First Joint Meeting Brazil-Spain in Mathematics
RSME-SBM-SBMAC-UFC

Program

December 7, 2015

Plenary talks

	Monday 07	**Tuesday 08**	**Wednesday 09**	**Thursday 10**
09:00 - 10:00	Opening ceremony	J. Peréz	M. J. Esteban	D. Peralta-Salas
10:00 - 11:00	E. Zelmanov	M. A. S. Ruas	F. Marcellán	C. Araujo
11:00 - 12:00	J. A. Cuminato	–	–	–

Efim Zelmanov (University of California, San Diego)

Title: Infinite dimensional Lie algebras and superalgebras

Abstract: We will discuss (i) basic examples of infinite dimensional Lie and Jordan (super) algebras, (ii) their classification, (iii) their representation theory.

José Alberto Cuminato (ICMC-Universidade de São Paulo, São Carlos)

Title: Numerical simulation of complex viscoelastic two-phase flow

Abstract: In this talk we shall present a number of techniques for the accurate simulation of two-phase viscoelastic flows modeled by differential constitutive laws. The Weissenberg effect will be discussed, as well as numerical methods for its simulation and difficulties.

The talk will be mostly devoted to discussing numerical techniques for flows with free surfaces and surface tension effects.

Joaquín Pérez (Universidad de Granada)

Title: Embedded minimal surfaces: a panoramic view

Abstract: We will cover some of the recent progresses in the classical theory of complete embedded minimal surfaces in Euclidean three-space, with emphasis on existence and classification results, asymptotics, the embedded Calabi-Yau problem and the Hoffman-Meeks conjecture. In most of these results, limits of embedded minimal surfaces is a crucial tool; we will also give some ideas of the different objects one may encounter when dealing with such limits, focusing on a recent convergence result by Meeks, Prez and Ros that generalizes the main global theorems of Colding-Minicozzi theory. If time permits, we will show how one uses this convergence result to give a partial answer to the Hoffman-Meeks conjecture.

Maria Aparecida S. Ruas (ICMC - Universidade de São Paulo, São Carlos)

Title: Mappings of the plane into the plane

Abstract: Hassler Whitney published in 1955 the article *Mappings of the plane into the plane*, laying the foundations of the theory of singularities. The aim of this talk is to review the classical results on stable mappings and present new results on stability of polynomial mappings $f : \mathbb{C}^2 \to \mathbb{C}^2$.

Maria J. Esteban (CEREMADE – Université Paris-Dauphine)

Title: Nonlinear flows and optimality for functional inequalities

Abstract: In this talk I will present some recent results about the qualitative properties of extremal functions for functional inequalities. I will show that linear and nonlinear flows are a very good tool to do this in an optimal way. The main subject of my talk will be the symmetry of extremals for Caffarelli-Kohn-Nirenberg inequalities on the Euclidean espace. But I will also explain how this method can be used to derive similar inequalities and results on Riemaniann manifolds.

Francisco Marcellán (Universidad Carlos III de Madrid and Instituto de Ciencias Matemáticas, ICMAT)

Title: Orthogonal Polynomials in Sobolev spaces. An overview

Abstract: Orthogonal polynomials with respect to a weighted Sobolev inner product have been extensively studied in the past quarter-century. The main Sobolev inner product that we consider can be written as

$$\langle f, g\rangle_S = \int_{\mathcal{R}} f(x)g(x)d\mu_0 + \sum_{k=1}^{m}\int_{\mathcal{R}} f^{(k)}(x)g^{(k)}(x)d\mu_k,$$

where $d\mu_k$, $k = 0, 1, \ldots, m$, are positive Borel measures supported on subsets of $\mathcal{R}$.

In this presentation an overview of the main developments in this domain will be addressed. We will focus our attention on some analytic properties of these polynomials. In particular, we will study their asymptotic behaviour (mainly, strong and n-th root asymptotics) as well as the distribution of their zeros. The comparison with classical results of the theory of standard orthogonal polynomials with respect to measures supported on the real line will be stated. Notice that in general the multiplication operator by x is not symmetric with respect to the Sobolev inner product. Thus, many properties of the standard polynomials are lost.

Finally, we will analyze weighted Sobolev inner products in the multivariate case and the applications of the corresponding sequences of orthogonal polynomials to the implementation of spectral methods when you deal with boundary value problems for elliptic partial differential equations.

Daniel Peralta-Salas (Instituto de Ciencias Matemáticas)

Title: Existence of knotted vortex structures in the stationary solutions of the Euler equations

Abstract: The goal of this talk is to introduce recent results on the existence of knotted vortex lines and vortex tubes for stationary solutions to the Euler equations in $\mathbb{R}^3$. More precisely, given a finite collection of (possibly linked and knotted) disjoint closed curves and tubes, I will show that they can be transformed using a diffeomorphism of $\mathbb{R}^3$ into a set of vortex lines and vortex tubes of a Beltrami field that tends to zero at infinity. Time permitting, I will discuss how to prove an analogous theorem for high-energy Beltrami fields in the flat torus $\mathbb{T}^3$ and the round sphere $\mathbb{S}^3$.

Carolina Araujo (IMPA)

Title: A Geometric view on Tsens Theorem

Abstract: In 1936 Tsen proved that a 1-dimensional family of hypersurfaces of degree d in projective n-space always admits a section provided that d is less than or equal to n. This simple statement has been generalized in many ways, and still inspires developments in algebraic geometry. In this talk I will survey the history of Tsens Theorem, mostly from the geometric point of view, and describe current research toward new interpretations and generalizations.

Invited talks

	Tuesday 08	**Wednesday 09**	**Thursday 10**
11:45 - 12:35 (Room 1)	L. J. Alías	M. del Mar González	J. Casado
11:45 - 12:35 (Room 2)	M. Rodríguez	Y. Lima	A. Fernandes
11:45 - 12:35 (Room 3)	E. Carneiro	J. Ribón	D. Kochloukova
11:45 - 12:35 (Room 4)	–	J. L. Barbosa	–

Luis J. Alías (Universidad de Murcia)

Title: Maximum principles and geometric applications

Abstract: The *Omori-Yau maximum principle* is said to hold on an n-dimensional Riemannian manifold M if, for any smooth function $u \in \mathcal{C}^2(M)$ with $u^* = \sup_M u < +\infty$ there exists a sequence of points $\{p_k\}_{k\in\mathbb{N}}$ in M with the properties:

$$\text{(i)}\ \ u(p_k) > u^* - \frac{1}{k}, \quad \text{(ii)}\ \ \|\nabla u(p_k)\| < \frac{1}{k}, \quad \text{and (iii)}\ \ \Delta u(p_k) < \frac{1}{k}.$$

In this sense, the classical result given by Omori (1967) and Yau (1975) states that the Omori-Yau maximum principle holds on every complete Riemannian manifold with Ricci curvature bounded from below. A *weaker* form of the maximum principle is obtained by dropping condition (ii) above from the requirements on the sequence $\{p_k\}_{k\in\mathbb{N}}$. That is, the *weak maximum principle* is said to hold on M if, for any smooth function $u \in \mathcal{C}^2(M)$ with $u^* = \sup_M u < +\infty$ there exists a sequence $\{p_k\}_{k\in\mathbb{N}}$ in M satisfying (i) and (iii) above. It is also known that the fact that the weak maximum principle holds on M is equivalent to the *stochastic completeness* of the manifold. In particular, the weak maximum principle holds on every parabolic Riemannian manifold. The aim of this lecture is to give an introduction to the Omori-Yau maximum principle, starting from its classical formulation up to the most recent generalizations, and to introduce some of its applications to differential geometry.

Magdalena Rodríguez (Universidad de Granada)

Title: Minimal surfaces with finite total curvature

Abstract: I will give an overview of the theory of minimal surfaces with finite total curvature in both the Euclidean space and the product space of the hyperbolic plane and the real line, focusing on recent results obtained in the later case. I will describe the geometry

of the ends of one such surface showing some new examples we have constructed. Finally I will present a characterization theorem we have recently obtained and some known classification results in the theory.

Emanuel Carneiro (IMPA)

Title: Extremal analysis and bounds in the theory of the Riemann zeta-function

Abstract: In this talk I will show how some extremal problems in Fourier analysis appear naturally in connection to number theory. I will talk about the constructive side of some special entire functions of order 1, and on their applications to bounding objects in the theory of the Riemann zeta-function and general L-functions (e.g. to bound the modulus on the critical line, the argument on the critical line and the pair correlation of zeros).

This talk will be aimed at a very broad audience, and the only requirement to attend is a basic knowledge of analysis and a strong desire to have a good time. Be prepared, as I promise you moments of happiness and sadness, brightness and darkness, with some surprises along the way.

Maria del Mar González (Universitat Politècnica de Catalunya)

Title: Some problems for the conformal fractional Laplacian

Abstract: The conformal fractional Laplacian is a fracional order (non-local) operator defined on a manifold, and presents nice conformal properties. We will present some problems for its associated curvature, such as the fractional Yamabe problem and its singular version. The techniques that are used come from both differential geometry and partial differential equations.

André Novotny (LNCC)

Title: Topological Asymptotic Analysis: Theory and Applications

Abstract: The topological derivative is defined as the first term (correction) of the asymptotic expansion of a given shape functional with respect to a small parameter that measures the size of singular domain perturbations, such as holes, inclusions, defects, source-terms and cracks. This relatively new concept has applications in many different fields such as shape and topology optimization, inverse problems, imaging processing, multi-scale material design and mechanical modeling including damage and fracture evolution phenomena.

In this work the topological derivative concept is presented, together with a portfolio of applications in the context of topology optimization and inverse problems.

Yuri Lima (Université Paris-Sud XI)

Title: On chaotic three-dimensional flows

Abstract: It is known for almost fifty years that geodesic flows on compact manifolds with negative sectional curvature are chaotic: the time–t maps ($t \neq 0$) are like coin tossing. In a joint work with Ledrappier and Sarig we show that this also holds for geodesic flows on surfaces with nonpositive and non-identically zero curvature and, more generally, for "most" three-dimensional Reeb flows. A main ingredient in the proof is the construction of a symbolic model for non-uniformly hyperbolic three-dimensional flows, developed jointly with Sarig. In the talk we will focus on general concepts, and provide schemes of the proofs.

Javier Ribón (Universidade Federal Fluminense)

Title: Algebraic theory of groups of local diffeomorphisms

Abstract: We introduce analogues of the Zariski-closure and algebraic groups in the infinitely dimensional setting of groups of local diffeomorphisms. We profit of the algebraic structure of such groups to obtain new results in the study of invariants by group actions, topological dynamics, local intersection theory...

Dessislava Kochloukova (Universidade Estadual de Campinas)

Title: Weak commutativity in groups

Abstract: We will discuss the homological and homotopical properties FPm and Fm for the groups $X(G)$ defined by S. Sidki. The homotopical type F_m in the case $m = 2$ is known as finite presentability and the homological version is defined in terms of a finiteness property of a projective resolution of the trivial module Z over ZG. The construction $X(G)$ associates to every group G a new group $X(G)$ defined by quotining a free product of two copies of G by some commutator relations. We will discuss some sufficient conditions for $X(G)$ to be finitely presented or of type FP_m. Furthermore we will show that for G soluble of type FP_∞ the group $X(G)$ is soluble of type FP_∞.

Juan Casado (Universidad de Sevilla)

Title: Smoothness results for the minimization of the firs eigenvalue of a two-phase material and applications to non-existence.

Abstract: Given two isotropic homogeneous materials (electric, thermic) in a smooth bounded open set of R^N we consider a classical problem in optimal design consisting in finding a mixture of them which given proportions minimizing the first eigenvalue of the corresponding diffusion operator. We prove some smoothness result for a relaxation of this problem. With respect to the unrelated problem it is known the existence of solution in the case of a ball. We show the following reciprocate result: If the open set is simply connected and has connected boundary, then the (unrelaxed) problem has a solution if and only if it is a ball. It is related to a previous result by F. Murat and L. Tartar for the optimal distribution of two materials in order to minimize the torsion of a beam.

Alexandre Fernandes (Universidade Federal do Ceará)

Title: Lipschitz Regular complex algebraic sets are smooth

Abstract: A classical Theorem of Mumford implies that a topologically regular complex algebraic surface in $\mathcal{C}^3$ with an isolated singular point is smooth. The aim of this talk is to show that any Lipschitz regular complex algebraic set is smooth. No restriction on the dimension and no restriction on the singularity to be isolated is needed.

J. L. Barbosa (Universidade Federal do Ceará)

Title: On regular algebraic surfaces with non zero constant mean curvature

Joint work with M. do Carmo

Abstract: We consider regular surfaces M that are given as the zeros of a polynomial function $p : \mathbb{R}^3 \to \mathbb{R}$, where the gradient of p vanishes nowhere. We assume that M has non-zero mean curvature and prove that there exist only two examples of such surfaces, namely the sphere and the circular cylinder.

Special sessions - Group 1

1 Operator algebras

Organizers

Pere Ara (Universitat Autònoma de Barcelona)
Alcides Buss (Universidade Federal de Santa Catarina)
Ruy Exel (Universidade Federal de Santa Catarina)
Enrique Pardo (Universidad de Cádiz)

	Monday 07	**Tuesday 08**
14:30 - 15:10	Z. Afsar	F. Perera
15:10 - 15:50	D. Gonçalves	A. Peralta
15:50 - 16:20	Coffee	
16:20 - 17:00	M. Laca	M. Dokuchaev
17:00 - 17:40	X. Li	V. Jones
17:40 - 18:00	Coffee	
18:00 - 18:40	F. Lledó	P. Grossmann
18:40 - 19:20	M. Bischoff	–

Zahra Afsar (University of Wollongong, New South Wales)

Title: KMS states on C*-algebras associated to a family of *-commuting local homeomorphisms

Abstract: Given a family of *-commuting local homeomorphisms on a compact space, we show that there is a compactly aligned product system of Hilbert bimodules (in the sense of Fowler). This product system has two interesting algebras, the Nica-Toeplitz algebra and the Cuntz-Pimsner algebra. Both algebras carry natural gauge actions of a higher-dimensional torus, and hence there are many possible dynamics obtained by different embedding of the real line in the torus. I will talk about the KMS (equilibrium) states of these dynamics. This work is a joint work with Astrid an Huef and Iain Raeburn.

Daniel Gonçalves (Universidade Federal de Santa Catarina)

Title: Ultragraphs and shift spaces over infinite alphabets

Abstract: In this talk we briefly introduce shift spaces over infinite alphabets, as defined recently by Ott, Tomforde and Willis. We then proceed to partially answer a question regarding conjugacy of shifts of finite type and edge shifts of graphs. Our techniques involve showing that, for a class of ultragraphs, the associated C*-algebras (which we realize as partial crossed products) are invariants for conjugacy of the associated ultragraph edge shifts.

Marcelo Laca (University of Victoria)

Title: Quantum equilibrium and self similarity

Abstract: The C*-algebras associated to various self similar structures have natural time evolutions. I will describe the structure of the simplex of equilibrium states for these C*-dynamical systems, giving specific examples, old and new, along the way.

Xin Li (Queen Mary University of London)

Title: Continuous orbit equivalence

Abstract: This talk is about continuous orbit equivalence for topological dynamical systems. We explain how this notion builds bridges between topological dynamics, operator algebras, and geometric group theory.

Fernando Lledó (Universidad Carlos III, Madrid)

Title: Amenability and Roe C*-algebras

Abstract: There is a classical mathematical theorem (based on the work by Banach and Tarski) that implies the following shocking statement: An orange can be divided into finitely many pieces, these pieces can be moved and rearranged in such a way to yield two oranges of the same size as the original one. In 1929 J. von Neumann recognized that one of the reasons underlying the Banach-Tarski paradox is the fact that on the unit ball there is an action of a discrete subgroup of isometries that fails to have the property of amenability ("Mittelbarkeit" in German).

In this talk we will approach the concept of amenability from very different perspectives: we will analyze metric, purely algebraic and operator theoretic aspects. In particular, we will define the class of Foelner C*-algebras in terms of a net of unital completely positive maps from the algebra to matrices that are asymptotically multiplicative in a weak sense. This class of C*-algebras include the quasidiagonal ones.

Finally, we will present Roe C*-algebras associated to discrete metric spaces with bounded geometry as an example where all these approaches unify.

(Joint work with P Ara (UAB), K. Li (U. Copenhagen), J.Wu (U. Muenster)).

Marcel Bischoff (Vanderbilt University)

Title: Conformal nets, Defects and Realization of Quantum Doubles

Abstract: Chiral conformal field theory can be axiomatized using von Neumann algebras, so-called conformal nets. In this setting braided subfactors naturally arise through the representation theory. We show that also non-braided subfactors naturally arise if one studies full conformal field theory with defects. Finite index finite depth subfactors describe quantum symmetries in the sense that they generalize the fixed points by a finite group. It is an open question if all subfactors arise from conformal nets in our sense. We show that a subfactor arises from a net if its representation category is the quantum double of the subfactor and give structural results how to obtain such quantum double nets.

Francesc Perera (Universitàt Autònoma de Barcelona)

Title: Near unperforation for $\mathcal{Z}$-stable C*-algebras

Abstract: We introduce the notion of near unperforation for positively ordered semigroups and show that it is stronger than the well known concept of almost unperforation. We study this in the context of the category Cu of Cuntz semigroups and show that the full subcategory consisting of those semigroups that are nearly unperforated is in fact reflective. In other words, we can associate to a semigroup in the category Cu a nearly unperforated semigroup (also in Cu), in a universal way. The question of whether it is possible to do this with only almost unperforation remains open. Rrdam proved in 2004 that the Cuntz semigroup of every Jiang-Su stable algebra is almost unperforated, and this condition (for simple C*-algebras) is one of the ingredients of the Toms-Winter conjecture. We explore the possibility that such a semigroup is always in fact nearly unperforated, and verify this in a number of instances. This is based on joint work with Ramon Antoine, Henning Petzka, and Hannes Thiel.

Antonio Peralta (Universidad de Granada)

Title: 2-Local *-Homomorphisms on Von Neumann Algebras and the Kowalski and Slodkowski Theorem

Abstract: A not necessarily linear (nor continuous) mapping T between Banach algebras A, B is said to be a local homomorphism if for every $a \in A$, there exists a homomorphism $\Phi_a : A \to B$ (depending on a), such that $T(a) = \Phi_a(a)$. We shall survey the connections of these mappings with the Kowalski and Slodkowski theorem. We shall present some recent advances on the study of 2-local *-homomorphisms between C*-algebras, showing a conclusive result which asserts that every (not necessarily linear) 2-local *-homomorphism from a von Neumann algebra (or from a compact C*-algebra) into another C*-algebra is linear and a *-homomorphism.

Michael Dokuchaev (Universidade de São Paulo)

Title: Cohomology based on partial actions and extensions

Abstract: Partial actions and partial representations were introduced in the theory of operator algebras as crucial ingredients of a new approach in the study of C*-algebras generated by partial isometries, permitting one to endow important classes of C*-algebras, such as the Cuntz-Krieger algebras [7], [8], [9], the Toeplitz algebras of quasi-lattice ordered groups [9], and more recently, the C*-algebras of dynamical systems of type (m, n) [1], with the structure of a crossed product by a partial action. The general notions of a (continuous) twisted partial action of a locally compact group on a C*-algebra and of the corresponding crossed product were introduced in [6], whose abstract algebraic counterparts were given in [2]. The definition involves a function, called twisting, that satisfies a sort of 2-cocycle equality, which, together with the partial 2-coboundaries appeared in the concept of the equivalence of twisted partial actions in [3], suggests the initial ingredients for a cohomology theory based on partial actions. The latter was developed in [4]. We shall present some results in collaboration with M. Khrypchenko, from [4] and [5] on partial cohomology and the interpretation of low dimensional partial cohomolgy groups in terms of extensions (references available upon request).

Vaughan Jones (UC Berkeley/Vanderbilt)

Title: Block spin renormalization, subfactors, Thompson groups and knots

Abstract: An attempt to take the continuum limit of the finite dimensional Hilbert spaces supplied by a subfactor using the block spin method yields a large family of unitary representations of Thompons groups F and T. In particular all knots and links, oriented or unoriented, arise as the coefficient of one of these representations for the vacuum vector.

Pinhas Grossmann (University of New South Wales, Sydney)

Title: Subfactors and quadratic fusion categories

Abstract: A quadratic fusion category is a type of tensor category which can be thought of as a quadratic extension of a tensor category associated to a finite group. Quadratic fusion categories arise in the classification of small-index subfactors, and there is a general method for constructing them from endomorphisms of Cuntz algebras, due to Izumi.

In this talk we will explain the notion of a quadratic fusion category, describe some examples of quadratic fusion categories coming from subfactors, and discuss relationships between these examples.

2 Geometric Variational Problems & Geometric Analysis

Organizers

Gregório Pacelli F. Bessa (Universidade Federal do Ceará)
Marcos Petrúcio Cavalcante (Universidade Federal de Alagoas)
Vicent Gimeno Garcia (Universitat Jaume I, Castelló)
Vicent Palmer (Universitat Jaume I, Castelló)
Magdalena Rodríguez (Universidad de Granada)

	Monday 07	**Tuesday 08**
14:30 - 15:10	H. Rosenberg	F. Urbano
15:10 - 15:50	S. Markvorsen	L. Jorge
15:50 - 16:20	Coffee	
16:20 - 17:00	G. Tinaglia	I. Ortiz
17:00 - 17:40	P. Mira	M. Domínguez
17:40 - 18:00	Coffee	
18:00 - 18:40	L. Mari	H. de Lima
18:40 - 19:20	A. Albujer	L. Alías

Harold Rosenberg (IMPA)

Title: Harmonic diffeomorphisms between complete surfaces of finite topology

Abstract: In this talk I will discuss work of Magdalena Rodríguez, Laurent Mazet and myself. We proved: Let S be a hyperbolic (curvature minus one) complete surface of finite topology and infinite area. There is a parabolic conformal structure on S and a harmonic diffeomorphism of S with this parabolic structure to S with its hyperbolic metric. I will explain this studiying minimal graphs over S.

Steen Markvorsen (TU Denmark)

Title: A Finsler geometric attack on wildfires

Abstract: This experiment began 10 years ago with the formulation of an exercise in vector analysis for first year calculus students at the Technical University of Denmark.

In the talk we will explain and illustrate how this relatively simple exercise over the years then inspired a surprising application of Finsler geometry, which has recently been reported in the article: http://dx.doi.org/10.1016/j.nonrwa.2015.09.011

At the end of the talk we finally present a general result about rheonomic Lagrange manifolds, which is needed for the proper analysis of wildfires in time-dependent fuel domains.

Giuseppe Tinaglia (King's College, London)

Title: The geometry of constant mean curvature disks embedded in $\mathbb{R}^3$

Abstract: I will talk about several results on the geometry of constant mean curvature surfaces embedded in $\mathbb{R}^3$. Among other things I will prove radius and curvature estimates for nonzero constant mean curvature embedded disks. It then follows from the radius estimates that the only complete, simply connected surface embedded in $\mathbb{R}^3$ with nonzero constant mean curvature is the round sphere. This is joint work with Bill Meeks.

Pablo Mira (Universidad Politécnica de Cartagena)

Title: A Hopf theorem for non-constant mean curvature and a conjecture of A.D. Alexandrov

Abstract: We present a uniqueness theorem for immersed spheres of prescribed (non-constant) mean curvature in homogeneous three-manifolds. In particular, this uniqueness theorem proves a conjecture by A.D. Alexandrov about immersed spheres of prescribed Weingarten curvature in R3 for the special but important case of prescribed mean curvature. As a consequence, we extend the classical Hopf uniqueness theorem for constant mean curvature spheres to the case of immersed spheres of prescribed antipodally symmetric mean curvature in $\mathbb{R}^3$.

Luciano Mari (Universidade Federal do Ceará)

Title: Ahlfors-Khas'minskii duality for fully nonlinear PDEs, and geometric applications

Abstract: Maximum principles at infinity (or "almost maximum principles") are a powerful tool to investigate the geometry of Riemannian manifolds. Among them, we stress the Ekeland, the Omori-Yau principles and their weak versions, in the sense of Pigola-Rigoli-Setti. These last have nice probabilistic counterparts in terms of stochastic and martingale

completeness, which are related to potential theory and parabolicity. The validity of such principles is usually granted via suitable exhaustion functions called Evans-Khas'minskii potentials. In this talk, I discuss an underlying, unifying duality that allows to uncover relations between the principles and solve some open questions. Indeed, duality holds for a broad class of fully-nonlinear operators of geometric interest. Our methods use the approach to nonlinear PDEs pioneered by Krylov ('95) and Harvey-Lawson ('09 -), and involve the study of viscosity "almost solutions" of obstacle type problems.
This is joint work with Leandro F. Pessoa

Alma Albujer (Universidad de Córdoba)

Title: Uniqueness results for spacelike hypersurfaces in spatially weighted generalized Robertson-Walker spacetimes

Abstract: In this talk we consider spacelike hypersurfaces in spatially weighted generalized Robertson-Walker spacetimes. Under natural constraints on the spacetime, on the weight function and on the f-mean curvature, we stablish sufficient conditions to guarantee that such a hypersurface must be a slice. In order to get our results we extend a parabolicity criteria due to Romero, Rubio and Salamanca, and we apply some maximum principles. Finally, we also present new Calabi-Bernstein type results concerning entire graphs in a spatially weighted generalized Robertson-Walker spacetime.

The results presented in this talk have been obtained in a joint work with Henriqe F. de Lima, Arlandson M. Oliveira and Marco Antonio L. Velásquez.

Francisco Urbano (Universidad de Granada)

Title: Hypersurfaces of $\mathbb{S}^2 \times \mathbb{S}^2$

Abstract: It is a classical problem the study of homogeneous hypersurfaces or isoparametric hypersurfaces or hypersurfaces of constant principal curvatures of a Riemannian manifold. Many results are known when the ambient manifold is the Euclidean space or the sphere or the hyperbolic space. In the talk I will expose some recent results about these kind of hypersurfaces when the ambient manifold is the symmetric space $\mathbb{S}^2 \times \mathbb{S}^2$.

Luquésio P. Jorge (Universidade Federal do Ceará)

Title: TBA

Abstract: to be informed.

Irene Ortiz (Universidad de Murcia)

Title: Eigenvalue estimates for the stability operator of compact CMC surfaces in warped products

Joint work with Miguel A. Meroño

Abstract: Constant mean curvature surfaces (CMC) are characterized as critical points of the area functional restricted to those variations which preserve certain volume function. For such critical points the stability is given by the Jacobi operator J, then a surface is said to be strongly stable if the first eigenvalue associated to the mentioned operator is non negative.

Our aim is the search of estimates for the first stability eigenvalue for compact CMC surfaces immersed into three-dimensional warped product spaces satisfying a suitable and well studied convergence condition. We also characterize the cases when the upper bound is reached. As an application, we derive some consequences for those surfaces that are stable, obtaining some classification results.

Miguel Domínguez (Universidad de Murcia)

Title: Classification of isoparametric hypersurfaces in complex hyperbolic spaces

This is a joint work with J. Carlos Díaz Ramos and Víctor Sanmartín López.

Abstract: A hypersurface in a Riemannian manifold is called isoparametric if it and its nearby equidistant hypersurfaces have constant mean curvature. The study of isoparametric hypersurfaces traces back at least to the works of Beniamino Segre and Élie Cartan in the 30s, who classified these objects in Euclidean and real hyperbolic spaces. Their classifications have been, until very recently, the only ones of this kind known for a complete family of symmetric spaces. Indeed, the problem in spheres is still open nowadays.

In this talk I will present and explain the classification of isoparametric hypersurfaces in complex hyperbolic spaces.

Henrique F. de Lima (Universidade Federal de Campina Grande)

Title: The stability of hypersurfaces revisited

The results that will be presented in this talk correspond to a part of a joint paper with J. F. da Silva and M. A. Velásquez, to appear in Monatshefte für Mathematik.

Abstract: In this talk, we will revisit the problem of characterize (r, s)-stable closed hypersurfaces immersed in the Euclidean space. In this setting, we will prove that if such a hypersurface has their higher order mean curvatures linearly related, then it must be a geodesic sphere.

Luis J. Alías (Universidad de Murcia)

Title: Geometric applications of the maximum principle on trapped submanifolds

Abstract: Let $\overline{M}$ be an n-dimensional spacetime, and consider either ϱ_p, the Lorentzian distance from a point $p \in \overline{M}$, or ϱ_Σ, the Lorentzian distance from an achronal spacelike hypersurface $\Sigma \subset \overline{M}$. Under suitable conditions these Lorentzian distances are differentiable at least in a "sufficiently near chronological future" of the point p or of the hypersurface Σ, so that some classical analysis can be done on those functions.

In this talk we will study the Lorentzian distance function restricted on a trapped submanifold M immersed into $\overline{M}$. In particular, we shall consider trapped submanifolds whose image under the immersion is bounded in the ambient spacetime, in the sense that the Lorentzian distance either from a fixed point or from an achronal spacelike hyperurface Σ is bounded. As an application of the weak maximum principle, we will derive sharp estimates for the mean curvature of such submanifolds under appropriate hypotheses on the curvature of the ambient spacetime.

The results in this talk are part of our recent research work developed jointly with G. Pacelli Bessa and Jorge H.S. de Lira, from Universidade Federal do Ceará, Fortaleza (Brazil).

3 Topological methods in algebra, geometry and nonlinear analysis

Organizers

Urtzi Buijs (Universidad de Málaga and Univesité Catholique de Louvain)
Daciberg L. Gonçalves (Universidade de São Paulo)
Alice K. M. Libard (Universidade Estadual Paulista)
Aniceto Murillo (Universidad de Málaga)

	Monday 07	**Tuesday 08**
14:30 - 15:10	U. Buijs	D. Girão
15:10 - 15:50	R. J. Flores	D. Vendrúsculo
15:50 - 16:20	Coffee	
16:20 - 17:00	E. Hoefel	C. Hayat Legrand
17:00 - 17:40	C. Costoya	A. Viruel
17:40 - 18:00	Coffee	
18:00 - 18:40	P. L. Pergher	A. Garvin
18:40 - 19:20	T. F. Monis	O. Ocampo

Urtzi Buijs (Université Catholique de Louvain and Univ. de Málaga)

Title: Generalized Quillen rational homotopy and its applications

Abstract: Starting from the study of the rational homotopy under Quillen's approach, we define a new realization functor connecting rational homotopy theory with a wide range of areas such as deformation theory and number theory.

Ramón J. Flores (Universidad de Sevilla)

Title: Approximating Lie groups by Notbohm kernels

Abstract: Let A be the classifying space of an abelian p-torsion group. We compute A-cellular approximations (in the sense of Chacholski and Farjoun) of classifying spaces of p-local compact groups, with special emphasis in the cases which arise from honest compact Lie groups. The main new ingredient of our construction is the Notbohm kernel, which appears to be the correct generalization to this context of the strongly closed subgroup of a finite group.

Eduardo Hoefel (Universidade Federal do Paraná)

Title: Homotopy Representations and Open-Closed Structures

This talk is based on joint work with Muriel Livernet.

Abstract: In this talk we study the homotopy representations of associative and Lie algebras in connection with several algebraic structures that appear in the study of the Swiss-cheese operad. We refer to this class of algebraic structures as "Open-Closed Structures", which naturally include the OCHAs discovered by Kajiura and Stasheff.

Cristina Costoya (Universidad de La Coruña)

Title: Kahn's problem: realizability of abstract groups

This is joint work with Antonio Viruel.

Abstract: Let G be an abstract group. Is there a simply-connected space X such that the group of self homotopy equivalences of X, $\mathcal{E}(X)$, is isomorphic to G?

This is the classical realizability problem for groups. It asks for charactherization of those groups that appear as the group of self homotopy equivalences of a space. In a recent paper [1] the authors gave an affirmative answer to that question in the case of finite groups. In this talk we will explain the general method we have introduced in [1] to build up those spaces, and we will show that it is useful for obtaining examples with interesting properties in subjects of different nature.

[1] C. Costoya and A. Viruel. *Every finite group is the group of self-homotopy equivalences of an elliptic space*. Acta Mathematica **213** (2014), 49–62.

Pedro Luiz Queiroz Pergher (Universidade Federal de São Carlos)

Title: Ações fixando variedades Dold do tipo $\mathbf{P}(\mathbf{1}, \mathbf{2n} + \mathbf{1})$

Joint work with Allan Edley Ramos de Andrade (Universidade Federal do Mato Grosso do Sul) and Sergio Tsuyoshi Ura (Universidade Federal de São Carlos)

Abstract: Sejam M uma variedade fechada e suave $T : M \to M$ uma involução suave com conjunto de pontos fixados F. É conhecido que F é uma reunião finita e não conexa de subvariedades compactas de M. Neste contexto, uma questão que aparece é, fixado

um conjunto F, a classificação, a menos de cobordismo equivariante, dos pares $(M;T)$, onde M é uma variedade fechada e T é uma involução cujo conjunto de pontos fixados é F. Em [4] e em [7], P. E. Conner, E. E. Floyd e R. E. Stong estabeleceram a classificação de involuções fixando os espaços projetivos reais $\mathbb{R}\mathrm{P}(n)$. Em [3], D. C. Royster estudou o problema quando F é união disjunta de dois espaços projetivos reais $\mathbb{R}\mathrm{P}(m) \cup \mathbb{R}\mathrm{P}(n)$, deixando a classificação em aberto quando m e n são ambos pares (o caso geral permanece em aberto). Em [2], A. Ramos estudou a classificação no caso de uniões de dois espaços projetivos com corpos de dimensões maiores. Em [1], A. E. R. de Andrade estudou a classificação de ações de $\mathbb{Z}_2^k$ fixando a união de dois espaąos projetivos relativos quaisquer corpos. O objetivo deste trabalho é a classificação das classes de cobordismo equivariante de pares de involuções comutantes em uma variedade fechada M^n cujo conjunto de pontos fixados pela ação são variedades de Dold da forma $P(1, 2n+1)$. Em [8], Stong classifica todas as possíveis classes características de fibrados vetoriais sobre variedades Dold. Baseado neste trabalho, classificamos a menos de classes de bordismo equivariante, todas involuções que possuem $P(1, 2n+1)$ como conjunto de pontos fixados, e por fim usando o ferramental criado em [5] e [6], obtemos a classificação de ações de $\mathbb{Z}_2^2$-ações fixando $P(1, 2n+1)$.

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[5] P. L. Q. Pergher. *Bordism of two commuting involutions*. *Proceedings of the AMS* Vol. **126** N. **7** (1998) 2141–2149.

[6] P. L. Q. Pergher and R. de Oliveira. *$\mathbb{Z}_2^k$-actions with a special fixed poit set*. Fundamenta Mathematicae **186** (2005).

[7] R. E. Stong. *Involutions fixing projective spaces*. Michigan Math. J. Vol.**13** (1966), 445–457.

[8] R. E. Stong. *Vector bundles over Dold manifolds*. Fundamenta Mathematicae **169** (2001) 2000 MSC: Primary 55R40.

Thaís Fernanda Mendes Monis (Universidade Estadual Paulista)

Title: Nielsen coincidence theory for manifolds with boundary in positive codimensions

This is joint work with Daciberg Lima Gonçalves and Alice Kimie Miwa Libardi

Abstract: Suppose $f_1, f_2 : M^m \to N^n$ maps between manifolds without boundary of dimensions m and n respectively, with $m \geq n$. The spirit of the classical Nielsen coincidence point theory is to attempt to minimize the coincidence set $\text{Coin}(f_1, f_2) = \{x \in M \mid f_1(x) = f_2(x)\}$ by means of homotopies of f_1 and f_2. In the case of codimension $m - n = 0$, the objective is to minimize the number of points in the set. In the case of positive codimension $m - n > 0$, the objective is to minimize the number of path components of the set. The study of the positive codimension situation is much more recent and the main tools that have been used to deal with the problem are normal bordism and obstruction theory.

In this work we are interested in the Nielsen Theory for the category $\mathcal{B}$ whose objects are ordered pairs M^m, N^n of connected smooth manifolds with nonempty boundaries, M being compact, of dimensions m and n, respectively, $m \geq n \geq 1$, and the morphisms are ordered pairs $f_1, f_2 : M \to N$ of maps where $f_2 : (M, \partial M) \to (N, \partial N)$ is a map of pairs. Given $f_2, f_2' : (M, \partial M) \to (N, \partial N)$ maps of pairs, f_2 and f_2' are said to be $\mathcal{B}$-homotopic if there is a homotopy $F : M \times I \to N$ between f_2 and f_2' such that $F(\partial M \times I) \subset \partial N$. Notation: $f_2 \sim_{\mathcal{B}} f_2'$. The problem that we will discuss is: given a morphism (f_1, f_2) in the category $\mathcal{B}$, minimizing the number of coincidence (path)-components

$$\text{MCC}(f_1, f_2) = \min\{\#\pi_0(C(f_1', f_2')) \mid f_1' \sim f_1 \text{ and } f_2' \sim_{\mathcal{B}} f_2\},$$

where $C(f_1', f_2') = \{x \in M \mid f_1'(x) = f_2'(x)\} = (f_1', f_2')^{-1}(\Delta_N)$. Note that since M is compact, $\text{MCC}(f_1, f_2)$ is finite. The approach will be via normal bordism, following the work developed by U. Koschorke [3]. Consider the particular case where $M = N = D^n$ the unitary closed disc n-dimensional. Given a map $f_2 : (D^n, S^{n-1}) \to (D^n, S^{n-1})$, it is know from Brown and Schirmer [1] that:

1. If $(f_2)_* : H_n(D^n, S^{n-1}) \to H_n(D^n, S^{n-1})$ is nonnull then, for every map $f_1 : D^n \to D^n$, $C(f_1, f_2) \neq \emptyset$.

2. If $(f_2)_* : H_n(D^n, S^{n-1}) \to H_n(D^n, S^{n-1})$ is trivial then there exists a map $f_1 : D^n \to D^n$ such that $C(f_1, f_2) = \emptyset$.

   In turn, the homomorphism $(f_2)_* : H_n(D^n, S^{n-1}) \to H_n(D^n, S^{n-1})$ is determined by the degree of the restriction $(f_2|_{S^{n-1}}) : S^{n-1} \to S^{n-1}$.

Now, in the case of a map $f_2 : (D^m, S^{m-1}) \to (D^n, S^{n-1})$, where $m \geq n$, a natural question is the relation beween the degree of the restriction $(f_2|_{S^{m-1}}) : S^{m-1} \to S^{n-1}$ and the number $MCC(f_1, f_2)$ for an arbitrary map $f_1 : D^m \to D^n$.

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[2] Brown, R., Schirmer, H.; *Correction to "Nielsen coincidence theory and coincidence-producing maps for manifolds with boundary".* Topology Appl. **67**, 233-234 (1995).

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Darlan Girão (Universidade Federal do Ceará)

Title: Tunnel number from a combinatorial point of view

Abstract: The tunnel number is a very important knot invariant. Given a knot or link K in S^3, it is usually very hard to estimate its tunnel number. We study the problem of estimating this number from a combinatorial perspective and show how this relates to a classic problem in graph theory. We also show how the estimates obtained form this combinatorial approach behave under the connected sum of knots.

Daniel Vendrúsculo (Universidade Federal de São Carlos)

Title: Involutions on Sol-manifolds and the Borsuk-Ulam type Theorem

This is joint work with A.P. Barreto, D.L. Gonçalves, D. Vendrúscolo

Abstract: In this talk we discuss first the problem of classification of involutions on a sol 3-manifolds. Then the Borsuk-Ulam theorem for the pairs (M, τ) where M is a sol manifold and τ is a free involution.

Firstly we discuss the case where the manifold is a torus semi-bundle (a Sapphire manifold) which is not a torus bundles. In the second part we consider the torus bundles where the gluing map is an Anosov diffeomorphism. For the case of a Sapphire sol manifold a complete classification is proved. For the torus bundle a partial result is obtained for the Borsuk-Ulam property. Follows some relevant references:

[1] A. Bauval, C. Hayat, D. L. Gonçalves and P. Zvengrowski, The Borsuk-Ulam theorem for manifolds, with applications to dimensions two and three, *Proceedings of the International Conference Bratislava Topology Symposium* "Group Actions and Homogeneous Spaces" (2009), 09–28.

[2] K. Morimoto, Some orientable 3-manifolds containing Klein bottles, *Kobe J. Math.* **2** (1985), 37–44.

[3] M. Sakuma, Involutions on torus bundles over S^1, *Osaka J. Math.* **22** (1985), 163–185.

Claude Hayat Legrand (Paul Sabatier, Toulouse)

Title: Involutions of 3-manifolds of geometry spherical and $S^2 \times R$ and the borsuk-Ulam theorem

Abstract: In the talk we compute all the involutions of a 3-manifold admiting geometry as in the title. Then we derive the Borsuk-Ulam type theorem for such pairs (M, τ) where τ is a free involution. The fundmental groups play an importante role in this study, but special attention must be given in the case where the manifold is a lens space. The classification of the lens space up to homeomorphism are used and general technique of cohomology are the main tools.

Antonio Viruel (Universidad de Málaga)

Title: Extended Kahn's problem: realizability of group actions

This is joint work with Cristina Costoya.

Abstract: In this talk we go one step further of the Kahn's realizability problem for abstract groups by raising the following question. Let G be a group acting on a finitely generated module M. Is there a space X such that, for some $n \geq 2$, the $\mathcal{E}(X)$-module $\pi_n(X)$ is isomorphic to the G-module M?

Ours is a realizability problem for group actions on modules. It asks for characterization of those actions that appear as the natural $\mathcal{E}(X)$-action on the homotopy groups of a space X. This work fits within the framework of (a dual of) the classical Steenrod problem for G-Moore spaces. By using Invariant Theory, we give a positive answer when G is a finite group acting faithfully on a module M over the rationals.

Antonio Garvin (Universidad de Málaga)

Title: The rational homotopy type of certain function spaces

Abstract: Following Sullivan's approach to rational homotopy theory we describe the rational homotopy type of function spaces through the Haefliger-Brown-Sczcarba model. The methods developed are specially fruithfull in the study of maps between Koszul spaces. As an aplication we give some explicit computations when the source and target are ordered configuration spaces.

Oscar Ocampo (Universidade Federal da Bahia)

Title: Quotient of the Artin Braid Groups and Crystallographic Groups

This is joint work with John Guaschi and Daciberg Lima Gonçalves

Abstract: Let B_n (resp. P_n) denote the Artin braid group (resp. the Artin pure braid group) with n strings and let $n \geq 3$. We show that the quotient

$$\frac{B_n}{[P_n, P_n]}$$

is a crystallographic group, where $[P_n, P_n]$ means the commutator subgroup of P_n. This quotient has torsion elements in contrast to the (pure) braid groups P_n and B_n. We classify the torsion elements and its conjugacy classes in the crystallographic group $B_n/[P_n, P_n]$. Finally, we discuss the existence of finite groups in $B_n/[P_n, P_n]$.

4 Geometry and mechanics

Organizers

Paula Balseiro (Universidade Federal Fluminense)
Jair Koiller (INMETRO)
Manuel de Len (ICMAT, Madrid)
Juan Carlos Marrero (Universidad Nacional de La Laguna)

	Monday 07	**Tuesday 08**
14:30 - 15:10	Tudor Ratiu	François Gay-Balmaz
15:10 - 15:50	David Martin de Diego	David Iglesias-Ponte
15:50 - 16:20	Coffee	
16:20 - 17:00	Marco Castrillón Lopez	Anete Cavalcanti
17:00 - 17:40	Luis Garcia-Naranjo	Eduardo Martinez
17:40 - 18:00	Coffee	
18:00 - 18:40	Edith Padron	Jaap Eldering
18:40 - 19:20	F.Michael Forger	Daniele Sepe

Tudor Ratiu (EPFL, Lausanne)

Title: The symplectic structure on simply connected coadjoint orbits of connected simply connected solvable Lie groups

Abstract: A 1992 theorem of Pukanszky states that simply connected coadjoint orbits of connected simply connected solvable Lie groups are diffeomorphic to the standard symplectic vector space. The proof is based on a theorem which turns out to be a corollary of the cotangent bundle reduction theorem and is more general than the one used in the original paper. I will present this result and then sketch in very broad lines the proof of Pukanszky's theorem.

David Martin de Diego (Instituto de Ciencias Matemáticas, Madrid)

Title: Simulating nonholonomic dynamics

Abstract: In this talk, we will discuss some new developments regarding the numerical integration of nonholonomic systems. These systems arise, for instance, in mechanical

systems that have a rolling or certain kinds of sliding contact. Moreover, they have a close relationship to new developments in control theory and robotics. Consequently, in the last years, several new numerical methods have developed through a discrete geometric approach; in particular, methods based on a discretization of Lagrange-d'Alembert's principle, methods based on projection techniques (geometric nonholonomic integrator), numerical schemes based on the hamiltonization of the nonholonomic system, energy preserving integrators...

Marco Castrillón Lopez (ICMAT- UCM, Currently at PUC-Rio, Brazil)

Title: Some applications of un-reduction for field Theories

Abstract: The variational equations obtained through Lagrange-Poincaré reduction are split in two sets. One is like Euler-Poincaré and the second like stardard Euler-Lagrange, with an additional term defined by the curvature of certain connection. The main idea in this talk is to use this process backwards. The un-reduction scheme is defined in such a way that some variational equations are lifted conveniently so that the Euler-Poincaré part and the curvature term can be neglected by the introduction of some external forces. In this talk the theoretical formulation of this process will be presented as well as applications in: sigma models, images evolution and hyperbolic flow equations.

Luis Garcia-Naranjo (UNAM, Mexico)

Title: Quasi-periodicity in relative quasi-periodic tori

Abstract: Under suitable hypotheses, we generalize known results on quasi-periodicity of the dynamics in relative equilibria and relative periodic orbits of symmetrical dynamical systems to the case of relative quasi-periodic tori.

Edith Padrón (Universidad de la Laguna)

Title: Classification of G-equivariant lagrangian fibrations with compact fibers

Abstract: It is well-known the local model of a Lagrangian fibration $\pi : (\pi : M, \omega) \to B$ on a symplectic manifold (M, ω) with compact fibers. Now, additionally we suppose that we have a G-Lagrangian fibration, that is, two G-actions Φ and ϕ on M and B respectively, such that π is equivariant and Φ is symplectic. In this talk we will present a local model for G-Lagrangian fibrations and we will give a cohomological classification of these models.

Frank Michael Forger (Universidade de São Paulo)

Title: Symmetries in Geometric Field Theory and Lie Groupoids

Abstract: We discuss how to implement the notion of symmetry in a geometric approach to field theory - more specifically, the covariant hamiltonian formalism using multisymplectic geometry - using Lie groupoids instead of Lie groups, so as to incorporate the basic idea of space-time locality into the mathematical modelling of the notion of symmetry, from the very beginning.

François Gay-Balmaz (CNRS, ENS, Paris, France)

Title: Ericksen-Leslie and Eringen theories of liquid crystals

Abstract: There are two competing descriptions of nematic liquid crystal dynamics: the Ericksen-Leslie director theory and the Eringen micropolar approach. Up to this day, these two descriptions have remained distinct in spite of several attempts to show that the micropolar theory comprises the director theory. In this talk I will show that this is the case by using Lie group symmetry reduction techniques. More precisely, I will show how these systems can be seen as reduced Euler-Lagrange equations on semidirect product Lie algebras and how this geometric approach can be used to prove that the micropolar theory of liquid crystal comprises the well-known Ericksen-Leslie theory.

David Iglesias-Ponte (Universidad de la Laguna)

Title: Poly-Poisson manifolds and reduction in field theory

Abstract: We introduce the notion of poly-poisson structure, which extends poly-symplectic manifolds. These structures play an important role in reduction procedures coming from field theory.

Anete S. Cavalcanti (Universidade Federal Rural de Pernambuco)

Title: An Existence Proof of a Symmetric Periodic Orbit in the Octahedral Six-Body Problem

Abstract: The *Variational Method* applied to the n-body Newtonian problem allows demonstrate the existence of periodic orbits, in most cases with some symmetry. It was exploited by the Italian school in the 90's (Coti-Zelati, Degiovanni-Gianonni-Marino, Serre-

Terracini). They give us the new periodics solutions to potential which satisfy a hypothesis called *strong force*, which excludes the newtonian potential. The hypothesis *strong force* was introduced by Poincaré. In this talk we propose a variational existence proof of a symmetric periodic orbit in the *octahedral six-body problem* with equal masses. This problem is the Newtonien 6BP with equal masses such that each two bodies are in one of the three axes mutually orthogonal.

Eduardo Martinez (Unizar, Spain)

Title: Higher-order Variational Calculus on Lie Algebroids

Abstract: The equations for the critical points of the action functional defined by a Lagrangian depending on higher-order derivatives of admissible curves on a Lie algebroid are found. The relation with Euler-Poincaré and Lagrange-Poincaré type equations is studied. Reduction and reconstruction results for such systems are established.

Jaap Eldering (PUC-Rio, Brazil)

Title: Nonholonomic dynamics as limit of infinite friction

Abstract: Nonholonomic dynamics is a principle to extend Lagrangian mechanics to incorporate constraints on velocities. Such "no slipping" constraints often show up in mechanical systems and it is natural to think of them as enforced by strong contact friction forces.

I will show how this idea can be made rigorous by considering the limit dynamics with infinite (viscous) friction forces added, using singular perturbation theory. We indeed recover nonholonomic dynamics, but moreover, obtain a simplified method to study systems with "non-ideal", large but finite friction.

I will illustrate the results applied to the Chaplygin sleigh toy model and discuss its possible use in studying the tippe top.

Daniele Sepe (Universidade Federal Fluminense)

Title: Global aspects of Hamiltonian integrability on contact manifolds

Abstract: Non-commutative Hamiltonian integrable systems (in the sense of Nekhoroshev or Mishenko-Fomenko) on symplectic manifolds are intimately related to isotropic realisations of regular Poisson structures, which can be seen as 'desingularisations' of the under-

lying Poisson manifold. It is natural to ask whether an analogous connection holds for integrable Hamiltonian systems on manifolds endowed with related structures (*e.g.* (twisted) symplectic, Poisson or Dirac). This talk is concerned with describing the global geometric objects behind non-commutative integrable Hamiltonian systems on contact manifolds (as defined by Khesin and Tabachnikov, Banyaga and Molino, and Jovanovic). This is joint work with M. A. Salazar.

Poster presentations

Bruno Tadeu Costa (Universidade de São Paulo)

Title: Induced actions and invariant forms

Abstract: Starting from a given action of a Lie groupoid on a fiber bundle, we show how to construct induced actions of certain Lie groupoids, derived from the original one, on certain fiber bundles, derived from the original one: this is an essential technical feature needed to understanding what it meant by invariance of a tensor field under the action of a Lie groupoid. As the most important example, we are able to show in which sense the multicanonical form θ and the multisymplectic form ω of the covariant hamiltonian formalism are invariant under the appropriate induced action, and similarly, the forms θ_H and ω_H, given by the pull-back of the forms θ and ω by the Hamiltonian H, respectively, are invariant under the action of a Lie groupoid leaving the Hamiltonian invariant. This is a joint work with Frank Michael Forger (IME-USP).

5 Topology and dynamics

Organizers

Begoña Alarcón Cotillas (Universidade Federal Fluminense)
Andrés Koropecki (Universidade Federal Fluminense)
Francisco Romero Ruiz del Portal (Universidad Complutense de Madrid)
José Manuel Salazar Crespo (Universidad de Alcalá de Henares)

	Monday 07	**Tuesday 08**
14:30 - 15:10	Antonio J. Ureña	André de Carvalho
15:10 - 15:50	Armengol Gasull Embid	Fabio A. Tal
15:50 - 16:20	Coffee	
16:20 - 17:00	J. J. Sánchez-Gabites	Javier Ribón
17:00 - 17:40	José M.R. Sanjurjo	Salvador Addas-Zanata
17:40 - 18:00	Coffee	
18:00 - 18:40	José M. Salazar	"Social Program"
18:40 - 19:20	–	–

Antonio J. Ureña (Universidad de Granada)

Title: The higher-dimensional Poincaré-Birkhoff theorem for Hamiltonian systems

Abstract: We propose a higher dimensional generalization of the Poincaré-Birkhoff Theorem which applies to Poincaré time maps of Hamiltonian systems. The maps under consideration are neither required to be close to the identity nor to have a monotone twist. The annulus is replaced by the product of an $N-$dimensional torus and the interior of an embedded sphere in the $N-$dimensional euclidean space; on the other hand, the classical boundary twist condition is replaced by an avoiding rays condition. This talk is based on a joint work with Alessandro Fonda (Università degli Studi di Trieste).

Armengol Gasull (Universitat Autònoma de Barcelona)

Title: Smooth linearization of planar periodic maps

Abstract: A continuous map $F : \mathbb{R}^n \to \mathbb{R}^n$ satisfying $F^m = \mathrm{Id}$ is called m*-periodic*. The celebrated Kerékjártó theorem asserts that planar continuous m-periodic maps can be continuously linearized. This result goes back to 1919 and appeared in the works of Brouwer

and Kerékjártó. Currently it is simply known as Kerékjártó theorem. A complete proof was presented by Eilenberg in 1934 (see [4] for more details). Later it was discovered that this theorem cannot be extended to higher dimensions. In fact, in [1,2], Bing constructed examples showing that, for any $m \geq 2$, there are continuous m-periodic maps in $\mathbb{R}^3$ which are not linearizable. The goal of this talk is to present the main steps to prove the $\mathcal{C}^k$ version of this theorem. A first step in this direction can be found in [3], where we dealt with $\mathcal{C}^1$-involutions. We prove:

Theorem. *Let $F : \mathbb{R}^2 \to \mathbb{R}^2$ be a $\mathcal{C}^k$-differentiable m-periodic map with $k \in \mathbb{N} \cup \{\infty\}$. Then F is $\mathcal{C}^k$-linearizable.*

This talk is based on a joint work with A. Cima, F. Mañosas and R. Ortega.

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[1] R. H. Bing. *A homeomorphism between the 3-sphere and the sum of two solid horned spheres*, Ann. of Math. **56** (1952), 354–362.

[2] R. H. Bing. *Inequivalent families of periodic homeomorphisms of E^3*, Ann. of Math. **80** (1964), 78–93.

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J. J. Sánchez-Gabites (Universidad Autónoma de Madrid)

Title: On Conley-type indices

*A*bstract: One of the key features of the Conley index of an isolated invariant set K is that it does not depend on the particular isolating neighbourhood N used to compute it. We would like to find, if possible, other indices having this same property (and we call these *Conley-type indices*). In this talk we shall concentrate on flows on 3manifolds. We will construct the finest possible Conley-type index and show that it is strictly finer than the Conley index, but essentially equivalent to it when K is a fixed point or a periodic orbit (satisfying some additional condition). This is work in progress, so a number of open questions will be stated along the way.

José M.R. Sanjurjo (Universidad Complutense de Madrid)

Title: Conley index and robustness of non-saddle sets

Abstract: We study topological and dynamical properties of non-saddle sets of flows in manifolds. In particular, we discuss the existence of dissonant points in their region of influence and the role of these points in the global dynamics of the flow. We also discuss relations with Morse decompositions and the Conley index and find necessary and sufficient conditions for robustness of non-saddle sets. The results presented in this talk are joint work with Héctor Barge.

José M. Salazar (Universidad de Alcalá de Henares)

Title: Lefschetz index of planar homeomorphisms at isolated invariant continua

Abstract: Let $f : U \subset \mathbb{R}^2 \to f(U) \subset \mathbb{R}^2$ be an arbitrary homeomorphism, with U an open set, and let $K \subset U$ be an isolated invariant continuum. If K does not decompose the plane, the fixed point indices of the iterates of f at K, $i_{\mathbb{R}^2}(f^n, K)$, follow the same behavior than the indices at a locally maximal fixed point. This problem was solved by P. Le Calvez and J.C. Yoccoz in the orientation preserving case. In this paper we compute the indices for arbitrary, not only orientation preserving, homeomorphisms and arbitrary isolated continua and show some dynamical implications.

André de Carvalho (Universidade de São Paulo)

Title: Dynamics, braids and 3-manifolds

Abstract: Let S be a surface, $f\colon S \to S$ a homeomorphism and $P \subset S$ an f-invariant subset. The *braid type* $\beta(f, P)$ is the isotopy class of f relative to P up to topological changes of coordinates. If S is the plane and P is a finite set, then $\beta(P, f)$ can be thought of as a geometric braid, hence the name. The *mapping torus* $\mapsto (f, P)$ is the suspension of the homeomorphism $f|_{S\setminus P}\colon S \setminus P \to S \setminus P$, i.e., the 3-manifold obtained taking the product $(S \setminus P) \times [0, 1]$ and identifying $(x, 1)$ and $(f(x), 0)$ for all $x \in S \setminus P$. Thurston's classification of surface homeomorphisms up to isotopy allows us to define the partial order of *implication* among braid types. Understanding this partial order is central to the understanding of how dynamics builds up in families of surface diffeomorphisms, for example. Thurston's hyperbolization theorem for fibered 3-manifolds (often) finds hyperbolic structures on the mapping tori $\mapsto (f, P)$. In this talk we will discuss how implication organizes braid types of periodic orbits of Smale's horseshoe and relate this to

the hyperbolic structures on the 3-manifolds $\mapsto (f, P)$. We will also discuss taking limits in both worlds: of braid types and of hyperbolic 3-manifolds.

Fabio Armando Tal (Universidade de São Paulo)

Title: Zero entropy homeomorphisms of the sphere

Abstract: We use a newly developed theory of forcing for surface homeomorphisms to obtain a Poincar-Bendixson like result for orientation preserving - homeomorphisms of the 2-sphere with zero topological entropy. If f is such a map and is not a pseudo-rotation, we show that for every x, there exists a power of f such that the omega limit of x must be either:

1. A cycle made of the union of unlinked fixed points and points heteroclinic to them.
2. A set rotating with irrational speed around a fixed point and possibly this fixed point.
3. An "infinitely renormalizable" set where the restriction of the dynamics is semi-conjugate to the odometer.

Joint work with P. Le Calvez

Javier Ribón (Universidade Federal Fluminense)

Title: Rotational properties of nilpotent groups of diffeomorphisms of surfaces

Abstract: Brouwer translation theorem implies that any orientation preserving homeomorphism of the plane that preserves a Borel probability measure has a fixed point. We show partial generalizations of this result in the context of nilpotent groups of diffeomorphisms of the plane. We will also discuss existence of global fixed points of nilpotent groups of diffeomorphisms in compact surfaces and the connection of this problem with the rotational properties of elements in the group.

Salvador Addas-Zanata (Universidade de São Paulo)

Title: Sobre difeomorfismos do toro com racionais no bordo do conjunto de rotação

Abstract: Nesse trabalho, supomos que f é um difeomorfismo do toro homotópico à identidade, cujo conjunto de rotao tem interior e um certo ponto racional $(p/q, r/q)$ pertence

ao bordo do conjunto de rotação. Supomos ainda que por perturbações C^0 arbitrariamente pequenas aplicadas a f, podemos obter um homeomorfismo que no contém $(p/q, r/q)$ em seu conjunto de rotação. O nosso objetivo é estudar se, nessas condiç ões podemos perturbar f de forma que para esse homeomorfismo perturbado, $(p/q, r/q)$ esteja agora no interior do novo conjunto de rotação. Apresentaremos dois resultados. O primeiro é um teorema que garante que se a dinâmica local na vizinhança do conjunto K de pontos periódicos de período q, com vetor de rotação $(p/q, r/q)$, tiver uma certa propriedade, então não é possível perturbar f de forma a mandar $(p/q, r/q)$ para o interior do conjunto de rotação. Em particular esse teorema se aplica nas situações onde os pontos de K tem um autovalor igual a 1 e o outro diferente de 1 e também no caso em que f é analítica e preserva área. O outro resultado consiste em exemplos que não satisfazem a propriedade local do teorema acima, para os quais é possvel mandar o racional $(p/q, r/q)$ para o interior do conjunto de rotação por perturbações.

Trabalho em colaboração com P. Le Calvez.

Posters

Naiara Vergian de Paulo Costa (IME-USP)

Title: On the multiplicity of periodic orbits and homoclinics near critical energy levels of Hamiltonian systems in $\mathbb{R}^4$

Abstract: We study the Hamiltonian dynamics associated to a real-analytic function H defined in $\mathbb{R}^4$. More precisely, we assume the existence of a critical energy level $H^{-1}(0)$ which cointains a saddle-center equilibrium lying in a strictly convex singular subset $S_0 \subset H^{-1}(0)$. Then for each $E > 0$ small, the energy level $H^{-1}(E)$ contains a closed 3-ball S_E near S_0 which admits a $2 - -3$ foliation. The regular leaves of such a foliation are transverse to the Hamiltonian vector field and the singularity is formed by two periodic orbits, one of them being the hyperbolic orbit $P_{2,E}$ in the center manifold of the saddle-center. The $2 - -3$ foliation provided valuable information about the dynamics restricted to S_E such as the existence of infinitely many homoclinics to $P_{2,E}$. In the particular case where the branches of the stable and unstable manifolds of $P_{2,E}$ inside S_E do not coincide, one obtains positive topological entropy. This is a joint work with Pedro A. S. Salomão (IME–USP).

6 Piecewise smooth differential systems

Organizers

Cláudio Aguinaldo Buzzi (Universidade Estadual Paulista)
Armengol Gasull (Universitat Autònoma de Barcelona)
Marco Antônio Teixeira (Universidade Estadual de Campinas)
Joan Torregrosa (Universitat Autònoma de Barcelona)

	Monday 07	**Tuesday 08**
14:30 - 15:10	Marco A. Teixeira	Enrique Ponce
15:10 - 15:50	Francisco Torres	Marcelo Messias
15:50 - 16:20	Coffee	
16:20 - 17:00	Claudio Buzzi	Douglas Novaes
17:00 - 17:40	Joan Torregrosa	Maurício Lima
17:40 - 18:00	Coffee	
18:00 - 18:40	João Medrado	Armengol Gasull
18:40 - 19:20	Victoriano Carmona	–

Marco Antonio Teixeira (IMECC-UNICAMP)

Chairman: Joan Torregrosa.
Title: Generic two parameter families of Planar Filippov Systems.

Abstract: Let $Z_0 = (X_0, Y_0)$ be a planar piecewise smooth vector field where the swichting set is concentrated on the line $\{y = 0\}$. Consider that Z_0 contains an orbit that connects a visible fold-fold singularity. Such phenomenun occurs generically for two parameter families in the non-smooth universe. Our goal is to exhibit the bifurcation diagram of such system.

Francisco Torres (Universidad de Sevilla)

Chairman: Joan Torregrosa.
Title: Resonance phenomena in homogeneous piecewise-linear area-preserving maps.

Abstract: In this talk the dynamical behavior of a planar continuous piecewise linear map is analyzed. From the initial system having in principle eight parameters, a canonical form

with only four parameters is obtained. Under the additional assumption of preservation of areas, both determinants are the unity and we have the traces of the matrices defining the system as the only two parameters. Apart from periodic dynamics it is shown the existence of resonance phenomena in some wedge shaped parameter regions. Moreover, each wedge connects at least other one through a vertex that is a point in the parameter plane with finite order dynamics.

Claudio Aguinaldo Buzzi (IBILCE-UNESP)

Chairman: Joan Torregrosa.
Title: Chaotic Planar Piecewise Smooth Vector Fields with non Trivial Minimal Sets.

Abstract: In this talk some aspects on chaotic behavior and minimality in planar piecewise smooth vector fields theory will be treated. The occurrence of non-deterministic chaos will be observed and the concept of orientable minimality will be introduced. It will be also investigated some relations between minimality and orientable minimality and will be observed the existence of new kinds of non-trivial minimal sets in chaotic systems. The approach will be geometrical and involve the ordinary techniques of non-smooth systems. It is a joint work with T. de Carvalho and R.D. Euzébio.

Joan Torregrosa (Universitat Autònoma de Barcelona)

Chairman: Marco Antonio Teixeira.
Title: Center, weak-focus and ciclicity problems for planar systems with few monomials.

Abstract: The center-focus problem consists in distinguishing whether a monodromic singular point is a center or a focus. For singular points with imaginary eigenvalues, usually called *nondegenerate singular points*, this problem was already solved by Poincaré and Lyapunov, see [4]. The solution consists in computing several quantities called commonly the *Poincaré–Lyapunov constants*, and study whether they are zero or not.

Despite the existence of many methods, the solution of the center-focus problem for simple families, like for instance the complete cubic systems or the quartic systems with homogeneous nonlinearities, has resisted all the attempts. For this reason, we propose to push on this question in another direction. We study this problem for a natural family of differential systems with few free parameters but arbitrary degree.

We consider planar systems with a linear center at the origin that in complex coordinates the nonlinearity terms are formed by the sum of few monomials. For some families in this class, we study the center problem, the maximum order of a weak-focus and the

ciclicity problem. Several centers inside this family are done. The list includes a new class of Darboux centers that are also persistent centers. We study if the given list is exhaustive or not. We show that for each natural number p there are differential equations of this type having at least p limit cycles. Moreover, for a particular case which has homogeneous non-linearities, we show examples with several limit cycles and give a condition that ensures uniqueness and hyperbolicity of the limit cycle.

The talk will be a review of the results [1,2,3].

References

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[4] A. M. Lyapunov. *The general problem of the stability of motion*. Taylor & Francis, Ltd., London, 1992. Translated from Edouard Davaux's French translation (1907) of the 1892 Russian original and edited by A. T. Fuller.

João Carlos da Rocha Medrado (Universidade Federal de Goiás)

Chairman: Marco Antonio Teixeira.
Title: On the number of limit cycles for sewing piecewise linear systems on the $\mathbb{R}^3$.

Abstract: In this work, for sewing piecewise linear systems defined on two zones separated by a plane, is proved two results: 1) the uniqueness of limit cycles where all tangencies are of type invisible fold; and 2) The existence of a surface formed by periodic orbits, i.e., a Lyapunov Center Theorem for this class of vector fields.

Victoriano Carmona (Universidad de Sevilla)

Chairman: Marco Antonio Teixeira.
Title: Poincaré half-maps in planar linear systems via inverse integrating factors.

Abstract: For piecewise systems, the partition of the phase space in different regions leads naturally to the use of Poincaré maps for the analysis of orbits that cross the separation manifolds between these regions. The Poincaré maps are therefore defined as composition

of transition maps between the separation boundaries. Sometimes, the explicit calculation of these maps is a difficult task because it obviously depends on the equations of the involved systems but in the case of piecewise linear systems, direct integration of the equations may be used in each region to obtain feasible expressions. Unfortunately, this advantage of linear systems, that is, the possibility of performing direct integration of the equations, has also two important weaknesses for the construction of transitions maps. The first one is that the final expression of the solutions is strongly conditioned by the spectrum of the matrix of the system. This fact forces the appearance of many different cases to study. The second weak point is the implicit (non linear) dependance of the transitions maps on the flight time, namely, the time required by the orbit to go from one separation manifold onto the next one. The main point of this talk is how to override the flaws in the computation of the transition maps due to performing the integration of planar systems. The obvious answer is to avoid the computation of the integrals of the equations by rewriting the transitions map in a more suitable way. In order to do it, we make use of inverse integrating factors.

This work is coauthored by Fernando Fernández-Sánchez and Elisabeth García-Medina.

Enrique Ponce (Universidad de Sevilla)

Chairman: Armengol Gasull.
Title: Revisiting the focus-fold singularity in planar Filippov systems.

Abstract: Planar Filippov differential systems with a straight line as the discontinuity manifold in the so called focus-fold singularity are revisited. This co-dimension two critical configuration appears when there is a collision between an invisible tangency (fold) from one side and a boundary focus, which represents the transition from invisible to visible tangency, from the other side.

The analysis is made in a piecewise linear context and the complete local unfolding of the focus-fold singularity is provided in a convenient two-parameter setting. A universal piecewise linear canonical form is proposed and exploited in order to show the existence of a missing, narrow parametric sector for which two small crossing limit cycles coexist.

The hidden subtleties of the boundary focus giving rise to special difficulties in its analysis are emphasized throughout.

Marcelo Messias (FCT-UNESP)

Chairman: Armengol Gasull.
Title: Bifurcations leading to nonlinear oscillations in a 3D piecewise linear memristor

oscillator.

Abstract: In this work, we make a bifurcation analysis of a mathematical model for an electric circuit formed by the four fundamental electronic elements: one memristor, one capacitor, one inductor and one resistor. The considered model is given by a discontinuous piecewise linear system of ordinary differential equations, defined on three zones in $\mathbb{R}^3$, determined by $|z| < 1$ (called the central zone) and $|z| > 1$ (the external zones). We show that the z-axis is filled by equilibrium points of the system, and analyze the linear stability of the equilibria in each zone. Due to the existence of this line of equilibria, the phase space $\mathbb{R}^3$ is foliated by invariant planes transversal to the z-axis and parallel to each other, in each zone. In this way, each solution is contained in a three-piece invariant set formed by part of a plane contained in the central zone, which is extended by two half planes in the external zones. We also show that the system may present nonlinear oscillations, given by the existence of infinitely many periodic orbits, each one belonging to one such invariant set and passing by two of the three zones or passing by the three zones. These orbits arise due to homoclinic and heteroclinic bifurcations, obtained varying one parameter in the studied model, and may also exist for some fixed sets of parameter values. This intricate phase space may bring some light to the understanding of these memristor properties. It is a joint work with M. de Cruz Scarabello.

Douglas Duarte Novaes (Universidade Estadual de Campinas)

Chairman: Armengol Gasull.
Title: Persistence of periodic solutions in nonsmooth systems.

Abstract: We consider a n-dimensional piecewise smooth vector fields with two zones separated by a hyperplane Σ which admits an invariant hyperplane Ω transversal to Σ containing a period annulus $\mathbb{A}$ fulfilled by crossing periodic solutions. For small discontinuous perturbations of these systems we develop a Melnikov-like function to control the persistence of periodic solutions contained in $\mathbb{A}$. Then we apply the deveploped theory to study discontinuous perturbations of some piecewise linear system.

Maurício F. S. Lima (Universidade Federal do ABC)

Chairman: Claudio Buzzi.
Title: Periodic Orbits and Sliding Bifurcation in discontinuous dry friction oscillator.

Abstract: We study a general relay system coming from the mass-spring problem on a

moving conveyor belt, subject to dry friction (Coulomb friction) and a periodic external force which dynamics can be written by:

$$\begin{aligned} &my'' + ky = -\mu N sgn\left(y' - r\theta'\right), \\ &J\theta'' + b\theta' = \mu N r sgn\left(y' - r\theta'\right) + \mu N r \sin\left(\Omega\tau\right), \end{aligned}$$

We present in an analytic way sliding bifurcations of periodic orbits for this three parameters $(\varsigma, \eta, \omega)$ dry friction oscillator. The parameter ς, related to the viscous damping, η corresponding to the Coulomb friction and ω, to the dimensionless frequency of the forcing. For this problem we provide analytical expressions of the codimension-one bifurcation points at the parameter space.

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[2] A. Colombo, M. di Bernardo, S.J. Hogan and M.R. Jeffrey, *Bifurcations of piecewise smooth flows: Perspectives, methodologies and open problems*. Physica D **241**, (2012), 1845-1860.

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[6] P. Kowalczyk and P. T. Piiroinen, *Two-parameter sliding bifurcations of periodic solutions in a dryfriction oscillator*. Physica. D, **237**-8, (2008), 1053-1073.

Armengol Gasull (Universitat Autònoma de Barcelona)

Chairman: Claudio Buzzi.
Title: Effective localization of limit cycles.

Abstract: We propose several methods for constructing Poincaré rings and consequently hyperbolic limit cycles. Our different approaches will be illustrated with several applications, including quadratic vector fields and piecewise linear systems with two zones. We

will also apply our techniques to localize saddle-node bifurcations of limit cycles for some Liénard equations. This talk is based on a joint work with M. Grau and H. Giacomini.

7 Singularity Theory and its Applications

Organizers

Roberta Wik Atique (Universidade de São Paulo)
Carles Bivià-Ausina (Universitat Politècnica de València)
Alexandre Fernandes (Universidade Federal do Ceará)
Maria Pe Pereira (Consejo Superior de Investigaciones Científicas)

	Monday 07	**Tuesday 08**
14:30 - 15:10	J. J. Nuño Ballesteros	Marcelo E. Hernandes
15:10 - 15:50	R. Oset Sinha	Edson Sampaio
15:50 - 16:20	Coffee	
16:20 - 17:00	Marcelo Saia	Javier F. de Bobadilla
17:00 - 17:40	–	–
17:40 - 18:00	Coffee	
18:00 - 18:40	Michel M. Buzunáriz	Lev Birbrair
18:40 - 19:20	–	–

Juan José Nuño Ballesteros (Universitat de València)

Title: Equisingularity of map germs from a surface to the plane.

Abstract: Let $(X, 0)$ be an ICIS of dimension 2 and let $f : (X, 0) \to \mathbb{C}^2$ be a map germ with an isolated instability. Given $F : (\mathcal{X}, 0) \to (\mathbb{C} \times \mathbb{C}^2, 0)$ a stable unfolding of f, we look to the invariants related to the family f_s and we find relations between them. We obtain necessary and sufficient conditions for F to be Whitney equisingular.
(Joint work with B. Oréfice-Okamoto and J. N. Tomazella).

Raúl Oset Sinha (Universitat de València)

Title: A formula relating inflections, bitangencies and the Milnor number of a plane curve

Abstract: We generalise a formula by Dias and Mello relating bitangencies, inflections and double points of plane real curves for a certain class of curves with singularities. We then adapt the techniques used in the real case to the complex case and prove a formula relating inflections, bitangencies and the Milnor number of an irreducible complex plane curve germ.

Marcelo José Saia (Universidade de São Paulo)

Title: Affine focal points for locally strictly convex surfaces in 4-space

Abstract: We consider locally strictly convex surfaces M in affine 4-space. By using the metric of the transversal vector field on M we introduce a new affine normal plane and the familly of affine distance functions on M. We show that the singularities of the family of affine distance functions appear at points on the affine normal plane and the affine focal points correspond to degenerate singularities of this family. Moreover we show that if M is immersed in a locally strictly convex hypersurface, then the affine normal plane contains the affine normal vector to the hypersurface and conclude that any surface immersed in a locally strictly convex hypersphere is affine semiumbilical. Joint work with: Juan J. Nuno-Ballesteros and Luis F. Sanchez.

Miguel Marco Buzunáriz (Universidad de Zaragoza)

Title: Approximate methods for exact solutions about the topology of curves.

Abstract: One of the main tools to study the topology of a plane curve is Zariski- van Kampen theorem. It allows to compute the fundamental group of the complement from the braid monodromy. However, the existence of arithmetic Zariski pairs shows that this invariants cannot be computed using only algebraic methods. In this talk we will introduce a numerical method to compute the braid monodromy by using interval arithmetic.

Marcelo Escudeiro Hernandes (Universidade Estadual de Maringá)

Title: On the Kahler differentials module associated to plane curves

Abstract: Let C be an analytic plane curve given by $f = 0$ with $f \in \mathbb{C}\{X, Y\}$ and the Kähler differentials module $\Omega_{\mathcal{O}/\mathbb{C}}$ where $\mathcal{O} = \frac{\mathbb{C}\{X,Y\}}{\langle f \rangle}$ is the local ring of C.

If $f = \prod_{i=1}^{r} f_i$ with f_i irreducible and $\phi_i(x_i(t), y_i(t))$ is a primitive parametrization of C_i then we define

$$\Lambda_C = \left\{(ord_{t_1}\omega(\phi_i) + 1, \ldots, ord_{t_1}\omega(\phi_i) + 1);\ \omega \in \Omega_{\mathcal{O}/\mathbb{C}}\right\}$$

that is an analytic invariant of C.

In this talk we present some results on the set Λ and its relationship with other analytic invariants, as the Tjurina number for example.

José Edson Sampaio (Universidade Federal do Ceará)

Title: Lipschitz invariance of Lelong's numbers

Abstract: We prove that if there exists a bi-Lipschitz homeomorphism between two complex analytic sets, then their Lelong's numbers are equal. As a consequence of this result, we show that any Lipschitz regular complex analytic set is smooth and we give partial answers to a metric version of Zariski's multiplicity conjecture, in particular, we prove that the multiplicity of complex analytic surface (not necessarily isolated) singularities in $\mathbb{C}^3$ is a bi-Lipschitz invariant.

Javier Fernández de Bobadilla (Consejo Superior de Investigaciones Científicas)

Title: Primitive cohomology of smooth projective complete and non-complete intersections and the Hartshorne conjecture

Abstract: to be informed.

Lev Birbrair (Universidade Federal do Ceará)

Title: Lipschitz geometry of singularities of real analytic functions - Pizza.

Abstract: We study Lipschitz contact equivalence of continuous function germs in the plane definable in a polynomially bounded o-minimal structure, such as semialgebraic and subanalytic functions. We partition the germ of the plane at the origin into zones where the function has explicit asymptotic behavior. Such a partition is called a pizza. We show that each function germ admits a minimal pizza, unique up to combinatorial equivalence. We show then that two definable continuous function germs are definably Lipschitz contact equivalent if and only if their corresponding minimal pizzas are equivalent.

8 Real and Complex Analytic Singular Foliations

Organizers

Felipe Cano (Universidad de Valladolid)
Márcio Soares (Universidade Federal de Minas Gerais)

	Monday 07	**Tuesday 08**
14:30 - 15:10	C. Alonso	L. Giraldo
15:10 - 15:50	F. Sanz	V. Grandjean
15:50 - 16:20	Coffee	
16:20 - 17:00	–	–
17:00 - 17:40	J. V. Pereira	G. Calsamiglia
17:40 - 18:00	Coffee	
18:00 - 18:40	F. Cano	A. Lozano
18:40 - 19:20	–	–

Clementa Alonso (Universidad de Alicante)

Title: Topología de singularidades de campos de vectores reales

Abstract: En esta charla discutiremos algunos aspectos acerca de la clasificación topológica de campos de vectores reales en dimension tres cerca de un punto singular y exhibiremos varios resultados relacionados.

Fernando Sanz (Universidad de Valladolid)

Title: Analytic Vector Fields and separatrices in dimension three

Joint work with R. Mol

Abstract: Let X be a real analytic germ of vector field in dimension three. If X has ana analytic first integral, then it has a formal separatrix. On the other hand if X is tangent to an analytic one-codimension foliation, then X has a formal complex separatrix.

Jorge Vitorio Pereira (IMPA)

Title: Compact leaves of holomorphic foliation

Joint work with B. Claudon, F. Loray and F. Touzet

Abstract: The talk will focus on codimension one foliations on projective manifolds having a compact leaf (free of singularities). I will discuss the following problems: existence of a foliation having as a leaf a given hypersurface with topologically torsion normal bundle, study of foliations having a compact leaf whose holonomy is abelian (resp. solvable) and factorization results.

Felipe Cano (Universidade de Valladolid)

Title: Brunella's Local alternative and partial separatrices

Joint work with M. Ravara-Vago

Abstract: The local Brunella's alternative may be interpreted as follows, a foliation in three dimension ambient without invariant surface satisfies that all the leaves contain a germ of analytic curve at the origin. We give positive answers in some cases and we explain the role of geometrical objects called local separatrices associated to the reduction of singularities of the foliation.

Luis Giraldo (Universidad Complutense de Madrid)

Title: Vector Fields with Simply Conected Trajectories Transverse to a Polynomial

Abstract: to be informed.

Vincent Grandjean (Universidade Federal do Ceará)

Title: Oscillation problem of gradient vector fields for singular metrics

Joint work with F. Sanz

Abstract: We discuss the problem of possible oscillating behavior of real analytic trajectories and their limit point when the gradient field is obtained from a real analytic semiriemann metric. We will exclusively deal with metrics degenerating at a single point.

Gabriel Calsamiglia (Universidade Federal Fluninense)

Title: A transfer principle: from periods to isoperiodic foliations

Joint work with B. Deroin and S. Francaviglia

Abstract: Consider the moduli space of pairs (C, ω) where C is a genus $g \geq 2$ smooth complex curve and ω is a holomorphic one form over C. The local isoperiodic equivalence relation induces a holomorphic foliation on this moduli space called isoperiodic foliation. I will give a model for the transverse dynamics of the isoperiodic foliations and deduce a description of the closed invariant sets.

Alvaro Lozano (CUD, Zaragoza)

Title: Cantor laminations and group actions

Joint work with F. Alcalde

Abstract: In this talk we show that any transversely Cantor lamination (also known as matchbox manifolds) are always *equivalent* to an action of a group, that is, the dynamics on a transverse are given by a action which also generates a graph structure casi-isometric to the leaves. Sadly, the action is far from being free, any point has isotropy. The question is, Is there a 'reasonable' action (free, or at least free in most of the space) with the same properties? We will show an example that *we believe* it is impossible to describe as a nice group action.

9 Geometric structures on manifolds

Organizers

Simon G. Chiossi (Universidade Federal da Bahia)
Paul-Andi Nagy (Universidad de Murcia)

	Monday 07	**Tuesday 08**
14:30 - 15:10	V. Cortés	H. Bursztyn
15:10 - 15:50	R. Rubio	M. Alexandrino
15:50 - 16:20	Coffee	
16:20 - 17:00	J. V. Pereira	M. Garcia-Fernandez
17:00 - 17:40	C. Gorodski	R. Villacampa
17:40 - 18:00	Coffee	
18:00 - 18:40	M. Ionel	–
18:40 - 19:20	–	–

Vicente Cortés (Universität Hamburg)

Title: Constructions of complete quaternionic Kähler manifolds inspired by string theory

Abstract: I will explain how constructions from supergravity and string theory can be effectively used to obtain new complete quaternionic Kähler manifolds of negative scalar curvature.

Roberto Rubio (IMPA)

Title: Geometric structures in B_n-geometry

Abstract: B_n-geometry of a manifold M is the generalized geometry of $TM + 1 + T^*M$, where $1 = M \times \mathbb{R}$. This is the setting where $G_2^{(2)}$-structures in 3-manifolds and B_n-generalized complex structures, both in even and odd-dimensional manifolds, are defined. In this talk we will present these generalized structures from the point of view of G-structures.

Jorge V. Pereira (IMPA)

Title: Geometric structures invariant by rational maps

Abstract: The talk will report on a work in progress with Guy Casale and Charles Favre aiming at the classification of birational maps on complex projective surfaces with non-trivial Malgrange groupoid.

Claudio Gorodski (USP)

Title: Some geometric properties of representations of compact Lie groups

Abstract: Consider a (finite dimensional) orthogonal representation of a compact Lie group on an Euclidean space and the associated orbit space with its natural metric space structure, given by declaring the distance between two points in the orbit space to be the distance of the corresponding orbits in the Euclidean space. In this talk, we would like to address the following question:

"How much of the representation can be recovered from the quotient metric space?"

The prototypical example of such situation is the adjoint representation of a compact connected Lie group on its Lie algebra, whose orbit space is identified with a Coxeter (good) orbifold of constant curvature one. Our work generalizes different aspects of adjoint representations to other representations. (Joint work with A. Lytchak (Cologne)).

Marianty Ionel (UFRJ)

Title: Special Lagrangian submanifolds in the cotangent bundle of complex projective space

Abstract: The special Lagrangian submanifolds are an important class of calibrated submanifolds in a Ricci-flat Kähler manifold. The cotangent bundle of the complex projective space admits a Ricci-flat metric, called the Stenzel metric. In this presentation, I will talk about the conditions a submanifold of the complex projective space has to satisfy in order for its conormal bundle be a special Lagrangian submanifold in the cotangent bundle of the complex projective space, endowed with the Stenzel metric. This is joined work with T. Ivey.

Henrique Bursztyn (IMPA)

Title: Lie theory of vector bundles and double structures

Abstract: I will discuss vector bundles in the realm of Lie groupoids (resp. Lie algebroids), known as VB-groupoids (resp. VB-algebroids). Just as Lie groupoids unify manifolds and Lie groups (often thought of as models for singular spaces), VB-groupoids encompass vector bundles and linear representations (and more...). I will explain the Lie theory relating VB-groupoids and VB-algebroids, including examples and applications. Time permitting, I will mention extensions of our results to more general "double structures". This is joint work with A. Cabrera and M. del Hoyo.

Marcos Alexandrino (USP)

Title: Isometry flows on orbit spaces

Abstract: In this talk, we discuss the following result: given a proper isometric action $K \times M \to M$ on a complete Riemannian manifold M then each continuous isometric flow on the orbit space M/K is smooth, i.e., it is the projection of an K-equivariant smooth flow on the manifold M. The first application of our result concerns Molino's conjecture, which states that the partition of a Riemannian manifold into the closures of the leaves of a singular Riemannian foliation is still a singular Riemannian foliation. We prove Molino's conjecture for the main class of foliations considered in his book, namely orbit-like foliations. We also discuss smoothness of isometric actions on orbit spaces. This talk is based on a joint work with Dr. Marco Radeschi (WWU Münster) and is aimed at a broad audience of students, faculties and researchers in geometry.

Mario Garcia-Fernandez (CSIC)

Title: Gravitating vortices and cosmic strings

Abstract: In joint work with Luis Álvarez-Cónsul and Oscar García-Prada (see reference arXiv:1510.03810), we study equations describing Abelian vortices on a Riemann surface with back reaction of the metric. The gravitating vortex equations are derived by dimensional reduction of the Kähler–Yang–Mills equations on the product of the complex projective line with a Riemann surface, and inherit their moment map interpretation. Applying the general theory for the Kähler–Yang–Mills equations, we give evidence of an analogue of the Donaldson–Uhlenbeck–Yau theorem for gravitating vortices — commonly referred to as a Hitchin–Kobayashi correspondence. As a particular case of the gravitating vortex equations on $\mathbb{P}^1$ we find the Einstein–Bogomol'nyi equations, whose solutions correspond to Nielsen–Olesen cosmic strings in the Bogomol'nyi phase. Using

an existence theorem by Yisong Yang, our main result implies a Hitchin-Kobayashi correspondence for the Einstein–Bogomol'nyi equations. In particular, we prove a conjecture by Yang about the non-existence of cosmic strings on $\mathbb{P}^1$ superimposed at a single point.

Raquel Villacampa (CUD–UZ)

Title: Balanced Hermitian geometry on solvmanifolds

Abstract: In this talk we will discuss different problems concerning balanced hermitian metrics and we will provide solutions to them based on solvmanifolds.

10 Lorentzian geometry and its applications

Organizers

Jónatan Herrera (Universidade Federal de Santa Catarina)
Miguel A. Javaloyes (Universidad de Murcia)
Paolo Piccione (Universidade de São Paulo)
Miguel Sánchez (Universidad de Granada)

	Monday 07	**Tuesday 08**
14:30 - 15:10	C. Jakel	A. Caminha
15:10 - 15:50	M. Caballero	J. L. Flores
15:50 - 16:20	Coffee	
16:20 - 17:00	C. Aquino	I. P. Costa e Silva
17:00 - 17:40	F. Girão	J. Herrera
17:40 - 18:00	Coffee	
18:00 - 18:40	F. Palomo	J. C. Díaz Ramos
18:40 - 19:20	–	–

Christian Jakel (Universidade de Sao Paulo)

Title: On the construction of relativistic quantum theories

Abstract: We present a purely operator-algebraic construction of quantum (field) theories on de Sitter space and Minkowski space, in space-time dimension (d+1), d= 1, 2, 3. Among the models constructed are the famous models with polynomial interactions, and several other well-known bosonic models, but also a large class of new models. Our construction is based on a.) the classification of the unitary irreducible representations of the Lorentz group; b.) the Bisognano-Wichmann relations and the concept of modular localisation introduced by Brunetti, Guido and Longo; c.) Arakis perturbation theory for modular automorphisms, as well as its connection to Connes' cocycles and non-commutative Radon-Nikodym derivatives. No field, neither classical nor quantum, appears at any stage of our construction.

Magdalena Caballero (University of Córdoba)

Title: Convexity of constant mean curvature spacelike graphs in the three dimensional Lorentz Minkowski space

Abstract: A surface in the 3-dimensional Lorentz-Minkowski space $\mathbb{L}^3$ is called spacelike if its induced metric from $\mathbb{L}^3$ is Riemannian. In this talk we consider compact spacelike surfaces immersed in $\mathbb{L}^3$, with non-zero constant mean curvature, and with (necessarily) non-empty smooth boundary. We study the influence of the geometry of the boundary on the shape of the surface. In particular, we prove that when the boundary is planar with the added property that it intersects any branch of any hyperbola at most at five points, the surface is convex. We call these curves pseudo-elliptic curves. Pseudo-elliptic curves are necessarily convex and, in particular, ellipses are examples of such curves. The proof of our result follows the ideas of Chen and Huang (Invent. Math., 1982), who were inspired by a previous argument by Aleksandrov (Amer. Math. Soc. Transl., 1962). Finally, we provide a concrete example which shows that the assupmtion of the boundary being a pseudo-elliptic curve cannot be removed. The results presented in this talk are based on a joint work with Alma Albujer (Universidad de Crdoba, Spain) and Rafael Lpez (Universidad de Granada, Spain).

Cicero Aquino (Universidade Federal do Piauí)

Title: Characterizations of linear Weingarten spacelike hypersurfaces in locally symmetric Lorentz spaces

Abstract: In this talk, we present some characterization results concerning to complete linear Weingarten spacelike hypersurfaces immersed in a locally symmetric Lorentz space. By using some suitable boundedness on the norm of the traceless part of the second fundamental form, we are able to show that such a hypersurface must be either totally umbilical or an isoparametric hypersurface with two distinct principal curvatures one of which is simple.

Frederico Girão (Universidade Federal de Ceará)

Title: Positive mass and Penrose type inequalities for hypersurfaces in space forms.

Abstract: Two very important problems in Mathematical General Relativity are the Positive Mass Conjecture and the Penrose Inequality. I will explain how one can solve these problems in the special case where the initial data set can be embedded in Euclidean space or in hyperbolic space. I will also explore the connections of these results with the so called Alexandrov-Fenchel type inequalities.

Francisco Palomo (Universidad de Málaga)

Title: A new approach to the study of lightlike manifolds

Abstract: The study of lightlike manifolds in a Lorentzian manifold has been a topic of growing interest in the development of General Relativity. The key difference between the lightlike manifolds and the cases of spacelike or timelike manifolds is due to the fact that a lightlike manifold inherits a degenerate tensor from the ambient metric. Therefore, the usual theory of non-degenerate submanifolds fails for lightlike manifolds. In order to avoid this difficulty, several techniques have been used from the sixties. In this talk, we provide a quick introduction to several of them. Our approach is based on the notion of Cartan geometry. Roughly speaking, Cartan geometries relate every n-dimensional homogeneous space G/H (the flat model of the Cartan geometry) to a differential geometric structure on n-dimensional manifolds. In this setting, the construction of correspondence spaces permits to relate Cartan geometries with model G/H to Cartan geometries with model G/K, for K a closed subgroup of H. In this talk, we show how certain lightlike manifolds can be seen as correspondence spaces of conformal structures and, therefore, the machinery of Cartan geometries can be applied to the study of such lightlike manifolds.

Antonio Caminha (Universidade Federal do Ceará)

Title: On the scarcity of spacelike cmc, non totally geodesic, hypersurfaces of Lorentzian groups

Abstract: The results of this talk can be viewed as giving a sort of heuristic explanation of why it is so hard to give examples of non totally geodesic, complete, spacelike, cmc hypersurfaces M^n of a Lorentzian group G^{n+1}. More precisely, let N be a timelike unit vector field on M and suppose that the Ricci curvature of G in the direction of N is greater than or equal to $-\frac{H^2}{n}$, where H is the mean curvature of M with respect to N. If M is compact and transversal to a timelike element of the Lie algebra of G, then we show that it is a lateral class of a Lie subgroup of G and, as such, totally geodesic in G. If M is noncompact and parabolic, then we get the same result, provided M has bounded hyperbolic Gauss map. This is a joint work of myself and professor José Luis Alías, from Universidad de Murcia.

José Luis Flores (University of Málaga)

Title: On the topological splitting problem for Lorentzian manifolds with a causal vector field

Abstract: In this talk we will describe some recent rigidity and splitting results for space-times with symmetries, providing some applications in the particular case of generalized plane waves.

I. P. Costa e Silva (Universidade Federal de Santa Catarina)

Title: Null-polar action and the global geometry of Brinkmann spaces

Abstract: We shall present recent results, obtained in collaboration with J.L. Flores from the Universidad de Málaga, on the geometry of Brinkmann spaces, i.e., Lorentzian manifolds which admit of a smooth isometric $\mathbb{R}$-action generated by a parallel null vector field. These are natural models, in General Relativity, to describe idealized gravitational waves far away from their sources, and in purely geometric terms they are important examples of manifolds with special holonomy. We show, in particular, that if the mentioned $\mathbb{R}$-action is polar in a suitable sense adapted to this null context, then the underlying global geometry is entirely classified.

Jónatan Herrera (Universidade Federal de Santa Catarina)

Title: The causal boundary under the action of a Group of Isometries

Abstract: In several contexts, symmetries are used for both, to show remarkable properties of the considered space and to simplify the computation of different objects. Such symmetries are usually presented as the discrete action of an isometry group. On this talk we will consider the problem of the computation of the c-completion of an space-time V where we have an isometry group G acting. Under simple and general conditions, the space $M = V/G$ is again a Lorentz manifold with the induced metric. In particular, we can define a principal covering projection $\pi : V \to M$ between both Lorentz manifolds. We will show under which conditions previous projection extends to the corresponding completions both, at the point set and the topological level. In particular, we will give sufficient conditions to ensure that $\overline{V}/G$ and $\overline{M}$ are homeomorphic, where $\overline{V}$ and $\overline{M}$ are the c-completions of V and M respectively. Finally, we will present some examples proving the applicability and optimality of our results.

José Carlos Díaz Ramos (University of Santiago de Compostela)

Title: Non-proper cohomogeneity one actions on Minkowski spaces

Abstract: A cohomogeneity one action is an isometric action whose orbits of maximal dimension have codimension one. It is customary to assume that isometric actions on Riemannian manifolds are proper so that isotropy groups are compact, orbits are closed embedded submanifolds and the orbit space is Hausdorff. However, this assumption is too restrictive in the Lorentzian setting as many natural actions are not proper. In this talk I discuss actions on Minkowski spaces that are non-proper and present some classification results in low dimensions.

Special sessions - Group 2

11 Poisson and generalized geometries

Organizers

Henrique Bursztyn (IMPA)
Roberto Rubio (IMPA)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	C. Hull	P. Hekmati
15:10 - 15:50	M. García-Fernández	M. A. Salazar
15:50 - 16:20	Coffee	
16:20 - 17:00	B. Pym	A. Kotov
17:00 - 17:40	P. Frejlich	D. Fernández
17:40 - 18:00	Coffee	
18:00 - 18:40	D. Martínez Torres	R. Heluani
18:40 - 19:20	R. Torres	A. Cabrera

Chris Hull (Imperial College, London)

Title: The Geometry of String Duality

Abstract: One of the ways in which string theory differs from conventional field theories is that it has duality symmetries, which allow the construction of so-called non-geometric backgrounds, such as T-folds which have T-duality transition functions. String theory on a torus requires the introduction of dual coordinates conjugate to string winding number. This leads to physics and novel geometry in a doubled space, with non-trivial dynamics in the full doubled space-time. The geometry and physics of doubled space-time will be developed and discussed.

Mario García-Fernández (ICMAT, Madrid)

Title: Moduli for the Strominger system, Killing spinors, and holomorphic Courant algebroids

Abstract: I will give an overview of joint work with R. Rubio and C. Tipler, in which we study the moduli problem for the Strominger system of equations. Building on the work of De la Ossa and Svanes and, independently, of Anderson, Gray and Sharpe, we construct an elliptic complex whose first cohomology group is the space of infinitesimal deformations of a solution of the strominger system. I will also discuss an intriguing link between this moduli problem and a moduli problem for holomorphic Courant algebroids over Calabi-Yau threefolds. Finally, we will see how the problem for the Strominger system embeds naturally in generalized geometry, and discuss some perspectives of this approach.

Brent Pym (University of Oxford)

Title: Hypersurface singularities on log symplectic manifolds

Abstract: Log symplectic manifolds are holomorphic Poisson manifolds that are symplectic on an open dense set, but degenerate along a reduced hypersurface. Examples include Hilbert schemes of del Pezzo surfaces, compactified moduli spaces of $\mathrm{SU}(2)$ monopoles, moduli spaces of decorated vector bundles on elliptic curves, and the linear duals of certain Frobenius Lie algebras. The hypersurfaces that arise in this way are typically highly singular, and I will describe several results that indicate a remarkable degree of rigidity in their local and global structure.

Pedro Frejlich (PUC, Rio de Janeiro)

Title: Transversals in Dirac geometry: Dual pairs and normal forms

Abstract: We investigate the notion of Dirac transversals – submanifolds X of a Dirac manifold (M, L), which intersect the leaves of L transversally. We describe how to realize a Dirac manifold by a presymplectic form, and derive normal forms for various situations. Applications are given to Hamiltonian normal forms in Poisson geometry.

David Martínez Torres (PUC, Rio de Janeiro)

Title: Coadjoint orbits and standard symplectic structures

Abstract: We will survey on some results on describing the symplectic structure of some (non-compact) coadjoint orbits as a standard one, providing an alternative approach to some known constructions.

Rafael Torres (SISSA, Trieste)

Title: Types of generalized complex structures and their type change loci.

Abstract: A fundamental invariant of a generalized complex structure is its type. We will review in this talk what is the state-of-the-art in its study.

Pedram Hekmati (IMPA, Rio de Janeiro)

Title: Gauge theoretic moduli spaces on foliated 5-manifolds

Abstract: The Yang-Mills instantons admit several natural extensions to higher dimensions. In this talk I will review a few such examples and then focus on contact instantons, which arise as critical points of a super Yang-Mills theory on 5-dimensional contact manifolds. The moduli space depends highly on the geometry transverse to the Reeb foliation and in particular, the local structure is described by a transversally elliptic complex. This is based on joint work with David Baraglia.

María Amelia Salazar (IMPA, Rio de Janeiro)

Title: Algebroids as a tool to classify contact isotropic realisations

Abstract: Jacobi manifolds are analogous (while at the same time generalising) Poisson manifolds, in the sense that the role of symplectic geometry in the latter is played by contact manifolds in the former. Recent work of Crainic and Salazar has provided a new geometric approach using algebroids and Spencer operator to studying Jacobi structures defined on any real line bundle, i.e. not necessarily trivial. This talk presents the classification of some special types of desingularisations of Jacobi structures by contact manifolds, which are analogous to those studied by Dazord and Delzant in the Poisson domain. This is joint work with D. Sepe.

Alexei Kotov (UFPR, Curitiba)

Title: DG Lie groups and groupoids, characteristic classes, and moduli problem

Abstract: A DG Lie group (groupoid) is a super Lie group (groupoid) endowed with a multiplicative homological vector field. We apply this formalism for constructing general characteristic classes of bundles. We show that, combining with the jet spaces technique,

DG Lie groups and groupoids is a powerful tool for the (derived) description of moduli spaces.

David Fernández (ICMAT, Madrid)

Title: Bi-Symplectic $\mathbb{N}Q$-Algebras of weight 1

Abstract: By a general principle in noncommutative algebraic geometry (as formulated by M. Kontsevich and A. Rosenberg), a property of an associative algebra A is geometric if it induces standard geometric properties on its representation spaces $\mathrm{Rep}(A;V)$. Here, $\mathrm{Rep}(A;V)$ is the space of all representations of A in a finite-dimensional vector space V, which has a well-known affine-scheme structure. According to this principle, the family of affine schemes $\mathrm{Rep}(A;V)$ should be regarded as a substitute for a hypothetical affine noncommutative scheme 'Spec(A)'.

This principle has been applied successfully to symplectic structures and Poisson structures on quiver algebras by W. Crawley-Boevey, P. Etingof, V. Ginzburg, and M. Van den Bergh, among others. In this talk we will consider noncommutative analogues of other standard geometric structures. More precisely, we will consider bi-symplectic $\mathbb{N}Q$-algebras. These are noncommutative counterparts of symplectic $\mathbb{N}Q$-manifolds, which are basic ingredients encoding higher Lie algebroid structures in the Batalin-Vilkovisky formulation of Topological Quantum Field Theories. The natural context to study these structures is graded noncommutative algebraic geometry. In particular, we will explain how bi-symplectic $\mathbb{N}Q$-algebras of weight 1 are closely related to Van den Berghs double Poisson algebras. To establish this result, we will explain an analogue of the odd Darboux Theorem in this setting. Joint work with Luis Álvarez-Cónsul.

Reimundo Heluani (IMPA, Rio de Janeiro)

Title: On a complex-symplectic mirror pair

Abstract: We will show with a naive approach that the Kodaira surface is mirror symmetric to an Abelian surface with a holomorphic gerbe. Mirror symmetry is implemented by an 8 dimensional twisted Poisson manifold in such a way that generalized complex structures on both the Kodaira and the Abelian surfaces correspond to complex structures on this manifold. This is joint work with M. Aldi.

Alejandro Cabrera (UFRJ, Rio de Janeiro)

Title: Supergeometry and characteristic classes

Abstract: We first review the role of supergeometry in obtaining representatives for characteristic classes of bundles, following the so called Mathai-Quillen formalism. We introduce a generalization of this formalism leading to more general characteristic classes related to Poisson manifolds, Lie algebroids and representations up to homotopy.

12 Associative rings and algebras

Organizers

Mikhailo Dokuchaev (Universidade de São Paulo)
Plamen Emilov Kochloukov (Universidade Estadual de Campinas)
Dolores Herbera Espinal (Universitat Autònoma de Barcelona)
Ángel del Ro Mateos (Universidad de Murcia)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	Gordana Todorov	Mercedes Siles Molina
15:10 - 15:50	Ruy Exel	César Polcino Milies
15:50 - 16:20	Coffee	
16:20 - 17:00	Dolors Herbera	Phạm Ngọc Ánh
17:00 - 17:40	Flavio Ulhoa Coelho	Plamen Kochloukov
17:40 - 18:00	Coffee	
18:00 - 18:40	Manuel Saorín Castaño	Ferran Cedó
18:40 - 19:20	Orlando Stanley Juriaans	David Bachiller
19:20 - 20:00	–	Javier Sánchez Serdá

Gordana Todorov

Title: Semi-invariant pictures, c-vectors, maximal green sequences

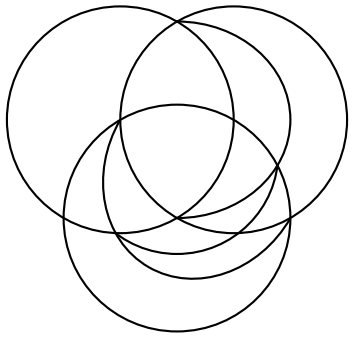
Abstract: This talk will be about several topics, with main emphasis on the connections between these topics.

I will lightly (sometimes only with examples) introduce: quiver representations, their relation to root systems, Auslander-Reiten quivers, derived categories of the representation category, cluster category, cluster tilting objects; I will define semi-invariants, domains of semi-invariants, c-vectors from cluster theory, mutations, green mutations as mutations in the direction of non-negative c-vectors, sequences of green mutations (the last notions are related to some of the notions in BPS states in physics).
I will state two conjectures that we proved using semi-invariant pictures and indicate how the semi-invariant pictures were used.

Below is the semi-invariant picture for the following quiver of type A_3:

$$Q = (1 \leftarrow 2 \leftarrow 3).$$

Each part of the picture (vertex, line segment, triangle, circle, semi-circle) has several interpretations, and I will be adding the following information on the picture: roots of Lie algebra, indecomposable quiver representations, cluster objects, cluster tilting objects, domains of semi-invariants, c-vectors, mutations, green mutations, maximal green sequences.



Ruy Exel

Title: Algebras associated to subshifts

Abstract: This talk is based on joint work with Misha Dokuchaev. I will show an alternative description, based on partial actions, of certain algebras defined by Carlsen-Matsumoto in terms of subshifts. In case the subshift is of finite type, one recovers the well known Cuntz-Krieger algebras, but in the general case this theory has had a very exciting history which I hope to briefly describe at the same time that I will try to outline our proofs of some of the main results in the area, in a very natural way, using partial actions.

Dolors Herbera

Title: A construction of big Maximal Cohen Macaulay modules

Abstract: Let R be a ring, and let M_R be a right R-module. Denote by $V(M)$ the monoid of isomorphism classed of direct summands of M^n for some $n \in \mathbb{N}$, and by $V^*(M)$ the monoid of isomorphism classes of direct summands of $M^{(\aleph_0)}$.

Let M be a module with a semilocal endomorphism ring. Then $V(M)$ can be seen as a submonoid of $\mathbb{N}^k$; moreover, the precise class of monoids that appears this way is the one of finitely generated reduced Krull monoids [1] and the same is true when we restrict

M to be a finitely generated module over a local commutative noetherian ring [8] (see also [3]).

In [2], it was proved that for a noetherian semilocal ring R, $V^*(R)$ can be identified with the set of solutions in $(\mathbb{N} \cup \{\infty\})^k$ of a system of congruences and linear equations of the form

$$D \cdot T \in \begin{pmatrix} m_1(\mathbb{N} \cup \{\infty\}) \\ \vdots \\ m_n(\mathbb{N} \cup \{\infty\}) \end{pmatrix} \qquad \text{and} \qquad E_1 \cdot T = E_2 \cdot T$$

where $T = (t_1, \ldots, t_k)^t$, D, E_1, E_2 are matrices with entries in $\mathbb{N}$, and $m_1, \ldots, m_n \in \mathbb{N}$. The reduced Krull monoids are the monoids that appear as the solutions in $\mathbb{N}^k$ of such systems.

The main aim of this talk will be to explain how we can apply the above result to produce *interesting* monoids of the form $V^*(M)$ for M a suitable finitely generated module over a noetherian local domain of Krull dimension 1. Here interesting means that $M^{(\mathbb{N})}$ has direct summands that are not a direct sum of finitely generated modules. Such direct summands are examples of balanced Big Maximal Cohen-Macaulay modules. Moreover, we will also see that for one dimensional domains of infinite Cohen Macaulay type the usual situation is to have such Big Maximal Cohen-Macaulay modules.

The results I will present are part of an ongoing long joint project with Pavel Příhoda and Roger Wiegand.

This work is partially supported by the grants DGI MINECO MTM2011-28992-C02-01 and MINECO MTM2014-53644-P (Spain).

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[1] A. Facchini, D. Herbera, K_0 *of a semilocal ring*, J. Algebra **225** (2000), 47–69.

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[3] G. L. Leuschke and R. Wiegand, Cohen-Macaulay Representations. Mathematical Surveys and Monographs **181**, American Mathematica Society 2012.

[4] R. Wiegand, *Direct-Sum Decompositions over Local Rings*. J. of Alg. **240** (2001), 83–97.

Flávio Ulhoa Coelho

Title: Linearly oriented pullbacks for some classes of algebras

This is a joint work with Heily Wagner (UFPr)

Abstract: Given two algebra morphisms $f_A\colon A \longrightarrow B$ and $f_C\colon C \longrightarrow B$, one can define a new algebra R given by $\{(a,c) \in A \times C\colon f_A(a) = f_C(c)\}$ and called it the *pullback of f_A and f_C*. The idea of this talk is to look at some homological relationships between the original algebras A, B and C and the corresponding properties for the pullback R. In order to relate, eg, the defining properties of classes of tilted, quasitilted, shod and sided supported algebras, one has to impose some further conditions on the algebras A, B and C and the so-called property *linearly oriented* given on their bounded quivers appears naturally.

Manuel Saorín Castaño

Title: The heart of a compactly generated t-structure in the derived category of a commutative Noetherian ring

Abstract: In a way that will be made precise in the talk, we will show that the heart of any compactly generated t-structure in the (unbounded) derived category of a commutative Noetherian ring is, except in pathological cases, a locally Noetherian Grothendieck category. However, this Grothendieck category is very rarely a module category, in fact only in case that the t-structure is induced by perfect localization of the ring.

Orlando Stanley Juriaans

Title: Hyperbolic Geometry and the Unit Group of Group Rings

Abstract: The unit group of a group ring is an interesting object of study. Over the years many authors has contributed to describe units and the unit group of these rings. In this talk we show how Hyperbolic Geometry can be used for this purpose. This has already been done by A. Del Rio, E. Jespers and many others. We develop tools and formulas to be used to compute fundamental domains of Fuchsian and Kleinian groups and use this to describe the unit group of some group rings. The tools obtained are also used to show how certain problems in Hyperbolic Geometry can be solved.

This is joint work with A. Kiever and E. Jespers from the Vrije Universiteit Brussels, A. de Andrade e Silva from UFParaíba-Brazil and A.C. Souza Filho from USP-Brazil.

Mercedes Siles Molina

Title: Gelfand-Kirillov dimension in graph algebras

Abstract: We study some properties of the Gelfand-Kirillov dimension in a non-necessarily unital context. In particular, its Morita invariance when the algebras have local units, and its commutativity with direct limits. We then give some applications in the context of graph algebras, which embraces, among some others, path algebras and Cohn and Leavitt path algebras. In particular we determine the GK-dimension of these algebras in full generality, so extending the main result in [1].

This is a joint work with José Manuel Moreno Fernández.

References

[1] A. Alahmadi, H. Alsulami, S. K. Jain, E. Zelmanov, Leavitt Path algebras of finite Gelfand-Kirillov dimension. In *J. Algebra Appl.* **11 (6)**, (2012) 1250225 6pp.

César Polcino Milies

Title: Finite group algebras and coding theory

Abstract: Since the pioneer papers by S.D. Berman and F.J. Mac Williams in the late sixties, finite group algebras have been an important tool in the theory of error correcting codes. In this talk, we shall compare the convenience of using cyclic, abelian and metacyclic codes and also study codes over chain rings from this point of view.

References

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[2] S. Assuena and C. Polcino Milies, Non central codes over metacyclic groups, preprint.

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Phạm Ngọc Ánh

Title: Peirce decompositions, Peirce idempotents and Peirce rings

Abstract: It is well-known that idempotents determine essentially the structure of rings when there are a lots of them as in the case of matrix rings or in coordinating projective geometries. In this talk we introduce the notion of n-Peirce idempotents and rings by analysizing a two-sided Peirce decomposition of a ring by a given idempotent. Surprising enough, one can develop a structure theory of n-Peirce rings quite similarly to the one of semiperfect rings where the 1-Peirce idempotents take almost the same role as primitive idempotents played in the classical theory.

Plamen Kochloukov

Title: Gradings on Lie algebras and their graded identities

Abstract: In this talk we discuss results concerning group gradings on Lie algebras and the corresponding graded identities. We shall focus mainly on the algebra UT_n of upper triangular matrices over a field. We shall describe the elementary grading for the Lie algebra UT_n^-. We shall produce a basis of the graded identities when the grading is the canonical one, with the cyclic group C_n of order n. It turns out that the description is rather more complicated than in the associative case. (The latter was given by Valenti and Zaicev in 2007.) We shall discuss also general gradings on UT_n^-. It turns out that there are gradings on it that are not elementary nor are isomorphic to elementary ones.

We shall also discuss briefly gradings on the Jordan algebra UT_n^+. The elementary ones are very close to the associative ones. But once again there appear nonelementary ones.

Whenever possible we shall make parallels with the associative case.

Parts of the results are joint with Yukihide, and/or with Martino.

Ferran Cedó

Title: Braces and set-theoretic solutions of the Yang-Baxter equation

Abstract: In [3] Etingof, Schedler and Soloviev associate with each non-degenerate involutive set-theoretic solution of the Yang-Baxter equation (solution of the YBE, for short) (X, r) two groups: its structure group $G(X, r)$ and its permutation group $\mathcal{G}(X, r)$. We explain several aspects of relations between these solutions, their associated groups and

braces, a concept introduced by Rump in [4]. We will see how this relation allows to give easier proofs of some previous results on the Yang-Baxter equation and even improve some of them (cf. [2]). Recently in [1], it is given a method to construct and classify all the finite solutions of the YBE (X, r) such that the natural structure of left brace of $\mathcal{G}(X, r)$ is isomorphic to a given finite left brace B. Therefore this reduces the problem of the classification of the finite solutions of the YBE to the classification of the finite left braces. We will survey the known results about this classification.

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[3] Etingof, P., Schedler, T., Soloviev, A, Set-theoretical solutions to the quantum Yang-Baxter equation, *Duke Math. J.* **100** (1999), 169–209.

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David Bachiller

Title: A counterexample in the theory of braces.

Abstract: The search for solutions of the Yang-Baxter equation has motivated the study of many algebraic structures. The most commonly used are quantum groups and Hopf algebras. In the last years, a new algebraic structure, called left braces, has been introduced for its relations with a specific class of solutions, the non-degenerate involutive set-theoretic ones. Recall that a left brace is a set B with two operations, $+$ and $\cdot$, such that $(B, +)$ is an abelian group, $(B, \cdot)$ is a group, and for every $a, b, c \in B$, we have $a\cdot(b+c)+a = a\cdot b+a\cdot c$.

A difficult open problem is the classification of finite left braces. For this, it would be useful to know which groups appear as multiplicative groups of left braces. It is known that, for a finite left brace B, $(B, \cdot)$ is always solvable. In this talk, we show that the converse is not true, by presenting a finite p-group which is not the multiplicative group of any left brace.

Javier Sánchez Serdà (Universidade de São Paulo)

Title: Free algebras generated by symmetric elements inside division rings with involution

This is a joint work with Vitor O. Ferreira and Jairo Z. Gonçalves

Abstract:

For any Lie algebra L over a field, its universal enveloping algebra $U(L)$ can be embedded in a division ring $D(L)$ constructed by Cohn (and simplied later by Lichtman). If $U(L)$ is an Ore domain, $D(L)$ coincides with its Ore ring of fractions.

Consider now the principal involution of L, $L \to L$, $x \mapsto -x$. It is well known that the principal involution of L can be extended to an involution of $U(L)$. It was proved by Cimpri c, that this involution can be extended to $D(L)$. For a large class of noncommutative Lie algebras L over a field of characteristic zero, we show that $D(L)$ contains noncommutative free algebras generated by symmetric elements (with respect to the extension of the principal involution). This class contains all noncommutative Lie algebras over a field of characteristic zero such that $U(L)$ is an Ore domain.

Poster presentations

Wagner Cortes

Title: Homological dimensions and triangular representation of partial crossed products

Abstract: We describe some homological dimensions of partial crossed products and consequently we obtain results about semisimplicity and hereditarity of partial crossed products. Moreover, we study a triangular representation, some theoretical properties of partial crossed products and when they are Morita algebra, Frobenius algebra and related themes. This is a joint work with Laerte Bemm (UEM).

O. S. Juriaans and A. C. Souza Filho

Title: Embedding free abelian groups of rank two in the unit group of integral group rings

Abstract: Let A denotes a finite Abelian group. It is well known that the unit group of augmentation one is $\mathcal{U}_1(\mathcal{Z}A) \cong A \times F$, where F is a free abelian group. In [1], the groups A for which F is trivial were classified. If the free rank of F is one then $A \in \{C_5, C_8, C_{12}\}$, where C_k is a cyclic group of order k. More generally, the finite groups G such that the unit

group $\mathcal{U}(\mathcal{Z}G)$ has a free abelian group of rank one were classified, [3]. In this article, we define conditions on a pair of elements of a finite Abelian group G so that the Abelian free rank of $\mathcal{U}(\mathcal{Z}G)$ be at least equal to n. We are working on a classification of the finite groups G such that $\mathcal{U}(\mathcal{Z}G)$ has a free abelian group of rank two and, also, on a classification of the finite dimensional algebras $\mathcal{A}$, over the rational numbers, which the Abelian free rank of the unit group of a $\mathcal{Z}$-order $\Gamma \subset \mathcal{A}$ be less or equal to two. The leading reference is [2].

References

[1] Higman, G. *The Units of Group-Rings*, Proc. London Math. Soc., (2)46, (1940), 231-248.

[2] Iwaki, E.; Juriaans, S. O.; Souza Filho, A. C. *Hyperbolicity of semigroup algebras*. J. Algebra 319 (2008), no. 12, 5000-5015.

[3] Juriaans, S. O., Passi, I. B. S., Prasad, D. *Hyperbolic Unit Groups*, Proceedings of the American Mathematical Society, vol 133(2), 2005, 415-423.

Simone Virili

Title: Algebraic entropy for amenable group actions

Abstract: Let R be a ring. A *length function*

$$L\colon R\text{-Mod} \to \mathbb{R}_{\geq 0} \cup \{\infty\}$$

on the category of left R-modules R-Mod is a non-negative real invariant of modules (which may attain infinity), such that $L(0) = 0$, it is additive on short exact sequences, and it is continuous on direct unions of sub-modules (this notion was introduced in [2]).

Let now G be an amenable group, and let $R * G$ be a crossed product. In the recent preprint [3], I have introduced the notion of *compatibility* of a given length function $L\colon R\text{-Mod} \to \mathbb{R}_{\geq 0} \cup \{\infty\}$ with the crossed product $R * G$. In particular, any length function of R-Mod is compatible with the group ring $R[G]$. If L is compatible with $R * G$, then it is possible to define a new length function

$$\mathrm{ent}_L\colon R * G\text{-Mod} \to \mathbb{R}_{\geq 0} \cup \{\infty\}\,,$$

called the *algebraic L-entropy*. This means that ent_L is additive and continuos on direct unions, and that $\mathrm{ent}_L(R * G \otimes_R K) = L(K)$ for all $K \in \mod R$.

If R is a left Noetherian ring, there is a family of length functions $\{L_\alpha : \alpha < \kappa\}$, where κ is the left Gabriel-Krull dimension of R, that are compatible with any crossed product $R * G$. The associated family of length functions $\{\mathrm{ent}_{L_\alpha} : \alpha < \kappa\}$ on $R * G\text{-}\mathrm{Mod}$ is sufficient to show that $R * G$ is stably finite, thus extending the main results of [1], where Ara, O'Meara and Perera proved that $R * G$ is stably finite when G is amenable and R is a skew field.

References

[1] P. Ara, K. C. O'Meara, F. Perera, *Stable Finiteness of Group Rings in Arbitrary Characteristic*, Advances in Mathematics, **170**, 2 (2002), 224–238.

[2] D. G. Northcott and M. Reufel, *A generalization of the concept of length*, Quart. J. of Math. (Oxford) (2), **16** (1965), 297–321.

[3] S. Virili, *Length functions of Grothendieck categories with applications to infinite group representations*, preprint, arXiv:1410.8306.

13 Group theory

Organizers

Pavel Shumyatsky (Universidade de Brasília)
Pavel Zalesski (Universidade de Brasília)
Gustavo A. Fernndez-Alcober (Universidad del País Vasco)
Andrei Jaikin-Zapirain (Universidad Autnoma de Madrid)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	C. Acciarri	M. Belolipetsky
15:10 - 15:50	S. Najati Sidki	J. González-Sánchez
15:50 - 16:20	Coffee	
16:20 - 17:00	S. Campos Chagas	J. González-Meneses
17:00 - 17:40	A. del Río & M. Serrano	–
17:40 - 18:00	Coffee	
18:00 - 18:40	–	–
18:40 - 19:20	–	–

Cristina Acciarri (UnB)

Title: Coverings of commutators in profinite groups

Abstract: By a result of Baer, when an abstract group G is covered by finitely many cyclic subgroups, then G is either cyclic or finite. This suggests the general idea that if w is a group word, for certain choices of w, and the set of all w-values in G is contained in the union of finitely many cyclic subgroups, then the verbal subgroup $w(G)$ should be not too far away from being finite or cyclic.

In a more general setting if the set of all w-values in G is covered by finitely, or countably, many subgroups with certain specific properties, then one should hope that the structure of the corresponding verbal subgroup $w(G)$ is somehow similar to that of the covering subgroups.

In this talk we will present several recent results that illustrate this phenomenon in the realm of abstract and profinite groups.

Said Najati Sidki (UnB)

Title: State-closed representations of Groups

Abstract: State-closed representations of a general group G, are obtained from *similarity pairs* (H, f) where H is a subgroup of G of finite index m and f is a homomorphism $H \to G$ called a *virtual endomorphism* of G. A similarity pair (H, f) leads to a recursively defined representation φ of G as a group of automorphisms of the 1-rooted regular m-tree. The image G^{φ} is a state-closed group of automorphisms of the tree. The kernel of φ, called the f-core of H, is the largest subgroup K of H which is normal in G and f-invariant (in the sense $K^f \leq K$); when the kernel is trivial, f and the similarity pair (H, f) are said to be *simple*.

Faithful state-closed representations are known for many finitely generated groups ranging from the torsion groups of Grigorchuk and Gupta-Sidki to free groups. Furthermore, such representations have been studied for the families of abelian groups, finitely generated nilpotent groups as well as for arithmetic groups.

In joint work with Alex Dantas, we have studied such representations for the restricted wreath products of groups $G_{p,d} = C_p wr X$ where C_p is a cyclic group of prime order p and X is a free abelian group of finite rank $d \geq 1$. The groups $G_{2,d}$ have served as examples in the study of probabilistic properties of random walks on groups and in particular, $G_{2,1}$, known as the lamplighter group, gained importance as a counterexample to a conjecture on the range of L_2-Betti numbers of closed manifolds.

Sheila Campos Chagas (Universidade de Brasília)

Title: Subgroup Conjugacy Separability

Abstract: A group G is called subgroup conjugacy separable if for every pair of non-conjugate finitely generated subgroups of G, there exists a finite quotient of G where the images of these subgroups are not conjugate. We shall discuss what groups of geometric nature possess this property.

Ángel del Río and Mariano Serrano (Universidad de Murcia)

Title: Torsion units of integral group rings and the HeLP Method

Abstract: Let G be a finite group and let $V(\mathcal{Z}G)$ denote the group of normalized units in the group ring $\mathcal{Z}G$. Hans Zassenhaus conjectured that every torsion unit of $V(\mathcal{Z}G)$ is conjugate in $\mathbf{Q}G$ to an element of G. This is still an open question which has been

verified for nilpotent groups, for cyclic-by-abelian groups and for some other families of groups. It has also been verified in a few groups of special type as some symmetric and some projective linear groups of small order. Marciniak, Ritter, Sehgal and Weiss related Zassenhaus Conjecture with the partial augmentations of the torsion units and Luthar, Passi and Hertweck provided constrains on the partial augmentations of the torsion units. One way to prove Zassenhaus Conjecture consists in showing that the only possible partial augmentations allowed by this constrains are those given in the Marciniak-Ritter-Sehgal-Weiss result. This is the so called the HeLP Method. For example, by results of Hertweck and Margolis one can prove Zassenhaus Conjecture for units of prime power order in $V(\mathbb{Z}G)$, with G a projective special linear group. The aim of this talk is to present some results on the limits of the HeLP Method for projective special linear groups.

Mikhail Belolipetsky (IMPA)

Title: Arithmetic hyperbolic reflection groups

Abstract: A group of isometries of the hyperbolic n-space is called a reflection group if it has a finite generating set which consists of reflections in hyperplanes. The study of hyperbolic reflection groups has a long and remarkable history going back to the papers of Makarov and Vinberg. In recent years there has been a wave of activity in this area which has led to a solution to the open question of the finiteness of these groups and to some quantitative results towards their classification. I am going to review the recent results and discuss some open problems concerning arithmetic hyperbolic reflection groups.

Jon Gonzalez-Sanchez (Univesrsidad de Sevilla)

Title: Cohomology and p-groups

Abstract: We will discuss some applications of cohomology theory in the theory of p-groups.

Juan Gonzalez-Meneses (Universidad de Sevilla)

Title: Algebraic and geometric tools in braid groups

Abstract: There are two apparently unrelated ways to study braid groups: Algebraically, using Garside normal forms obtained by endowing them with a lattice structure, and geometrically, regarding braids as mapping classes and applying Nielsen-Thurston theory.

We will present some results, joint with Volker Gebhardt and Bert Wiest, showing some relations between these two approaches: we will see how conjugations which simplify braids algebraically, also simlpify them geometrically, in the case of periodic and reducible braids. We will also present some work in progress with Marta Aguilera, aiming to show that the same holds for pseudo-Anosov braids.

14 Infinite dimensional analysis

Organizers

Geraldo Botelho (Universidade Federal de Uberlândia)
Jesús Ángel Jaramillo (Universidad Complutense de Madrid)
Daniel Pellegrino (Universidade Federal da Paraíba)
Pilar Rueda (Universidad de Valencia)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	L. A. Moraes	N. C. Bernardes Jr.
15:10 - 15:50	P. Galindo	J. Calabuig
15:50 - 16:20	Coffee	
16:20 - 17:00	J. Santos	J. Mujica
17:00 - 17:40	V. V. Fávaro	E. A. Sánchez-Pérez
17:40 - 18:00	Coffee	
18:00 - 18:40	D. M. Vieira	M. L. Lourenço
18:40 - 19:20	P. Rueda	M. Sanchis

Luiza A. Moraes (Universidade Federal do Rio de Janeiro)

Title: Analytic mappings in the sense of Lorch

Abstract: If U is an open subset of a complex Banach algebra E, a mapping $f : U \subset E \to E$ is analytic in U in the sense of Lorch if given any $a \in U$ there exists $\rho > 0$ an there exist unique elements $a_n \in E$, such that $\{z \in E : \|z - a\| < \rho\} \subset U$ and $f(z) = \sum_{n=0}^{\infty} a_n (z-a)^n$, for all $z \in E$ satisfying $\|z - a\| < \rho$. The theory of the analytic mappings in this sense goes back to the 1940's and provides a very natural extension of the classical concept of analytic function to infinite dimensional algebras that allows concepts as Laurent series, singularities or a Mittag-Leffler's theorem (see [1,2]). In this talk we are going to present recent results on topological and algebraic properties of algebras of analytic mappings in the sense of Lorch. Joint work with A. F. Pereira.

[1] E. K. Blum, *A theory of analytic functions in Banach algebras*, Trans. Amer. Math. Soc. **78** (1955) 343-370.

[2] B. W. Glickfeld, *Meromorphic functions of elements of a commutative Banach algebra*, Trans. Amer. Math. Soc. **151** (1) (1970) 293-307.

Pablo Galindo (Universidad de Valencia)

Title: Group-symmetric polynomials on a Banach space

Abstract: We discuss polynomials on a complex Banach space E that are invariant under the action of a given group G of linear operators on E: We call them G-symmetric. The G-symmetric polynomials are composition of the most natural ones and polynomials of a finite number of variables. We will mainly focus on examples where the elements of G are self-mappings of $[0, 1]$ that preserve the Lebesgue measure. This is based on joint work with Richard Aron, Kent State University, Damián Pinasco and Ignacio Zalduendo, Universidad Torcuato di Tella.

Joedson Santos (Universidade Federal da Paraíba)

Title: Some consequences of the full general version of the Pietsch Domination Theorem

Abstract: In this talk we present some recent consequences of the full general version of the Pietsch Domination Theorem. For example, the improvement of the unified version of the Pietsch Domination Theorem, a parcial solution for a problem of Blasco and Signes on summing operators and the characterization of uniformly dominated sets for several classes summing mappings. Joint work with G. Botelho, D. Pellegrino and J. B. Seoane-Sepúlveda.

Vinícius V. Fávaro (Universidade Federal de Uberlândia)

Title: On hypercyclic convolution operators on spaces of entire functions

Abstract: In this talk we study two problems about hypercyclicity of convolution operators on spaces of entire functions. In the first one we prove that no translation operator on $\mathcal{H}(\mathbb{C}^{\mathbb{N}})$ is hypercyclic. Note that this result is in sharp contrast with the classical result of Birkhoff [3] that every nontrivial translation operator on the space $\mathcal{H}(\mathbb{C})$ is hypercyclic and a classical result due to Godefroy and Shapiro [4] which asserts that every nontrivial convolution operator on the space $\mathcal{H}(\mathbb{C}^n)$ is hypercyclic. We recall that a *convolution operator* on $\mathcal{H}(\mathbb{C}^n)$ is a continuous linear operator that commutes with translations. By a *nontrivial convolution operator* we mean a convolution operator which is not a scalar multiple of the identity. In the second problem we prove that every nontrivial convolution operator on the space $\mathcal{H}_{\Theta b}(E)$ of all functions of Θ-bounded type from the Banach space E to $\mathbb{C}$ is frequently hypercyclic, a property stronger than hypercyclicity, which was introduced by Bayart and Grivaux in [1]. The hypercyclicity of nontrivial convolution operators

on $\mathcal{H}_{\Theta b}(E)$ was proved in [2]. This is a joint work with Jorge Mujica.

[1] F. Bayart, S. Grivaux, *Frequently hypercyclic operators*, Trans. Amer. Math. Soc. **358** (2006), 5083-5117.

[2] F. Bertoloto, G. Botelho, V. V. Fávaro, A. M. Jatobá, *Hypercyclicity of convolution operators on spaces of entire functions*, Ann. Inst. Fourier (Grenoble) **63** (2013), 1263-1283.

[3] G. D. Birkhoff, *Démonstration d'un théorème élémentaire sur les fonctions entières*, C. R. Acad. Sci. Paris **189** (1929), 473–475.

[4] G. Godefroy, J. H. Shapiro, *Operators with dense, invariant, cyclic vector manifolds*, J. Funct. Anal. **98** (1991), 229–269.

Daniela Mariz Vieira (Universidade de São Paulo)

Title: On the Banach-Stone theorem for algebras of holomorphic germs

Abstract: The classical Banach-Stone theorem (Banach, 1932 and Stone, 1937) asserts that two compact metric spaces K and L are homeomorphic if and only if the Banach spaces $\mathcal{C}(K)$ and $\mathcal{C}(L)$ are isometrically isomorphic. In this work, we present a variation of this theorem in the setting of the algebras of holomorphic germs. Given a compact subset K of a Banach space X, we consider $\mathcal{H}(K)$ as the inductive limit of a sequence of topological algebras of holomorphic functions on open sets containing K. Given two balanced compact subsets K and L of two Banach spaces X and Y respectively such that every continuous m-homogeneous polynomial on X^{**} and on Y^{**} is approximable, for all $m \in \mathbb{N}$, we characterize when the algebras of holomorphic germs $\mathcal{H}(K)$ and $\mathcal{H}(L)$ are topologically algebra isomorphic. This happens if and only if the polynomial hulls of K and L on their respective biduals are biholomorphically equivalent. This is a joint work with D. García and M. Maestre.

Pilar Rueda (Universidad de Valencia)

Title: Dominated polynomials and their Pietsch type factorization theorem

Abstract: Pietsch factorization theorem is a building block of the theory of absolutely summing operators. Several different attemps have been made in order to find a similar factorization when extending summing linear operators to homogeneous polynomials,

showing that this extension can be highly intriguing. We show some factorization results for dominated polynomials obtained with G. Botelho, D. Pellegrino and E. A. Sánchez and introduce the subclass of dominated polynomials that behaves to the full extent of absolutely p-summing linear operators.

Nilson C. Bernardes Jr (Universidade Federal do Rio Janeiro)

Title: Li-Yorke chaos for linear operators

Abstract: We study the notions of Li-Yorke chaos, dense Li-Yorke chaos and generic Li-Yorke chaos for continuous linear operators on arbitrary infinite-dimensional separable Fréchet spaces. We establish several characterizations of these notions, including a Li-Yorke Chaos Criterion and a Dense Li-Yorke Chaos Criterion. For instance, we prove that dense Li-Yorke chaos is equivalent to the existence of a dense (or residual) set of irregular vectors and that generic Li-Yorke chaos is equivalent to the whole space being a scrambled set. We also offer conditions under which an operator admits a dense linear manifold of irregular vectors. Our general results are applied to some fundamental classes of operators, including weighted backward shifts on Fréchet sequence spaces and composition operators on spaces of holomorphic functions. This is a joint work with A. Bonilla, V. Müller and A. Peris.

[1] N. C. Bernardes Jr., A. Bonilla, V. Müller and A. Peris, *Distributional chaos for linear operators*, J. Funct. Anal. **265** (2013), 2143–2163.

[2] N. C. Bernardes Jr., A. Bonilla, V. Müller and A. Peris, *Li-Yorke chaos in linear dynamics*, Ergodic Theory Dynam. Systems, to appear.

José Calabuig (Universidad Politécnica de Valencia)

Title: The Bishop-Phelps-Bollobás property and differentiability of L_p of a positive vector measure

Abstract: In this talk we present results on differentiability and uniform differentiability of the norm of the space of scalar functions whose p-th power function is integrable with respect to a positive vector measure. Some examples and applications in the setting of the Bishop-Phelps-Bollobas property are also given. This is a joint work with L. Agud (UPV), S. Lajara (UCLM), E.A. Sánchez (UPV).

Jorge Mujica (Universidade Estadual de Campinas)

Title: Algebras of holomorphic functions and the Michael problem

Abstract: In 1952 Michael [2] posed the problem as to whether every complex ho momorphism on a commutative Fréchet algebra is necessarily continuous, and despite the efforts of many researchers the Michael problem still remains open. Clayton [1], Schottenloher [4] and Mujica [3] have reduced the study of the Michael problem to certain specific Fréchet algebras of holomorphic functions on infinite dimensional spaces. More precisely they have exhibited certain Fréchet algebras of holomorphic functions on infinite dimensional spaces such that, if the Michael problem has a positive solution for one of those algebras, then it has a positive solution for every commutative Fréchet algebra. In this talk we will present a general theorem that yields as special cases the results of [1], [4] and [3].

[1] D. Clayton, *A reduction of the continuous homomorphism problem for F-algebras*, Rocky Mountain Math. J. **5** (1975), 337–344.

[2] E. Michael, *Locally Multiplicatively-Convex Topological Algebras*, Mem- oirs American Mathematical Society 11, American Mathematical Society, Providence, Rhode Island, 1952.

[3] J. Mujica, *Complex Analysis in Banach Spaces*, Dover, Mineola, New York, 2010.

[4] M. Schottenloher, *Michael problem and algebras of holomorphic functions*, Arch. Math. (Basel) **37** (1981), 241–247.

Enrique A. Sánchez-Pérez (Universidad Politécnica de Valencia)

Title: Geometric properties and factorization of homogeneous polynomials

Abstract: Geometrical properties of the Banach spaces involved in the definition of multilinear operators and polynomials often lead to integral dominations for the corresponding maps. This always provides useful tools for the analysis of these operators, but does not provide always factorization schemes. In the multilinear setting something else is required for assuring the existence of good factorizations, in the sense that they would provide fundamental information on the maps. This is a critical difference among the linear and the multilinear case; for instance, for p-summing operators and $(q,1)$-summing operators from $C(K)$-spaces, domination and factorization hold together and can be understood to be the same property. We will explain the differences between integral-domination inequalities

and a map-factorization inequalities involving new polynomial versions of Pietsch's and Pisier's Factorization Theorems.This is a joint work with M. Mastylo and P. Rueda.

Mary Lilian Lourenço (Universidade de São Paulo)

Title: Absolutely bounding sets in Banach spaces

Abstract: An extension of Lempert's result about non approximability by entire functions of analytic functions on some open subsets of ℓ_∞ is obtained for Banach spaces having a bounding non relatively compact set. We also prove that subsets A that are bounding for analytic functions defined in any of its neighborhoods whose boundary lies at positive distance from A are relatively compact. This is a joint work with P. Galindo and H. Carrión.

Manuel Sanchis (Universitat Jaume I, Castelló)

Title: Sequentially compact subsets and monotone functions: an application to fuzzy theory

Abstract: Let $(X, <, \tau_{\mathbb{O}})$ be a first countable compact linearly ordered topological space. If $(Y, \mathcal{D})$ is a uniform sequentially compact linearly ordered space with density less than the splitting number $\mathfrak{s}$, then we characterize the sequentially compact subsets of the space $M(X, Y)$ of all monotone functions from X into Y endowed with the topology of the uniform convergence induced by the uniformity $\mathcal{D}$. In particular, our results are applied to identify the compact subsets of $M([0, 1], Y)$ for a wide class of linearly ordered topological spaces, including $Y = \mathbb{R}$. This allows us to provide a characterization of the compact subsets of an extended version of the fuzzy number space (with the supremum metric) where the reals are replaced by certain linearly ordered topological spaces, which corrects some characterizations which appear in the literature. Since fuzzy analysis is based on the notion of fuzzy number just as much as classical analysis is based on the concept of real number, our results open new possibilities of research in this field. Joint work with J. J. Font.

15 Banach spaces and set theory in interaction

Organizers

Cristina Brech (Universidade de São Paulo)
Pedro Tradecete (Universidade Carlos III, Madrid)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	V. Ferenzci	P. Koszmider
15:10 - 15:50	Y. Moreno	A. Avilés
15:50 - 16:20	Coffee	
16:20 - 17:00	P. Kaufmann	L. Candido
17:00 - 17:40	J. López-Abad	–
17:40 - 18:00	Coffee	
18:00 - 18:40	C. Barroso	–
18:40 - 19:20	G. Martínez	–

Antonio Avilés (Universidad de Murcia)

Title: Rosenthal compact spaces

Abstract: A topological space is called a Rosenthal compactum if it is homeomorphic to a pointwise compact set of functions of the first Baire class on a Polish space. This class emerged in relation with Banach spaces that do not contain ℓ_1. I will review some facts and present some new results in collaboration with S. Todorcevic.

Cleon Barroso (Universidade Federal do Ceará)

Title: On pathologies related to abstract differential equations

Abstract: We study the compact characterization of the fixed point property under the perspective of Banach space structures. In particular, we will present some known results on the weak-compactness of the generic fixed point property and open questions.

Leandro Candido (Universidade de São Paulo)

Title: On complemented copies of $c_0(\omega_1)$ in $C(K^n)$ spaces

Abstract: Given a compact Hausdorff space K we consider the Banach space of real continuous functions $C(K^n)$ or equivalently the n-fold injective tensor product $\hat{\bigotimes}_\varepsilon C(K)$ or the Banach space of vector valued continuous functions

$$C(K, C(K, C(K..., C(K)...)$$

We address the question of the existence of complemented copies of $c_0(\omega_1)$ in $C(K^n)$ under the hypothesis that $C(K)$ contains an isomorphic copy of $c_0(\omega_1)$. This is related to results of E. Saab and P. Saab that $X\hat{\otimes}_\varepsilon Y$ contains a complemented copy of c_0 if one of the infinite dimensionals Banach spaces X, Y contains a copy of c_0 and of E. M. Galego and J. Hagler that it follows from Martin's Maximum that if $C(K)$ has density ω_1 and $C(K)$ has a copy of $c_0(\omega_1)$, then $C(K \times K)$ has a complemented copy $c_0(\omega_1)$.

The main result is that under the assumption of $\clubsuit$ for every $n \in \mathbb{N}$ there is a compact Hausdorff space K_n of weight ω_1 such that $C(K)$ is Lindelöf in the weak topology, $C(K_n)$ contains a copy of $c_0(\omega_1)$, $C(K_n^n)$ does not contain a complemented copy of $c_0(\omega_1)$ while $C(K_n^{n+1})$ does contain a complemented copy of $c_0(\omega_1)$. This shows that additional set-theoretic assumptions in Galego and Hagler's nonseparable version of Cembrano and Freniche's theorem are necessary as well clarifies the matter unsettled in a paper of Dow, Junilla and Pelant whether half-p.c.c. Banach spaces must be weakly p.c.c.

Valentin Ferenczi (Universidade de São Paulo)

Title: On non-unitarizable representations and Mazur's rotations problem

Abstract: We investigate some aspects of the isometric version of Mazur's rotations problem: "Is every equivalent transitive norm on the Hilbert space H hilbertian?", in relation with the existence of certain bounded non-unitarizable representations of the free group F_∞ on H.

Pedro L. Kaufmann (Universidade Federal de São Paulo)

Title: On products of Lipschitz-free spaces

*Abstract:*Given a Banach space X, we denote by $\mathcal{F}(X)$ the *Lipschitz-free space over* X, which is the natural predual for the space of real-valued Lipschitz functions f on X. We show that, for any given Banach space X, $\mathcal{F}(X)$ and $\mathcal{F}(X) \oplus_1 \mathcal{F}(X)$ are isomorphic and at Banach-Mazur distance at most 4 of each other, and derive some consequences.

Piotr Koszmider (Mathematical Institute of the Polish of Academy of Sciences, Poland)

Title: Uncountable equilateral sets in Banach spaces of the form C(K)

Abstract: The talk is concerned with the problem whether a nonseparable Banach space must contain an uncountable set of vectors such that the distances between every two distinct vectors of the set are the same. Such sets are called equilateral. We show that Martin's axiom and the negation of the continuum hypothesis imply that every nonseparable Banach space of the form C(K) has an uncountable equilateral set. We also show that one cannot obtain such a result without an additional set-theoretic assumption since we construct an example of nonseparable Banach space of the form C(K) which has no uncountable equilateral set (or equivalently no uncountable (1+?)-separated set in the unit sphere for any ?¿0) making another consistent combinatorial assumption. The compact K is a version of the split interval obtained from a sequence of functions which behave in an anti-Ramsey manner. It remains open if there is an absolute example of a nonseparable Banach space of the form different than C(K) which has no uncountable equilateral set. It follows from the results of S. Mercourakis, G. Vassiliadis that our example has an equivalent renorming in which it has an uncountable equilateral set. It remains open if there are consistent examples which have no uncountable equilateral sets in any equivalent renorming but it follows from the results of S. Todorcevic that it is consistent that every nonseparable Banach space has an equivalent renorming in which it has an uncountable equilateral set.

Jordi López-Abad (Instituto de Ciencias Matemáticas, Spain)

Title: Ramsey Properties of finite dimensional normed spaces and extremely amenable groups.

Abstract: Given two finite dimensional normed spaces X and Y, and $\theta \geqslant 1$, let $\mathrm{Emb}_\theta(X,Y)$ be the set of all linear 1-1 operators $T : X \to Y$ such that $\|T\| \cdot \|T^{-1}\| \leqslant \theta$. We will discuss the following Ramsey type result: Given two finite dimensional normed spaces X and Y, an integer r and two numbers $\varepsilon > 0$ and $\theta > 1$ there is some finite dimensional space Z such that for every coloring $c : \mathrm{Emb}_{\theta^2}(X,Z) \to \{1,2,\dots,r\}$ there exists ¿$\gamma \in \mathrm{Emb}_\theta(Y,Z)$ and $i \in \{1,\dots,r\}$ such that

$$\gamma \circ \mathrm{Emb}_\theta(X,Y) \subseteq (c^{-1}(i))_{\varepsilon+\theta^2-1},$$

where $\gamma \circ \mathrm{Emb}_\theta(X,Y) = \{\gamma \circ \sigma \,|\, \sigma \in \mathrm{Emb}_\theta(X,Y)\}$, and $(A)_\delta$ is the δ-fattening of A with respect to the corresponding operator norm-distance. As a consequence we obtain

that the group of isometries G of the *Gurarij* space is extremely amenable, that is, every continuous action of G on a compact space has a fixed point. The proof of this approximate Ramsey result is based on an application of the *Dual Ramsey Theorem* to linear isometric embeddings between ℓ_∞^n's. I will also discuss an alternative, more combinatorial, proof of the Gromov-Milman result on the approximate Ramsey property for Hilbert spaces and its generalization to the ℓ_p spaces.

Gonzalo Martinez Cervantes (Universidad de Murcia)

Title: On weakly Radon-Nikodym compact spaces

Abstract: A compact space is said to be weakly Radon-Nikodym if it is homeomorphic to a weak* compact subset of the dual of a Banach space not containing an isomorphic copy of ℓ_1. We study some topological properties of this class of compact spaces and, in particular, we prove that it is not stable under continuous images. Moreover, we define a superclass of the continuous images of weakly Radon-Nikodym compacta and study its relation with other classes of compact spaces.

This work is supported by the research project 19275/PI/14 funded by Fundación Séneca - Agencia de Ciencia y Tecnología de la Región de Murcia within the framework of PCTIRM 2011-2014. This work is also supported by Ministerio de Economía y Competitividad (project MTM2014-54182-P).

Yolanda Moreno (Universidad de Extremadura)

Title: Banach spaces of universal complemented disposition.

Abstract: Banach spaces of universal and almost universal disposition were introduced and studied by Gurari, who constructed a separable space of almost universal disposition with respect to finite dimensional spaces. Several subsequent papers established its uniqueness, maximality and gave different descriptions for this space. Gurari also conjectured the existence of Banach spaces of universal disposition with respect to finite dimensional or separable spaces. Kubis used a categorical approach to construct the Fraïssé limit in the category of separable Banach spaces and into isometries, and a thorough study performed in [Avilés-Cabello-Castillo-González-Moreno, J Funct. Anal 261 (2011)] presented a unified approach to spaces of (almost) universal disposition, constructed the space that Gurari conjectured and showed it to be isometric to Kubis space. Recently, the paper [Cabello-Garbulinska-Kubis, J. Funct. Anal. 267 (2014)] extends these methods to study quasi-Banach spaces of (almost) universal disposition, in particular, it is constructed a p-Gurari,

$p < 1$.
More delicate is the notion of (almost) universal complemented disposition ((a.)u.c.d. in short), which we will consider in this talk. We will construct (separable) p-Banach spaces, $p \leq 1$, of (almost) universal complemented disposition and we will show a number of results about their existence and complementably universal character for spaces admitting a (finite dimensional decomposition) separable skeleton. The isometric uniqueness of those spaces follows once provided they themselves admit a 1-skeleton (FDD) structure. In particular, the space $\mathfrak{K}_p$ of a.u.c.d. we construct is the analogue, in the category of p-Banach spaces and double-arrows (isometries projections), to the p-Gurari object in the category of Banach spaces and operators. We moreover show that $\mathfrak{K}_1$ is isometric to the one constructed by Garbulinska. Yet, it is unknown whether $\mathfrak{K}_1$ is also isometric either to the Kadec and Pelczynski spaces, equivalently, if the latter are spaces of a.c.u.d.

16 Mathematical logic and set theory

Organizers

Marcelo Esteban Coniglio (UNICAMP, Brasil)
Francesc Esteva (IIIA, Barcelona)
Llus Godo (IIIA, Barcelona)
Samuel Gomes da Silva (UFBA, Brasil)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	Marcelo E. Coniglio	Samuel G. da Silva
15:10 - 15:50	Hugo L. Mariano	Umberto Rivieccio
15:50 - 16:20	Coffee	
16:20 - 17:00	Ciro Russo	Félix Bou
17:00 - 17:40	Walter A. Carnielli	Francesc Esteva
17:40 - 18:00	Coffee	
18:00 - 18:40	Juliana Bueno-Soler	Ramon Jansana
18:40 - 19:20	Brazil, Spain, Italy: Perspectives in Logic	

Marcelo E. Coniglio (UNICAMP)

Title: Modal logic S4 as a paraconsistent logic with a topological semantics

Abstract: A propositional logic called TOP is defined by means of a Hilbert calculus over a language containing two negations ($\sim$ and $\neg$) plus an implication $\rightarrow$. From this, modalities $\Box$ and $\Diamond$ can be defined, having a topological meaning: $\Box A$ means the interior of A, while $\Diamond A$ means the closure of A. The negation $\sim A$ means the Boolean complement of A (and so it is a classical negation), while $\neg A$ means the closure of the complement of A, and so $\neg$ is a paraconsistent negation: A and the closure of the complement of A are not necessarily disjoint sets. The paraconsistent logic TOP is a Logic of Formal Inconsistency, since consistency and inconsistency connectives can be defined in a natural way (the latter interpreted as the boundary or frontier operator). The proof of soundness and completeness of TOP with respect to topological models is obtained. In such models the formulas are interpreted as arbitrary subsets of the space, not necessarily closed or open in the given topology. Finally, it is proved that TOP is equivalent to the propositional modal logic S4 up to language. This constitutes a new proof of S4 as being "the logic of topological spaces", but now under the perspective of paraconsistent logics. This is a joint work with Leonardo Prieto-Sanabria (PUC-Campinas, Brazil).

Hugo Luiz Mariano (IME - Universidade de São Paulo)

Title: The von Neumann-regular Hull of (preordered) rings and quadratic forms

Abstract: The class of (commutative, unitary) von Neumann-regular rings (vN-rings) has been studied under algebraic and model-theoretic aspects. It is closed under several constructions and it can be characterized as the class of rings isomorphic to the ring of global sections of a sheaf of rings over a Boolean space such that the stalks are fields – from a broader logical perspective they are "fields". In this work we build, by sheaf-theoretic methods, a vN-Hull for every commutative unitary ring, giving a left adjoint to the inclusion of categories $vNRings$ in $Rings$. This result is immediately extended to categories of preordered rings and we present some applications to abstract codifications of the algebraic theory of quadratic forms over rings with 2^{-1} (ATQF). For instance we address two subjects in the theory of Special Groups. **(I)** We determine interesting classes of rings relative to ATQF: we show that the class of rings whose induced (proto)special group morphism into the special group of its vN-hull is a pure embedding is an elementary class in the language of rings that can be axiomatized by sets of Horn sentences or by $\forall\exists$-sentences. **(II)** We determine a class of reduced special groups (rsg) of interest for a variant of the representation problem in SG-theory: we show that the class of reduced special groups that can be purely embedded into a special group of a preordered vN-ring is an elementary class in the language of special groups which can be axiomatized by sets of Horn sentences. Moreover, every rsg in the class satisfies the K-theoretic property called [SMC].

Ciro Russo (Universidade Federal da Bahia)

Title: Combination of logics and Deduction Theorems from the order-theoretic viewpoint

Abstract: In this talk we will present recent and ongoing results on how to combine abstract deductive systems, and a characterization of those systems for which a Deduction Theorem is provable. The two problems are approached by means of the order-theoretic framework introduced by Nick Galatos and Constantine Tsinakis, and further developed by the speaker

Walter Carnielli (Universidade Estadual de Campinas)

Title: Rolling Strange Dice: Probability and Logic in Parallel

Abstract: Logic and probability are more dependent we might admit: as nonclassical logics have flourished nowadays, it is only natural to think on probabilities based on such new

logics. A few logicians have already considered, for instance, the possibility of attaching positive values to contradictory propositions, opening the way to paraconsistent probabilities. The same for intuitionistic logic, giving rise to incomplete or default probabilities. I intend to show here that very natural notions of probability measure can be assigned to intuitionistic logic and to the (paraconsistent) Logics of Formal inconsistency. By concentrating on the second case, I argue that distinct contradictory beliefs may have significantly different probability degrees, reflecting the fact that not all contradictions are necessarily equivalent. Moreover, the notion of consistency can also be attached a measure of probability, and the interplay between the notions of contradiction and consistency generalizes the classical instance of probability. This permits one to define a new notion of Bayesian conditionalization, with interesting consequences for the adventure of reasoning.

Juliana Bueno-Soler (Universidade Estadual de Campinas)

Title: Fibring modal-levelled semantics for BDI logics

Abstract: Multi agent systems (MAS), and in particular BDI systems, concern combining rational agents into systems of logic of beliefs, desires and intentions. MAS and BDI systems help to formalize reasoning systems used in artificial intelligence, computer science, game theory, etc. Among the various formalisms specifying MAS and BDI systems, modal logics are the most appropriate and versatile. Restricted modal logics (RML) are modal systems where the consequence relation is bounded in the sense that agents do have the same deductive power. I will show that the combination of restricted versions of the systems KD45 (to express belief (B)) and KD (to express desire (D) and intension (I)) can be used as a new formalism to express and specify natural MAS and BDI systems closer to human reasoning.

Samuel Gomes da Silva (Universidade Federal da Bahia)

Title: Categorial forms of the Axiom of Choice

Abstract: In this work, we will be interested on the investigation of *categorial forms* of the Axiom of Choice ($\mathbf{AC}$). We introduce a quite comprehensive list of categorial forms of $\mathbf{AC}$, which are all equivalent statements within the category $\mathbf{Set}$ – but which may behave differently in some other categories. We exemplify (either the presence or the absence of) all of these introduced categorial versions of $\mathbf{AC}$ in several categories; a number of applications of such forms, mostly related to the notion of initial objects, are also presented. This is a joint work with Hugo Mariano (USP) and Andreas Brunner (UFBA).

Umberto Rivieccio (Universidade Federal do Rio Grande do Norte)

Title: Non-classical Dynamic Epistemic Logics

Abstract: A. Baltag, L. S. Moss and S. Solecki introduced a well-known dynamic epistemic logic designed to reason about "public announcements, common knowledge and private suspicions". A. Kurz and A. Palmigiano recently showed that duality theory provides a flexible framework for modeling epistemic changes, allowing one to develop dynamic epistemic logics on an intuitionistic propositional basis. This can be useful for a variety of reasoning contexts where classical logic is less suitable. I will show how the techniques of Kurz and Palmigiano can be further extended to define and axiomatize dynamic epistemic logics in an even more general setting, for example taking as propositional base four-valued bilattice modal logic or finite-valued Lukasiewicz modal logic.

16.1 Félix Bou (IIIA, Barcelona)

Title: A Combinatorial (and Computational) Approach to Finite MTL-chains
(tele-conference)

Abstract: The aim of this talk is to provide a better understanding of which monoidal operations appear in finite MTL-chains (i.e., the finite subdirectly irreducible algebras of the algebraic counterpart associated with the monoidal t-norm logic). We remind that MTL-chains are exactly the FLew-algebras which are also finite chains. Moreover, it is very easy to introduce them without requiring any logical background. They are the commutative monoid operations over $\{0, 1, 2, ..., n-1\}$ (for some finite cardinal number n) such that n-1 is a neutral element, and the monoid operation is monotonic with respect to the standard order in $\{0, 1, 2, ..., n-1\}$.

16.2 Francesc Esteva (IIIA, Barcelona)

Title: Paraconsistent fuzzy logics: the case of logics between truth and degree preserving Łukasiewicz Logic

Joint work with Marcelo Coniglio and Lluís Godo

Abstract: Among the plethora of fuzzy logics defined in (Hajek, 1998) as many-valued logics with semantics over the structure defined on the real unit interval by a continuous t-norm and its residuum we take the special case of the well known propositional

Łukasiewicz logic. This logic is finitely axiomatizable and finitely strong complete (complete for deductions from a finite set of premises). In the preliminaries of the talk we introduce this logic together with its degree preserving companion (see Bou, Esteva, Font, Gil, Godo, Verd 2009) and their relationship. In particular we show that truth preserving Łukasiewicz logic Ł is explosive while its degree preserving companion $Ł^{\leq}$ is paraconsistent.

In the main part of the talk we will present the results in (Coniglio, Esteva, Godo, in press). In that paper we have started the study of intermediate logics between Ł, and $Ł^{\leq}$. We show that there are infinitely-many explosive and paraconsistent logics in between and we provide some general results about these logics. A more detailed description of the family of intermediate logics is presented in the particular case of finitely-valued Łukasiewicz logics $Ł_n$.

Ramon Jansana (UB, Barcelona)

Title: TBA (tele-conference)

17 Non-associative algebras

Organizers

Henrique Guzzo Jr (Universidade de São Paulo)
Juan Carlos Gutirrez Fernndez (Universidade de São Paulo)
Jos Mara Prez Izquierdo (Universidad de La Rioja)
Irene Paniello Alastruey (Universidad Pblica de Navarra)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	Alberto Elduque	Antonio J. Calderón Martín
15:10 - 15:50	Luisa M. Camacho	Cristina Draper
15:50 - 16:20	Coffee	
16:20 - 17:00	Daniel de la Concepción	Xabier G. Martínez
17:00 - 17:40	Alexandre Grishkov	Ivan Shestakov
17:40 - 18:00	Coffee	
18:00 - 18:40	Irene Paniello	Juan C. Gutiérrez
18:40 - 19:20	José M. Pérez-Izquierdo	Henrique Guzzo Jr.

Alberto Elduque (Universidad de Zaragoza)

Title: Octonions in low characteristics

Abstract: Some special features of Cayley algebras, and their Lie algebras of derivations, over fields of low characteristics will be presented. As an example, over fields of characteristic two, the isomorphism class of the Lie algebra of derivations of a Cayley algebra does not depend on the Cayley algebra itself.

Luisa M. Camacho (Universidad de Sevilla)

Title: Solvable Leibniz algebras with filiform nilradical]Solvable Leibniz algebras with filiform nilradical

Leibniz algebras were introduced by Loday [10] as a non-skew symmetric version of Lie algebras. These algebras generalize Lie algebras in natural way. The theory of Leibniz algebras has been actively investigated in the last two decades. Many results of the theory of Lie algebras have been extended to Leibniz algebras. For instance, the classical results

on Cartan subalgebras [14], Levi's decomposition [4], the properties of solvable algebras with given nilradical [6] and other from the theory of Lie algebras are also true for Leibniz algebras.

As far as physical applications are concerned, we note that solvable Lie algebras often occur as Lie algebras of symmetry groups of differential equations [13]. Group invariant solutions can be obtained by symmetry reduction, using the subalgebras of the symmetry algebra [18]. In this procedure an important step is to identify the symmetry algebra and its subalgebras as abstract Lie algebras. A detailed identification presupposes the existence of a classification of Lie algebras into isomorphism classes.

In this paper we continue the description of solvable algebras with a given nilradical. The first work which was devoted to the description of such Lie algebras is the paper [11]. In fact, it was proved that the complemented space to nilradical forms an abelian subalgebra, consisting of semisimple elements of an algebra. However, the structure of the nilradical depends on this subalgebra. Later, Mubarakzjanov G.M. proposed the description of solvable Lie algebras with a given structure of nilradical by means of outer derivations of the nilradical. Papers [1, 2, 5, 12, 16, 17] were devoted to the application of Mubarakzjanov's method for solvable Lie algebras with different kinds of nilradicals. Some results of the Lie algebra theory generalized to Leibniz algebras in [3] allow us to apply the Mubarakzjanov's method to the case of Leibniz algebras. In this direction papers [6] and [7] deal with the description of solvable Leibniz algebras with null-filiform and naturally graded filiform nilradicals, respectively. We continue the description of solvable Leibniz algebras whose nilradical is a filiform algebra. In fact, solvable Leibniz algebras whose nilradical is a naturally graded filiform Leibniz algebra are known. Here we extend the description to solvable Leibniz algebras whose nilradical is a filiform algebra. Moreover, we establish that solvable Leibniz algebras with filiform Lie nilradical are Lie algebras.

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Daniel de la Concepción (Universidad de La Rioja)

Title: On the classification of some nilpotent Lie algebras

Abstract: The problem of classifying nilpotent Lie algebras is an extremely complicated problem. In this talk, we consider this problem in a subclass of nilpotent Lie algebras: those whose algebras of derivations have semisimple subalgebras. Under this condition, we make use of the representation theory of semisimple Lie algebras to advance towards a solution. However, as we will show, some of the algorithms used to solve this problem are of exponential type. Thus, it is still wild.

Alexandre Grishkov (Universidade de São Paulo)

Title: Grupos com trialidade e loops de Moufang

Abstract: Vamos lembrar que um loop M é um loop di-associativo se qualquer par de elementos de M gera um subgrupo e M é de Bol (à esquerda) se para x, y, z em M temos $(x(yx))z = (x(y(xz)))$. Um loop é de Moufang se ele é de Bol e di-associativo ao mesmo tempo. Se a teoria dos loops de Moufang finitos está em fase bastante avançada (de fato: temos a classificação dos loops finitos simples, teorema de Lagrange, classificação dos loops de ordem < 64, teoria dos loops comutativos), as teorias dos loops de Bol e di-associativos tem apenas resultados esporádicos.

Os Problemas principais em aberto na teoria dos loops de Moufang são o Problema de Burnside Restrito (provar um análogo do Teorema de Zelmanov (veja [9] e [10]) para loops de Moufang e grupos com trialidade) e o Problema de estrutura dos loops de Moufang finitos sem subloops abelianos normais (veja abaixo uma formulação exata).

O Teorema do Zelmanov é um dos resultados mais profundos na álgebra, este teorema afirma que existe um grupo finito de expoente n com m geradores, tal que qualquer outro grupo finito com estes propriedades é imagem homomorfa deste grupo. Em colaboração com Prof. E. Zelmanov (San Diego, USA) vamos tentar provar um análogo deste resultado para os loops de Moufang e grupos com trialidade. No caso dos grupos com trialidade o

resultado esperado é seguinte: existe um grupo com trialidade com m geradores tal que todos os elementos antissimétricos ($x^\sigma = x^{-1}$) são de ordem n, tal que qualquer outro grupo com estas propriedades é uma imagem homomórfica deste grupo.

No trabalho [5] foi provado um análogo do teorema de Sylow de existência dos subloops de Sylow para os loops de Moufang finitos. Em particular, neste trabalho foi provado que para qualquer loop de Moufang finito M existe um subloop normal canônico $G(M) < M$, tal que

$M/G(M) \simeq (M_1 \times \ldots M_s).C_2^n$,

onde M_i é um loop de Moufang simples não associativo, $i = 1, \ldots, s$, C_2 o grupo de dois elementos. E mais, $G(M)$ é um loop de Moufang com todos os componentes simples associativos. O loop $G(M)$ tem o radical solúvel $R(G)$ tal que o loop $G(M)/R(G)$ não contém subloops normais abelianos. Agora o problema principal na teoria dos loops de Moufang finitos é provar a seguinte conjectura:

Conjetura 1 . *Seja M um loop de Moufang finito. Nas notações acima, provar que*
$G(M)/R(M) \simeq H.C_2^m$,
onde H é um grupo sem subgrupos normais abelianos.

Para provar esta Conjectura é importante entender a estrutura do loop de Moufang M tal que $M \simeq (G \times \cdots \times G).C_r$, onde G é um grupo finito simples e C_r um grupo cíclico de ordem r.

Conjetura 2 *Seja M um loop de Moufang finito tal que $M \simeq (G \times \cdots \times G).C_r$, onde G é um grupo finito simples e C_r um grupo cíclico de ordem r. Então M é um grupo se $r > 2$.*

Observamos que para $r = 2$ esta Conjectura é falsa, pois existe um loop de Moufang $M(G, 2)$ para cada grupo G tal que $G < M(G, 2)$ é um subgrupo normal e $M(G, 2)/G \simeq C_2$. E mais, $M(G, 2)$ é um grupo se e somente se G é um grupo abeliano.

A teoria dos loops de Moufang comutativos (CML) tem resultados profundos e importantes (o Teorema de Bruck-Slaby, sobre nilpotência local dos CML de período 3, por exemplo). Mas ainda temos problemas em aberto que desafiam matemáticos por muito tempo, como o Problema de ordem dos CML de período 3 livres com número finito de geradores (o Problema de Yu. Manin) e o Problema de especialidade dos CML de período 3. Lembramos que um loop de Moufang é especial se ele é um subloop de um loop dos elementos inversíveis da uma álgebra alternativa. O famoso especialista em geometria algébrica Yuriy Manin dedicou-se ao estudo dos CML e das relações de CML com outras variedades de loops e quasi-grupos, porque provou que para cada forma cúbica temos um CML de período 6 correspondente. Mas um CML de período 6 é produto direto de

um grupo abeliano elementar e um CML de período 3. Até agora o Problema de Manin foi resolvido só para CML com 5 geradores. A.Grichkov e I.Shestakov, resolveram este problema para os casos 6, 7 ([6]). Esperamos resolver este problema para CML com 8 geradores. No mesmo artigo [6] foi formulada a conjectura sobre a estrutura da álgebra alternativa $C(n)$ gerada por n elementos. A dificuldade deste problema cresce com aumento de parametro natural n. Esperamos provar este problema para $n < 6$. Mais exatamente, vamos provar que as álgebras $C(n)$ são livres para $n < 6$.

A construção de novos loops finitos (especialmente de Bol e di-associativos) sempre foi uma tarefa difícil, por isso pretendemos começar um estudo sistemático dos loops algébricos.

Como no caso dos grupos algébricos, cada loop algébrico, considerado sobre um corpo de definição finito (ou anel finito), fornece um exemplo de um loop finito. Mas aqui temos um problema grave: a diferença entre os loops algébricos locais e globais. Para grupos algébricos esta diferença não existe, pois temos o teorema de A.Weyl [8]. Vamos provar que este teorema é válido para loops de Moufang (pelo menos em característica zero) e não é válido em caso dos loops de Bol e diassociativos. É bem provável que no caso de loops de Bol tenhamos um contra-exemplo já no caso dos loops algébricos de dimensção 2.

Um grupo G se chama grupo com trialidade se G admite o grupo $S(3) = \{s, t | s^2 = t^3 = 1, sts = T^{-1}\}$ como um grupo dos automorfismos tal que, para todos os elementos x de G, temos $(x^s x^{-1})(x^s x^{-1})^t (x^s x^{-1})^{t^2} = 1$.

Glauberman [9] e Doro [2] descobriram a conexão dos grupos com trialidade com os loops de Moufang. Se G é um grupo com trialidade $H = \{x | x \in G \ e \ x^s = x\}$, $M = \{x^s x^{-1} | x \in G\}$, então M^{t^2} é um loop de Moufang com produto $x.y = z$, se $xy = hz$, $h \in H, z \in M^{t^2}$. Esta conexão permitiu classificar os loops de Moufang finitos (Liebeck, [7]). Nós (em colaboração com A. Zavarnitsine (Rússia)) aprofundamos esta conexão, provando que M possui a estrutura de um loop de Moufang a respeito da multiplicação dada por formula exata: $n \star m = n^t m n^{t^2}$.

A Conjectura 1 (se for verdadeira!) reduz estudo dos loops de Moufang finitos para o caso dos loops solúveis. Estrutura dos loops de Moufang solúveis depende da solução do seguinte problema:

Problema 1 *(O.Chein) Seja L um loop de Moufang e N um subloop normal abeliano. Vamos supor que $|G|$ é ímpar e $(|N|, |G/N|) = 1$. É verdade que G é um grupo?*

No trabalho [4] foram constriudas os novos loops de Moufang M tal que $M/N \simeq C_r$ é um suloop normal e N é um grupo abeliano $2-$elementar. Em particular estes exemplos mostram que a condição "$|G|$ é ímpar" é essencial no Problema 1. É importante classificar, a menos de isomorfismos, os loops de Moufang construidos em [4].

Outro problema importante para os loops de Moufang solúveis é provar um análogo do famoso teorema de Hall-Higman sobre $p-$comprimento dos grupos solúveis.

Por analogia com grupos, podemos definir o subloop de Frattini $Fr(M)$ de um loop de Moufang finito M como intersecão dos subloops maximais.

Conjetura 3 *Seja N um loop de Moufang. Então $Fr(M)$ é um subloop normal nilpotente de M.*

Como no caso dos grupos finitos, provavelmente a confirmação da Conjectura 3 vai ajudar na prova da seguinte conjectura:

Conjetura 4 *Seja M um loop de Moufang finito e $Var(M)$ a variedade dos loops de Moufang gerado por M. Então $Var(M)$ é definida por um número finito de identidades.*

A teoria das representações dos loops de Moufang ainda é muito pobre no sentido dos resultados relevantes e problemas em aberto. Pretendemos atacar ambas as deficiências através dos grupos com trialidade. Seja G um grupo com trialidade e V um $G-$módulo. Se a ação do grupo $S(3)$ pode ser estendida a uma ação no $G-$módulo V de tal modo que o grupo de extensão cindido $G+V$ é um grupo com trialidade, vamos chamar o $G-$módulo V um $G-$módulo com trialidade. O problema principal é o seguinte:

Problema 2 *Seja G um grupo finito com trialidade. Existe ou não um $G-$módulo com trialidade fiel?*

Notemos que construir os grupos com trialidade às vezes é mais difícil que os loops de Moufang. Por isso pretendemos (em colaboração com os Profs. M.Lourdes M.Giuliani e Zavarnitzine A.) começar o trabalho sobre os grupos com trialidade de ordem pequena. Aqui a palavra "pequena" significa que o loop de Moufang correspondente tem a ordem menor que 64. Um passo importante nesta direção é a construção geral dos grupos com trialidade correspondentes aos loops de Moufang obtidos por O.Chein e conhecidos como "duplicação" de Chein [1].

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Irene Paniello (Universidad Pública de Navarra)

Title: Localization of Jordan Pairs

Abstract: The study of systems of quotients for Jordan systems has its origin in Jacobson's question about whether it was possible or not to imbed a Jordan domain into a Jordan division algebra following Ore's construction for associative algebras. Among all results achieved in this area deserving to be mentioned we point out the development of Goldie theory for linear and quadratic Jordan algebras (due to E. Zelmanov and to A. Fernández-López, E. García-Rus and F. Montaner respectively) together to C. Martínez's work on the necessary and sufficient Ore type conditions for a linear Jordan algebra to have a ring of fractions. J. A. Anquela, E. García and M. Gómez-Lozano described Martindale-like quotients for linear Jordan algebras and later on Jordan analogues of Johnson's (joint work with F. Montaner) and Lambeck and Utumi's algebras of quotient of associative algebras (due to F. Montaner) were obtained for quadratic Jordan algebras. Regarding to Jordan systems different from algebras, besides of a first attempt to extend Goldie's theorems to linear Jordan pairs due to A. Fernández-López, E. García-Rus and O. Jaa, more recently E.

García and M. Gómez-Lozano studied Martindale-like systems of quotients for linear Jordan pairs. Our aim now is to report on constructions of systems of quotients for quadratic Jordan pairs based on the existence of inner ideals of denominators.

José M. Pérez-Izquierdo (Universidad de La Rioja)

Title: Nilpotent loops

Abstract: Loops are the non-associative counterpart of groups. The connection between nilpotent groups and Lie rings has a venerable tradition in Mathematics. In this talk we discuss some recent developments on nilpotent loops.

Alberto J. Calderón Martín (Universidad de Cádiz)

Title: Arbitrary algebras with a multiplicative basis

Abstract: Let $\mathfrak{A}$ be an algebra of arbitrary dimension, over an arbitrary base field $\mathbb{F}$ and in which any identity on the product is not supposed. A basis $\mathcal{B} = \{e_i\}_{i\in I}$ of $\mathfrak{A}$ is called multiplicative if for any $i, j \in I$ we have that $e_i e_j \in \mathbb{F}e_k$ for some $k \in I$. We show that if $\mathfrak{A}$ admits a multiplicative basis then it decomposes as the direct sum $\mathfrak{A} = \bigoplus_k \mathfrak{I}_k$ of well-described ideals admitting each one a multiplicative basis. Also the minimality of $\mathfrak{A}$ is characterized in terms of the multiplicative basis and it is shown that, under a mild condition, the above direct sum is by means of the family of its minimal ideals admitting a multiplicative basis.

Cristina Draper (Universidad de Málaga)

Title: Simetrías en álgebras de Lie simples reales de tipo excepcional

Abstract: Una G-graduacíon de un álgebra, para G grupo abeliano, es una descomposición del álgebra en suma directa de subespacios indizada en G de modo compatible con el producto. En el caso de álgebras complejas, dichas graduaciones están en correspondencia con subgrupos diagonalizables del grupo de automorfismos del algebra, lo que ha permitido clasificar salvo equivalencia todas las graduaciones finas (que no pueden partirse más) de las álgebras de Lie simples complejas finito-dimensionales. La monografía [4], recientemente publicada por la AMS, recoge dicha clasificación, con excepción de los casos $\mathfrak{e}_7$ y $\mathfrak{e}_8$, de los que sólo aparece una conjetura (para más información, consultar [2]).

Esta técnica no puede emplearse en el caso de álgebras reales, cuyas simetrías son bastante más desconocidas incluso en el caso clásico (álgebras de tipo A, B, C y D), en el que están estudiados sólo algunos casos de dimensiones bajas. En esta charla hablaremos de las formas reales de las álgebras de Lie excepcionales $\mathfrak{g}_2$, $\mathfrak{f}_4$ y $\mathfrak{e}_6$ y de las distintas graduaciones que poseen, asícomo de las técnicas para obtener dichas graduaciones.

Algunos de los precedentes en los que se apoya este trabajo son [3], en el que se clasifican las 14 graduaciones finas del álgebra compleja $\mathfrak{e}_6$ (clasificación que también aparece en [4]), y [1], en el que se estudian las graduaciones de las formas reales de $\mathfrak{g}_2$ y $\mathfrak{f}_4$. Asímismo presentamos parte de los resultados de la tesis doctoral [5], recientemente defendida en la Universidad del Salento y cuyos resultados aún están sin publicar.

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Xabier García-Martínez (Universidad de Santiago de Compostela)

Title: Universal central extensions of LieRinehart algebras

Abstract: In this work we study central extensions of Lie-Rinehart algebras [3, 4]. They do an algebraic codification of Lie algebroids. The concept of Lie-Rinehart A-algebra generalizes the concept of Lie A-algebra and A-module and the main example of Lie-Rinehart algebra is the set $Der_K(A)$ of all K-derivations of A.

We study central extensions of Lie-Rinehart algebras an we prove that if L is A-projective then the second cohomology group $H^2_{\mathrm{Rin}}(L, I)$ classifies central extensions of L

by I. Then we build a non-abelian tensor product of Lie-Rinehart algebras extending the non-abelian tensor product of Lie algebras [2] and we obtain the existence of the universal central extension when the Lie-Rinehart algebra is perfect and we characterize it with the non-abelian tensor product.

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Ivan Shestakov (Universidade de São Paulo)

Title: Estudo e classificação de superálgebras simples de dimensão finita nas classes mais gerais

Abstract: Depois de classificar as superálgebras simples de dimensão finita de Lie, alternativas e de Jordan, é natural considerar a tarefa de classificação de superálgebras simples nas classes mais gerais, onde existe uma boa teoria estrutural para as álgebras de dimensão finita.

As álgebras alternativas à direita foram uma das primeiras classes de álgebras não associativas que atraíram a atenção de pesquisadores. Elas estão relacionadas com a teoria de planos projetivos (planos l-Desargueanos e de Moufang [42]) e a teoria de loops (loops de Bol à direita) (veja [20]).

Uma álgebra A chama-se alternativa à direita se ela satisfaz a identidade $xy \cdot y = x \cdot y^2$. Cada álgebra alternativa é naturalmente alternativa à direita; além disso, para cada álgebra alternativa à direita A, a álgebra A^+, com a multiplicação simetrizada $a \cdot b = \frac{1}{2}(ab + ba)$, é de Jordan. Assim, a classe das álgebras alternativas à direita generaliza a classe das álgebras alternativas e está relacionada naturalmente com as álgebras de Jordan.

Uma das linhas de pesquisa mais relevantes na área de álgebras alternativas à direita

consiste em demonstrar que, sob condições adequadas, uma álgebra alternativa à direita também é alternativa à esquerda e, então, é alternativa. Assim, Albert [1], [2] demonstrou que cada álgebra alternativa à direita nil semisimples de dimensão finita é alternativa e, portanto, isomorfa a uma soma direta de álgebras de matrizes e octónios; Skornyakov [42] demonstrou que cada álgebra alternativa à direita com divisão é alternativa (portanto, cada plano projetivo que é l-Desargueano para duas linhas l diferentes, é de Moufang); Kleinfeld [15] generalizou este resultado para álgebras sem elementos nilpotentes. O resultado mais forte nesta direção foi obtido em 1984 por Skosyrski (veja [20]): cada álgebra alternativa à direita nil semisimples é alternativa. Por outro lado, existem álgebras alternativas à direita simples que não são alternativas (veja [20], [51]). Claro que estas são de dimensão infinita.

Uma teoria estrutural de álgebras de dimensão finita em qualquer classe normalmente inclui também uma teoria de representações e bi-representaç ões. Nos últimos anos, o estudo e classificação de superálgebras simples também forma uma parte natural da teoria estrutural.

Em [43], foram tratadas representações à direita (como uma generalização da teoria correspondente para álgebras alternativas desenvolvida em [51] e [40]). Se A é uma álgebra alternativa à direita de dimensão finita com um nil radical N então N está no núcleo de cada representação irredutível, cada módulo sobre a álgebra quociente A/N é completamente redutível e a estrutura de módulos irredutíveis é conhecida. No caso de bi-representações, o comportamento é bem diferente. Em [28] foi provado que existem infinitos bimódulos alternativos à direita irredutíveis não isomorfos para a álgebra de matrizes $M_2(F)$, já em dimensão 4. Além disso, existe, para cada inteiro $n \geq 1$, pelo menos um bimódulo irredutível de dimensão $4n$.

O estudo de superálgebras alternativas à direita ainda nem foi começado. A primeira pergunta a ser tratada aqui é:

é finito ou não o número de superálgebras alternativas à direita simples de dimensão finita?

Para isso, pretende-se analisar os bimódulos irredutíveis obtidos em [28], uma vez que, dada uma superálgebra alternativa à direita $A = A_0 \oplus A_1$, a parte par A_0 é uma álgebra alternativa à direita e a parte ímpar, A_1, é um bimódulo sobre A_0. A existência de infinitos bimódulos alternativos à direita irredutíveis não isomorfos já para álgebras de matrizes sugere que a a resposta à pergunta acima formulada seja negativa. Se confirmada a expectativa, pretende-se analisar subclasses de álgebras alternativas à direita que contenham propriamente as álgebras alternativas. Mais especificamente, pretende-se investigar a estrutura de $(-1, 1)$-superálgebras binárias. As álgebras $(-1, 1)$ binárias já se mostraram bem comportadas no que se refere à estrutura de seus bimódulos: em [29], por exemplo, foi provado que, se A for uma álgebra alternativa simples de dimensão finita

e característica zero ou uma álgebra de composição de característica diferente de 2 e 3, então todos os seus $(-1,1)$-bimódulos irredutíveis são alternativos.

Superálgebras estruturáveis

A classe de álgebras de Jordan tem três generalizações interessantes. A primeira é dada pelas chamadas álgebras estruturáveis, introduzidas pelo Kantor [11] e Allison [7], que incluam também as álgebras alternativas com involução. O estudo desta classe de álgebras foi motivado pelo fato que, usando a famosa construção de Tits-Kantor-Koecher (a TKK-construção), se pode obter todas as álgebras de Lie simples de dimensão finita sobre um corpo de característica zero de maneira unificada, aplicando a TKK-construção para as álgebras estruturáveis. É lógico esperar que o estudo de superálgebras estruturáveis pode dar novas construções de superálgebras de Lie simples, portanto o problema de classificação de superálgebras simples estruturáveis parece muito interessante.

Superálgebras de Jordan não-comutativas

Outra generalização de álgebras de Jordan consta de álgebras de Jordan não-comutativas. Esta classe de álgebras foi estudada nos trabalhos de McCrimmon [22], Schafer [34] e outros autores. O estudo de superálgebras nesta classe de álgebras também não foi começado.

Superálgebras comutativas de potências associativas

Uma álgebra A pertence à classe das álgebras de potências associativas quando toda subalgebra gerada por um único elemento é associativa. As álgebras comutativas de potências associativas são uma generalização natural de álgebras de Jordan e formam uma classe de álgebras mais ampla onde pode-se esperar construir uma teoria estrutural mais ou menos satisfatória, pelo menos no caso de álgebras de dimensão finita.

Em um corpo de característica diferente de $2, 3, 5$ a identidade $(x^2)^2 = (x^2x)x$ é suficiente para definir potências associativas em uma álgebra comutativa [3]. Em característica 3 e 5 é necessário considerar também associatividade de quintas e sextas potências respectivamente ([17]).

Diz-se que uma álgebra com unidade tem grau n, quando n é o número máximo de parcelas em que a unidade pode ser decomposta como soma de idempotentes não nulos. Todas as álgebras de potências associativas simples de grau maior que 2 e em característica zero são álgebras de Jordan ([5]).

Para extender esta classificação no caso de superálgebras, precisamos primeiro desenvolver uma teoria de representações. Pretende-se, então, desenvolver uma tal teoria para estas álgebras. Para iniciar, estudaremos os módulos irredutíveis sobre as álgebras simples de Jordan (que a priori não têm que ser de Jordan). Exemplos de módulos irredutíveis para álgebras de Jordan que não são módulos de Jordan podem ser encontrados em [34].

O principal objetivo é estudar e classificar os módulos irredutíveis para álgebras comutativas de potências associativas. Para tanto, usaremos os resultados já desenvolvidos para módulos de Jordan e tentaremos encontrar inicialmente resultados referentes a módulos

para álgebras de potências associativas considerando álgebras de Jordan simples.

O passo seguinte será o estudo de superálgebras simples nesta classe.

Superálgebras de Lie-binárias

As álgebras de Lie-binárias generalizam as álgebras de Malcev e se definam como as álgebras onde cada subálgebra 2-gerada é uma álgebra de Lie. Uma álgebra anticomutativa A é de Lie-binária se e somente se ela satisfaz a identidade

$$J(ab, a, b) = 0,$$

onde $J(a, b, c) = (ab)c + (bc)a + (ca)b$ é o jacobiano de elementos $a, b, c \in A$. Cada álgebra de Lie-binária simples de dimensão finita sobre um corpo de característica 0 é uma álgebra de Malcev [9]. Para cada álgebra de $(-1, 1)$ binária A, a álgebra comutador A^- é de Lie binária, mas ainda não é claro se esta relação é universal. As superálgebras de Lie-binárias ainda não foram estudadas.

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Juan Carlos Gutiérrez Fernández (Universidade de São Paulo)

Title: O Problema de Albert para Nilálgebras

Abstract: Seja A uma álgebra comutativa. A álgebra A é dita *nilálgebra* se para cada a em A existe um inteiro k tal que cada produto de k ou mais fatores cada um deles igual a a, em qualquer associação, é zero. Se pudermos escolher k independente de a, então A tem índice limitado, ou nilíndice k se k é o menor tal inteiro. Lembramos que uma álgebra A é de potências associativas se para cada a em A, a subálgebra gerada por a é associativa. Um dos mais intrigantes e difíceis problemas na teoria das álgebras de dimensão finita é a famosa

Conjectura de Albert [1]: *Seja A uma álgebra comutativa, nil de potências associativas e dimensão finita sobre um corpo de característica zero. Então A é uma álgebra solúvel.*

A conjectura é muito profunda e difícil, porém alguns resultados parciais foram obtidos. Gerstenhaber e Myung [GM] mostraram que as nilálgebras comutativas de dimensão 4 são nilpotentes. Correa e Peresi [3] e [2] (veja também [4]) mostraram que as nilálgebras comutativas e de potências associativas de dimensão ≤ 7 são solúveis. Em [5] (ver também [2]) mostramos que nilálgebras comutativas de dimensão n e nilíndice $n-2$ são solúveis. O problema é muito difícil, portanto vamos tentar provar a conjectura para casos particulares:

- estudar a estrutura das álgebras comutativas de nilíndice 4, isto é, as álgebras comutativas que verificam a identidade $x(x(xx)) = 0$;
- dimensão 8 e não necessariamente de potências associativa;
- dimensão 9 e 10 e de potências associativa;
- para álgebras de dimensão n e nilíndice $n-3$;
- para álgebras de dimensão n com uma subalgebra de codimensão 3;
- para álgebras de nilíndice 4.

Também pretendemos trabalhar neste problema através da teoria de módulos. Seja Ω a variedade das nilálgebras comutativas e de potências associativas de nilíndice 4 sobre um

corpo k de característica zero. Seja $N^2 = 0$: observamos que a estrutura dos N-módulos não é trivial. Em particular, os problemas seguintes são interessantes:

- Classificar os N-módulos indecomponíveis de dimensão finita;
- Determinar o N-módulo livre.

Se resolvermos o último problema poderíamos atacar a Conjectura de Albert para Ω-álgebra usando a teoria dos módulos e seus produtos tensoriais. Também poderiamos usar os módulos classificados para tentar achar um contraexemplo para a Conjectura de Albert.

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Henrique Guzzo Jr. (Universidade de São Paulo)

Title: O teorema principal de Wedderburn

Abstract: Sejam A uma álgebra sobre um corpo F e K uma extensão arbitrária de F. é fácil ver que $A_K = K \otimes_F A$ é uma álgebra sobre K com produto dado por $(\alpha \otimes x)(\beta \otimes y) = \alpha\beta \otimes xy$. Se a dimensão de A é finita, então A é chamada **separável** se para qualquer K, a álgebra A_K é uma soma direta de ideais simples. Para as álgebras alternativas, isto é

equivalente a dizer que a álgebra $A = I_1 \oplus \cdots \oplus I_t$ é semisimples com o centro Z_i de cada componente simples I_i ($i \geq 1$) sendo uma extensão separável de F. O próximo teorema generaliza para as álgebras alternativas o conhecido **teorema principal de Wedderburn para as álgebras associativas**.

Teorema 1 (Teorema principal de Wedderburn para as álgebras alternativas) *Seja A uma álgebra alternativa de dimensão finita sobre um corpo F. Se $A/Nil(A)$ é separável, então $A = B \oplus Nil(A)$, onde B é uma subálgebra semisimples de A e $B \cong A/Nil(A)$.*

Se (A, ω) é uma b-álgebra sobre um corpo F, então (A_K, δ) é uma b-álgebra sobre K, onde $\delta(\alpha \otimes x) = \alpha\omega(x)$, para quaisquer $\alpha \in K$ e $x \in A$, o que motiva os seguintes

Definição 1 *Uma b-álgebra de dimensão finita sobre um corpo F é chamada* **b-separável** *se para toda extensão K de F, a b-álgebra A_K é o join de um número de finito de b-álgebras normais b-simples.*

Conjetura 5 *Provar que a conjectura "Seja (A, ω) uma b-álgebra alternativa de dimensão finita sobre um corpo F. Se $A/R_b(A)$ é b-separável então $A = B \oplus R_b(A)$, onde B é uma b-subálgebra de A b- semisimples e $B \cong_b A/R_b(A)$." é verdadeira.*

Poster presentations

Irene Paniello (Universidad Pública de Navarra)

Title: Genetic coalgebras

Abstract: Coalgebras with genetic realization were introduced by J. P. Tian and B-L. Li (J. P. Tian, B-L. Li, Coalgebraic structure of genetic inheritance, Math. Biosciences and Engineering, 1 (2), 243–266 (2004)) in an attempt to model the backwards genetic inheritance in Mendelian genetic systems and later on revisited in (I. Paniello, Stochastic matrices arising from genetic inheritance, Linear Algebra and its Applications 434, 791–800 (2011)) to be endowed with a matrix realization in terms of cubic stochastic matrices. The aim of this poster is to report on some results on the asymptotic behaviour of genetic coalgebras obtained when exploiting their relationship with cubic stochastic matrices.

José M. Pérez-Izquierdo (Universidad de La Rioja)

Title: The Magnus expansion for free loops

Abstract: In 1963 G. Higman proved that the terms of the lower central series of a free loop intersect in the identity. For free groups this results follows from the well-known Magnus expansion for elements in these groups in terms of formal power series in free associative algebras. However, such an expansion for free loops does not appear in the literature. In this poster we show that Higman's approach can be modified to get a non-associative version of the Magnus expansion. This poster is based on joint research with Professors J. Mostovoy and I. Shestakov.

18 Differential methods in algebra and algebraic geometry

Organizers

S. C. Coutinho (Universidade Federal do Rio de Janeiro)
D. Levcovitz (Universidade de São Paulo)
L. Narváez Macarro (Universidad de Sevilla)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	–	–
15:10 - 15:50	A. Simis	D. Levcovitz
15:50 - 16:20	Coffee	
16:20 - 17:00	J. Alvarez-Montaner	R. Bedregal
17:00 - 17:40	–	L. N. Macarro
17:40 - 18:00	Coffee	
18:00 - 18:40	A. Castaño	–
18:40 - 19:20	–	–

Aron Simis (Universidade Federal da Paraíba)

Title: Birational maps having arithmetically Cohen-Macaulay graphs

Abstract: A rational map whose source and image are projectively embedded varieties is said to have an *arithmetically Cohen–Macaulay graph* if the Rees algebra of one (hence any) of its base ideals is a Cohen–Macaulay ring. If the map is birational onto the image one considers how this property forces an upper bound on the degree of a representative of the map. In the plane case a complete description is given of the Cremona maps with Cohen–Macaulay graph, while in arbitrary dimension n it is shown that a Cremona map with Cohen–Macaulay graph has degree at most n^2.

Josep Alvarez-Montaner (Universitat Politècnica de Catalunya)

Title: Characteristic cycles of local cohomology modules

Abstract: The theory of D-modules has been a fundamental tool in the study of local cohomology modules over the last decades. In particular, the characteristic cycle is a

very useful invariant that allows to decide the vanishing of local cohomology modules and describe their set of associated primes. Morover, the multiplicities of the characteristic cycle also provide a nice set of invariants that generalize the so-called Lyubeznik numbers.

The aim of this talk is to introduce this approach with a special regard to the case of local cohomology modules supported on monomial ideals

Alberto Castaño (TU Chemnitz)

Title: Exponents of one-dimensional Gauss-Manin systems

Abstract: The exponents at a point of a D-module in dimension one are an algebraic way of understand the behaviour of regular singularities. In this talk I will present a result about the exponents of some one-dimensional Gauss-Manin systems, understood as a direct image of a structure sheaf, and the vanishing of the cohomologies of certain Koszul complex associated with the morphism under consideration.

Daniel Levcovitz (Universidade de São Paulo)

Title: On the Isotropy Group of a Simple Derivation

Abstract: In this talk we want to give the status of the following conjecture made by Baltazar and Pan: Conjecture: Let d be a simple derivation of an affine k-algebra (k a field of characteristic zero). Then, its isotropy group is finite. We present a recent result of ours and Luciene Bertoncelo that shows that if d is a simple Shamsuddin derivation of a polynomial ring, then its isotropy group is, in fact, trivial.

Roberto Bedregal (Universidade Federal da Paraíba)

Title: Quasi-holonomic D-modules and Local Cohomolgy

Abstract: Let R be a commutative Noetherian ring with unity. If M is an R-module and $I \subseteq R$ is an ideal, the i-th cohomology of M with support in I is denoted by $H^i_I(M)$. One encounters in the literature the following finiteness properties for certain regular rings.

1. The set of associated primes of $H^i_I(R)$ is finite.
2. The Bass numbers of $H^i_I(R)$ are finite.
3. $\mathrm{inj.dim}\,(H^i_I(R)) \leq \mathrm{dimSupp}\, H^i_I(R)$.

G. Lyubeznik showed that these three properties hold in the local case of equal characteristic 0. His technique relies on the use of D-modules on a power series ring over a field of characteristic 0.

In this talk I will address these issues and show how we generalize Lyubeznik's result. This is a joint work with L. Alba-Sarria and N. Caro-Tuesta.

Luis Narvez Macarro (Universidad de Sevilla)

Title: Differentiably admissible algebras over a field of positive characteristic

Abstract: In this talk I will explain a class of regular noetherian algebras over a field of positive characteristic, non-necessarily finitely generated, for which the ring of differential operators behaves similarly to the case of polynomial or power series rings. One of the key points is the notion of "integrable derivations" in the sense of Hasse-Schmidt derivations. These algebras admit a good theory of D-modules.

19 Elliptic partial differential equations

Organizers

Boyan Sirakov (PUC-RJ)
Jorge Garca-Melin (Universidad de La Laguna)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	C. Tomei	Carmona Tapia
15:10 - 15:50	J. García-Melián	Edgard A. Pimentel
15:50 - 16:20	Coffee	
16:20 - 17:00	D. Bonheure	P. Álvarez-Caudevilla
17:00 - 17:40	Ederson M. dos Santos	Boyan Sirakov
17:40 - 18:00	Coffee	
18:00 - 18:40	Hugo Tavares	S. Villegas
18:40 - 19:20	J.-B. Casteras	–

Carlos Tomei (PUC-Rio)

Title: Homotopy beyond degree theory: some applications in differential equations

Abstract: If you remove a point from Banach space, no topologist notices. Extensions of this fact lead to topological triviality in many situations, which in turn imply strong global statements about differential operators, both ordinary and partial.

Jorge García-Melián (Universidad de La Laguna)

Title: Some Liouville theorems for positive radially symmetric solutions of nonlinear equations

Joint work with L. Iturriaga and A. Quaas

Abstract: We analyze Liouville theorems for positive solutions of some nonlinear elliptic problems, whose prototype is:

$$-\Delta u = f(u) \quad \text{in } \mathbb{R}^N \tag{1}$$

where $N \geq 3$ and the nonlinearity $f(u)$ is assumed to be continuous in $[0, +\infty)$ and positive in $(0, +\infty)$. We show that if f verifies the additional condition that $F(t)t^{-\frac{2N}{N-2}}$ is nonincreasing, where $F(t) = \int_0^t f(s)ds$, then any positive, radially symmetric solution u of (1) is of the form

$$u(x) = c\left(\frac{\mu}{1+\mu^2|x|^2}\right)^{\frac{N-2}{2}}$$

for some $c, \mu > 0$, and necessarily $f(t) = c^{-\frac{4}{N-2}}t^{\frac{N+2}{N-2}}$ for $t \in [0, \|u\|_\infty]$. This improves, in the radially symmetric case, previous known results where the monotonicity condition was imposed on f.

We also obtain analogous Liouville theorems for problems where the Laplacian is replaced by the $p-$Laplacian or when a weight of the form $|x|^a$, $a > -2$ is included in the right-hand side of (1).

Denis Bonheure (Université Libre de Bruxelles)

Stationary NLS driven by an equivariant magnetic potential

Abstract: In this talk, I will discuss recent results on NLS driven by a cylindrically equivariant exterior magnetic potential. Our recent progress concern uniqueness and qualitative results for groundstate solutions when the magnetic field is constant and has a small intensity (joint work with Manon Nys and Jean Van Schaftingen) and the existence of solutions concentrating around circles in the semiclassical limit (joint work with Manon Nys and Sylvia Cingolani). I emphasize that the concentration can be produced by the magnetic potential alone when the electrical field is constant or by a constant magnetic field when the electrical field is a decreasing power. These phenomena cannot be observed when the concentration happens on a set of points.

Ederson Moreira dos Santos (ICMC - Universidade de São Paulo, São Carlos)

Title: On the finite space blow up of the solutions of the Swift-Hohenberg equation

Abstract: We study the finite space blow up of the solutions for a class of fourth order differential equations. Our results have implications on the nonexistence of beam oscillation given by traveling wave profile at low speed propagation and answer a conjecture in [F. Gazzola and R. Pavani. Wide oscillation finite time blow up for solutions to nonlinear fourth order differential equations. Arch. Ration. Mech. Anal., 207(2):717- 752, 2013].

This is a joint work with Vanderley Alves Ferreira Junior.

Hugo Tavares (Instituto Superior Técnico, Universidade de Lisboa)

Title: Semitrivial and fully nontrivial solutions for cubic Schrödinger systems

Joint works with S. Correia, F. Oliveira, N. Soave

Abstract: In this talk we focus on the cubic Schrödinger system with $d \geq 3$ equations:

$$-\Delta u_i + \lambda_i u_i = \mu_i u_i^3 + u_i \sum_{jineqj} \beta_{ij} u_j^2 \quad \text{in } \Omega \subset \mathbb{R}^N, \qquad i = 1, \dots d$$

where $\lambda_i, \mu_i > 0$, $\beta_{ij} = \beta_{ji} \in \mathbb{R}$ for $j \neq i$, $N = 2, 3$. The underlying domain Ω is either bounded or the whole space, and $u_i \in H_0^1(\Omega)$ or $u_i \in H_{rad}^1(\mathbb{R}^N)$ respectively. For the case $\beta_{ij} > 0$ (called cooperative), we provide optimal qualitative conditions on the parameters λ_i, μ_i and β_{ij} under which the ground state solutions have all components nontrivial, or, conversely, are semitrivial. Moreover, in the case of mixed cooperation and competition coefficients, we present new existence and symmetry results of positive solutions.

Jean-Baptiste Casteras (Université Libre de Bruxelles)

Title: A flow approach to the mean field equation

Abstract: This talk will be focus on an evolution problem associated to the mean field equation. We will first show the global existence of this flow and then we will prove, under suitable assumptions, that it converges to a solution of the stationary equation.

José Carmona Tapia (Universidad de Almería)

Title: Quasilinear elliptic problems with natural growth in the gradient and variable exponent singularities

Abstract: We review some recent results obtained for a class of quasilinear elliptic boundary value problems modeled by

$$\begin{cases} -\Delta u + g(x,u)|\mathcal{D}u|^2 = f(x,u) & \text{in } \Omega, \\ u = 0 & \text{on } \partial\Omega. \end{cases}$$

where Ω is an open bounded set of $\mathbb{R}^N$ and f, g are positive functions defined in $\overline{\Omega} \times (0, +\infty)$ with $g(x, \cdot)$ unbounded at zero.

Special attention will be paid to the case $g(x, s) = \frac{1}{s^{\gamma(x)}}$ with $\gamma(x)$ being a positive continuous function and $f(x, s) \equiv f_0(x)$ is a positive function in a suitable Lebesgue space. Here the behavior of $\gamma(x)$ near the boundary of Ω is determinant for the existence or nonexistence of solution.

[1] D. Arcoya, J. Carmona, T. Leonori, P. J. Martínez-Aparicio, L. Orsina and F. Petitta, *Existence and nonexistence of solutions for singular quadratic quasilinear equations*. J. Differential Equations **246** (2009), 4006–4042.

[2] D. Arcoya, J. Carmona, P.J. Martínez-Aparicio, *Bifurcation for Quasilinear Elliptic Singular BVP.* Communications in Partial Differential Equations **36** (2011), 670-692.

[3] D. Arcoya, J. Carmona and P. J. Martínez-Aparicio, *Comparison principle for elliptic equations in divergence with singular lower order terms having natural growth*. Preprint 2014.

[4] J. Carmona, P. J. Martínez-Aparicio and J. D. Rossi, *A singular elliptic equation with natural growth in the gradient and a variable exponent.* Nonlinear Differential Equations and Applications NoDEA (2015), DOI 10.1007/s00030-015-0351-0

[5] J. Carmona, P. J. Martínez-Aparicio and A. Suárez, *Existence and non-existence of positive solutions for nonlinear elliptic singular equations with natural growth.* Nonlinear Analysis **89** (2013), 157-169.

[6] J. Carmona, P. J. Martínez-Aparicio and A. Suárez, *A sub-supersolution method for nonlinear elliptic singular systems with natural growth and some applications* Preprint 2015.

[7] J. Carmona, A. Molino, L. Moreno-Mérida, *Existence of a continuum of solutions for a quasilinear elliptic singular problem.* Preprint (2015).

Edgard A. Pimentel (Universidade Federal de São Carlos)

Title: Hessian integrability estimates for nonlinear elliptic equations: a geometric approach

Abstract: In this talk, we present sharp $W^{2,p}$ regularity estimates for viscosity solutions of fully nonlinear elliptic equations under minimal, asymptotic assumptions on the governing operator F. By means of geometric tangential methods, we show that if the *recession* of the operator F – formally given by $F^*(M) := \infty^{-1}F(\infty M)$ – is convex, then any viscosity solution to the original equation $F(D^2u) = f(x)$ is locally of class $W^{2,p}$, provided $f \in L^p$, $p > d$, with appropriate universal estimates. Our main result extends to operators with variable coefficients and in this setting they are new even under convexity of the frozen coefficient operator, $M \mapsto F(x_0, M)$, as oscillation is measured only at the recession level. The methods further yield BMO regularity of the hessian, provided the source lies in that space. As a final application, we establish the density of $W^{2,p}$ solutions within the class of all continuous viscosity solutions, for generic fully nonlinear operators F. This result gives an alternative tool for treating common issues often faced in the theory of viscosity solutions.

This is joint work with E. Teixeira (UFC).

Pablo Álvarez-Caudevilla (Universidad Carlos III, Madrid)

Title: Existence and multiplicity results of a Fourth-Order Cahn–Hilliard equation Type

Abstract: Assuming fourth-order semilinear parabolic equations of the Cahn–Hilliard-type

$$u_t + \Delta^2 u = \gamma u \pm \Delta(|u|^{p-1}u) \quad \text{in} \quad \Omega \times \mathbb{R}_+,$$

we will discuss several aspects regarding existence and multiplicity results of classic steady states when $\Omega \subset \mathbb{R}^N$ is a bounded domain under Navier boundary conditions and, also, considering the whole $\mathbb{R}^N$ and in a class of functions properly decaying at infinity,

$$\lim_{|x|\to\infty} u(x) = 0.$$

Boyan Sirakov (PUC-Rio)

Title: A priori bounds for elliptic inequalities via regularity estimates

Abstract: We show how basic estimates from elliptic regularity theory, such as growth lemmas and half-Harnack inequalities, can be used to obtain new and optimal a priori bounds for positive sub- and super-solutions of nonlinear elliptic equations.

We prove new boundary versions of these regularity estimates, which play an important role in the proofs of the a priori bounds, and are of importance in themselves.

We apply the a priori bounds in order to study the existence and multiplicity of solutions of the Dirichlet problem for a general class of elliptic operators in which the first and the second order terms have the same scaling with respect to dilations.

Salvador Villegas (Universidad de Granada)

Title: Stable radial solutions of $-\Delta u = f(u)$ outside a ball

Abstract: We study stable radial solutions of $-\Delta u = f(u)$ in $\mathbb{R}^N \setminus B_1 = \{x \in \mathbb{R}^N : |x| \geq 1\}$, where $f \in C^1(\mathbb{R})$ and $N \geq 2$. We prove that such solutions are either large [in the sense that $|u(r)| \geq Mr^{-N/2+\sqrt{N-1}+2}$, if $2 \leq N \leq 9$; $|u(r)| \geq M\log(r)$, if $N = 10$; $|u(r) - u_\infty| \geq Mr^{-N/2+\sqrt{N-1}+2}$, if $N \geq 11$; $\forall r \geq r_0$, for some $M > 0$, $r_0 \geq 1$] or small [in the sense that $|u(r)| \leq M\log(r)$, if $N = 2$; $|u(r) - u_\infty| \leq Mr^{-N/2-\sqrt{N-1}+2}$; if $N \geq 3$; $\forall r \geq 2$, for some $M > 0$], where $u_\infty = \lim_{r\to\infty} u(r) \in [-\infty, +\infty]$. These results can be applied to stable outside a compact set radial solutions of equations of the type $-\Delta u = g(u)$ in $\mathbb{R}^N$. We prove also the optimality of these results, by considering solutions of the form $u(r) = r^\alpha$ or $u(r) = \log(r)$, $\forall r \geq 1$, where $\alpha \in \mathbb{R} \setminus \{0\}$.

[1] S. Villegas, *Dichotomy of stable radial solutions of $-\Delta u = f(u)$ outside a ball,* arXiv:1404.1722v1 (2014).

20 Special functions and approximation theory

Organizers

Francisco Marcellán (ICMAT and Universidad Carlos III, Madrid)
Alagacone Sri Ranga (Universidade Estadual Paulista)

	Wednesday 09	**Thursday 10**
14:30 - 15:10	Dimitar K. Dimitrov	Manuel Mañas
15:10 - 15:50	Antonio J. Durán	Maxim Yattselev
15:50 - 16:20	Coffee	
16:20 - 17:00	Felipe F. Gonçalves	Alagacone Sri Ranga
17:00 - 17:40	Ana Foulquié Moreno	Teresa E. Pérez
17:40 - 18:00	Coffee	
18:00 - 18:40	Amílcar Branquinho	Pablo Román
18:40 - 19:20	José Madrid	Renan H. Finder
19:20 - 20:00	Cleonice F. Bracciali	–

Dimitar K. Dimitrov (Departamento de Matemática Aplicada, IBILCE, UNESP)

Title: Orthogonal Polynomials in Number Theory and Physics

Abstract: The Riemann Ξ function is an entire function of order one and of infinite type defined by $2\,\Xi(z) = -(z^2 + 1/4)\pi^{-1/4-iz/2}\Gamma(1/4 + iz/2)\zeta(1/2 + iz)$. The Riemann hypothesis is equivalent to the fact that the zeros of Ξ are all real. Since Ξ can be represented in terms of a Fourier transform, introducing an additional "time" parameter t, one generates a heat equation. The natural question arises if the solution of this equation is "strongly oscillating" for certain values of t. The study of this heat process led de Bruijn to prove that the solution is strongly oscillation for some value of t and Newman to conjecture that it is not true after one passes through the critical time which corresponds to the Riemann Ξ function. Since the heat process on the real line is naturally governed by the so called heat polynomials, studied by Rosenbloom and Widder, and these polynomials are related to the Hermite polynomials, we report a result which is inspired by these classical interplays.

Antonio J. Durán (Universidad de Sevilla)

Title: Some Conjectures on Wronskian Determinants of Orthogonal Polynomials

Abstract: In this talk we consider some conjectures on regularity properties for the zeros of Wronskian determinants whose entries are orthogonal polynomials. These determinants are formed by choosing orthogonal polynomials whose degrees run on a finite set F of nonnegative integers. The case when F is formed by consecutive integers was studied by S. Karlin and G. Szegö in 1961.

Felipe Ferreira Gonçalves (IMPA)

Title: Band-Limited Approximations and Interpolation Formulas

Abstract: In the late 1930s A. Beurling found a function $B(x)$ with Fourier transform supported in the interval $[-1, 1]$ such that $B(x) \geq sgn(x)$ for all real x and the norm $\|B(x) - sgn(x)\|_{L^1}$ is minimized. In the 1974s, A. Selberg used A. Beurling construction to define functions L(x) and M(x) with Fourier transform supported in [-1,1] such that $L(x) \leq \chi_{[a,b]}(x) \leq M(x)$ for all real x and the norm $\|M(x) - L(x)\|_{L^1}$ is minimized. These special functions are now called extremal functions. A crucial property of these extremal functions is that they interpolate the target function in a sequence of real points and are often given by an interpolation formula involving these interpolation nodes. In this talk we give a quick view of the main aspects of the theory as it is now-a-days and also its connection with a special space of entirefunctions, called de Branges Spaces.

Ana Foulquié Moreno (Universidade de Aveiro)

Title: Laguerre-Hahn Orthogonal Polynomials

*A*bstract: In this talk we present a study for the Laguerre-Hahn orthogonal polynomials sequences on the real line. The starting point is the result established by Magnus concerning to the semi-classical orthogonal polynomials. We show that the LaguerreHahn families on the real line are characterized in terms of second-order differential equations with matrix coefficients for vectors involving the orthogonal polynomials and their associated polynomials, as well as in terms of second-order differential equation for the functions of the second kind. At the end we show some characterizations of the classical families.

Amílcar Branquinho (Universidade de Coimbra)

Title: Dynamics and Interpretation of some Integrable Systems via (Multiple) Orthogonal Polynomials

Abstract: Some discrete dynamical systems defined by a Lax pair are considered. The method of investigation is based on the analysis of the matricial moments for the main operator of the pair. The solutions of these systems are studied in terms of properties of this operator, giving, under some conditions, explicit expressions for the resolvent function.

José Madrid (IMPA)

Title: On Derivative Bounds for Fractional Maximal Functions

Abstract: We will talk about the regularity properties of fractional maximal operators acting on BV-functions and $W^{1,1}$-functions. In this talk, we will be presenting recent results about new bounds for the derivative of the fractional maximal function, both in the continuous and in the discrete settings.

This is a joint work with E. Carneiro.

Cleonice F. Bracciali (IBILCE, UNESP)

Title: Para-orthogonal Polynomials on the Unit Circle with some Restrictions on the Recurrence Relation Coefficients

This is a joint work with J. Silva, A. Sri Ranga and D.O. Veronese.

Abstract: We consider a sequence of para-orthogonal polynomials on the unit circle that satisfy a three term recurrence relation. The coefficients of this recurrence relation are periodic and with alternating signals. We use information about the zeros of theses para-polynomials to show to give some estimative of the support of the measure associated.

Manuel Mañas (Universidad Complutense de Madrid)

Title: Multivariate Orthogonal Polynomials in the Real Space and in the Torus. Darboux Transformations and Integrable Systems

Abstract: We review some recent results we have obtained for multivariate orthogonal polynomials either in the multidimensional real space or the unit torus. The study is based in a lexicographic order, the associated moment matrix and its varying size block LU factorization. We give for both cases Darboux transformations and the corresponding nonlinear integrable equations of Toda-KP type for which are solutions.

Maxim Yattselev (Indiana University-Purdue University)

Title: Hermite-Padé Approximants for a Pair of Cauchy Transforms with Interlacing Symmetric Supports

This is a joint work with A.I. Aptekarev and W. Van Assche.

Abstract: Hermite-Padé approximants of type II are vectors of rational functions with common denominator that interpolate a given vector of power series at infinity with maximal order. We are interested in the situation when the approximated vector is given by a pair of Cauchy transforms of smooth complex densities supported on the real line. The convergence properties of the approximants are rather well understood when the supports consist of two disjoint intervals (Angelesco systems) or two intervals that coincide under the condition that the ratio of the measures is a restriction of the Cauchy transform of a third measure (Nikishin systems). I shall describe the case where the supports form two interlacing symmetric intervals and the ratio of the measures extends to a holomorphic function in a region that depends on the size of interlacing. Szegő-type formulae for the asymptotics of the approximants are derived, the convergence and divergence domains are identified (the divergence domains appear for Angelesco systems but are not present in Nikishin ones), and the presence of the overinterpolation is shown (a feature peculiar to Nikishin but not to Angelesco systems).

Alagacone Sri Ranga (IBILCE-UNESP)

Title: Zeros of Para-orthogonal Polynomials on the Unit Circle: Constant Verblunsky Coefficients

This is a joint work with A. Martínez-Finkelshtein and D.O. Veronese.

Abstract: Orthogonal polynomials on the unit circle (OPUC) were introduced by Gábor Szegő in the first half of the 20th century. Thus, they are also referred to as Szegő polynomials. These polynomials, which have received a lot of attention in recent years, have

applications in quadrature rules, signal processing, operator and spectral theory and many other topics. Orthogonal polynomials on the unit circle associated with constant Verblunsky coefficients are also known as Geronimus polynomials. The name para-orthogonal polynomials for $\Phi_n(z) - \tau_n \Phi_n^*(z)$, where $|\tau_n| = 1$ and Φ_n are OPUC, is due to Jones, Njåstad and Thron in a paper that appeared in 1989. Here, $\Phi_n^*(z) = z^n \overline{\Phi_n(1/\overline{z})}$. We present a technique to estimate the location of the extreme zeros (those closest to $z = 1$) of certain para-orthogonal polynomials, and use this information to establish sufficient conditions for the existence of a gap in the support of μ at $z = 1$. As an example to justify the tightness of our estimations, we present the results that follow from the Geronimus polynomials.

Teresa E. Pérez (Universidad de Granada)

Title: Ball Polynomials and Non–Standard Modifications

Abstract: Ball polynomials can be considered as a multivariate extension of the Gegenbauer orthogonal polynomials. Their classical character came from the existence of a partial second order differential equation having the ball polynomials as solutions. Classical multivariate orthogonal polynomials on the unit ball and non–standard modifications of the measure are studied. Connection formulas and algebraic and differential properties for the orthogonal polynomials associated with the modification will be deduce.

Pablo Román (Universidad Nacional de Córdoba)

Title: Matrix-valued Orthogonal Polynomials Related to Quantum Groups

This is a joint work with N. Aldenhoven and E. Koelink.

Abstract: Recently, matrix-valued orthogonal polynomials have driven much attention. In order to derive new examples and study their properties, a suitable group theoretic interpretation has shown to be fruitful. This has been carried out for Gelfand pairs of rank one, leading to families of matrix-valued orthogonal polynomials that can be considered as analogues of Gegenbauer and Jacobi polynomials.

In this work we investigate an analogue construction for quantum groups. We introduce matrix-valued orthogonal on the quantum analogue of the pair $(G, K) = (\mathrm{SU}(2) \times \mathrm{SU}(2), \mathrm{diag})$.

The spherical functions are eigenfunctions of the Casimir operators on the quantum group and this leads to two q-difference operators that have the polynomials P_n as eigenfunctions. We construct explicitly a positive definite weight matrix W such that

$$\langle P_n, P_m \rangle = \int_{-1}^{1} P_n(x) W(x) (P_m(x))^* dx = \delta_{n,m} H_n, \qquad n, m \in \mathbb{N}_0,$$

where H_n is a constant diagonal matrix. We calculate the LDU decomposition of the weight and we show that the matrix entries of L are given in terms of continuous q-Ultraspherical polynomials.

By conjugating the q-difference operators with L^t, it is possible to find an expression for the the matrix entries of P_n in terms of q-Racah and continuous q-Ultraspherical polynomials.

We will also discuss how to extend this construction to other quantum groups. In particular we will study in the detail the case of the quantized universal enveloping algebra of sl_3.

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Title: L-functions, the Generalized Riemann Hypothesis and Extremal Functions of Exponential Type

Abstract: The distribution of the zeros of an L-function is related to its argument on the critical line. J. E. Littlewood has proved that the Riemann hypothesis implies a bound on the growth of the argument of zeta. We talk about the latest improvement of this and of related bounds, which rely on approximating certain functions by functions of exponential type.