfaces, foliations and metrics; regularity analysis of Poincaré transition maps; and on a simpletic argument, concerning a transversal metric of an isotropic singular foliation.

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

10 – Geometry and Dynamics of Constant Curvatures Spaces - Room 224

Time	Thursday, 18	Friday, 19
14:30 - 15:20	**Lucas Kaufmann** (National University of Singapore) *Dynamics of correspondences and products of random matrices*	**Marcel Vinhas Bertolini** (Universidade Federal do Pará) *Kleinian Representations and $\mathbb{R}$-trees*
15:30 - 16:20	**Martin Mion-Mouton** (Université de Strasbourg) *Partially hyperbolic diffeomorphisms and lagrangeancontact structures in dimension three*	**Uirá Matos** (IME-USP) *Pseudo-metric preserving Anosov Actions*
16:30 - 16:45	Coffee	
16:45 - 17:35	**Leon Carvajales** (Sorbonne Université & Universidad de la República) *Anosov representations and counting in some PSO(p, q)-symmetric spaces*	**Thierry Barbot** (Avignon Université, France) *Anosov Representations and Lorentzian space-times*
17:45 - 18:35	**Misha Belolipetsky** (IMPA) *Free subgroups of 3-manifold groups*	

Dynamics of correspondences and products of random matrices

Lucas Kaufmann [1]

[1] National University of Singapore

Let X be a compact Riemann surface. A holomorphic correspondence f on X is a multi-valued holomorphic map from X to itself. Each point of X has d images and d' pre-images counting multiplicity. As in the case of maps, we can iterate f and study its dynamics. When d and d' are different the global dynamics of f is well understood and f admits a canonical invariant probability measure.

In this talk I will present some results concerning the case $d = d'$. We show that, under a mild and necessary condition that we call non weak modularity, f admits two canonical probability measures μ^+ and μ^- which are invariant by f^* and f_* respectively. These measures enjoy many good properties and describe the distribution of images and pre-images of f

As an application, we can consider group actions on the Riemann sphere. In that case we recover and improve some classical results about products of random two by two matrices. This is joint work with T.-C. Dinh and H. Wu.

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Partially hyperbolic diffeomorphisms and lagrangean-contact structures in dimension three

Martin Mion-Mouton[1]

[1] IRMA, Université de Strasbourg

Whereas numerous examples of partially hyperbolic diffeomorphisms are known in dimension three, we know very few examples of them having smooth stable and unstable distributions. The rigidity of this situation relies on the smooth geometric structure (E^s, E^u), which happens to be a *rigid geometric structure* in dimension three if the sum $E^s \oplus E^u$ is a contact distribution. In this case, (E^s, E^u) is called a *lagrangean-contact structure*, and in this talk, we will introduce these structures, and adress the question of the interaction between lagrangean-contact structures and partially hyperbolic diffeomorphisms in dimension three. We will present some progresses made on the study of this question, with an emphasis on the new problems that it raises, and on the specific tools adapted to this situation.

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Anosov representations and counting in some $\mathrm{PSO}(p,q)$-symmetric spaces.

León Carvajales [1]

[1] Sorbonne Université - Universidad de la República.

For positive integers p and q consider a quadratic form on $\mathbb{R}^{p+q}$ of signature (p,q) and let $\mathrm{O}(p,q)$ be its group of linear isometries. We study counting problems in the Riemannian symmetric space of $\mathrm{PSO}(p,q)$ and in the pseudo-Riemannian hyperbolic space of signature $(p,q-1)$. The space X of q-dimensional subspaces of $\mathbb{R}^{p+q}$ on which the quadratic form is negative definite is the Riemannian symmetric space of $\mathrm{PSO}(p,q)$. Let

$$\rho : \Gamma \longrightarrow \mathrm{PSO}(p,q)$$

be a projective Anosov representation and $S \subset X$ be a totally geodesic copy of the Riemannian symmetric space of $\mathrm{PSO}(p,q-1)$. For certain choices of S we prove that

$$\#\{\gamma \in \Gamma : \quad d_X(S, \rho\gamma \cdot S) \leq t\} \tag{1}$$

is finite for all $t \geq 0$ and show a purely exponential asymptotic of (1) as t goes to infinity. We provide an interpretation of this result in the pseudo-Riemannian hyperbolic space of signature $(p,q-1)$, as the counting of lengths of space-like geodesic segments in the orbit of a point.

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Free subgroups of 3-manifold groups

Mikhail Belolipetsky
IMPA

We show that any cocompact Kleinian group Γ has an exhaustive filtration by normal subgroups Γ_i such that any subgroup of Γ_i generated by k_i elements is free, where $k_i \geq [\Gamma : \Gamma_i]^C$ and $C = C(\Gamma) > 0$. Together with this result we prove that $\log k_i \geq C_1 \mathrm{sys}_1(M_i)$, where $\mathrm{sys}_1(M_i)$ denotes the systole of M_i, thus providing a large set of new examples for a conjecture of Gromov. In the second theorem $C_1 > 0$ is an absolute constant. We also consider a generalization of these results to non-compact finite volume hyperbolic 3-manifolds.

In the talk, I will discuss the proofs of these theorems and some related open problems. This is a joint work with Cayo Dória.

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Kleinian Representations and $\mathbb{R}$-trees

Marcel Vinhas Bertolini [1]

[1] Universidade Federal do Pará

Let ϕ be a L-biLipschitz self-homeomorphism of a 3-manifold of the form $\mathbb{H}^3/\Gamma$, where Γ is a Kleinian group – possibly infinitely generated. Consider the space $\mathcal{R}_\phi$ of Kleinian representations ρ of Γ such that $\rho \circ \phi_* = f_* \circ \rho$ for a L-biLipschitz self-homeomorphism f of $\mathbb{H}^3/\rho(\Gamma)$, where ϕ_* and f_* denote induced group-automorphisms. Call ϕ "generating" if the HNN-extension of Γ associated to ϕ_* is finitely generated. We extend results of Morgan-Shalen-Bestvina-Paulin and show that: for generating ϕ, if a sequence $\rho_n \in \mathcal{R}_\phi$ does not contain convergent subsequences, then it contains a subsequence that converges projectivelly to an isometric action of Γ on an $\mathbb{R}$-tree. Further properties and generalizations will be discussed. This is a joint work with André de Carvalho (IME-USP).

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Pseudo-metric preserving Anosov Actions

Uirá N. Matos de Almeida[1],

[1] IME-Universidade de São Paulo

We propose the study of Anosov action of $\mathbb{R}^k$ with smooth invariant bundles and which preserves a pseudo-Riemannian metric g. On this talk, we show that under some circumstances, this action is conjugate to an affine action on a homogeneous space $\Gamma\backslash G/H$. This is a partial extension of Y. Fang's ([1]) work on flows and represents one more step towards Kalinin-Spatzier's ([2]) conjecture on the algebraicity of abelian Anosov actions of higher rank.

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Anosov Representations and Lorentzian space-times.

Thierry Barbot [1]

[1] Avignon University

In this talk, I will give an overview on two decades of development of the theory of representations of Gromov hyperbolic groups into SO(2,n), inspired by the geometric feature involved in General Relativity and impulsed by the pioneering paper [6] (pre-published in 1992).

I will also explain how the preprint [1], as partially explained in [7], open the way to a generalization of the main results in [2, 5, 3], summarized in [4], leading to an AdS/CFT correspondence in a new context of multi-black holes in AdS geometry.

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11 – Elliptic Equations and Minimal Surfaces - Multiuso Room

Time	Monday, 15	Tuesday, 16	Friday, 19
14:30 - 15:20	**Paolo Piccione** (Universidade de São Paulo) *Solutions of the Yamabe problem on noncompact manifolds via squeezing*	**Frank Pacard** (École Polytechnique) *TBA*	**Lucas Ambrozio** (IAS) *Volume of closed Riemannian manifolds and geometric invariants related to their area-minimising hypersurfaces*
15:30 - 16:20		**Benoît Daniel** (Université de Lorraine) *Constant mean curvature surfaces and parallel mean curvature surfaces in product manifolds*	**Pieralberto Sicbaldi** (Universidad de Granada & Université de Marseille) *Overdetermined elliptic problems in exterior domains*
16:20 - 16: 40		Coffee	
16:40 - 17:30		**Alvaro Ramos** (Univ. Federal do Rio Grande do Sul) *Moves preserving hyperbolicity of link complements*	**Martin Traizet** (Université de Tours) *On the area of Lawson minimal surfaces in the 3-sphere*
17:40 - 18:30		**Marcio Batista** (Universidade Federal de Alagoas) *Rigidity of manifolds admitting a local minimum of an Energy Functional*	

Solutions of the Yamabe problem on noncompact manifolds via squeezing

Paolo Piccione [1]

[1] IME - USP

The Yamabe problem on noncompact manifolds asks for a complete metric with constant scalar curvature in a given conformal class. Unlike its compact counterpart, this problem may have no solutions. In this talk I will discuss a multiplicity result in manifolds that are conformally equivalent to products M x S, where M is a compact manifold with positive scalar curvature, and S is either the hyperbolic or the Euclidean space. The desired solutions are obtained by "squeezing" some compact quotients of M x S.

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Entire solutions of the Allen-Cahn equation in low dimensions

Frank Pacard [1]

[1] École Polytechnique

I will report some results concerning the Allen-Cahn equation in Euclidean space, emphasizing the rôle played by minimal surfaces in construction of solutions. I will mostly concentrate on the description of entire solutions of the Allen-Cahn equation in low dimensional Euclidean spaces.

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Constant mean curvature surfaces and parallel mean curvature surfaces in product manifolds

Benoît Daniel[1], Iury Domingos[2], Feliciano Vitório[3]

[1] Université de Lorraine

[2] Université de Lorraine and Universidade Federal de Alagoas

[3] Universidade Federal de Alagoas

We classify constant mean curvature surfaces with constant intrinsic curvature in the product manifolds $\mathbb{S}^2 \times \mathbb{R}$ and $\mathbb{H}^2 \times \mathbb{R}$, where $\mathbb{S}^2$ and $\mathbb{H}^2$ denote respectively the constant curvature 2-sphere and the hyperbolic plane. As a consequence, using Torralbo and Urbano's correspondence, we classify parallel mean curvature surfaces with constant intrinsic curvature in $\mathbb{S}^2 \times \mathbb{S}^2$ and $\mathbb{H}^2 \times \mathbb{H}^2$.

Moves preserving hyperbolicity of link complements

Álvaro Ramos[1], Colin Adams[2], William Meeks III[3]

[1] Universidade Federal do Rio Grande do Sul

[2] Williams College

[3] UMass, Amherst

Given a link Γ in a 3-manifold P such that the complement $P \setminus \Gamma$ admits a complete hyperbolic metric of finite volume, we provide two potential alterations to the link, called the Chain Move and the Switch Move, that preserve hyperbolicity of the complement, with only a few manifold-link pair exceptions. These allow for a substantial increase in the number of known hyperbolic links in the 3-sphere and other 3-manifolds. Using such moves, we prove that any surface with admissible finite topology (i.e. negative Euler characteristic) can be realized as a properly embedded, totally geodesic surface in some complete hyperbolic 3-manifold of finite volume.

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Rigidity of manifolds admitting a local minimum of an Energy Functional

Márcio Batista [1], José I. Santos[2],

[1] Federal University of Alagoas

[2] Federal Institute of Alagoas

In this talk, we will consider Riemannian manifolds admitting non-trivial solutions of a PDE obtained from a variational problem. In this setting, it is well known that there is a notion of stability and this allows us to use some ideas of Schoen and Yau to handling the stability operator and so, under suitable hypotheses, get a necessary condition for a Riemannian manifold to admit a stable solution. Furthermore, under the non-negativity of the Ricci curvature, we also obtain information about stable solutions. This is joint work with J. I. Santos.

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Volume of closed Riemannian manifolds and geometric invariants related to their area-minimising hypersurfaces.

Lucas Ambrozio [1], Rafael Montezuma[2]

[1] Institute for Advanced Study

[2] Princeton University

The variational methods used to find closed embedded minimal submanifolds in a closed Riemannian manifold define several notions of "systole" and "width", which can be regarded as functionals on the space of Riemannian metrics. In this talk, we will focus on the properties of some of these functionals on the space of unit volume metrics, mainly when the underlying manifolds are real projective spaces and the minimal submanifolds associated to the functionals are of minimising type. This is joint work with Rafael Montezuma.

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Overdetermined elliptic problems in exterior domains.

Pieralberto Sicbaldi [1]

[1] Université d'Aix-Marseille (France) and Universidad de Granada (Spain)

Overdetermined elliptic systems of the form

$$\begin{cases} \Delta u + f(u) = 0 & \text{in} \quad \Omega \subset \mathbb{R}^n, n \geq 2 \\ u = 0 & \text{on} \quad \partial\Omega \\ \frac{\partial u}{\partial \vec{n}} = \text{constant} & \text{on} \quad \partial\Omega \end{cases}$$

appear in many problems in Physics and Applied Mathematics. In this talk, I will consider overdetermined elliptic systems in exterior domains, i.e. domains that are the complement of a compact region. I will present a symmetry results with classification of solution for the case where the PDE is a Allen-Cahn type equation, and a perturbation results with the construction of new solutions in the case where the PDE is the Nonlinear Schroedinger equation.

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On the area of Lawson minimal surfaces in the 3-sphere

Martin Traizet [1], Lynn Heller[2], Sebastian Heller[3]

[1] University of Tours, France

[2] University of Hannover, Germany

[3] University of Hamburg, Germany

Lawson has constructed minimal surfaces in the 3-sphere which have genus k and area less than 8π. They are conjectured to minimize the Willmore energy amongst compact surfaces of genus k. We construct Lawson surfaces by integrable system (DPW) methods and obtain a precise estimate of their area as k goes to infinity.

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12- Graph Theory - Room 349

Time	Thursday, 18	Friday, 19
14:30 - 15:30	Chair: Jayme L. Szwarcfiter (UFRJ) **Yoshiko Wakabayashi** (USP) *Decomposing highly connected graphs into paths of any given length*	Chair: Diana Sasaki Nobrega (UERJ) **Ana Shirley Silva** (UFC) *b-colorings and related problems*
15:30 - 16:30	Chair: Nelson Maculan **Leo Liberti** (École Polytechnique) *Distance Geometry and Data Science*	Chair: Sulamita Klein (UFRJ) **Ignasi Sau** (LIRMM, Montpellier) *Hitting minors on graphs of bounded treewidth*
16:30 - 16:45	Coffee	
16:45 - 17:45	Chair: Cláudia Linhares Sales (UFC) **Philippe Michelon** (Université d'Avignon) *Financial tools for the French-Brazilian cooperation in Mathematics*	Chair: Celina Miraglia Herrera de Figueiredo (UFRJ) **Mario Valencia-Pabon** (Université Paris-Nord) *Hom-idempotent graphs, normal Cayley graphs and stable Kneser graphs*
17:45 - 18:45	Chair: Raphael Carlos Santos Machado (INMETRO, UFF) **Guilherme Dias da Fonseca** (Université Clermont Auvergne) *Fast Algorithms for Geometric Intersection Graphs*	Chair: Simone Dantas de Souza (UFF) **Sylvain Gravier** (Université Joseph Fourier) *Games on hypergraph*

Decomposing highly connected graphs into paths of any given length

Yoshiko Wakabayashi

University of São Paulo

In 2006, Barát and Thomassen conjectured that, for each tree T, there exists a constant k_T such that, if G is a k_T-edge-connected graph and $|E(G)|$ is a multiple of $|E(T)|$, then G can be edge-decomposed into copies of T. In a series of papers, starting in 2008, Thomassen verified this conjecture for stars, some bistars, paths of length 3, and paths whose length is a power of 2. In 2014, we verified this conjecture when T is a path of length 5, and subsequently, for paths of any given length. In this talk we address this last result. We note that further results on this conjecture were obtained by Bensmail, Harutyunyan, Le and Thomassé (2015), who also proved this conjecture for paths, but using a different approach and weakening the condition on high edge-connectivity. In 2017, these authors, together with Merker, proved the Barát-Thomassen conjecture in its full generality. This is joint work with F. Botler (UFRJ), G. O. Mota (UFABC), and M. T. I. Oshiro (B2W), Brazil.

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Distance Geometry and Data Science

Leo Liberti[1]

[1] CNRS LIX, Ecole Polytechnique, France. liberti@lix.polytechnique.fr

Many problems in data science are defined on relational structures which are naturally represented as graphs. Many successful methods for achieving goals such as learning, clustering, statistical inference, visualization, however, require their input in vector form. Moreover, many of these methods are based, explicitly or implicitly, on the concept of distance between vectors. This requires tools for mapping graph vertices into vectors, in such a way as to keep graph distances approximately invariant. I shall survey some of the methodologies of distance geometry from this point of view [1, 2].

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Financial tools for the French-Brazilian cooperation in Mathematics

Philippe Michelon [1]

[1] Consulat général de France à Rio de Janeiro

Nowadays, research is international or is not. It is therefore very important for researchers (and their governments) to have strong and variate international collaborations. Nevertheless, international research is much more expensive than old times research, which was more local. In this talk, we will make a survey of the financial tools for supporting French-Brazilian cooperation in research in the Rio de Janeiro and Espirito Santo states.

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Fast Algorithms for Geometric Intersection Graphs

Guilherme D. da Fonseca [1]

[1] Université Clermont Auvergne

Geometric intersection graphs are graphs whose n vertices correspond to geometric objects and whose m edges correspond to pairs of intersecting objects. Several classes of geometric intersection graphs are defined by restricting the shape of the objects: disks, unit disks, squares, rectangles, etc. *Graph-based* algorithms receive as input solely the adjacency representation of the graph while *geometric* algorithms receive the geometric representation of the graph. In this talk, we consider approximation algorithms to two classic hard optimization problems: maximum independent set and minimum dominating set. We are particularly interested in algorithms whose running times are close to linear in the input size, i.e. $\widetilde{O}(n+m)$ for graph-based algorithms and $\widetilde{O}(n)$ for geometric algorithms (the $\widetilde{O}(\cdot)$ notation conceals logarithmic factors). We will discuss four different approaches to obtain such algorithms: greedy, local search, strip decomposition, and shifting coresets, comparing their performance for different problems and graph classes.

This work is based on multiple papers co-written by the author with Celina M. H. de Figueiredo, Vinicius G. Pereira de Sá, Raphael Machado, Gautam K. Das, and Ramesh K. Jallu.

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b-colorings and related problems

Ana Silva [1]

[1] Universidade Federal do Ceará

Given a proper coloring $S_1, \ldots, S_k$ of a graph G, if every vertex of S_i is non-adjacent to some color S_j, with$j \neq i$, then we can change the color of each vertex in S_i in order to get rid of this color. A coloring where this procedure cannot be applied to decrease the number of used colors is called a *b-coloring* of G. This definition was introduced in 1999 by Irving and Manlove and was the topic of my PhD thesis, finished in 2010 under the supervision of Professor Frédéric Maffray. Since then many results have been published concerning b-colorings and many interesting aspects related to it. In this presentation, I will talk about some of these aspects related to my work.

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Hitting minors on bounded treewidth graphs

Ignasi Sau[1], Julien Baste[2], Dimitrios M. Thilikos[1]

[1] CNRS, LIRMM, Université de Montpellier, Montpellier, France

[2] Institute of Optimization and Operations Research, Ulm University, Ulm, Germany

For a finite collection of graphs $\mathcal{F}$, the $\mathcal{F}$-M-Deletion problem consists in, given a graph G and an integer k, decide whether there exists $S \subseteq V(G)$ with $|S| \leq k$ such that $G \setminus S$ does not contain any of the graphs in $\mathcal{F}$ as a minor. This problem has a big expressive power, as it captures, in particular, Vertex Cover ($\mathcal{F} = \{K_2\}$), Feedback Vertex Set ($\mathcal{F} = \{K_3\}$), and Vertex Planarization ($\mathcal{F} = \{K_5, K_{3,3}\}$).

We are interested in the parameterized complexity of the $\mathcal{F}$-M-Deletion problem when the parameter is the treewidth of G, denoted by tw. Our objective is to determine, for a fixed $\mathcal{F}$, the asymptotically smallest function $f_{\mathcal{F}}$ such that $\mathcal{F}$-M-Deletion can be solved in time $f_{\mathcal{F}}(\mathsf{tw}) \cdot n^{\mathcal{O}(1)}$ on n-vertex graphs.

In this talk I will survey several results and techniques that we have obtained in the last years about this problem [1], as well as a recent result that provides a tight dichotomy on the function $f_{\mathcal{F}}$ when $\mathcal{F}$ consists of a single connected graph H.

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Hom-idempotent graphs, normal Cayley graphs and stable Kneser graphs

Mario Valencia-Pabon

LIPN - University Paris-Nord, France

In this talk, we will discuss the notion of hom-idempotence on graphs: A graph G is said to be *hom-idempotent* if there is a homomorphism from the Cartesian product $G\Box G$ to G. This notion is strong related to a special family of Cayley graphs: the normal Cayley graphs. We will mention some results concerning hom-idempotence of Kneser graphs and s-stables Kneser graphs. We will also show some applications of hom-idempotence of graphs to k-tuple colorings of graphs.

13 – Harmonic Analysis and Geometric Measure Theory – *Room 349*

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

13 - Harmonic Analysis and Geometric Measure Theory - Room 349

Time	Monday, 15	Time	Tuesday, 16	Wednesday, 17
14:30 - 15:20	**Emanuel Carneiro** (ICTP & IMPA) *Fourier restriction, Bessel functions, and beyond*	14:30 - 15:20	**Hervé Queffélec** (University of Lille-France) *Twisting a composition operator by an analytic weight*	**Emmanuel Russ** (University of Grenoble Alpes) *Existence and regularity of an optimal shape for the Laplacian with a drift*
		15:30 - 16:20	**Lucas Oliveira** (UFRGS) *Generalized T(1) theorems*	**Gustavo Hoepfner** (UFSCar) *The restriction problem with moment*
		16:30 - 16:45	Coffee	
		16:45 - 17:35	**Laurent Moonens** (Université Paris-Sud) *Almost everywhere averaging on rectangles*	**Antonin Monteil** (Université Catholique de Louvain) *Uniform boundedness principles for Sobolev maps into manifolds*
		17:45 - 18:35	**Felipe Gonçalves** (Universität Bonn) *Uncertainty Principles and Sphere Packings*	**Jean Pech Moraes** (UFRGS) *Sparse Domination and Haar Multipliers*
		18:45 - 19:35		**Alex Amenta** (Universität Bonn) *Banach-valued modulation-invariant Carleson embeddings and outer-L^p spaces: the Walsh case*

Fourier restriction, Bessel functions, and beyond

Emanuel Carneiro [1] [2]

[1] ICTP - The Abdus Salam International Centre for Theoretical Physics

[2] IMPA - Instituto de Matemática Pura e Aplicada

This talk will be a brief survey on the problem of finding the sharp forms and classifying the extremizers of some Fourier restriction inequalities. I will present some recent results on the sharp form of a mixed norm Fourier extension inequality first proposed by Luis Vega in his Ph.D. thesis (Madrid - 1988). This problem has interesting connections to questions of independent interest in the theory of special functions. The talk will be accessible to a broad audience, with a minimal background in Analysis.

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Twisting a composition operator by an analytic weight

Herve Queffelec[1], P. Lefevre[2], D.Li[3], L.Rodriguez-Piazza[4]

[1] University of Lille–France

Weighted composition operators are natural companions to composition operators acting on Hardy spaces (adjoints, isometries, etc...). Following a joint work with G. Lechner, we study the effect of a weight on a composition operator, for the best or for the worst, in terms of compactness, or membership in a Schatten class. A key role is played by Carleson measures and outer functions.

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Generalized $T(1)$ theorems

Lucas Oliveira

Universidade Federal do Rio Grande do Sul

In 1984, Guy David e Jean-Lin Journé have published their famous $T(1)$ *theorem*. In this talk we will discuss what this theorem is, its main applications, and the possible directions for possible extensions. In particular, we will discuss some results that were obtained in collaboration with Jarod Hart and Lucas Chaffee over the last 3 years.

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Almost everywhere averaging on rectangles

Laurent Moonens [1], Emma D'Aniello[2], Joseph Rosenblatt[3]
[1] Université Paris-Sud
[2] Università degli studi della Campania *Luigi Vanvitelli*} [3] Indiana University-Purdue University Indianapolis

If (B_k) is a sequence of measurable subsets (with positive Lebesgue measure) of the Euclidean space containing (or "close" to) the origin and whose diameters tend to zero, one can associate to it an approximate identity $(\chi_{B_k}/|B_k|)_{k\in\mathbb{N}}$ and the corresponding averages:

$$A_k f(x) := \frac{\chi_{B_k}}{|B_k|} * f(x).$$

While the L^p convergence of the sequence $(T_k f)$ to f for $f \in L^p(\mathbb{R}^n)$ is usually an obvious fact, the issue of its almost everywhere convergence if often delicate (it holds *e.g.* if (B_k) is a sequence of cubes, while it may not hold if (B_k) is a sequence of parallelepipeds without control on its "flatness"). This talk will review some recent works about those averaging processes when (B_k) is a sequence of rectangles — and about the corresponding Lebesgue's differentiation theorems in the context of differentiation bases of rectangles.

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Uncertainty Principles and Sphere Packings

Felipe Gonçalves [1]

[1] Hausdorff Center for Mathematics, Universität Bonn

In this talk we describe uncertainty principles connected with sphere packings. If both f and $\widehat{f}$ are real and eventually nonnegative, both having nonpositive total mass, then it is impossible for both f and $\widehat{f}$ be nonnegative outside an arbitrarily small neighborhood of the origin. This uncertainty principle (now we call $+1$ uncertainty) was discovered first in 2010 by Bourgain, Clozel and Kahane with applications to discriminant bounds in algebraic number theory. Recently, in joint work with Henry Cohn, we discovered a cousin uncertainty principle (now called -1 uncertainty) which is connected with bounds sphere packings densities. Adapting the modular functions technique introduced by Viazovska's solution of the 8 and 24 dimensional packing problem we were able to solve completely the $+1$ uncertainty principle in dimension 12, and thus producing for the first time an extremizer of a uncertainty inequality via modular forms. Time permitting, we will also quickly discuss some unknown numerical phenomena and open conjectures connected with the topic.

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Existence and regularity of an optimal shape for the Laplacian with a drift

Emmanuel Russ [1], Baptiste Trey [1], Bozhidar Velichkov[1]

[1] University of Grenoble Alpes

Let $D \subset \mathbb{R}^d$ be a fixed domain, $m \in (0, |D|)$ and $\tau \geq 0$. For all quasi-open sets $\Omega \subset D$ and all vector fields $V \in L^\infty(\Omega, \mathbb{R}^d)$, let $\lambda_1(\Omega, V)$ be the principal eigenvalue of the operator $L = -\Delta + V \cdot \nabla$ in Ω under Dirichlet boundary condition. We prove that the following minimization problem:

$$\min \Big\{ \lambda_1(\Omega, V) \ : \ \Omega \subset D \text{ quasi-open}, \ |\Omega| \leq m, \ \|V\|_{L^\infty} \leq \tau \Big\}$$

has a solution. If V is furthermore assumed to be the gradient of a Lipschitz function, we describe the regularity of optimal domains.

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The restriction problem with moments

Gustavo Hoepfner [1], Andrew Raich[2]

[1] Universidade Federal de São Carlos - UFSCar

[2] University of Arkansas

In these paper we introduce a new type of restriction problem, called the *restriction problem with moments*.

Essentially, the restriction problem with moments is the restriction problem applied to a measure (as in the classical case) and moments of the measure. Moments of the measure correspond to derivatives of the Fourier transform, so we are, in effect, showing that the restriction problem can hold for certain tempered distributions. This is a new phenomenon.

We show that the Fourier transform of the surface area measure of the sphere S^{d-1} satisfies the restriction problem with moments if $1 \leq p < \frac{2(d+2)}{d+3}$. We prove a similar result for the Fourier transform of a Salem measure and show that it satisfies the restriction problem with moments if $1 \leq p < \frac{2(2-2\alpha+\beta)}{4(1-\alpha)+\beta}$ for certain values of α and β.

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Uniform boundedness principles for Sobolev maps into manifolds

Antonin Monteil [1]

[1] Université Catholique de Louvain

We will discuss the existence of uniform bounds on the energy associated to the problems of weak-bounded approximation, lifting, extension (etc...) in $W^{s,p}(\mathcal{M},\mathcal{N})$, where $\mathcal{M}$, $\mathcal{N}$ are given Riemannian manifolds, $p \in [1,+\infty)$ and $s \in (0,1]$. Namely, in some regimes, including the subcritical case $sp < dim(\mathcal{M})$, we will see that each of the preceding qualitative properties implies a corresponding quantitative energy bound. For instance, if every map $u : \mathcal{M} \to \mathbb{S}^1$ lifts to $\mathbb{R}$, then it is always possible to find at least one lifting with Sobolev seminorm controlled linearly by that of u. This can be seen as a nonlinear counterpart of the Banach-Steinhaus theorem.

Sparse Domination and Haar Multipliers

Jean Carlo Moraes [1]

[1] Federal University of Rio Grande do Sul

Sparse domination has become a leading technique in Harmonic Analysis, it has been used to prove new bounds for a variety class of operators as Calderon-Zygmund, Bochner-Riesz type multipliers, oscillatory integrals and many others. In this talk, we will survey the main results in Weighted Theory dealing with sharp dependence on the characteristic norm of the operator. Moreover, we will present how to use Sparse Domination to improve the bounds of the Haar multipliers T^t_w, on the corresponding RH^d_2 or A^d_2 characteristic of the weight w, for some $t \in \mathbb{R}$.

Banach-valued modulation-invariant Carleson embeddings and outer-L^p spaces: the Walsh case

Alex Amenta[1], Gennady Uraltsev[2]

[1] Universität Bonn

[2] Cornell University

We prove modulation-invariant embedding bounds for Banach-valued functions on the 3-Walsh group into iterated outer-L^p spaces on the 3-Walsh time-frequency space. Our Banach spaces are UMD and sufficiently close to Hilbert spaces in an interpolative sense, with the RMF property after identification with a set of operators. These embedding bounds imply L^p-bounds and sparse domination for the Banach-valued tritile operator, a discrete model of the Banach-valued bilinear Hilbert transform.

1ST JOINT MEETING BRAZIL-FRANCE IN MATHEMATICS

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

14 – Holomorphic Foliations and Complex Geometry - Room 236

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:10	**Carolina Araujo** (IMPA) *On automorphisms of moduli spaces of parabolic vector bundles*	**Eleonora Di Nezza** (Sorbonne Université) *Monge and Ampère : waiting for pluripotential theory*
15:15 - 15:55	**Andre Belotto** (Aix-Marseille Université) *Monomialization of a quasianalytic morphism*	**Marianna Ravara Vago** (UFSC) *Invariant hypersurfaces and nodal components for codimension one singular foliations*
16:00 - 16:40	**Gabriel Calsamiglia** (UFF) *Branched covers and isoperiodic abelian differentials*	**Federico Lo Bianco** (Université d'Aix-Marseille) *On symmetries of codimension 1 foliations*
16:40 - 17:10	Coffee	
17:10 - 17:50	**Benoit Claudon** (Université Rennes 1) *Fundamental groups of compact Kähler threefolds*	**Jorge Vitório Pereira** (IMPA) *Codimension one foliations on projective manifolds*
18:00 - 18:40	**Marcos Jardim** (UNICAMP) *Foliations by curves on threefolds*	**Laurent Meersseman** (Université d'Angers) *Quantum Torics*

On automorphisms of moduli spaces of parabolic vector bundles

Carolina Araujo

IMPA

Parabolic vector bundles were introduced by Mehta and Seshadri in the 1970's in order to generalize to curves with cusps the classical Narasimhan-Seshadri correspondence between stable vector bundles on smooth projective curves and unitary representations of their fundamental groups. Let C be a smooth complex projective curve and fix distinct points $p_1, \ldots, p_n \in C$. A *parabolic vector bundle* on $\big(C, p_1, \ldots, p_n\big)$ is a vector bundle E on C with the additional data of a flag on the fiber over each parabolic point p_i. A choice of weights $\mathcal{A}$ for the parabolic flags yields a notion of slope-stability, and there is a projective moduli space $\mathcal{M}_{\mathcal{A}}$ of semistable parabolic vector bundles having a fixed determinant line bundle. Different choices of weights usually yield different moduli spaces, coming from variation of GIT.

In this talk, we will consider the case when $C \cong \mathbb{P}^1$ is the complex projective line, the vector bundles have rank 2, and the flags are given by parabolic directions $V_i \subset E_{p_i}$ over each parabolic point. In this special case, the weight vector $\mathcal{A} = (a_1, \ldots, a_n)$ consists of an n-uple of real numbers $0 \leq a_i \leq 1$, and the different moduli spaces $\mathcal{M}_{\mathcal{A}}$ are well described. Under some restrictions on the weights, we determine and give a modular interpretation of the automorphism groups of $\mathcal{M}_{\mathcal{A}}$. This is a joint work with Thiago Fassarella, Inder Kaur and Alex Massarenti.

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Monomialization of a quasianalytic morphism

André Belotto da Silva [1], Edward Bierstone[2],

[1] Aix-Marseille Université

[2] University of Toronto

I will present a monomialization theorem for mappings in general classes of infinitely differentiable functions that are called quasianalytic (work in collaboration with Edward Bierstone). Examples include Denjoy-Carleman classes (of interest in real analysis), the class of infinitely differentiable functions which are definable in a given polynomially bounded o-minimal structure (in model theory), as well as the classes of real- or complex-analytic functions, and algebraic functions over any field of characteristic zero. The monomialization theorem asserts that mapping in a quasianalytic class can be transformed to mapping whose components are monomials with respect to suitable local coordinates, by sequences of simple modifications of the source and target (local blowings-up and power substitutions in the real cases, in general, and local blowings-up alone in the algebraic or analytic cases). It is not possible, in general, to monomialize by global blowings-up, even in the real analytic case.

The problem of monomialization has been considered a problem in algebraic geometry, and has an extensive literature. The result has previously been proved in the algebraic and analytic cases by D. Cutkosky, using valuation theory. Our point of view is rather that of analysis, and we develop a calculus of derivations tangent to the fibres of a morphism, which is valid for any class satisfying the quasianalytic axioms. Applications of monomialization include results on the rectilinearization of sub-quasianalytic sets, that were obtained by J.-P. Rolin and T. Servi using model-theoretic techniques.

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Branched covers and isoperiodic abelian differentials

Gabriel Calsamiglia

Universidade Federal Fluminense

I will discuss special properties of isoperiodic sets of abelian differentials on stable curves constructed via families of branched covers of low degree over elliptic curves (joint work with B. Deroin and S. Francaviglia).

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Fundamental groups of compact Kähler threefolds

Benoît Claudon[1], Andreas Höring[2], Hsueh-Yung Lin[3]

[1] Université Rennes 1

[2] Université Nice-Sophia-Antipolis

[3] Mathematisches Institut der Universität Bonn

This talk will be concerned with the Kodaira problem for the fundamental group which consists in asking whether the fundamental group of a compact Kähler manifold can be also realized as the fundamental group of a smooth projective variety. I will explain how to get a positive answer to this question in dimension 3.

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Foliations by curves on threefolds

Marcos Jardim [1]

[1] University of Campinas, Brazil

We show that codimension two foliations with at most isolated singularities on certain smooth projective 3-folds with rank one Picard group have stable tangent sheaves. For non generic foliations by curves, we also provide a formula to count the number of connected components of the pure 1-dimensional scheme consisting of non-isolated singularities. Next, we focus on the projetive space $\mathbb{P}^3$ and provide a full classification of foliations by curves of degree 1, plus a classification of foliations of degrees 2 and 3 of local complete intersection type. This is joint work with Alana Cavalcante and with Mauricio Correa and Simone Marchesi.

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Monge and Ampère : waiting for pluripotential theory

Eleonora Di Nezza[1], Tamás Darvas[2], Chinh Lu[3]

[1] Laboratoire IMJ-PRG, Sorbonne Université, Paris, France

[2] Department of Mathematics, University of Maryland, College Park, MD, United States

[3] Laboratoire de Mathématiques d'Orsay, Universiteé Paris-Saclay, Orsay, France

A fondamental problem in Kähler geometry is to look for canonical metrics on a Kähler manifold, where the word "canonical" means that the metric satisfies a curvature condition. Such geometric problem boils down to a complex non-linear PDE of Monge-Ampère type. In the last 50 years the study of the regularity of solutions of such equations (elliptic and parabolic) has motivated a lot of works. I will give a survey of what is known in this direction (also in singular settings), emphasising how the developments in pluripotential theory were crucial in order to treat (singular) complex Monge-Ampère equations.

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Invariant hypersurfaces and nodal components for codimension one singular foliations

Marianna Ravara Vago [1], Felipe Cano[2], Jean-François Mattei[3]

[1] UFSC (Brasil)

[2] Universidad de Valladolid (Spain)

[3] Université Paul Sabatier de Toulouse (France)

It is known that there is at least one invariant analytic curve passing through each of the components in the complement of nodal singularities, after reduction of singularities of a germ of singular foliation in $\mathbb{C}^2, 0$ (Camacho-Sad Theorem). Here, we prove a generalization of this property to any ambient dimension.

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On symmetries of codimension 1 foliations

Federico Lo Bianco [1], Jorge Vitório Pereira[2], Erwan Rousseau[3], Frédéric Touzet[4]

[1] University of Aix-Marseille

[2] IMPA

[3] University of Aix-Marseille

[4] University of Rennes 1

Given a codimension 1 foliation $\mathcal{F}$ on a projective manifold X, we study groups $G \leq (X, \mathcal{F})$ of birational transformations of X which preserve $\mathcal{F}$; in particular, we seek conditions for G to be finite or, more generally, to induce a finite permutation group of the space of leaves (in such case we say that the action of G is transversely finite). We show finiteness for general type foliations with tame singularities and transverse finiteness for (non-virtually euclidean) transversely projective foliations. In this talk I will focus on the latter result and show how the presence of a transverse structure (projective, hyperbolic, spherical...) and the analysis of the resulting monodromy representation allow to reduce to the case of modular foliations on Shimura varieties and to conclude.

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Codimension one foliations on projective manifolds

Jorge Vitorio B. dos S. Pereira

IMPA

Review of old and new results on the global structure of singular holomorphic foliations on projective manifolds and their moduli spaces. A substantial portion of the theory under review is the fruit of French-Brazilian collaborations.

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Quantum Torics

Laurent Meersseman [1], Ludmil Katzarkov[2], Ernesto Lupercio[3] , Alberto Verjovsky[4]

[1] Laboratoire Angevin de Recherhe en Mathématiques, Université d'Angers, F-49045 Angers Cedex, France

[2] University of Miami, Department of Mathematics, PO Box 249085, Coral Gables, FL 33124-4250

[3] Departamento de Matemáticas, Cinvestav, Av. IPN #2508, Col. San Pedro Zacatenco, D.F., México

[4] Instituto de Matemáticas, Universidad Nacional Autonoma de México, Cuernavaca, México

In this talk, I will outline the construction of Quantum Torics. Classical Toric Varieties are algebraic varieties encoded in a fan whose generators belong to a lattice of integer points in some $\mathbb{C}^d$. Quantum Torics are stacks encoded in a fan whose generators belong to an arbitrary additive subgroup of some $\mathbb{C}^d$ that may be dense. If time permits, I will intoduce the moduli space of such Torics.

1ST JOINT MEETING BRAZIL-FRANCE IN MATHEMATICS

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

15 – Mathematical Logic - Room 333

Time	Thursday, 18	Friday, 19
14:30 - 15:00	**Valeria de Paiva** (Samsung Research America) *Benchmarking Linear Logic Proofs*	**Max Dickmann** (CNRS, Institut de Mathématiques de Jussieu) *Faithfully Quadratic Rings*
15:00 - 15:30	**Jean-Baptiste Joinet** (Lyon University & Centre Cavaillès) *Closure by bi-orthogonality : an unifying tool for classification theory*	**Francisco Miraglia** (University of São Paulo) *Special groups and quadratic forms over rings with non zero-divisor coefficients*
15:30 - 16:00	**Giorgio Venturi** (University of Campinas) *Infinite forcing and the generic multiverse*	**Christina Brech** (University of São Paulo) *Rigidity in combinatorial Banach spaces*
16:00 - 16:30	**Hugo Luiz Mariano** (IME-USP) *A Galois group functor for the category of Special Groups*	**Samuel G. da Silva** (Federal University of Bahia) *Reductions between certain incidence problems and the Continuum Hypothesis*
16:30 - 16:45	Coffee	
16:45 - 17:15	**Elaine Pimentel** (UFRN) *Focused proof systems for geometric theories*	**Bruno Lopes** (Universidade Federal Fluminense) *A logical framework to reason about Reo circuits*
17:15 - 17:45	**Alexandre Miquel** (ENS de Lyon) *Implicative algebras: a new foundation for realizability and forcing*	**Juliana Bueno-Soler** (University of Campinas) *A P F-polynomial calculus representing plain fibring of matrices*
17:45 - 18:15	**Hermann Haeusler** (Pontifical Catholic of University of Rio de Janeiro) *Huge Propositional Proofs are Redundant: Towards a proof that NP=PSPACE*	**Luiz Carlos Pereira** (Pontifical Catholic of University of Rio de Janeiro) *Revisiting Gödel's Koan*
18:15 - 18:45	**Walter Carnielli** (University of Campinas) *How a computer should think about evidence*	**Gilles Dowek** (Inria & Ecole normale supérieure de Paris-Saclay) *Logical frameworks, reverse mathematics, and formal proofs translation*

Benchmarking Linear Logic Proofs

Valeria de Paiva[1], Carlos Olarte and Elaine Pimentel[2], Giselle Reis[3]

[1] Samsung Research America, USA

[2] Universida Federal do Rio Grande do Norte, BR

[3] Carnegie Mellon University, Qatar

Benchmarking automated theorem proving (ATP) systems using standardized problem sets is a well-established method for measuring their performance. The availability of these benchmarks for non-classical logics is very limited, but we recently proposed such a library for Girard's (propositional) intuitionistic linear logic. In this talk I want to build on this previous work, to propose a new use for benchmarking proofs. I want to use the computer generated proofs we assembled before, to investigate translations between Kleene's intuitionistic theorems in his monograph "Introduction to Metamathematics" and their possible versions in Linear Logic.

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Closure by bi-orthogonality : an unifying tool for classification theory

Jean-Baptiste Joinet[1], Thomas Seiller[2]

[1] IRPhiL, Lyon University & Centre Cavaillès (ENS Paris)

[2] CNRS, LIPN, University Paris-Nord

* Supported by Action Capes-Cofecub Sh-873 17

In the recent decades, the closure by bi-orthogonality methodology underwent an increasing spread at the interface between Computing theory and Logic, being notably used to define the notion of *type* (as sets of processes closed by bi-orthogonality, for an orthogonality binary relation between processes and contexts defined in terms of the computational dynamic).

In this talk, we will analyse the typing by bi-orthogonality methodology from a more general, unifying point of view, where orthogonality is defined w.r.t. any binary relation R (i.e. independently of any dynamical perspective). In particular, we will see how one recovers the main classical concepts of Theory of classification by varying the particular properties of the relation R.

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Infinite forcing and the generic multiverse

Giorgio Venturi [1]

[1] University of Campinas. IFCH

In this talk we discuss the application of Robinson infinite model theoretic forcing to the generic multiverse obtained by forcing (à la Cohen) over a countable transitive model of ZFC. We discuss the closure properties of the infinite generic models thus obtained, showing an interesting connection between these structures and generic absoluteness principles as Bounded Forcing Axioms and Maximality Principles.

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A Galois group functor for the category of Special Groups

Hugo Luiz Mariano

[1] University of São Paulo, IME-USP, hugomar@ime.usp.br

The relationship between Galois groups of fields with orderings and quadratic forms, established by the works of Artin-Schreier (1920's) and Witt (late 1930's) are reinforced by a seminal paper of John Milnor ([5], 1971) through the definition of a (mod 2) k-theory graded ring that "interpolates" the graded Witt ring and the cohomology ring of fields: the three graded rings constructions determine functors from the category of fields where 2 is invertible that, almost tree decades later, are proved to be naturally isomorphic by the work of Voevodsky with co-authors.

Since the 1980's, have appeared many abstract approaches to the algebraic theory of quadratic forms over fields that are essentially equivalent (or dually equivalent): between them we emphasize the (first-order) theory of special groups developed by Dickmann-Miraglia. The notions of (graded) Witt rings and k-theory are extended to the category of Special groups with remarkable pay-offs on questions on quadratic forms over fields ([2], [3]).

In the present ongoing work we extended to (well-behaved) Special Groups the work of J. Mináč and Spira ([6]) that describes a (pro-2)-group of a field extension that encodes the quadratic form theory of a given field F: in [1] it is shown that its associated cohomology ring is contains a copy of the cohomology ring of the field F. Our construction, a contravariant functor $G \in SG \mapsto Gal(G) \in Pro-2-groups$, is essentially given by generators and relations

of profinite-2-groups. We prove that such profinite groups $Gal(G)$ encodes the space of orders of the special group G and provide a criteria to detect when G is formally real or not. We calculate the Galois groups associated to some of the main constructions of special groups like quotients, directed colimits and extensions. The next step is to develop and understand the associated cohomology ring, relating it with k-theory functor of the special groups, and apply such machinery to questions on Special Groups theory.

This is a joint work with Kaique Mathias de Andrade Roberto, IME-USP.

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Focused proof systems for geometric theories

Elaine Pimentel[1], Dale Miller[2], Sonia Marin[3], Marco Volpe[4]

[1] UFRN, Brazil

[2] École Polytechnique, France

[3] IT-University, Danmark

[4] Fortiss Research Institute, Germany

In the past years, there has been a great effort in order to systematically add non-logical axioms to first order logics, so that standard proof-theoretical results obtained for pure logic could be extended to the case of a certain class of mathematical theories. The main challenge is to determine a general procedure that guarantees that extensions are *smooth*, in the sense that good proof-theoretical properties, such as analyticity, are preserved.

Both semantic and syntactic approaches have been proposed for such a task. As an example for the first approach, in [4], Kracht establishes a correspondence between special rules and modal axioms in the setting of tense modal logic, result further generalized in [3] for logics with algebraic semantics based on bounded distributive lattices. On the other hand, Ciabattoni et al. [1] introduce a systematic procedure for transforming large classes of (Hilbert) axioms into equivalent structural inference rules in sequent and hypersequent substructural calculi. Analyticity for hypersequent calculi is proved semantically. Interestingly enough, both works use Ackermann lemma based algorithms in order to uniformly construct rules out of axioms. Considering syntactic methods only, in a series of works [7, 5, 6, 2, 8], Negri et al. introduce a general method for the representation of axioms as rules of inference of a suitable form. Their method is restricted to a certain form of axioms, called *geometric*, and it consists on converting simple conjuncts of formulas into their well known rule representations, so that that the logical content of the axiom is replaced by the meta-linguistic meaning of sequent rules. It should be noted that the method assumes some artificial conditions in order to assure the admissibility of contrac-

tion and, unlike Ciabattoni's work, it does not explore axioms falling outside the class of geometric axioms.

In this work, we strive at combining the rigor of the classification of axioms into a polarities' hierarchy with a systematic proof-theoretical construction of inference rules from axioms, using *focusing*. We show that, in fact, focusing *justifies* the inclusion of a class of axioms that *subsumes* the geometric ones, also shedding some light on the behavior of formulas falling outside this class. Moreover, our approach enables a uniform presentation for classical and intuitionistic first order systems.

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Implicative algebras: a new foundation for realizability and forcing

Alexandre Miquel [1]

[1] Instituto de Matemática y Estadística "Rafael Laguardia"

Facultad de Ingeniería, Universidad de la República, Montevideo, Uruguay

In this talk, we will present the notion of implicative algebra, a simple algebraic structure intended to factorize the model-theoretic constructions underlying forcing [1, 2, 4] and realizability [5, 7, 8] (both in intuitionistic and classical logic). We shall see that the salient feature of this structure is that its elements can be seen both as truth values and as (generalized) realizers, thus blurring the frontier between proofs and types. We will show that each implicative algebra induces a (Set-based) tripos [3], using a construction that is reminiscent from the construction of a realizability tripos from a partial combinatory algebra. Relating this construction with the corresponding constructions in forcing and realizability, we will see that implicative triposes encompass all forcing triposes (both intuitionistic and classical), all classical realizability triposes [6, 9], all intuitionistic realizability triposes built from partial combinatory algebras, and actually all (Set-based) triposes [3].

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Huge Propositional Proofs are Redundant: Towards a proof that NP=PSPACE

Edward Hermann Haeusler [1] and **Lew Gordeev**[2]

[1] Pontifical Catholic of University of Rio de Janeiro

[2] Tuebingen Universität

We discuss an argument in favour of NP=PSPACE. Any exponentially sized linearly bounded height proof Π of a formula A in implicational minimal logic is highly redundant. This is expressed by the fact that there is at least one derivation Π^* that occurs exponen-

tially many times as sub derivation of Π. This is a consequence that any tree-like proof is labeled with linearly many formulas (subformulas from A) and the proof is linearly height-bounded. May exists more than one (different) derivation that occur exponentially many times as sub-derivations of Π. They and the way that they glue in each other to form the proof itself raises a kind of spectral analysis of proofs, components are the occurring derivations and the analysis is the way they combine, by means of repetitions to the whole proof. We decompose exponentially linearly height-bounded proof into, somehow, combinations of polynomially sized derivations. This combination resembles the horizontal compression method we presented previously in [1]. We show a new horizontal compression, based on rewriting rules, that obtains a polynomially sized dag-like (compressed) proof of A. We provide polynomial algorithm for the verification of the validity of dag-like proofs.

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How a computer should think about evidence

Walter Carnielli[1]

[1] University of Campinas - CLE

Evidence, probability, and logic are related in several ways, and reasoning with evidence is a philosophical topic with strong interest for machine learning and AI. I discuss an intuitively appealing probabilistic semantics for LET_F, a paracomplete and paraconsistent extension of the logic of First-Degree Entailment (FDE) expanded with operators for consistency $\circ\alpha$ and inconsistency $\bullet\alpha$. I show that LET_F is suitable for an interpretation in terms of preservation of non-conclusive and conclusive evidence, the later being understood as truth. Extending work done in [2], evidence can be quantified by giving a probabilistic semantics for LET_F in terms of measures of evidence.

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Faithfully Quadratic Rings

Max Dickmann

CNRS, Institut de Mathématiques de Jussieu – Paris Rive Gauche

Université de Paris, France

I'll describe the main features of an extension of the classical algebraic theory of quadratic from fields to a broad class of (commutative, unitary) rings; full development appears in [1]. This extension applies to:

- Diagonal forms with invertible coefficients [1].
- Rings where 2 is invertible, endowed with a proper preorder (in particular, -1 is not a sum of squares).

The extension is achieved by:

- Extending the notion of matrix isometry of quadratic forms to a suitable notion of **T-isometry**, where T is a preorder of the base ring A, or $T = A^2$, and

- Introducing in this context three axioms expressing simple properties of (value) representation of ring elements by quadratic forms, well-known to hold in the field case.

Under these axioms the ring-theoretic approach based on T-isometry coincides with the formal, abstract approach formulated in terms of reduced special groups, cf. [2]. Preordered rings $< A, T >$ satisfying these axioms are called **T-faithfully quadratic**.

In [1] we prove that the following classes of preordered rings (among others) are T-faithfully quadratic:

- Rings with many units satisfying a mild restriction (for all preorders T).
- Reduced f-rings (for any preorder T containing the underlying partial order of A). An outstanding class of examples of this type are the rings of continuous real-valued functions on a topological space.
- Strongly representable rings (i.e., bounded inversion preordered rings $< A, T >$ with an Archimedean preorder T).

For all these classes we can determine the reduced special group $G_T(A)$ canonically associated to $< A, T >$.

Most of the structural properties involving quadratic forms known to hold for fields extend to (T)-faithfully quadratic rings.

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Special groups and quadratic forms over rings with non zero-divisor coefficients

F. Miraglia *

In all that follows, the word **ring** will stand for a reduced (0 is its only nilpotent element), unitary, semi-real (-1 is not a sum of squares) commutative ring, in which 2 is a unit. Recall that a formula in a first-order language with equality is **Horn-geometric** if it is the negation of an atomic formula or the form $\forall \overline{v}(\varphi(\overline{v}) \rightarrow \psi(\overline{v}))$, where φ and $\psi$are **primitive positive (pp)**, that is, of the form $\exists \overline{y}\ \theta(\overline{y}; \overline{v})$, where θ is a conjunction of atomic formulas.

In [1] and [2], it is shown that there is a set of Horn-geometric axioms so that if a p-ring $\langle R, P \rangle$, where P is either proper preorder of the ring R or $P = R^2$, then there is a special group, $G := G_P(R)$, canonically associated to $\langle R, P \rangle$, so that both P-isometry and P-representation of diagonal quadratic forms with unit coefficients in R is faithfully coded by the corresponding concepts in G. It is then shown that a very significant class of preordered rings satisfy this axioms, that in turn yields significant information on the properties of ring-theoretic representation and isometry of these types of quadratic forms (see [1] and [2] for more details).

The present talk reports on joint work with M. Dickmann (Institut de Mathématiques de Jussieu – Paris Rive Gauche (IMJ-PRG))and Hugo Ribeiro (IME-USP), endeavoring to extend the results in [1] and [2] to diagonal quadratic forms over preordered rings, whose coefficients are *non zero-divisors*. We show that also in this case there are Horn-geometric axioms so that if a p-ring, $\langle R, P \rangle$, satisfies these axioms, then there is a special group $G_{NP}(R)$, so that ring-theoretic P-representation and P-isometry of these forms is faithfully coded by the corresponding concepts in $G_{NP}(R)$. We then prove that if X is a completely regular topological space, both the ring of bounded real valued continuous functions and the full ring of real valued continuous functions on X satisfy these axioms. The perspective is to extend these results to even wider classes of rings (e.g., reduced f-rings, rings with many units, Archimedean bounded inversion rings, among others), as well as to relate the present pursuit to the results in [1] and [2].

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Rigidity in combinatorial Banach spaces

Christina Brech [1]

[1] University of São Paulo

A combinatorial Banach space $X_{\mathcal{F}}$ is a Banach space defined as the completion of some norm defined on the vector space $c_{00}(\mathbb{N})$. The norm is induced by a compact family $\mathcal{F}$ of finite subsets of $\mathbb{N}$ with certain properties, and this can be generalized to the uncountable setting.

In our talk, we will present results which relate the combinatorial properties of the family $\mathcal{F}$ and the geometric properties of its corresponding Banach space $X_{\mathcal{F}}$, in particular in terms of rigidity.

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Reductions between certain incidence problems and the Continuum Hypothesis

Samuel G. da Silva [1]

[1] UFBA Federal University of Bahia, samuel@ufba.br

In this work, we consider two families of incidence problems, $\mathcal{C}_1$ and $\mathcal{C}_2$, which are related to real numbers and countable subsets of the real line. Instances of problems of $\mathcal{C}_1$ are as follows: given a real number x, pick randomly a countable set of reals A hoping that $x \in A$, whereas instances of problems of $\mathcal{C}_2$ are as follows: given a countable set of reals A, pick randomly a real number x hoping that $x \notin A$. One could arguably defend that, at least intuitively, problems of $\mathcal{C}_2$ are easier to solve than problems of $\mathcal{C}_1$. After some suitable formalization, we prove (within **ZFC**) that, on one hand, problems of $\mathcal{C}_2$ are, indeed, at least as easy to solve as problems of $\mathcal{C}_1$. On the other hand, the statement "Problems of $\mathcal{C}_1$ have the exact same complexity of problems of $\mathcal{C}_2$" is shown to be an equivalent of the Continuum Hypothesis (**CH**).

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A logical framework to reason about Reo circuits

Bruno Lopes[1]

[1] Instituto de Computação

Universidade Federal Fluminense

Critical systems require high reliability and are present in many applications. Standard software engineering techniques are not sufficient to ensure that there are no unacceptable failures and/or critical requirements are fulfilled. The verification and certification of systems still present challenges and, in this context, Reo is a language tailored to simplify the modeling of the connection of components. This talk intends to present some efforts on the construction of a logical framework to certificate and reason about Reo circuits. The approach adopted consists of the construction of tools that translate these languages into formal models for tools that automate the verification and validation of the models. In this framework, it is included a compiler using the Coq framework, the translation to a model checker and initial studies on the combination with dynamic logics to develop a native proof theory.

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A PF-polynomial calculus representing plain fibring of matrices

Juliana Bueno-Soler[1], Mariana Matulovic[2],

[1] University of Campinas

[2] São Paulo State University

Our aim is to propose a method which produces an algebraic polynomial representation for a fibred product of logics $L_1 \oplus L_2$, starting from the algebraic representation of the components L_1 and L_2.

As there are different methods to combine logics, we expect that to each one there will be a corresponding method to combine polynomial ring calculi, introduced in [1]. In this work we restrict our analysis to the method of plain fibring, proposed in [2], by proposing a method for combining polynomial calculi called *PF-Polynomial Calculus* that preserves the product obtained by plain fibring.

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Revisiting Gödel's Koan

Luiz Carlos Pereira [1], Edward Hermann Haeusler[2], Daniel Durante[3]

[1] PUC-Rio/UERJ

[2] PUC-Rio

[3] UFRN

In 1938, Gentzen published a new version of the consistency proof for elementary arithmetic ([3]). In this proof he used for the second time transfinite induction up to the ordinal ϵ_0. In 2015 Dag Prawitz (see [7]) proved for the first time Gentzen's result for a Natural Deduction formalization of Peano's arithmetic and showed in a very interesting way how the fundamental ideas in Gentzen's proof were related to the elimination of (local) detours in Natural Deduction. We can describe the general structure of Gentzen's proof as follows: Consider a formulation of arithmetic in sequent calculus.

1. Define an assignment Ord of ordinals $< \epsilon_0$ to proofs in the system.
2. Define a set of reduction operations OP.
3. Show that if there is a proof Π of the empty sequent in the system, then there is always an operation op $\in$ OP such op[Π] is a proof of the empty sequent and Ord[op[Π] $<$ Ord[Π] .
4. The result immediately follows by transfinite induction up to ϵ_0.

In 1982 (see [6]) it was shown that the reductions used by Gentzen in this new version of the consistency could be used to obtain a cut-elimination proof for Gentzen's LK. The proof was carried out by induction on a natural number assignment to proofs in LK. This assignment produced a better estimation for the length of cut-free proofs in LK. It was shown in 1996 (see [4]) that in the case of the propositional fragment of LK, Gentzen's reductions always yield a smaller natural number and hence that they could be used to obtain a strong cut-elimination result for this fragment. This natural number assignment, that depends solely on the structure of the proof, obviously provides a bound for the longest reduction sequence. It was suggested in the paper that the same result could be obtained for the propositional fragment of the intuitionistic system FIL, a system where the usual cardinality restriction on the consequent of intuitionistic sequents is replaced by a sort of restriction on dependency relations (see [1]).

In 1968 William Howard proposed an assignment of ordinals $< \epsilon_0$ to terms for primitive recursive functionals of finite type with the property that the reduction of a term always lowers its ordinal measure. It was Howard's assignment that motivated the apearence in 2014 of problem 26 (submitted by Henk Barendregt) in the TLCA list of open problems, the so-called Gödel's Koan.

"Statement: Assign (in an "easy" way) ordinals to terms of the simply typed lambda calculus such that reduction of the term yields a smaller ordinal."

We will examine in this paper several strategies to solve Gödel's Koan and propose an extension of Gentzen's assignment and reductions to the implicational fragment of LJ that, under certain conditions, can be considered an "easy"solution to Gödel's Koan.

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Logical frameworks, reverse mathematics, and formal proofs translation

Gilles Dowek [1]

[1] Inria and École normale supérieure de Paris-Saclay

Logical systems such as Geometry, Set theory, Simple type theory, or the Calculus of constructions, can either be defined as autonomous systems or as theories expressed in a logical framework, such as predicate logic. The latter definition allows to decompose them into a number of ingredients (for instance: axioms) and to analyze which proof uses which ingredient. This is the basis of the design of algorithms translating formal proofs from one theory to another and to interoperability between computerized proof processing systems based on different theories.

But to do so, we need new logical frameworks, allowing bound variables, explicit proof-terms, computation rules, and peaceful coexistence of constructive and non constructive proofs.

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1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

16 – Metric and Hyperbolic Geometry - Multiuso Room

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:30	**Françoise Dal'Bo** (Université de Rennes 1) *Co-amenability and Geometry*	**Jean Raimbault** (Université Toulouse III) *Topology of arithmetic hyperbolic manifolds*
15:30 - 16:30	**André de Carvalho** (Universidade de São Paulo) *Convergence of sequences pseudo-Anosov homeomorphisms and of hyperbolic 3-manifolds*	**Gisele Teixeira Paula** (Universidade Federal do Espírito Santo) *Height Estimates for Bianchi Groups*
16:30 - 16:45	Coffee	
16:45 - 17:45	**Florent Balacheff** (Université de Lille & Universitat Autónoma de Barcelona) *Length product of homologically independent closed geodesics*	**Marcos Cossarini** (IMPA) *Discrete geometry of surfaces towards the filling area conjecture*

Co-amenability and Geometry

Françoise Dal'Bo[1], Rémi Coulon[2], Andrea Sambusetti[3]

[1] Université de Rennes

[2] Université de Rennes

[3] Universita La Sapienza

Take a group G acting by isometries on a $CAT(-1)$-space. Suppose that its action is convex-cocompact. Let H be a subgroup of G. Under which conditions on H the growth rates of G and H are the same?

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Convergence of sequences pseudo-Anosov homeomorphisms and of hyperbolic 3-manifolds

André de Carvalho
IME – USP

Two theorems of Thurston associate 'canonical' objects to a pseudo-Anosov mapping class on a surface: a pseudo-Anosov homeomorphism in the class and a hyperbolic structure on its mapping torus. Having called them 'canonical' it might seem natural to expect that limiting processes in both classes of objects – the class of pseudo-Anosov maps and that of hyperbolic 3-manifolds – also correspond to one another. We show that this is not the case by exhibiting a family of braids $\{\beta_q;\, q \in \mathbb{Q} \cap (0, 1/3]\}$ with the following properties: on the one hand, there is a homeomorphism $\varphi_0 \colon S^2 \to S^2$ to which the (suitably normalized) pseudo-Anosov homeomorphisms $\varphi_q \colon S^2 \to S^2$, associated to the mapping class determined by β_q, converge as $q \to 0$; on the other hand, there are infinitely many distinct hyperbolic 3-manifolds which arise as geometric limits of sequences of the form $\lim_{k\to\infty} M_{\beta_{q_k}}$, for sequences $q_k \to 0$. The proof uses Dehn surgery techniques, combined with experiments with the program SnapPy and some luck.

This is joint work with S. Bonnot, J. Gonzáles-Meneses and T. Hall.

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Length product of homologically independent closed geodesics

Florent Balacheff [1], Steve Karam[2], Hugo Parlier[3]

[1] Autonomous University of Barcelona

[2] Lebanese University

[3] University of Luxembourg

In this talk, we will consider generalizations of Minkowski's second theorem to Riemannian and Finsler manifolds. For example we will explain why graphs, Finsler tori or Finsler surfaces with normalized volume always admit a $\mathbb{Z}_2$-homology basis induced by closed geodesics whose length product is bounded from above by some constant depending only on their topology. Based on a joint work with S. Karam and H. Parlier.

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Topology of arithmetic hyperbolic manifolds

Jean Raimbault

Université Paul Sabatier, Toulouse

I this talk I will present a panorama of instances where arithmetic congruence hyperbolic manifolds (and orbifolds) have a much stronger relation than general hyperbolic manifolds between their geometric invariants (mainly the hyperbolic volume) and their purely topological invariants (genus, betti numbers and some other). The talk consists mostly of material from joint work with Mikołaj Frączyk [1] and Steffen Kionke [2].

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Height Estimates for Bianchi Groups

Gisele Teixeira Paula [1], Cayo Dória[2]

[1] Universidade Federal do Espírito Santo - UFES

[2] Universidade de São Paulo - USP

Consider the action of Bianchi groups on the hyperbolic space $\mathbb{H}^3$. We obtain, for the case with class number 1, an upper estimate for the height of a matrix that takes a point in $\mathbb{H}^3$ into the fundamental domain of the group. Siegel sets were used as auxiliary sets in this computation. As a corollary, fixed a Bianchi group, we give an estimate for the number of possible intersections of any Siegel set with their translates by the group. We can also give an estimate for the height of matrices that reduce positive binary quadratic Hermitian forms.

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Discrete geometry of surfaces towards the filling area conjecture

Marcos Cossarini [1]

[1] Université Paris-Est Marne-la-Vallée

Is the hemisphere a minimal isometric filling of its boundary circle, or can it be replaced by a Riemannian surface of smaller area without reducing the distance between any pair of boundary points? Gromov posed the question and proved the strict minimality of the Euclidean hemisphere among surfaces homeomorphic to a disk. Ivanov considered more general Finsler metrics and proved that the Euclidean hemisphere is still minimal among Finsler disks, but it is not the unique minimizer. In this talk I will discuss a discrete version of the problem: Can a cycle graph of length $2n$ be filled isometrically with a square-celled combinatorial surface made of less than $\frac{n(n1)}{2}$ cells? (The filling is said isometric if the distance between each pair of boundary vertices, measured along the 1-skeleton graph of the filling surface, is not smaller than the distance along the boundary cycle.) This discrete question is equivalent to the continuous problem for self-reverse Finsler metrics and is related to pseudoline arrangements. If time permits, we will discuss also a version of the problem for directed metrics, which is related to simplicial sets and plabic graphs

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1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

17 – Nonlinear Parabolic and Elliptic PDE's and their Applications - Room 228

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:10	**Cyril Imbert** (CNRS & IMPA) *Schauder estimates for kinetic equations*	**Gabrielle Nornberg** (ICMC) *Regularity of fully nonlinear equations with superlinear gradient growth*
15:10 - 15:50	**Flavio Dickstein** (UFRJ) *Positive solutions of a semilinear heat equation with singular nonlinear term*	**Edgard Pimentel** (PUC-Rio) *Improved regularity theory for degenerate diffusions*
15:50 - 16:30	**Marek Fila** (Comenius University) *Continuation beyond interior gradient blow-up in a semilinear parabolic equation*	**François Hamel** (Aix-Marseille University) *Bistable transition fronts in unbounded domains*
16:30 - 16:45	Coffee	
16:45 - 17:25	**Nicolas Vauchelet** (Université Paris 13) *Mathematical modeling of spatial propagation of Wolbachia to control dengue spread*	**Hugo Tavares (**Universidade de Lisboa) *Least energy nodal solutions of Hamiltonian elliptic systems with Neumann boundary conditions*
17:25 - 18:05	**Olivier Ley** (Univ. Rennes) *Mean Fields Games on networks*	**Ederson Moreira dos Santos** (USP) *Sobolev embeddings of G-symmetric functions and applications*
18:05 - 18:45	**Diego Moreira** (UFC) *New regularity results on the regularity of semiconvex supersolutions and convex envelope of supersolutions to fully nonlinear Elliptic PDEs*	**Jean-Michel Roquejoffre** (Université Paul Sabatier) *Large time behaviour in multi-dimensional FisherKPP equations*

Schauder estimates for kinetic equations

Cyril Imbert [1]

[1] UMI J.-C. Yoccoz (CNRS & IMPA)

This talk is concerned with Schauder estimates for kinetic equations with either integral or local diffusions. A Schauder estimate relates a higher order Hölder norm with the Hölder norm of the right hand side of the equation under the assumption that the coefficients are also Hölder continuous. After presenting the proper Hölder spaces to work with, we will review two Schauder estimates, one for local equations and one for integral diffusions. Joint works with C. Mouhot (Cambridge) and L. Silvestre (Chicago).

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Positive solutions of a semilinear heat equation with singular nonlinear term

Flávio Dickstein [1]

[1] Universidade Federal do Rio de Janeiro

We study the existence of positive solutions $u(t,x)$ of the homogeneous Dirichlet problem for the equation $u_t - \Delta u = f(t,x,u)$ on a bounded domain $\Omega \subset \mathbb{R}^N$. Here $f(t,x,z) \to \infty$ as $z \to 0$. A model problem is $f(z) = z^{-\gamma}$, $\gamma \in (0,1]$.

We present some existence and uniqueness results. We also discuss the long time behavior of the solutions, showing that under appropriate assumptions that $u(t,x)$ converges to the stationary solution of the corresponding elliptic problem.

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Continuation beyond interior gradient blow-up in a semilinear parabolic equation

Marek Fila, Johannes Lankeit

Comenius University, Slovakia

It is known that there is a class of semilinear parabolic equations for which interior gradient blow-up (in finite time) occurs for some solutions. We construct a continuation of such solutions after gradient blow-up. This continuation is global in time and we give an example when it never becomes a classical solution again.

Mathematical modeling of spatial propagation of Wolbachia to control dengue spread

Nicolas Vauchelet [1], Grégoire Nadin [2], Martin Strugarek[3], Jorge Zubelli[4]

[1] Université Paris 13

[2] Sorbonne Université and CNRS

[3] Sorbonne Université

[4] IMPA

Aedes mosquitos are the main vectors of several diseases like dengue, chikungnya, zika. New strategies of control consist in acting on the mosquitos population. For example, it has ben observed that when a mosquito is infected by the bacteria Wolbachia it cannot transmit such diseases. Moreover, Wolbachia is transmitted from mother to offspring and is characterized by a cytoplasmic incompatibility. Then a strategy of fight against arboviruses consists in releasing Wolbachia infected mosquitoes. After presenting the mathematical modeling of the spatial spread of this bacteria thanks to reaction-diffusion equations, we investigate the success of the spatial invasion thanks to local releases and the influence of spatial heterogeneities.

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Mean Fields Games on networks

Olivier Ley [1], Yves Achdou[2], Manh-Khang Dao[3] Nicoletta Tchou[4]

[1] Univ Rennes, INSA Rennes, CNRS, IRMAR - UMR 6625

[2] Univ. Paris Diderot, Sorbonne Paris Cité, LJLL, UMR 7598, UPMC, CNRS

[3] Department of Mathematics, KTH Royal Institute of Technology, Stockholm

[3] Univ Rennes, CNRS, IRMAR - UMR 6625

We consider Mean Field Games (MFG) for which the state space is a network. More precisely, we consider a coupled system of a backward in time Hamilton-Jacobi-Bellman (HJB) equation and a forward in time Fokker-Planck (FP) equation. The solution u of the HJB equation is the value function of the optimal control problem for a representative agent and the solution m of the Fokker-Planck equation is the density of the distribution of the players. The main difficulty is to deal with the transition conditions at the vertices of the network: The function u is continuous and satisfies general Kirchhoff conditions at the vertices whereas the density m satisfies dual transmission conditions and is discontinuous in general. We will discuss the well-posedness of the system in two cases. The first one is concerned with elliptic systems related to infinite stochastic MFG and the second one addresses parabolic problems related to finite horizon stochastic MFG.

New regularity results on the regularity of semi-convex supersolutions and convex envelope of supersolutions to fully nonlinear Elliptic PDEs

Diego Moreira[1], Alessio Figalli[2], J. Ederson Braga[3]

[1] UFC-Brazil

[2] ETH-Zurich

[3] UFC-Brazil

In this talk, I will briefly discuss some new developments on the regularity of semi-convex supersolutions of fully nonlinear PDEs and well as the convex envelope of supersolutions. This extends the $C^{1,1}$ regularity of L. Caffarelli (for the convex envelope) as well as the apriori estimate obtained by Cafarelli, Kohn, Nirenberg, and Spruck (for semi-convex supersolutions) in the 80's.

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Regularity of fully nonlinear equations with superlinear gradient growth

Gabrielle Nornberg [1],

[1] ICMC - Universisty of São Paulo

In this talk we discuss some recent results which extend Caffarelli-Świech-Winter regularity and estimates to a class of fully nonlinear uniformly elliptic partial differential equations of second order in nondivergence form, with superlinear growth in the gradient and measurable coefficients.

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Improved regularity theory for degenerate diffusions

Edgard A. Pimentel [1]

[1] Department of Mathematics, PUC-Rio

In this talk we discuss recent developments concerning the regularity of the solutions certain classes of degenerate diffusions. First, we examine a fully nonlinear model, with a state-dependent degeneracy rate. In this context, we produce results on the Hölder-regularity of the solutions. In the sequel, we tackle a variational problem. In this case, we produce improved regularity for the p-Poisson equation, importing information from the Laplacian operator. Of particular interest here, is a sequential stability result. We finish the talk with a number of consequences of our findings and a few related directions of research yet to be pursued.

Bistable transition fronts in unbounded domains

François Hamel [1]

[1] Aix-Marseille University

The standard notions of reaction-diffusion fronts can be viewed as examples of generalized transition fronts describing the invasion of a state by another one. These notions involve uniform limits, with respect to the geodesic distance, to a family of time-dependent hypersurfaces. The existence of transition fronts has been proved in various contexts where the standard notions of fronts make no longer sense. Even for homogeneous equations, fronts with various non-planar shapes or with varying speeds are known to exist. In this talk, I will report on some recent existence results and qualitative properties of transition fronts for bistable equations. I will also discuss their mean speed of propagation in various domains, such as the whole space, exterior domains or domains with cylindrical branches. The talk is based on some joint works with H. Berestycki, H. Guo, H. Matano and W.-J. Sheng.

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Least energy nodal solutions of Hamiltonian elliptic systems with Neumann boundary conditions

Hugo Tavares[1], Alberto Saldaña[2]

[1] Universidade de Lisboa

[2] Karlsruhe Institute of Technology

In this talk we will discuss existence, regularity, and qualitative properties of solutions to the Hamiltonian elliptic system system

$$\begin{cases} -\Delta u = |v|^{q-1}v & \text{in } \Omega, \\ -\Delta v = |u|^{p-1}u & \text{in } \Omega, \\ \partial_\nu u = \partial_\nu v = 0 & \text{on } \partial\Omega, \end{cases}$$

with $\Omega \subset \mathbb{R}^N$ bounded, both in the sublinear $pq < 1$ and superlinear $pq > 1$ problems, in the subcritical regime. In balls and annuli we show that least energy solutions (l.e.s.) are *not* radial functions, but only partially symmetric (namely foliated Schwarz symmetric). A key element in the proof is a new L^t-norm-preserving transformation, which combines a suitable flipping with a decreasing rearrangement. This combination allows us to treat annular domains, sign-changing functions, and Neumann problems, which are non-standard settings to use rearrangements and symmetrizations. Our theorems also apply to the scalar associated model, where our approach provides new results as well as alternative proofs of known facts.

Sobolev embeddings of G-symmetric functions and applications

Ederson Moreira dos Santos [1]

[1] Universidade de São Paulo - São Carlos - Brazil

Let $N > kp$, $B \subset \mathbb{R}^N$ be the open unit ball centered at zero and let G be a closed connected subgroup of $SO(N)$. Consider the Sobolev space of G-symmetric functions

$$W_G^{k,p}(B) = \{u \in W^{k,p}(B);\ u \circ g = u \text{ for all } g \in G\}.$$

In this talk I will prove some new embeddings of the type $W^{k,p}(B) \hookrightarrow L^q(B, |x|^\alpha)$, with q higher than the classical critical Sobolev exponent $\frac{pN}{N-kp}$. For each $x \in S^{N-1}$ denote by $d(xG)$ the dimension of the orbit xG.

- I will stress the role played in these embeddings by the minimal dimension
$$d_G = \min_{x \in S^{N-1}} d(xG).$$
- Prove the symmetry breaking for G-symmetric groundstate solutions of the Hénon equation.
- Show that G-symmetric ground state solutions of the Hénon equation concentrates and blow up around G-minimal orbits.

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Large time behaviour in multi-dimensional Fisher-KPP equations

Jean-Michel Roquejoffre [1]

[1] Institut de Mathématiques, Université Paul Sabatier, Toulouse, France

The question dealt with in this talk is the large time behaviour of the solutions of the Fisher-KPP (Kolmogorov, Petrovskii, Piskunov) equation, one of the simplest looking reaction-diffusion equations. In one space dimension the level sets of the solution starting from a Heaviside initial datum will converge, in some Galilean reference frame, and up to an additional nontrivial logarithmic time delay, to constants. This result was proved by Bramson in the early 80's, using elaborate probabilistic arguments.
A little later, Gärtner provided the following multi-dimensional extension: in every direction, the level sets of an initially compactly supported solution will spread linearly in time, modulo a dimension dependent correction, that is asymptotically logarithmic.
In this talk, we will explain the following more precise result: in every direction, the level sets will stabilise, in the Gärtner reference frame, to a constant position that will, in general, depend on the direction. Joint work with L. Rossi and V. Roussier.

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1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

18 – Organization Principles for Living Systems - Room 206

Time	Thursday, 18	Friday, 19
14:30 - 15:20	**Maria-Soledad Aronna** (EMAp/FGV) *Modeling and analysis of the contribution of fish farming to the population of the anopheles mosquito and its impact in malaria transmission*	**Paulo Amorim** (UFRJ) *Reaction-diffusion and individual-based models for ant movement*
15:30 - 16:20	**Pierre-Alexandre Bliman** (Sorbonne Université) *Feedback Control Principles for Biological Control of Dengue Vectors*	**Lionel Roques** (INRIA) *Modelling the evolution of asexuals: PDE, integrodifferential and stochastic approaches*
16:30 - 16:45	Coffee	
16:45 - 17:35	**Nicolas Vauchelet** (Université Paris 13) *Mosquito population control strategies for the fight against arboviruses*	**Luis Almeida** (Université Pierre et Marie Curie) *Mathematical models of resistance and resistance to cancer treatments and simple therapy optimization*
17:45 - 18:35	**Boyan Sirakov** (PUC - Rio) *Stationary states of reaction-diffusion-advection systems with inhomogeneous diffusion*	**Jorge Zubelli** (IMPA) *Quantifying the survival uncertainty of Wolbachia-infected mosquitoes in a spatial model*

Modeling and analysis of the contribution of fish farming to the population of the anopheles mosquito and its impact in malaria transmission

M. Soledad Aronna[1], Felipe Antunes[1], Cláudia Codeço[2]

[1] Escola de Matemática Aplicada EMAp/FGV, Rio de Janeiro, Brazil

[2] Fiocruz, Rio de Janeiro, Brazil

It has been observed that in the Amazonic region of Acre, in the West of Brazil, fish farming contributes to the transmission of Malaria [1, 2]. This activity is carried out in artificial ponds that have become attractive spaces for mosquitoes to lay their eggs. Evidence has been found indicating that cleaning the vegetation from the edges of the crop tanks helps to control the size of the mosquito population [1, 2]. In this work, we introduce a model that represents the relation between fish ponds, the mosquito population and the transmission of malaria. We use this model to quantify the effective contribution of the fish tanks to the epidemic. The model consists of a system of nonlinear ordinary differential equations with jumps in the cleaning instants, which act as "impulsive controls". We study the asymptotic behavior of the system in function of the intensity and periodicity of the cleaning [3, 4].

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Feedback Control Principles for Biological Control of Dengue Vectors

Pierre-Alexandre Bliman[1]

[1] Sorbonne Université, Université Paris-Diderot SPC, Inria, CNRS, Laboratoire Jacques-Louis Lions, équipe Mamba, F-75005 Paris, France

Controlling diseases such as dengue fever, chikungunya or zika by spreading the parasitic bacterium *Wolbachia* in mosquito populations which are their vectors, is considered a promising tool to reduce their spread. While description of the conditions of such experiments has received ample attention from biologists, entomologists and applied mathematicians, the effective scheduling of the releases remains an interesting issue for Control theory. Having in mind the important uncertainties on the dynamics of the two populations in interaction, we attempt here to identify general ideas for building release strategies, applicable to various models and situations. These principles are exemplified by two interval observer-based feedback control laws whose stabilizing properties are demonstrated when applied to an ODE model retrieved from [1]. Crucial use is made of the theory of monotone systems [3]. See [2] for details.

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Mosquito population control strategies for the fight against arboviruses

Nicolas Vauchelet [1], Luis Almeida[2], Michel Duprez[2], Yannick Privat[3], Martin Strugarek[2]

[1] Université Paris 13

[2] Sorbonne Université

[3] Université de Strasbourg

In the fight against arboviruses, new strategies consist in acting directly on the population of mosquitoes, which are the main vector for diseases like dengue, chikungunya, zika. Among these strategies, we may consider the Wolbachia strategy and the sterile insect technique. These two strategies consist in releasing mosquitoes in the field in order to, either replace the wild population by a population unable to transmit arboviruses for the Wolbachia strategy, or diminish the size of the population of mosquitoes for the sterile insect technique. In this presentation we will consider the mathematical modelling of theses strategies and focus on the question of optimization of the releases in the aim to be as close as possible of the desired state at the end of the period of treatment.

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Stationary states of reaction-diffusion-advection systems with inhomogeneous diffusion

Boyan Sirakov[1],

[1] PUC-Rio

We obtain classification, solvability, and nonexistence theorems for positive stationary states of reaction-diffusion-advection systems involving a balance between repulsive and attractive terms. This class of systems contains PDE arising in biological models of Lotka-Volterra type, in physical models of Bose-Einstein condensates, and in models of chemical reactions. We consider general heterogeneous media, and even controlled inhomogeneous diffusions.

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Reaction-diffusion and individual-based models of ant movement

Paulo Amorim [1]

[1] Instituto de Matemática, Universidade Federal do Rio de Janeiro

We develop two distinct approaches to modeling, simulation, and mathematical analysis of ant movement. In the first approach, we consider a system of reaction-diffusion equations of chemotaxis type modeling ant foraging dynamics [2]. We present a thorough mathematical analysis of the system [1]. In the second approach, we present and discuss an individual based model for ant movement which takes into account the rules for individual response to pheromones. For this model, we present stability results, and discuss the emergence of collective behavior, including spontaneous trail formation [3]. This is joint work with R. Alonso, T. Goudon, and F. Peruani.

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Modelling the evolution of asexuals: PDE, integro-differential and stochastic approaches

Lionel Roques [1], Jimmy Garnier[2], Marie-Eve Gil[1,3], François Hamel[3], Florian Lavigne[1,3,4], Guillaume Martin[4]

[1] BioSP - INRA - Avignon

[2] LAMA - CNRS - Chambery

[3] I2M - Aix-Marseiille University

[4] ISEM - CNRS - Montpellier

The genetic adaptation of asexual organisms to a previously unfavorable niche underlies a wide range of biological processes, such as biological invasions by alien organisms, host shifts in pathogens or the emergence of resistance to pesticides or antibiotics. We develop here several PDE approaches (integro-differential equations, nonlocal equations on generating functions and free boundary approaches) to follow the dynamics of the fitness distribution in an asexual population, under the effects of selection and mutation. Using these approaches, we explore the behavior of the fitness distribution under different types of assumptions on the fitness effects of mutations (beneficial, deleterious, fitness-dependent, anisotropic). We compare our results with empirical results given by stochastic individual-based simulations of Wright-Fisher type models.

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Mathematical models of resistance and resistance to cancer treatments and simple therapy optimization

Luis Almeida[1],

[1] Université Pierre et Marie Curie

Some simple mathematical phenotype structured population models for cancer cells allow us to describe the dynamics of persistent and resistant behaviors in tumor cell populations subject to chemotherapy. We will also see how a further simplification of these models can be used to get some insight into simple strategies that may help optimizing the treatment protocols in order to avoid the appearance of resistance.

Quantifying the survival uncertainty of Wolbachia-infected mosquitoes in a spatial model

Jorge P. Zubelli[1], Martin Strugarek[2], Nicolas Vauchelet[3]

[1] LAMCA, Instituto Nacional de Matemàtica Pura e Aplicada, IMPA, Rio de Janeiro, RJ 22460-320, Brazil zubelli@gmail.com

[2] Sorbonne Université, CNRS, UMR 7598, Laboratoire Jacques-Louis Lions, F-75005, Paris, France. martin.strugarek@gmail.com

[3] LAGA, UMR 7539, CNRS, Université Paris 13 - Sorbonne Paris Cité, Université Paris 8, 99 avenue Jean-Baptiste Clément, 93430 Villetaneuse - France. vauchelet@math.univ-paris13.fr

This talk concerns a spatially distributed model for the spread of Wolbachia-infected mosquitoes in an Aedes aegypti population and its success as far as non-extinction probabilities are concerned. More precisely, we obtain lower bounds so as to quantify the success probability of spatial spread of the introduced population according to a mathematical model. The underlying framework is based on existing nonlinear reaction-diffusion models.

Artificial releases of Wolbachia-infected Aedes mosquitoes have been under study in the past years for fighting vector-borne diseases such as dengue, chikungunya and zika. Several strains of this bacterium cause cytoplasmic incompatibility (CI) and can also affect their host's fecundity or lifespan, while highly reducing vector competence for the main arboviruses.

We measure the success of a field release by the sustained rate of Wolbachia infection it achieves (usually 1 - invasion - or 0 - extinction). Space plays a crucial role in the choice of the release protocol and the problem contains many uncertainties, on estimating biological parameters of the native population or of the introduced individuals as well as on assessing the population distribution after a release. We obtain both theoretical and numerical lower bounds for the probability of release success and give new quantitative results concerning the one (space) dimensional case.

This is joint work with Nicolas Vauchelet and Martin Strugarek (Paris).

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

19 – Partial Differential Equations - Room 345

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:30	**Abigail Folha** (Universidade Federal Fluminense) *H-Graphs in $\mathbb{H}\times\mathbb{R}$*	**Marcos Calvacante** (Universidade Federal de Alagoas) *Fully Nonlinear Conformal Equations and hypersurfaces of the hyperbolic space*
15:30 - 16:30	**Nicolas Marque** (Université Paris 7) An exploration of bubbling phenomenons for Willmore surfaces	**Marina Ville** (CNRS) *Local and global topology of minimal surfaces in $\mathbb{R}^4$*
16:30 - 16:45	Coffee	
16:45 - 17:45	**Gabriela Wanderley** (Universidade Federal da Paraíba) *A half-space theorem for graphs of constant mean curvature $0 < H < 1/2$ in $\mathbb{H}^2\times\mathbb{R}$*	**Rafael Montezuma** (Princeton Univeristy) *Extremal metrics for the min-max width*
17:45 - 18:45	**Phillipe Castillon** (Univeristé de Montpellier) *Prescribing the Gauss curvature of hyperbolic convex bodies*	**Romain Petrides** (Université Paris 7) *Critical metrics for Laplace eigenvalues on Riemannian surfaces*

H-Graphs in $\mathbb{H} \times \mathbb{R}$

Abigail Folha [1],

[1] Universidade Federal Fluminense

We give necessary and sufficient conditions to the existence of graphs over unbounded domains in $\mathbb{H} \times \mathbb{R}$ having infinite boundary values and constant mean curvature $H, 0 < H < 1/2$, where $\mathbb{H}$ is the hyperbolic plane. We also give some geometric properties and applications of these graphs.

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An exploration of bubbling phenomenons for Willmore surfaces

Nicolas Marque [1],

[1] Université Paris Diderot

The Willmore energy naturally arises as a measure of how curved an immersed surface in $\mathbb{R}^3$ is, with interesting applications to general relativity (namely the Hawking mass). Critical points of this energy are called Willmore surfaces, and sequences of Willmore surfaces are subject to concentration-compactness phenomenons, and thus to bubbling. After exposing the state of the art I will study the specific case of simple minimal bubbles and detail consequences on the compactness of Willmore surfaces below certain thresholds.

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A half-space theorem for graphs of constant mean curvature $0 < H < \frac{1}{2}$ in $\mathbb{H}^2 \times \mathbb{R}$

G.A. Wanderley [1], L. Mazet[2]

[1] Universidade Federal da Paraíba, João Pessoa, Brasil.

[2] Université Paris-Est, Laboratoire d'Analyse et de Mathématique Appliquée (UMR 8050), UPEC, UPEM, CNRS, F-94010, Créteil, France.

We study a half-space problem related to graphs in $\mathbb{H}^2 \times \mathbb{R}$, where $\mathbb{H}^2$ is the hyperbolic plane, having constant mean curvature H defined over unbounded domains in $\mathbb{H}^2$.

More precisely, we consider graphs of functions u defined in a domain $D \subset \mathbb{H}^2$ whose boundary ∂D is composed of complete arcs $\{A_i\}$ and $\{B_j\}$, such that the curvatures of the arcs with respect to the domain are $\kappa(A_i) = 2H$ and $\kappa(B_j) = -2H$. These graphs will have constant mean curvature and u will assume the value $+\infty$ on each A_i and $-\infty$ on each B_j . These domains D will be called Scherk type domains and the functions u Scherk type solutions. The existence of these graphs is assured by A. Folha and S. Melo in [2]. In this context, we prove the following result in [1].

Theorem(Wanderley, Mazet). Let $D \subset \mathbb{H}^2$ be a Scherk type domain and u be a Scherk type solution over D (for some value $0 < H < \frac{1}{2}$). Denote by $\Sigma = Graph(u)$. If S is a properly immersed CMC H surface contained in $D \times \mathbb{R}$ and above Σ, then S is a vertical translate of Σ.

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Prescribing the Gauss curvature of hyperbolic convex bodies

Philippe Castillon[1], Jérôme Bertrand[2]

[1] Institut Montpellirain Alexander Grothendieck, Universié de Montpellier.

[2] Institut de Mathématique de Toulouse, Universié Paul Sabatier.

The Gauss curvature measure of Euclidean convex body is a measure on the unit sphere which extends the notion of Gauss curvature to non-smooth bodies. Given a measure μ, Alexandrovs problem consists in finding a convex body whose curvature measure is μ. In Euclidean space, A.D. Alexandrov gave necessary and sufficient conditions on μ for this problem to have a solution, and it was observed later that proving the existence of a convex body of given curvature measure μ is equivalent to an optimal transport problem on the sphere.

In this talk I will address Alexandrovs problem for arbitrary convex bodies in the hyperbolic space. After defining the curvature measure, I will give the necessary and sufficient conditions on a measure μ to solv Alexandrov's problem in this setting, and I will explain how the optimal transport approach leads to a non-linear Kantorovich problem on the sphere, which is the weak form of a Monge-Ampère equation. Joint work with Jérôme Bertrand.

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Min-Oo conjecture for fully nonlinear conformally invariant equations.

Marcos Petrúcio Cavalcante [1], Ezequiel Barbosa[2], José Espinar[3]

[1] Universidade Federal de Alagoas

[2] Universidade Federal de Minas Gerais

[3] IMPA/Universidad de Cadiz

We show rigidity results for super-solutions to fully nonlinear elliptic conformally invariant equations in subdomains of the standard n-sphere under suitable conditions on the boundary. This proves rigidity for compact connected locally conformally flat manifolds (M, g) with boundary such that the eigenvalues of the Schouten tensor satisfy a fully nonlinear elliptic inequality and whose boundary is isometric to a geodesic sphere $\partial D(r)$, $D(r)$ a geodesic ball of radius $r \in (0, \pi/2]$ in S^n, and totally umbilical with mean curvature bounded bellow by the mean curvature of this geodesic sphere. Under the above conditions, we prove that (M, g) must be isometric to the closed geodesic ball $D(r)$.

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Local and global topology of minimal surfaces in $\mathbb{R}^4$

Marina Ville [1]

[1] Institut Denis Poisson, University of Tours, France

The talk is about local and global topological aspects of minimal surfaces in $\mathbb{R}^4$ (I will recall the definitions and basic facts). I will discuss their branch points, the knots these define and their desingularization by immersed minimal disks. I will then move on to global minimal surfaces, mention one or two open problems and explain how knots appear also in this context. I will compare and contrast with local and global complex curves in $\mathbb{C}^2$. Time permitting, I may say a word about symplectic minimal surfaces. Partly joint work with Marc Soret.

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Extremal metrics for the min-max width

1st Joint Meeting Brazil-France in Mathematics, IMPA, July 15 – 19, 2019

Speaker: Rafael Montezuma

Abstract: We present our study on the min-max width of Riemannian three-dimensional spheres. This is a natural geometric invariant which is closely related with critical values of the area functional acting on closed surfaces, and can be interpreted as the first eigenvalue of a non-linear spectrum of a Riemannian metric, as suggested by Gromov.

We will focus first on optimal bounds for the above invariant involving their volumes in a fixed conformal classes. If time permits we will discuss some general properties of extremal metrics for the min-max width.

This is all part of a joint work with Lucas Ambrozio.

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Critical metrics for Laplace eigenvalues on Riemannian surfaces

Petrides Romain [1]

[1] Université de Paris

We investigate the general link between the critical unit area metrics for eigenvalues of the Laplace operator on closed surfaces, and minimal immersions of these surfaces by eigenfunctions. We will discuss the existence of such objects by variational methods. An analogous link between the critical unit perimeter metrics of the Steklov eigenvalues on surfaces with boundary and free boundary minimal immersions will be given.

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

20 – Probability Session - Room 236

Time	Monday, 15	Time	Thursday, 18	Time	Friday, 19
14:30 - 15:20	**Giambattista Giacomin** (Paris Diderot University) *Continuum limit of random matrix products in statistical mechanics of disordered systems*	14:30 - 15:15	**Oriane Blondel** (Lyon University) *Hydrodynamic limit for a facilitated exclusion process*	14:30 - 15:20	**Ellen Saada** (Paris Descartes University) *Zero-range process in random environment*
		15:15 - 16:00	**Alexandre Gaudillière** (Aix-Marseille University) *The exponential law for the metastable kinetic Ising model*	15:20 - 16:10	**Francis Comets** (Paris Diderot University) *Renormalizing KPZ equation at weak disorder in dimension ≥ 3*
		16:00 - 16:45	**Sandro Gallo** (São Carlos Federal University) *Large Deviations for the return times in stochastic processes*	16:10 - 16:45	Coffee
		16:45 - 17:00	Coffee	16:45 - 17:35	**Stefano Olla** (Dauphine University) *Hyperbolic Hydrodynamic Limits with Boundaries*
		17:00 - 17:50	**Veronique Gayrard** (Aix-Marseille University) *Aging of mean-field spin glasses*	17:35 18:25	**Patricia Gonçalves** (IST Lisboa) *A microscopic model for the regional fractional Laplacian with several boundary conditions*
		17:50 - 18:40	**Luiz Renato Fontes** (São Paulo University) *Hierarchical hopping dynamics for the low temperature cascading 2-GREM on ergodic time scales*		

Continuum limit of random matrix products in statistical mechanics of disordered systems

Giambattista Giacomin [1]

[1] Université Paris Diderot

The talk will be about a particular weak disorder limit (*continuum limit*) of matrix products that arise in the analysis of disordered statistical mechanics systems, with a particular focus on random transfer matrices. The limit system is a diffusion model for which the leading Lyapunov exponent can be expressed explicitly in terms of modified Bessel functions, a formula that appears in the physical literature on these disordered systems. I will first present results about connecting (the leading Lyapunov exponent of) the diffusion system and (the leading Lyapunov exponent of) the matrix products. Then I will discuss the application to two specific cases: 1. the strong interaction limit of the disordered Ising model in one dimension; 2. the two dimensional Ising model with columnar disorder (McCoy-Wu model). This talk will be based on work in collaboration with Francis Comets and Rafael L. Greenblatt.

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Front progression in Kinetically Constrained Spin Models

Oriane Blondel [1], Aurelia Deshayes[2], Cristina Toninelli[2]

[1] Univ Lyon, CNRS, Université Claude Bernard Lyon 1, UMR5208, Institut Camille Jordan, F-69622 Villeurbanne, France.

[2] Laboratoire de Probabilités, Statistiques et Modélisation, UMR8001, Université Paris Diderot, Sorbonne Paris Cité, CNRS, F-75013 Paris, France.

In Kinetically Constrained Spin Models (KCSM), each site of a lattice refreshes with rate one its occupation variable to empty (respectively occupied) with probability q (respectively $p = 1 - q$), provided some of its neighbors are empty. Here, we study the non equilibrium dynamics of two one-dimensional KCSM started from a configuration entirely occupied on the left half-line and focus on the evolution of the front, namely the position of the leftmost zero. We prove, for q larger than a threshold $\bar{q} < 1$, a law of large numbers and a central limit theorem for the front, as well as the convergence to an invariant measure of the law of the process seen from the front.

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Exponential transition law for the kinetic Ising model

A. Gaudillière[1], A. Bianchi[2], P. Milanesi[3], M. E. Vares[4]

[1] CNRS - Marseille

[2] Università di Padova

[3] Universitè d'Aix-Marseille

[4] Universidade Federal do Rio de Janeiro

We prove that a metastable two-dimensional Ising model evolving at subcritical temperature in a finite but diverging box exhibits a transition from metastability to equilibrium at an asymptotically exponential time in the limit of vanishing magnetic field. We establish this result by following a pathwise approach combined with the introduction of soft-measures. We use the basics of the Wulff construction to prove that local relaxation times are short with respect to typical exit times from the basins of attraction of metastable and stable equilibria. Getting such an upper bound on local relaxation times is the key point of the proof and is based on a random path estimate inspired from block dynamics to control spectral gaps.

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Concentration bounds for stochastic chains

Sandro Gallo [1], Jean-René Chazottes[2], Daniel Y. Takahashi[3]

[1] UFSCar, Brasil

[2] École Polytechnique, France

[3] UFRN, Brasil

We present new gaussian concentration bounds in the context of stochastic chains with countable alphabet. These results apply for two regimes of interest, the case of Dobrushin uniqueness, and the case of summable continuity rate. Our results are tight in the sense that, if we relax our conditions, then there exist examples for which no gaussian concentration bounds are possible. We will also present two applications, one is a Dvoretzky-Kiefer-Wolfowitz inequality, and the other is an approximation, in the $\bar{d}$-metric, of the stochastic chain by Markov chains of increasing order.

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Aging of mean-field spin glasses

Véronique Gayrard

CNRS, Aix-Marseille University

At a microscopic level spin glasses are strongly disordered correlated systems that undergo a liquid to solid transition upon appropriate cooling but without any apparent order emerging and the resulting solids are never observed in equilibrium in laboratory experiments – instead, they undergo a slow relaxation dynamics with peculiar universal properties that physicists have termed *aging*.

The aging phenomenon opened a wealth of new problems of probability theory in connection with Markov jump processes in highly disordered random environments. The analysis of several models and dynamics in the past 15 years allowed to isolate a general mechanism that relates aging to the classical *arcsine law* for stable subordinators through the asymptotic behavior of a partial sum process called *clock process*. This links aging to some of the most classical parts of probability, namely, extreme value theory, limit theorems for sums of correlated random variables, and Lévy processes.

In this talk, I will give an overview of the current knowledge on aging of mean-field spin glasses (the REM, the p-spin SK models, the GREMs) and succinctly present the state of the art techniques that have recently allowed to understand aging of Metropolis dynamics of the REM.

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Hierarchical dynamics for the low temperature cascading 2-GREM on ergodic time scales

Luiz Renato Fontes[1], Véronique Gayrard[2]

[1] University of São Paulo

[2] Aix-Marseille Université

We present a dynamics for the Generalized Random Energy Model, a hierarchical spin glass introduced by Derrida in the 80's, at low temperature, in a parameter regime where the equilibrium configurations are arranged in cascades, and on time scales where we are close to equilibrium. There are 3 dynamical regimes, with 3 different processes showing in the scaling limit.

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Zero-range process in random environment

Ellen Saada [1], Christophe Bahadoran[2], Thomas Mountford[3], K. Ravishankar[4]

[1] CNRS, MAP5, Université Paris Descartes, Paris, France

[2] Laboratoire de Mathématiques Blaise Pascal, Université Clermont Auvergne, Aubière, France

[3] Institut de Mathématiques, École Polytechnique Fédérale, Lausanne, Switzerland

[4] NYU-ECNU Institute of Mathematical Sciences at NYU Shanghai, Shanghai, China

We consider a zero-range process with site disorder. This one-dimensional, nearest-neighbor, attractive dynamics with a bounded jump rate, exhibits a phase transition: there are no invariant measures above some critical density. In collaboration with C. Bahadoran, T. Mountford and K. Ravishankar (see [2, 3, 4, 5] and also [1]), we have first obtained necessary and sufficient conditions for weak convergence to the critical invariant measure. We have then derived the hydrodynamical behavior of the system, and finally, we have proven local equilibrium results, and a dynamical loss of mass.

Renormalizing KPZ equation at weak disorder in dimension ≥ 3

Francis Comets[1], Clément Cosco[1], Chiranjib Mukherjee[2]

[1] Université de Paris, France

[2] Universität Münster, Germany

We study the solution $h_\epsilon(t,x)$ of the (regularized) Kardar-Parisi-Zhang (KPZ) equation on $[0,\infty)\times\mathbb{R}^d, d\geq 3$,

$$\frac{\partial}{\partial t}h_\epsilon = \frac{1}{2}\Delta h_\epsilon + \left[\frac{1}{2}|\nabla h_\epsilon|^2 - C_\epsilon\right] + \beta\epsilon^{\frac{d-2}{2}}\xi_\epsilon \qquad (1)$$

with $h_\epsilon(0,x) = 0$. Here $\beta > 0$ quantifies the disorder strength, $\xi_\epsilon = \xi \star \phi_\epsilon$ is a spatially smoothened (at scale ϵ) Gaussian space-time white noise and C_ϵ is a divergent constant as $\epsilon \to 0$.

For sufficiently small β, there exists a stationary solution of (1) for $\epsilon = 1$, and we denote by $h_\epsilon(t,x)$ the one driven by the diffusively rescaled (at scale ϵ), time-reversed and spatially translated white noise $\xi^{\epsilon,t,x}$. Then, it is known that $h_\epsilon(t,x) - \mathfrak{h}_\epsilon(t,x) \to 0$ in probability as $\epsilon \to 0$.

In this talk, we will show convergence in law of the process:

$$\epsilon^{1-\frac{d}{2}}\big[h_\epsilon(t,x) - \mathfrak{h}_\epsilon(t,x)\big] \longrightarrow \mathcal{H}(t,x)$$

to a centered Gaussian field which is the (real-valued) solution of the *non-noisy heat equation* $\partial_t\mathcal{H} = \frac{1}{2}\Delta\mathcal{H}$ with a random initial condition $\mathcal{H}(0,x)$ given by a Gaussian free field on $\mathbb{R}^d$.

Hyperbolic Hydrodynamic Limits with Boundaries

Stefano Olla [1], Stefano Marchesani[2]

[1] CEREMADE, Université Paris Dauphine PSL

[2] GSSI, L'Aquila

I will present a review of old and new results (and open problems) concerning hydrodynamic limits for a system of an-harmonic oscillators with external boundary tension in the hyperbolic space-time scale. The macroscopic equations are given by non-linear systems of hyperbolic conservation laws, like the compressible Euler system (3 conservation laws) or the p-system (2 conservation laws), with corresponding boundary conditions. The problem is particularly challenging when shockwaves are present and the limit profiles are L^2-valued weak solution. Some results exist when the microscopic dynamics is perturbed by a conservative stochastic viscosity, modelling the contact with a heat bath. The new results concern the p-system in presence of shockwaves, where a stochastic version of the Tartar-Murat compensated compactness can be adapted to the presence of the boundary conditions. This requires also a proper definition of L^2-valued weak entropy solutions with boundary conditions, that we call thermodynamic entropic solution, since they satisfy Clausius inequality.

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A microscopic model for the regional fractional Laplacian with several boundary conditions

Patricia Gonçalves[1],

[1] IST, Lisbon

In this seminar I will describe the derivation of some partial differential equations that rule the space-time evolution of the density of some stochastic processes. The goal is to describe the connection between the macroscopic (continuous) equations and the microscopic (discrete) system of random particles. The former can be either PDEs or stochastic PDEs depending on whether one is looking at the law of large numbers or the central limit theorem scaling; while the latter is a collection of particles that move randomly according to a transition probability. I will focus on a model for which we can obtain a collection of (fractional) reaction-diffusion equations given in terms of the regional fractional Laplacian with different types of boundary conditions. This is a joint work with Cédric Bernardin, Byon Jiménez-Oviedo and Stefano Scotta and it is based on the articles [1, 2, 3].

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

21 – Representation of Algebras, Homological, Geometrical, and Related Methods - Auditorium 3

Time	Monday, 15	Time	Tuesday, 16	Wednesday, 17
14:30 - 15:20	**Heily Wagner** (DMAT-UFPR) *On the representation dimension of finite dimensional algebras*	14:30 - 15:20	**Yuri Volkov** (San Petersburg University) *Actions generated by spherical twists on triangulated categories*	**Viktor Bekkert** (UFMG) *Derived tame and derived wild algebras*
		15:30 - 16:20	**Patrick Le Meur** (Université Paris 7) *Group Actions and Calabi-Yau Duality*	**Hagen Meltzer** (University of Szczecin) *Nilpotent operators with invariant subspaces*
		16:30 - 16:45	Coffee	
		16:45 - 17:35	**Edson Ribeiro Alvares** (DMAT-UFPR) *Compatible t-structures*	**Eduardo Marcos** (IME-USP) *Adding or deleting arrows of a bound quiver algebra and Hochschild (co)homology*
		17:45 - 18:35	**Marcelo Lanzilotta** (UdR) *Split bounded extension algebras and Han's conjecture*	**Roland Berger** (Université de Lyon) *Koszul Calculus of Preprojective Algebras*

On the representation dimension of finite dimensional algebras

Heily Wagner

[1] Universidade Federal do Paraná

The representation dimension of artin algebra was introduced by Auslander. He showed that an artin algebra is representation-finite if and only if its representation dimension equals two, which made him expect that this invariant would give a measure of how far an algebra is from being representation-finite. In the past few years it was proven that many classes of algebras have representation dimension at most three. For instance, tilted, quasitilted, cluster-concealed and ada algebras. This show us that the behavior of the module categories of algebras with representation dimension three can be very different, including tame and wild algebras.

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Actions generated by spherical twists on triangulated categories

Yury Volkov [1]

[1] Saint Petersburg State University

In this talk we will present some results about actions of groups generated by spherical twists on enhanced triangulated categories. Mainly two results in this direction will be presented. The first one is the description of actions generated by two twists along spherical sequences. In particular, it will be shown that A_2, B_2 and G_2 configurations of spherical sequences almost always induce actions of the corresponding Artin groups. In some exceptional cases the counterexamples will be given. Another result is the new proof of the faithfulness of braid group actions of types A_n and D_n induced by the corresponding configurations of spherical objects. This proof was obtained in collaboration with Anya Nordskova. Our proof works for any sphericity except 1. Note that even the action of the braid group corresponding to an A_3 configuration of 1-spherical objects can be non faithful.

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Group Actions and Calabi-Yau Duality

Patrick Le Meur

Institut de Mathématiques de Jussieu - Paris Rive Gauche, Université Paris Diderot

Recently, several investigations in cluster tilting theory focused on the generalised cluster categories associated to the triangulations of certain orbifold surfaces with marked points ([1, 2, 5]). These investigations involve an action of a group on a quiver with potential (QP).

This talk will present general results ([3, 4]) on the behaviour of cluster tilting theory - from the viewpoint of generalised cluster categories - under the actions of finite groups. This includes a description of the skew group algebras $\mathcal{A}(Q,W) * G$ of Ginzburg dg algebras $\mathcal{A}(Q,W)$ acted on by finite groups G as well as a comparison of the associated generalised cluster categories.

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Compatible t-structures

Edson Ribeiro Alvares [1], Cleber Barreto dos Santos[2], Tanise Carnieri Pierin[3]

[1] Universidade Federal do Paraná

[2] Universidade Federal do Paraná

[3] Universidade Federal do Paraná

The concept of compatibility between t-structures was introduced by Keller and Vossieck and recently studied by Bondal. In this talk, we present the progress that we have done when studying the compatibility between t-structures obtained after applying tilting processes.

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Split bounded extension algebras and Han's conjecture

Claude Cibils, Marcelo Lanzilotta, Eduardo N. Marcos, and Andrea Solotar *

Abstract

This talk is given by Marcelo Lanzilotta, one of the authors of the paper in preparation. The main purpose of this paper is to prove that the class of finite dimensional algebras which verifie Han' conjecture is closed under split bounded extensions.

Derived tame and derived wild algebras

Viktor Bekkert [1]

[1] Universidade Federal de Minas Gerais

The notions of tame and wild problems is now rather popular in various branches of representation theory and related topics, especially because of the so-called tame-wild dichotomy. Namely, in most cases it so happens that either indecomposable representations depend on at most one parameter or their description becomes in some sense "universal", i.e. containing a classification of representations of all finitely generated algebras. Last time these notions have also been studied for derived categories, and tame-wild dichotomy has been proved. We shall give a very quick survey on the derived representation type of finite dimensional algebras and discuss some recent results.

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Nilpotent operators with invariant subspaces

Hagen Meltzer

This is a report on joint work with Piotr Dowbor (Toruń) and partially also with Markus Schmidmeier (Boca Raton). We study exceptional objects in categories $\mathcal{S}$ of nilpotent operators on vector spaces with invariant subspaces. By joint work with Dirk Kussin and Helmut Lenzing these categories are related to stable categories of vector bundles on weighted projective lines. Using other methods they have been also studied by Claus M. Ringel and Markus Schmidmeier. Classically the problem goes back to David Birkhoff who studied subgroups of abelian groups already in 1934.

Of particular interest are the tubular cases, here almost all indecomposable objects of $\mathcal{S}$, or their shifts, are modules over a certain tubular algebra, which we can realize as endomophism algebra of a tilting bundle on a weighted projective line of weight type $(3,3,3)$, $(2,4,4)$ or $(2,3,6)$.

For the situation, that the degree of the nilpotent operator is bounded by 6 and that we are dealing with only one subspace we determine all dimensions vectors of the exceptional objects. Further we show that each exceptional object can be exhibited by matrices having as coefficients only 0 and 1.

By extending the methods we will also discuss the case of two independent subspaces where the degree of the nilpotent operator is bounded by 3.

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Adding or deleting arrows of a bound quiver algebra and Hochschild (co)homology

Eduardo N. Marcos[1]

[1] IME-USP

This is a talk by E. Marcos on a joint work of C. Cibils, M. Lanzilotta, E. Marcos and A. Solotar.

We describe how the Hochschild (co)homology of a bound quiver algebra changes when adding or deleting arrows to the quiver. The main tools are relative Hochschild (co)homology, the Jacobi-Zariski long exact sequence obtained by A. Kaygun and a one step relative projective resolution of a tensor algebra.

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Koszul Calculus of Preprojective Algebras

Roland Berger [1], Rachel Taillefer[2]

[1] University of Saint-Etienne, France

[2] University of Clermont-Auvergne, France

It is a joint work with Rachel Taillefer (arXiv:1905.07906). A Koszul calculus was introduced and developed in [1] for associative algebras defined by homogeneous quadratic algebras. We study the Koszul calculus of preprojective algebras. We prove that a Poincaré duality is valid for these algebras. This duality is new when the algebra is not Koszul, showing how Koszul (co)homology can be drastically different to Hochschild (co)homology in the non-Koszul situation. In general, a Calabi-Yau property adapted to the Koszul complex is defined for any quadratic quiver algebra, in terms of derived categories, and a Poincaré Van den Bergh duality is deduced from this property.

1st Joint Meeting Brazil-France in Mathematics

IMPA, Rio de Janeiro, July 15 – 19, 2019

22 – Singularity Theory Session - Room 333

Time	Tuesday, 16	Wednesday, 17
14:30 - 15:20	**Hellen Santana** (Institut de Mathématiques de Marseille) *Local topology of function-germs with nonisolated singularities*	**Octave Curmi** (Aix-Marseille Université) *Topology of smoothings of non-isolated singularities of complex surfaces*
15:30 - 16:20	**Thaís Dalbelo** (UFSCar) Brasselet Number and Toric Varieties	**Luis Renato Dias** (Universidade Federal de Uberlândia) *Bifurcation values of algebraic mappings and its applications*
16:30 - 16:45	Coffee	
16:45 - 17:35	**Jean-Paul Brasselet** (CNRS - Aix-Marseille Université) *Franco-Brasilian characteristic classes*	**Mihai Tibar** (Université de Lille I) *Concentration of curvature and Lipschitz invariants of holomorphic functions of two variables*
17:45 - 18:35	**David Trotman** (Aix-Marseille Université) *Whitney cellularisation and Goresky's homology conjecture*	**Maria Aparecida Ruas** (ICMC - USP) *Density of Lipschitz stable mappings in the boundary of the nice dimensions*

Hellen Santana

May 2019

Title: Local topology of function-germs with nonisolated singularities

Abstract: The Brasselet number is an invariant associated to a function-germ f defined over a stratified complex analytic space $(X, 0)$. It was introduced by Dutertre and Grulha, in [1], as a generalization of the local Euler obstruction, an important singular invariant defined by MacPherson, in [2]. The Brasselet number can also be seen as a generalization of the Milnor number for a function with nonisolated singularities defined over a (possibly) singular space, since it numerically describes the topology of $X \cap \{f = \delta\} \cap B_\epsilon$, the generalized Milnor fibre of f, where $0 < |\delta| \ll \epsilon$ is a regular value of f. Given two function-germs $f, g : (X, 0) \to (C, 0)$, we present formulas to compare the Brasselet numbers of f and of the restriction of f to $X \cap \{g = 0\}$, in the case where g has a one-dimensional critical set.

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BRASSELET NUMBER AND TORIC VARIETIES

THAÍS MARIA DALBELO
JOINT WORK WITH LUIZ HARTMANN

We present a formula to compute the Brasselet number of $f : (Y, 0) \to (\mathbb{C}, 0)$ where $Y \subset X$ is a non-degenerate complete intersection in a toric variety X. As applications we establish several results concerning about invariance of the Brasselet number for families of non-degenerate complete intersections. Moreover, when $(X, 0) = (\mathbb{C}^n, 0)$ we derive sufficient conditions to obtain the invariance of the Euler obstruction for families of complete intersections with isolated singularity which are contained on X.

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Franco-Brasilian characteristic classes

Jean-Paul Brasselet[1]

[1] CNRS & Aix-Marseille University

This is a survey on the recent results obtained jointly by Brazilian and French researchers in the domain of characteristic classes for singular varieties. I will focus on two direction.

One of the main ingredients in the definition of Schwartz-MacPherson classes is the local Euler obstruction. I will present the recent results obtained by Nicolas Dutertre (Angers) and Nivaldo Grulha (USP, São Carlos) concerning Euler local obstruction, more precisely in the case of a polynomial function $f : X \to \mathbb{C}$ where X is a complex algebraic variety.

The second part will concern the applications in cobordism theory of singular varieties and maps of the so-called Wu classes. These classes coincide with the Mather classes, another ingredient of the definition of Schwartz-MacPherson classes. That is a join work with Marcelo Saia (USP, São Carlos) and Alice Libardi and Eliris Rizziolli (UNESP, Rio Claro).

Whitney cellularisation and Goresky's homology conjecture

David Trotman[1]

[1] Aix-Marseille-University

In 1981 Mark Goresky conjectured that the homology of a Whitney stratified set can be represented by Whitney stratified cycles. More precisely he defined a Whitney homology theory using Whitney stratified chains and conjectured the bijection of the resulting homology groups with those of the usual homology. He proved such a bijection for cohomology, and in the special case of a Whitney stratified manifold proved the bijection for homology. We prove Goresky's conjecture by showing that every Whitney stratified set admits a refinement which is a Whitney regular cell decomposition. Our proof depends on results obtained in our recent proof of the smooth Whitney fibering conjecture (2016), in particular on a horizontally C1 improvement of the Thom-Mather isotopy theorem and the existence of a local Whitney regular wing structure in a neighbourhood of each stratum.

This is a joint work with Claudio Murolo.

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Topology of smoothings of non-isolated singularities of complex surfaces

Octave Curmi[1]

[1] Aix-Marseille Université

Milnor fibers play a crucial role in the study of the topology of a singularity of surface. They correspond to the different possible smoothings of this singularity. A description of this fiber is known in some particular cases, but in general it is not, even for isolated singularities. However, the study of its boundary has been an active field of research in the last decades. In different settings, this boundary has been proven to be a graph manifold. (Mumford, 1961, for isolated singularities, Michel-Pichon, 2003, 2014, for a smoothing of a reduced surface with smooth total space, Némethi-Szilard, 2012, with the same hypothesis, Bobadilla-Menegon Neto, 2014, for a non-reduced surface and a total space with isolated singularity). I will explain how the constructive proof provided by Némethi and Szilard can be adapted to prove, constructively, the same result for a smoothing of a reduced surface with any total space. This allows the hope for a characterization of the manifolds bounding Milnor fibers of surface singularities. Furthermore, I provide a simple algorithm for computing the boundary of the Milnor fiber, in the case of a surface defined by a generic function on a toric germ.

Bifurcation values of algebraic mappings and its applications

Luis Renato G. Dias[1]

[1] Universidade Federal de Uberlândia

Let $f : R^n to R^p$ be an algebraic mapping $n \geq p$. The bifurcation set of f, denoted by B(f), it is the smallest set such that $f : R^n \setminus f^{-1}(B(f)) \to R^p \setminus B(f)$ is a locally trivial fibration. Finding an effective description of the set B(f) is still an open question. In this talk we present an effective algorithm to describe an approximation to B(f) and its applications.

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Concentration of curvature and Lipschitz invariants of holomorphic functions of two variables

Mihai Tibar[1]

[1] Université Lille I

By combining analytic and geometric viewpoints on the concentration of the curvature of the Milnor fibre, we find new Lipschitz invariants.

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Density of Lipschitz stable mappings in the boundary of the nice dimensions

Maria Aparecida Soares Ruas[1]

[1] ICMC - USP

We define the Lipschitz nice-dimensions (l.n.d) as the pairs (n,p) for which the Lipschitz stable mappings form a dense set in the set of all smooth mappings $f : N^n \to P^p$ with the Whitney topology. The aim is to show that the l.n.d contains Mather's nice dimensions and its boundary.

This is a joint work with Nhan Nguyen and Saurabh Trivedi.

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23 – Stability and Global Questions for Evolution Problems - Room 224

Time	Tuesday, 16	Wednesday, 17
15:00 - 15:45	**Lionel Rosier** (MINES Paris Tech) *Exact controllability of nonlinear heat equations in spaces of analytic functions*	**Luc Robbiano** (Université de Versailles) *Semi-classical defect measure and stabilization for Zaremba problem*
15:45 - 16:30	**Alexandre Nolasco de Carvalho** (State University of São Paulo) *On the Gradient Structure of a Non-autonomous Chafee –Infante Like Problem*	**Márcia Federson** (USP) *New results in generalized ODEs*
16:30 - 16:45	Coffee	
16:45 - 17:30	**Ludovick Gagnon** (INRIA) *Sufficient conditions for the controllability of wave equations with transmission condition at the interface*	**Carole Rosier** (Université du Littoral Côte d'Opale) *Well-posedness of general cross-diffusion systems*
17:30 - 18:15	**Roberto Capistrano Filho** (Federal University of Recife) *Stability and Global Questions for Biharmonic Schrödinger Equation*	

Exact controllability of nonlinear heat equations in spaces of analytic functions

Lionel Rosier[1], Camille Laurent[2]
[1] MINES ParisTech, CAS-CAOR, Paris
[2] CNRS, Sorbonne Université, LJLL, Paris

It is by now well known that the use of Carleman estimates allows to establish the controllability to trajectories of nonlinear parabolic equations. However, by this approach, it is not clear how to decide whether a given function is indeed reachable. That issue has obtained very recently almost sharp results in the linear case (see [4, 1, 2]). In this talk, we investigate the set of reachable states for a nonlinear heat equation in dimension one. The nonlinear part is assumed to be an analytic function of the spatial variable x, the unknown y, and its derivative y_x. By investigating carefully a nonlinear Cauchy problem in x in some space of Gevrey functions, and the relationship between the jet of space derivatives and the jet of time derivatives, we derive an exact controllability result for small initial and final data that can be extended as analytic functions on some ball of the complex plane. It time allows, works in progress about the reachable states for KdV and for ZK will be outlined.

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On the Gradient Structure of a Non-autonomous Chafee–Infante Like Problem

Alexandre N. Carvalho,

Universidade de São Paulo

In this work we prove that some non-autonomous scalar one dimensional semi-linear parabolic problems have an associated skew-product semigroup with gra- dient structure similar to that observed for the autonomous Chafee–Infante problem. The aim is to exhibit a non-autonomous problem for which the asymptotic dynamics can be fairly well described. The tools involved are symmetry, invariance, comparison and the lap-number.

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Sufficient conditions for the controllability of wave equations with transmission condition at the interface

Ludovick Gagnon [1]

[1] Inria Grand-Est

In this talk, we will consider the controllability of two wave equations with a transmission condition at the interface. Rays encountering the interface are reflected and transmitted according to the Snell's law. Controllability in this context is difficult to establish since interference may occurs at the interface. We will introduce a geometric construction that allows one to follow the propagation of the bicharacteristics to ensure that no interference occurs under an escaping geometry assumption. We will present the application of this geometrical assumption in the context of the controllability of waves evolving over manifolds that intersect each other.

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Stability and Global Questions for Biharmonic Schrödinger Equation

Roberto de Almeida Capistrano Filho [1]

[1] Universidade Federal de Pernambuco

In this talk we first present some results of controllability and stabilizability of a class of distributed parameter control system described by the fourth order nonlinear Schrödinger on the torus $\mathbb{T}$ with internal control acting on a sub-domain ω of T. More precisely, by certain properties of propagation of compactness and regularity in Bourgain spaces for the solutions of the associated linear system, we will show that the system is globally exactly controllable and globally exponentially stabilizable.

Finally, we present works in progress about the controllability of the biharmonic nonlinear Schrödinger equation in half-line $\mathbb{R}^+$, star graphs and manifolds.

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Semi-classical defect measure and stabilization for Zaremba problem

Luc Robbiano [1]

[1] University Versailles Saint-Quentin

We present in this talk results on exponential decay of energy for the wave equation with Zaremba boundary condition. This boundary condition is the following, on one part of the boundary, we set the Dirichlet boundary condition, on another part we set the Neumann boundary condition. The two parts are separated by a smooth manifold on the boundary. The proof is based on propagation of measure. Actually, we prove a resolvent estimate by contradiction. From this contradiction, we construct a semi-classical measure admitting some properties. On one hand, it is supported on characteristic set, the support of measure propagates along bicharacteristic flow, the measure is null on damping support. Under geometrical properties on damping support, we yield that the measure is null everywhere. On other hand, we prove that the measure is not identically null. This gives a contradiction.

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New results in generalized ODEs

Márcia Federson [1], Everaldo M. Bonotto[2], Rodolfo Collegari[3], Marta C. Gadotti[4]

[1] Universidade de São Paulo

[2] Universidade de São Paulo

[3] Universidade Federal de Uberlândia

[4] Universidade Estadual Paulista

We present new results within the theory of generalized ordinary differential equations based on the non-absolute integral of Jaroslav Kurzweil which enables one to handle functions with of unbounded variation and many discontinuities which, in turn, provide a good environment for models involving highly oscillating phenomena with many jumps.

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Well-posedness of general cross-diffusion systems

C. Rosier [1], C. Choquet[2]

[1] University of Littoral, Calais, France

[2] University La Rochelle, La Rochelle, France

In this paper, we are concerned with the Cauchy problem for some quite general cross-diffusion systems. Their analysis is known to be difficult because of the coupling of the highest order derivatives terms (see [1, 2, 3, 4, 5]). A global existence result for nonnegative solutions is obtained by applying Schauder fixed point theorem to a linearized system using some energy estimates. An extension of a regularity result due to Meyer allows to prove that the gradient of the solution belongs to the space $L^r((0,T)\times\Omega)$ for some $r>2$. This regularity for $r=4$ implies the uniqueness of the solution.

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24 – Stochastic Analysis and Applications - Room 232

Time	Monday, 15	Tuesday, 16	Friday, 19
14:30 - 15:10	**14:30 - 15:20** **Fracesco Russo** (ENSTA ParisTech) *McKean stochastic differential equations and nonconservative PDEs*	**Ciprian Tudor** (Lille) *Behavior of Hermite and related processes with respect to the Hurst parameter*	**Wladimir Neves** (UFRJ) *Homogenization of Liouville Equations beyond stationary ergodic setting*
15:10 - 15:50		**Paulo Ruffino** (UNICAMP) *An averaging principle in homogeneous spaces*	**Jean Colombeau** (Institut Fourier) *Solving the conflict between differentiation and nonlinear operations*
15:50 - 16:30		**Alexandre Richard** (CNRS) *Penalisation techniques for one-dimensional reflected rough differential equations*	**Alberto Ohashi** (UFPB) *Existence of densities for stochastic evolution equations driven by fractional Brownian motion*
16:30 - 16:45		Coffee	
16:45 - 17:25		**Christian Olivera** (UNICAMP) *Regularization by noise in some PDEs*	**Andre de Oliveira Gomes** (IMECC) *Variational formulas for functionals of the Fractional Brownian Motion and applications to Large Deviations Principles*
17:25 - 18:05		**Clement Erignoux** (Università Degli Studi di Roma 3) *Free boundary problem for a non-ergodic facilitated exclusion process*	
18:05 - 18:45		**Pedro Catuogno** (UNICAMP) *An Itô-Ventzel formula for Holder paths and some applications*	

McKean stochastic differential equations and non-conservative PDEs

Francesco RUSSO [1],

[1] ENSTA ParisTech, Institut Polytechnique de Paris

Stochastic differential equations (SDEs) in the sense of McKean are stochastic differential equations whose coefficients do not only depend on time and on the position of the process solution but also on its marginal laws. Often they constitute probabilistic representation of conservative PDEs. The possibility of approaching them with particle systems provides a Monte-Carlo type approximation of the mentioned conservative PDEs. In this talk we will illustrate how the method can be adapted to the case of a class of non-conservative PDEs. The talk is based on recent work with A. Le Cavil, J. Lieber and N. Oudjane (see [10, 7, 6, 8, 9]) and on a survey of less recent wotk with Ph. Blanchard, V. Barbu, N, Belaribi, M. Röckner, see [5, 1, 11, 4, 3, 2].

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Behavior of Hermite and related processes with respect to the Hurst parameter

Ciprian Tudor[1],

[1] Université de Lille

The Hermite processes are self-similar process with stationary increments. The class of Hermite processes includes the fractional Brownian motion but it also contains non-Gaussian processes. We will discuss their asymptotic behavior with respect to the self-similarity index. We also present how some related processes, such as solution to SPDE driven by Hermite noises, behaves when the Hurst parameter approaches the critical values.

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An averaging principle in homogeneous spaces

Paulo Ruffino

University of Campinas

Mathematics Department

Brazil

Consider an stochastic differential equation on a space such that the trajectories lay on compact surfaces (say, energy levels, foliation etc), depending on the initial condition. We investigate the effective behaviour on the transversal direction of a small transversal perturbation of order ϵ. An average principle has been shown such that the energy level behaviour converges to the solution of a deterministic ODE, according to the average of the perturbing transversal vector field as ϵ goes to zero. Many applications appear in this context. We are particularly interested on the case of a Lie foliation: the leaves are the cosets of a Lie subgroup H in a Lie group G. The interesting phenomenon here is that if the Lie brackets of the transversal perturbation and the vector fields in the SDE do not vanish, noise in the foliated direction are transmitted to the transversal direction, identified with the homogenous space G/H.

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Penalisation techniques for one-dimensional reflected rough differential equations

Alexandre Richard [1], Etienne Tanré[2], Soledad Torres[3]

[1] CentraleSupélec, Université Paris-Saclay

[2] Université Côte d'Azur, Inria

[3] Facultad de Ingeniería, CIMFAV, Universidad de Valparaíso

In this talk, I will show how to solve real-valued rough differential equations reflected on a rough boundary using penalization. The solution Y is constructed as the limit of a sequence $(Y^n)_{n\in\mathbb{N}}$ of solutions to RDEs with unbounded drifts $(\psi_n)_{n\in\mathbb{N}}$, where the penalisation ψ_n increases with n. Along the way, we thus also provide an existence theorem and a Doss-Sussmann representation for RDEs with a drift growing at most linearly. A speed of convergence of the sequence of penalised paths to the reflected solution is obtained.
Finally we will discuss how to use the penalisation method to show that for some Gaussian RDEs reflected on the horizontal line, the restriction to $(0,\infty)$ of the law at time $t > 0$ of the solution is absolutely contiuous with respect to the Lebesgue measure.

--

Regularization by noise in some PDEs

Christian Olivera [1],

[1] UNICAMP

I will discuuss some aspects regarding the effects of noise in some partial differential equations (PDEs). We present results on regularization by noise in transport and continuity equation and some class of conservation law.

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Free boundary problem for a non-ergodic facilitated exclusion process

Clément Erignoux [1], Oriane Blondel[2], Makiko Sasada[3] Marielle Simon[4]

[1] Universita degli studi Roma Tre

[2] University Claude Bernard, Lyon 1

[3] Tokyo University

[4] INRIA Lille

The Entropy Method introduced by Guo, Papanicolaou and Varadhan (1988) has been used with great sucess to derive the scaling hydrodynamic behavior of wide ranges of conserved lattice gases (CLG). It requires to estimate the entropy of the measure of the studied process w.r.t. some good, usually product measure. In this talk, I will present a 1-D lattice exclusion model with a dynamical constraint, where a particle at site x can only jump to $x + \delta$ iff site $x - \delta$ is occupied as well. I will give some insight on the different microscopic and macroscopic situations that can occur for this model, and briefly describe how this model requires other tools than the Entropy Method due to its two (diffusive and frozen) phases. I will also expand on the challenges and question raised by this model and on some of its nice mapping features.

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An Itô-Ventzel formula for Holder paths and some applications

Pedro Catuogno [1], Rafael Castrequini[2]

[1] IMECC- Universidade Estadual de Campinas

[2] Universidad de Valparaiso

We present an Itô-Ventzel formula for Holder paths. We also give some applications to the Cauchy problem of the first order rough partial differential equation and composition of rough flows.

Homogenization of Liouville Equations beyond stationary ergodic setting

Wladimir Neves [1], Taynara Andrade[2], Jean Silva[3]

[1] UFRJ

[2] UFRJ

[3] UFMG

In this talk, we consider the homogenization's problem of the Liouville's equation for non-crystalline materials, namely the coefficients are given by the composition of stationary functions with stochastic deformations. We show the asymptotic equations, which involves both macroscopic and microscopic scales.

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Solving the conflict between differentiation and nonlinear operations

Jean-François Colombeau[1]

[1] University of Grenoble 1, Institut Fourier (retired) & State University of Campinas, IMECC (visitor)

We will recall the classical conflict between differentiation and nonlinear operations that appears in form of paradoxes and mistakes when one does calculations on non smooth functions even when these calculations are indispensable. Then we recall how this can be solved rather generally and easily [Bull. Amer. Math. Soc. 23,1990,2,pp.251-268] by a simple mathematical construction that indicates how to compute. We expose the use of this method in physics according to [Lecture Notes in Math. 1532, Springer Verlag, 1992], insisting on a possible trap in modeling physics when one does this for the first time. The conflict appears in stochastic PDEs and can be solved with this method.

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Existence of densities for stochastic evolution equations driven by fractional Brownian motion

Alberto Ohashi [1]

[1] Universidade de Brasília

In this talk, I will describe a version of Hörmander's theorem for a stochastic evolution equation driven by a trace-class fractional Brownian motion with Hurst exponent $\frac{1}{2} < H < 1$ and an analytic semigroup on a given separable Hilbert space. In contrast to the classical finite-dimensional case, the Jacobian operator in typical solutions of parabolic stochastic PDEs is not invertible which causes a severe difficulty in expressing the Malliavin matrix in terms of an adapted process. Under Hörmander's bracket condition on the vector fields and the additional assumption that the range of the semigroup is dense, we prove the law of finite-dimensional projections of such solutions has a density w.r.t Lebesgue measure. The argument is based on rough path techniques and a suitable analysis on the Gaussian space of the fractional Brownian motion. This is a joint work with Jorge Nascimento and it is based on the article [1].

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Variational formulas for functionals of the Fractional Brownian Motion and applications to Large Deviations Principles

André de Oliveira Gomes [1], Pedro Catuogno[2]

[1] IMECC-Instituto de Matemática, Estatística e Computação Científica. UNICAMP

[2] IMECC-Instituto de Matemática, Estatística e Computação Científica. UNICAMP

The equivalence between the large deviations principle (LDP for short) and the Laplace-Varadhan principle in the setting of Polish spaces is the starting point for the designated weak convergence approach to large deviations theory. Instead of the usual approximation procedures and the cumbersome verification of exponential tightness, this approach allows the user to derive simpler sufficient conditions for establishing LDPs that rely on the verification of tightness for the laws of the processes involved and the verification of the convergence, through compactness arguments, in well-known functional spaces, of the associated controlled equations to the problem of finding the rate function for the LDP. This approach was developed in different settings by Dupuis, Ellis, Budhiraja and collaborators (we refer the reader to the book [4], [2] and [3]). It is our purpose to derive a variational formula for functionals of Fractional Brownian Motions (fBMs for short) and to establish a sufficient condition for the verification of a LDP for families of measurable maps of fBMs. As a first application we show how the robustness of this approach allow us to study the first exit time problem of randomly perturbed dynamical systems by the fBM in the small noise limit, bypassing the usual Freidlin-Wentzell toolbox, that is heavily based on the strong Markov property (we refer the reader to the classic reference [5] and the thesis [6], where the author studies the first exit time problem in the spirit of the Freidlin-Wentzell theory for the Lévy case). As a second application we generalize the work [1] giving a nonlinear Feynman-Kac formula for nonlocal partial differential equations (PDEs for short) associated to forward-backward stochastic differential equations driven by the fBM and studying, via probabilistic arguments that rely on Malliavin calculus for those objects, the homogenization regime of those PDEs. This is a joint work with Pedro Catuogno from IMEEC-UNICAMP.

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25 - Systems of Low Complexity - Room 345

Time	Monday, 15	Time	Thursday, 18	Friday, 19
14:30 - 15:20	**Boris Adamczewski** (CNRS-Université Claude Bernard, Lyon 1) *The complexity of real numbers in independent bases*	14:30 - 15:20	**Diana Davis** (Swarthmore College, USA) *Periodic paths on the pentagon*	**Luna Anna Lomonaco** (IME-USP) *Mating quadratic maps with the modular group*
		15:40 - 16:30	**Albert Meads Fisher** (USP) *Finite and infinite measures for adic transformations*	**Danilo Antônio Caprio** (IBILCE-UNESP) *Julia sets for endomorphisms of $\mathbb{R}^2$ and $\mathbb{C}^2$*
		16:30 - 16:45	Coffee	
		16:45 - 17:35	**Eduardo Garibaldi** (IMECC-Unicamp) *Thermodynamic Formalism and Intermittence*	**Marcelo Sobottka** (UFSC) *Inverse Semigroup Shifts*
		17:40 - 18:10	**Isabelle Liousse** (Université des sciences et Technologies de Lille 1) *Subgroups of Interval Exchange Transformations*	**Ali Messaoudi** (Universite D'aix-Marseille) *Dynamics of linear operators*
		18:15 - 18:45		**Pierre Arnoux** (Unesp) *Interval exchange maps with episturmian dynamics*

The complexity of real numbers in independent bases

Boris Adamczewski[1]

[1] CNRS-Université Claude Bernard, Lyon 1

Some natural properties of real numbers, such as having a periodic expansion or being computable, do not depend on the integer base one chooses to represent them. In contrast, it is expected that having a (non- periodic) low complexity expansion is strongly base-dependent. One typical example is the conjecture that an irrational real number cannot be generated by a finite automaton in two multiplicatively independent integer bases. It is completely open. In this talk, I will explain how this conjecture can be attacked by using Mahler's method in several variables. This is a joint work with Colin Faverjon.

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Periodic paths on the pentagon

Diana Davis[1]

[1] Swarthmore College

Mathematicians have long understood periodic trajectories on the square billiard table, which occur when the slope of the trajectory is rational. In this talk, we will explain my joint work with Samuel Leli‘evre on periodic trajectories on the regular pentagon, describing their geometry, symbolic dynamics, and group structure. The periodic trajectories are very beautiful, and some of them exhibit a surprising dense but not equidistributed behavior.

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Finite and infinite measures for adic transformations

Albert Fisher[1]

[1] USP

An adic transformation, as defined by Vershik, defines a dynamics on a one- sided nonstationary subshift of finite type which is transverse to the usual shift dynamics, much as the horocycle flow is transverse to the geodesic flow: it acts on the stable manifolds of the shift space. The most classic example of adic transformation (the odometer) is, like the horocycle flow of a compact Riemann surface, both minimal and uniquely ergodic. This happens more generally whenever the matrix is primitive (some power is strictly positive), in the stationary case. Things get more interesting in the nonstationary situation (a sequence of matrices) where, just as for interval exchanges, one can find examples which are minimal but not uniquely ergodic. But the really fascinating things happen in the nonstationary, nonprimitive case, where one can also find interesting infinite measures. In this talk we sketch a classification of such measures. (Precisely, we classify the invariant Borel measures for adic transformations of finite rank which are finite on the path space of some sub-Bratteli diagram). This extends and builds on work by Bezuglyi, Kwiatkowski, Medynets and Solomyak. An application is given to nested circle rotations, where our necessary and sufficient condition for the measure to be infinite is expressed in terms of continued fractions. (Joint work with Marina Talet).

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Thermodynamic Formalism and Intermittence

Eduardo Garibaldi[1]

[1] IMECC-Unicamp

In this lecture, we discuss an original version of the Ruelle-Perron-Frobenius theorem in the context of interval dynamics with indifferent fixed point and its consequences. This is a work in collaboration with Irene Inoquio-Renteria (Universidad Austral de Chile).

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Subgroups of Interval Exchange Transformations

Isabelle Louisse[1]

[1] Université des sciences et Technologies de Lille 1

An interval exchange transformation (IET) is a bijective map $f : I = [0, 1) \to [0, 1)$ defined by a finite partition of I into half-open subintervals and a reordering of these intervals by translations. We denote by IET the group consisting in all IETs. The IETs have been a very popular subject of study in ergodic theory: most papers on IETs concern specific dynamical and spectral properties (minimality, ergodicity, mixing properties $\cdots$) of a single map. In this talk, I will address certain questions on the group-theoretical structure of IET and the question I will focus on is what abstract groups can be represented as subgroups of IET. I will discuss examples and properties of certain subgroups in IET. This is a joint work with Nancy Guelman.

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Mating quadratic maps with the modular group

Luna Anna Lomonaco[1]

[1] IME-USP

In 1994 S. Bullett and C. Penrose introduced a one complex parameter family of holomorphic correspondences, which we denote Fa, and proved that for every real parameter in the connectedness locus such correspondence is a mating between a quadratic polynomial and the modular group. They conjectured that this is the case for every parameter in the connectedness locus. We show here that matings between the modular group and rational maps in the parabolic quadratic family provide a better model: we prove that every member of the family Fa which has the parameter in the connectedness locus is such a mating. Moreover, we develop a dynamical theory for such a family which parallels the Douady- Hubbard theory of quadratic polynomials. This is a joint work with S. Bullett.

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Julia sets for endomorphisms of $\mathbb{R}^2$ and $\mathbb{C}^2$

Danilo Antônio Caprio[1]

[1] IBILCE-UNESP

In this talk we consider a class of endomorphisms of $\mathbb{R}^2$ defined by $f(x,y) = (xy + c, x)$, where c is a real number. We prove that when $-1 < c < 0$, the forward (resp. backward) filled Julia set of f is the union of stable (resp. unstable) manifolds of fixed and 3-periodic points of f. We also study dynamical properties of the family $f_{c,d}(x,y) = (xy + c, x + d)$ of endomorphisms of $\mathbb{C}^2$, where c and d are complex parameters. This class of polynomial maps is related to the stochastic Vershik-Bratteli diagrams. This is a joint work with Pierre Arnoux and Ali Messaoudi.

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Inverse Semigroup Shifts

Marcelo Sobottka[1]

[1] UFSC

For the case of shift spaces over finite alphabets, Kitchens proved that any group shift is isomorphic to a full shift product a finite set. We extend Kitchens's result for shift spaces over infinite count able alphabets with the Ot t-Tomforde-Willis compactification scheme. We prove that inverse semigroup shifts are always isomorphic to a full shift (over a countable alphabet) product a special type of shift spaces which we named 'fractal shifts'.

This is a joint research with D. Gonçalves (UFSC-Brazil) and C. Starling (Carleton-Canada).

This research was supported by CNPq-Brazil and Capes-Brazil grants.

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Dynamics of linear operators

Ali Messaoudi[1]

[1] Universite D'aix-Marseille

In this work, we study the shadowing and stability properties in linear dynamical systems. In particular, we prove that for any invertible operator T on any complex Banach space X:

1. T is shadowing and expansive if and only if T is hyperbolic;
2. T is struturally stable and expansive implies that T is uniformly expansive.

We also prove that there exist invertible operators on Banach spaces that are shadowing, structurally stable but are not hyperbolic.

This is a joint work with Nilson Bernardes (IME, UFRJ).

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Interval exchange maps with episturmian dynamics

Pierre Arnoux[1]

[1] Unesp

Episturmian sequences are generalisations of sturmian sequences, the episturmian systems they generate are one of the simplest examples of system of low complexity. It has been known for a long time that a family of interval exchange maps admits a coding which gives episturmian sequences, but this coding is not generating. We study this family and show that, for almost all values of the parameter (for a family of measures on the parameter space), the interval exchange map is measurably conjugate to the symbolic system, but for some exceptional values, it is not uniquely ergodic, and the ergodic measures all project to the unique invariant measure of the sturmian system.

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