



Instituto Superior Técnico



Center for Mathematical Analysis,  
Geometry, and Dynamical Systems

# Report 2017

March 2018

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# 1 Research Projects and Special Grants

The following research projects were coordinated by CAMGSD members in 2017:

## **Categorification, quantization and knots**

(Started: January 1, 2017, duration: 60 months)

*Funding agency:* Fundação para a Ciência e a Tecnologia

*Reference:* Exploratory research project associated to the "FCT Investigator" Program, Ref. IF/00998/2015

*Researcher:* Marko Stošić

The principal goal of this research project is to study the concepts of categorification and quantization, in particular in the context of quantum polynomial link invariants. The main line of this interdisciplinary proposal comes from surprising and exciting connections between the knot theory and homological knot invariants on the mathematical side, and quantum field theory and string theory on the physics side, with outcomes in other fields, like number theory or spectral curves.

## **CoLab Program UT Austin | Portugal**

*Funding agency:* Fundação para a Ciência e a Tecnologia

The Center for Mathematical Analysis, Geometry, and Dynamical Systems has been one of the main participants in this collaborative program between Portuguese Universities and the University of Texas at Austin since the program was initiated in 2007.

## **Defects: a bridge between Geometry and Physics**

(Started: February 1, 2015, duration: 60 months)

*Funding agency:* Fundação para a Ciência e a Tecnologia

*Reference:* Exploratory research project associated to the "FCT Investigator" Program, Ref. IF/01426/2014/CP1214/CT0001

*Researcher:* Michele Cirafici

The aim of this project is to investigate the mathematical structures associated with defects in quantum field theory. The question addressed are the properties of BPS enumerative invariants which arise in the presence of defects and their relation with wall-crossing structures.

## **Derivation of macroscopic PDE's from kinetic theory (mesoscopic) and from interacting particle systems (microscopic)**

(Started: January 1, 2017, duration: 24 months)

*Funding agency:* Fundação para a Ciência e a Tecnologia and Égide (France).

*Principal Investigator:* Patrícia Gonçalves (CAMGSD-IST)

*Number of participants:* 4 (Portugal) + 4 (France)

In this research project we want to obtain an hydrodynamic limit in different contexts starting from a microscopic description (stochastic models) or from a mesoscopic description (Boltzmann equation). Two different types of systems will be considered, namely, systems which are described by a Boltzmann type equation for which a chemically reactive mixture of different constituents is considered; and systems with some conserved quantities, one or several, as the chains of coupled oscillators and exclusion processes with long jumps where one can investigate the anomalous fractional diffusion type limit. In the former type of systems we want to investigate the effects of the mixture and the influence of the chemical reaction in the different types of hydrodynamic limits. In the latter type of systems, we want to investigate the presence of an anomalous diffusion of fractional type and establish the crossover between different diffusion regimes.

## **Dispersive Evolution Equations**

(Started: March 1, 2016, duration: 2+1 years)

*Funding agencies:* FCT-Portugal and CAPES-Brazil (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior)

*Coordinator at IST:* Jorge Drumond Silva

*Number of participants:* 3 (Portugal) + 7 (Brazil)

The project is concerned with wave propagation in dispersive media. The aim is to investigate dispersive models arising, e.g., in Fluid Mechanics and Plasma Physics, and study their properties such as local and global well-posedness, stability of solutions and finite time singularities.

## **Global Properties of Solutions of the Einstein Equations**

(Started: January 1, 2016, duration: 3 years)

*Funding agency:* Fundação para a Ciência e a Tecnologia

*Reference:* TDC/MAT-ANA/1275/2014

*Principal investigator:* João L. Costa

*Local Coordinator at IST:* Jorge Drumond Silva

*Number of participants:* 13

The main goal of the project is the study of global properties of solutions of the Einstein equations, especially in what concerns cosmic censorship and the formation of singularities in general relativity. This requires the use of techniques of geometry and analysis, particularly hyperbolic partial differential equations.

## **Hydrodynamic Limits and Equilibrium Fluctuations: universality from stochastic systems**

(Started: December 1, 2016, duration: 5 years)

*Funding agency:* European Research Council - Starting Grant

*Contract number:* 715734

*Principal investigator:* Patricia Gonçalves

*Other participants:* 7 (3 postdoctoral, 2 PhD and 2 MSc students)

The research project aims at characterizing the universality of the macroscopic behavior of some physical systems from underlying microscopic stochastic dynamics, by deriving the macroscopic laws, namely, (stochastic) partial differential equations, which govern the space-time evolution of the thermodynamic quantities of those physical systems.

## **Quantization and Kahler Geometry**

(Started: April, 1, 2016, duration: 36 months)

*Funding agency:* Fundação para a Ciência e a Tecnologia

*Reference:* PTDC/MAT-GEO/3319/2014

*Principal investigator:* João Pimentel Nunes

*Number of participants: 7*

The project studies the relations between Kahler geometry and geometric quantization. The focus is on degenerating families of Kahler metrics, in the space of Kahler metrics for a fixed cohomology class equipped with the Mabuchi metric, and relations to both Kahler and real polarizations in quantization.

### **Quantum Structure of Spacetime**

(Started: April 30, 2015, duration 48 months)

*Funding agency: EU*

*Reference: COST Action MP1405*

*Member of the Management Committee: José Mourão*

*Substitute Member of the Management Committee: Roger Picken*

*Number of CAMGSD participants: 7*

Noncommutative geometry (NCG) is at the heart of quantum physics, and its many facets and developments have widely influenced both physics and mathematics. This Action aims to create a Network with world experts from across Europe in the interconnected research subjects of NCG and gravity. As data emerges from Cosmic Microwave Background and quantum interferometry experiments, a prime objective of the Action will be to seek measurable signatures of quantum spacetime.

### **Riemannian and Kähler Geometry on Toric Manifolds**

(Started: May 1, 2016, duration: 3 years)

*Funding agency: Fundação para a Ciência e a Tecnologia*

*Reference: PTDC/MAT-GEO/1608/2014.*

*Principal investigator: Rosa Sena-Dias*

*Other participant: Miguel Abreu*

Toric Manifolds are particular Kähler Manifolds but have extremely rich geometric behavior. This project's motto is to use Toric Manifolds as testing ground for two of the main questions in Geometry, namely: is a Riemannian Manifold determined by its spectrum? And, what is the best metric on a Manifold?

## **Scaling Limits for particle systems with long jumps**

(Started: January 1, 2017, duration: 12 months)

*Funding agency:* Fundação das Universidades Portuguesas (CRUP) and PAULIF (France)

*Participants:* Patrícia Gonçalves (CAMGSD-IST), Cédric Bernardin and Byron Jyménez-Oviedo (University of Nice).

The thesis of Byron Oviedo is devoted to the derivation of the hydrodynamic and the hydrostatic limit of the exclusion process with long jumps in contact with infinitely many reservoirs. The jump rate is described by a transition probability  $p$  which is symmetric and has a long tail. Two cases are considered: 1) the transition probability rate  $p$  has finite variance, it is proved that the time evolution of the spatial density of particles is described by some partial differential equations with various boundary conditions; 2) the probability transition rate  $p$  has infinite variance, and it is obtained a collection of regional fractional reaction-diffusion equations with Dirichlet boundary conditions. It is also analyzed the convergence of the unique weak solution of these equations when a parameter is taken to zero and to infinity.

## **Two Related Topics in Clifford Analysis**

(Started: January 1, 2015, duration: 36 months)

*Funding agency:* Macau Government, Fundo para o Desenvolvimento das Ciências e da Tecnologia (FDCT)

*Reference:* FDCT 099/2014/A2

*CAMGSD participants:* José Mourão (Co-PI) and João P. Nunes

The main objective of the project, in broad terms, is to understand the role of Clifford time in quantization. It is expected that this will also find an interesting application of the (existing and developing) research in Clifford analysis, by linking it to geometry and quantization. These developments are expected to be analogs of the important role of complex time in quantization and geometry.

## 2 Visitors

The following researchers visited the Center in 2017:

Rui Albuquerque, Universidade de Évora, January 10

Ieke Moerdijk, Universiteit Utrecht, January 20

Mahendra Pantee, Universidade Estadual de Campinas, January 20

Urs Schreiber, Czech Academy of Sciences, January 20

Sari Ghanem, Max-Planck-Institut für Gravitationsphysik, January 27

Minna Salminen Karlsson, Uppsala universitet, January 30-February 3

Capitolina Díaz, Universitat de València, January 30-February 3

Daniel Gonçalves, Universidade Federal de Santa Catarina, February 7

Oguzhan Kaya, Galatasaray University, February 13

José Ricardo Oliveira, University of Nottingham, February 15

André Gama Oliveira, CMUP, February 21

Pascal Lambrechts, Université catholique de Louvain, Feb. 22-March 10

Thomas Johnson, Imperial College, February 23-26

Katrin Wendland, Universität Freiburg, February 27

Peter Hintz, University of California at Berkeley, March 5-8

Aleksandar Mikovic, Universidade Lusófona, March 8

Nicola Abatangelo, Université Libre de Bruxelles, March 10

Cristiano Spotti, Aarhus Universitet, March 13-15

Cho-Ho Chu, Queen Mary University of London, March 18

C. Martin Edwards, University of Oxford, March 21-31

Ricardo Campos, ETH Zürich, March 31-April 5

Juliana Pimentel, UFABC, April 4

Vishnu Jejjala, University of the Witwatersrand, April 17

Tom Gustafsson, Aalto University, April 18-26

Adam Levi, Technion – Israel Institute of Technology, April 23-28

Lucile Vandembroucq, Universidade do Minho, April 26

Claude Warnick, Imperial College, April 26-29

Kamila Klis Garlicka, CYFRONET AGH - Krakow, April 26-May 6

Marel Ptak, CYFRONET AGH - Krakow, April 26-May 6

Valentin Reys, Università degli Studi di Milano-Bicocca, May 8



Paul Wedrich, Imperial College London, May 20-24  
Tobias Weth, Goethe-Universität Frankfurt, May 26-June 2  
Paulo Lima Filho, Texas A&M University, May 31-June 13  
Emmanuel Wagner, Université de Bourgogne, June 6-9  
Louis H. Kauffman, University of Illinois at Chicago, June 17-July 2  
Gonçalo Oliveira, Duke University, June 27  
Teresa Malheiro, Universidade do Minho, July 2-6  
Ana Pires, University of Fordham, New York, July 2-30  
Bruno Oliveira, University of Miami, July 5-31  
Francesco Russo, Università degli Studi di Catania, July 9-14  
Rachi El Harti, Université Hassan I, July 9-20  
Edgar Costa, Dartmouth College, July 10-14  
Gonçalo Oliveira, Duke University, July 10-14  
André Neves, Imperial College London, July 10-15  
Marco Robalo, Sorbonne Université, July 11-15  
Inês Henriques, Sheffield University, July 12-13  
Diogo Oliveira e Silva, Universität Bonn, July 12-15  
Afonso Bandeira, NYU Courant, July 12-15  
Joel Moreira, Ohio State University, July 12-16  
Luis Abreu, Austrian Academy of Sciences, July 12-20  
Rita Ferreira, KAUST, July 13-14  
Martin Schlichenmaier, Université du Luxembourg, July 14  
João Rodrigues, University of the Witwatersrand, July 17  
Jeffrey Morton, SUNY at Buffalo, July 18-28  
Nick Sheridan, Princeton University, July 21  
Manuel Barenz, Universität Wien, July 23-28  
David Carchedi, George Mason University, July 23-28  
Vanessa Miemitz, East Anglia University, July 23-28  
Simona Paoli, University of Leicester, July 23-28  
Hongyi Chu, Université Lille 1, July 23-28  
Marta Batoréo, Universidade Federal do Espírito Santo, July 26  
Ana Ros Camacho, Universiteit Utrecht, July 26-29  
Felix Finster, Universität Regensburg, August 16-24

Beatriz E. Navascués, IEM-Madrid, September 5-7  
Guilherme Mena Marugan, IEM-Madrid, September 5-7  
Francesco Russo, Università degli Studi di Catania, September 9-14  
Ailsa Keating, Cambridge University, September 15-19  
Sergey Naboko, St. Petersburg State University, Sept. 18-Oct. 2  
Bernold Fiedler, Freie Universität Berlin, Sept. 25-Oct. 12  
Heinrich Freistähler, Universität Konstanz, October 5-15  
Janko Bračić, University of Ljubljana, October 10-18  
Adriana Neumann, Universidade Federal do Rio Grande do Sul, Oct. 17  
Blake Temple, University of California at Davis, October 16-27  
Levon Nurbekyan, KAUST, October 19  
David Krejcirik, Czech Technical University, October 19-25  
Geoffroy Horel, Université Paris XIII, October 26  
Alissa Crans, Loyola Marymount University, October 29-31  
Daniel Rodrigues, Rijksuniversiteit Groningen, October 31  
Martin Taylor, Imperial College, October 31-November 3  
Alexandre Boritchev, Université Lyon 1, November 2  
Milton Jara, IMPA, November 11- December 18  
João Miguel Nogueira, Universidade de Coimbra, November 22  
Nora Ganter, University of Melbourne, December 3-7  
Junya Yagi, Perimeter Institute for Theoretical Physics, Waterloo, Dec. 4  
Marcos Mariño, Université de Genève, December 5  
Paul Tod, St. John's College, University of Oxford, December 5-10  
Rui Loja Fernandes, University of Illinois at Urbana-Champaign, Dec. 7  
Igor Salom, University of Belgrade, December 14-25  
Ana Ros Camacho, Universiteit Utrecht, December 18  
Gonçalo Oliveira, IMPA, December 19

### 3 Seminar Series & Working Seminars

#### 3.1 Algebra

Jan 20

**Ieke Moerdijk.** *University of Utrecht.* Shuffles and Trees.

Apr 03

**Ricardo Campos.** *ETH Zurich.* Configuration spaces of points and their homotopy type.

Oct 26

**Geoffroy Horel.** *Université Paris XIII.* Mixed Hodge structure, Galois actions and formality.

#### 3.2 Analysis, Geometry, and Dynamical Systems

Feb 07

**Daniel Gonçalves.** *Universidade Federal de Santa Catarina.* Representations of graph algebras via branching systems and the Perron-Frobenius Operator.

Apr 04

**Juliana Pimentel.** *UFABC (Brazil).* Unbounded Attractors Under Perturbations.

Jun 20

**Louis H. Kauffman.** *University of Illinois at Chicago.* Reconnection, Vortex Knots and the Fourth Dimension.

Jun 27

**Louis H. Kauffman.** *University of Illinois at Chicago.* Knotoids and Virtual Knot Theory.

Jul 10

**Francesco Russo.** *University of Catania.* On (special versions of) the Hartshorne Conjecture on Complete Intersections.

Jul 12

**Francesco Russo.** *University of Catania.* Some loci of rational cubic fourfolds.

Jul 18

**Rachid El Harti.** *Université Hassan I.*  $C^*$ -algebra valued numerical range for adjointable operators and some applications.

Oct 17

**Adriana Neumann.** *Universidade Federal do Rio Grande do Sul.* Asymptotic behavior of the exclusion process with slow boundary.

**Oct 24**

**David Krejcirik.** *Czech Technical University in Prague.* Absence of eigenvalues of Schrödinger operators with complex potentials.

**Oct 31**

**Daniel Rodrigues.** *University of Groningen.* Percolation on the stationary distribution of the voter model on  $\mathbb{Z}^d$ .

**Nov 02**

**Alexandre Boritchev.** *Institut Camille Jordan, Université Lyon 1.* A random particle system and nonentropy solutions of the Burgers equation on the circle.

**Nov 21**

**Leonardo de Carlo.** *CAMGSD, IST.* Geometric and combinatoric structures in stationary Markov chains.

**Dec 15**

**Otávio Menezes.** *CAMGSD, IST.* Invariance principle for a slowed random walk driven by symmetric exclusion.

### **3.3 Geometria em Lisboa**

**Jan 10**

**Rui Albuquerque.** *Universidade de Évora.* Riemannian 3-manifolds and Conti-Salamon  $SU(2)$ -structures.

**Feb 21**

**André Gama Oliveira.** *CMUP.* Parabolic Higgs Bundles and Topological Mirror Symmetry.

**Mar 13**

**Cristiano Spotti.** *Centre for Quantum Geometry of Moduli Spaces, Aarhus.* Kähler-Einstein Fano varieties and their moduli spaces.

**May 08**

**Thomas Baier.** *CAMGSD, IST.* Higher rank Prym varieties and Hitchin's connection.

**May 15**

**José Natário.** *CAMGSD, IST.* A Minkowski-type inequality for convex surfaces in the hyperbolic 3-space.

**Jun 27**

**Gonçalo Oliveira.** *Duke University.*  $G_2$ -instantons on noncompact  $G_2$ -manifolds.

**Jul 21**

**Nick Sheridan.** *Princeton University.* Cubic fourfolds, K3 surfaces, and mirror symmetry.

**Jul 21**

**Ana Rita Pires.** *Fordham University, NY.* Symplectic embedding problems and infinite staircases, with some proofs.

**Jul 26**

**Marta Batoréo.** *Universidade Federal do Espírito Santo.* On periodic points of symplectomorphisms on closed manifolds.

**Jul 26**

**Miguel Abreu.** *CAMGSD, IST.* Contact topology of Gorenstein toric isolated singularities.

**Sep 18**

**Ailsa Keating.** *Cambridge University.* Examples of monotone Lagrangians.

**Dec 05**

**Marcos Mariño.** *University of Geneva.* Spectral theory and enumerative geometry.

**Dec 07**

**Rui Loja Fernandes.** *University of Illinois at Urbana-Champaign.* Associativity and Integrability.

**Dec 19**

**Gonçalo Oliveira.** *Instituto de Matemática Pura e Aplicada.* Instantons from vortices.

### 3.4 Microlocal Analysis

**Feb 08 – Jul 19 (14 lectures)**

**Jorge Drumond Silva.** *CAMGSD, IST.*

### 3.5 Partial Differential Equations

**Jan 20**

**Mahendra Pantee.** *Universidade Estadual de Campinas.* On well-posedness of some bi-dimensional dispersive models.

**Jan 27**

**Sari Ghanem.** *Albert Einstein Institute, Max-Planck Institute for Gravitational Physics.* The decay of spherically symmetric  $SU(2)$  Yang-Mills fields on a black hole.

**Feb 24**

**Thomas Johnson.** *Imperial College London.* The linear stability of the Schwarzschild solution to gravitational perturbations in the generalised harmonic gauge.

**Mar 06**

**Peter Hintz.** *University of California at Berkeley.* Non-linear stability of Kerr-de Sitter black holes.

**Mar 10**

**Nicola Abatangelo.** *Université Libre de Bruxelles.* Keller-Osserman type solutions for the fractional laplacian.

**Apr 26**

**Adam Levi.** *Technion, Israel Institute of Technology* Regularization of the stress-energy tensor, and semi-classical effects in black holes.

**Apr 28**

**Claude Warnick.** *Imperial College London.* Linear fields on anti-de Sitter spacetimes.

**May 31**

**Tobias Weth.** *Goethe-Universität Frankfurt.* On the unique continuation property for sublinear elliptic equations.

**Oct 06**

**Heinrich Freistähler.** *University of Konstanz.* A Causal Five-Field Theory of Dissipative Relativistic Fluid Dynamics.

**Oct 19**

**Levon Nurbekyan.** *KAUST* First-order, stationary mean-field games with congestion.

**Oct 25**

**Blake Temple.** *University of California at Davis.* An Instability of the Standard Model of Cosmology Creates the Anomalous Acceleration Without Dark Energy.

**Nov 02**

**Martin Taylor.** *Imperial College London.* Global nonlinear stability of Minkowski space for the massive and massless Einstein-Vlasov systems.

**Dec 06**

**Paul Tod.** *University of Oxford.* Penrose's Weyl Curvature Hypothesis and his Conformal Cyclic Cosmology.

### 3.6 String Theory

Feb 27

**Katrin Wendland.** *Albert-Ludwigs-Universität Freiburg.* Reflections on  $K3$  theories.

Mar 20

**Suresh Nampuri.** *CAMGSD, IST.* A Riemann-Hilbert approach to rotating attractors.

Apr 17

**Vishnu Jejjala.** *University of the Witwatersrand.* On the Shape of Things: From holography to elastica.

May 08

**Valentin Reys.** *University of Milano-Bicocca.* Exact entropy of 1/4-BPS black holes in  $N = 4$  supergravity and the mixed Rademacher expansion.

Jul 17

**João Rodrigues.** *University of the Witwatersrand.* Constructing  $AdS_4$  from 3 dimensional vector valued fields.

Nov 02

**Gabriel Lopes Cardoso.** *CAMGSD, IST.* Exact results in the STU model.

Nov 02

**Suresh Nampuri.** *CAMGSD, IST.* Hot Attractors and Area Laws.

Nov 13

**Michele Cirafici.** *CAMGSD, IST.* On two applications of persistent homology to string theory vacua.

Dec 04

**Junya Yagi.** *Perimeter Institute for Theoretical Physics, Waterloo.* String theory and integrable lattice models.

### 3.7 Topological Quantum Field Theory

Jan 20

**Urs Schreiber.** *Czech Academy of Sciences, Prague.* Duality in String/M-theory from Cyclic cohomology of Super Lie  $n$ -algebras.

Feb 15

**José Ricardo Oliveira.** *University of Nottingham.* EPRL/FK Asymptotics and the Flatness Problem: a concrete example.

- Mar 08**  
**Aleksandar Mikovic.** *Universidade Lusófona.* Hamiltonian analysis of the BFCG theory for a generic Lie 2-group.
- Mar 22**  
**Pedro Boavida.** *CAMGSD, IST.* Operads of genus zero curves and the Grothendieck-Teichmuller group.
- Apr 05**  
**John Huerta.** *CAMGSD, IST.* M-theory from the superpoint revisited.
- Apr 26**  
**Lucile Vandembroucq.** *Universidade do Minho.* Topological Complexity of the Klein Bottle.
- May 10**  
**Marco Mackaay.** *Universidade do Algarve.* A diagrammatic categorification of the higher level Heisenberg algebras.
- May 24**  
**Paul Wedrich.** *Imperial College, London.* On colored link homologies.
- Jun 07**  
**Emmanuel Wagner.** *Université de Bourgogne, France.* Trivalent TQFT and applications.
- Jun 21**  
**Louis H. Kauffman.** *University of Illinois, Chicago* Majorana Fermions, Braiding and Quantum Computing.
- Sep 06**  
**Beatriz Elizaga de Navascués.** *Instituto de Estructura de la Materia, Madrid.* Unitary dynamics as a uniqueness criterion for the quantization of Dirac fields.
- Sep 14**  
**Luis Miguel Pereira.** *IPFN, IST.* The quantum pendulum in the Wigner formalism and Mathieu functions.
- Oct 11**  
**Luis Miguel Pereira.** *IPFN, IST.* Techniques for the summation of hypergeometric series and the quantum pendulum.
- Oct 30**  
**Alissa Crans.** *Loyola Marymount University, USA.* Crossed Modules of Racks.



**Nov 10**

**Carlos Florentino.** *Universidade de Lisboa.* Geometry, Topology and Arithmetic of character varieties.

**Nov 22**

**João Miguel Nogueira.** *Universidade de Coimbra.* Meridional essential surfaces of unbounded Euler characteristics in knot exteriors.

**Dec 06**

**Nora Ganter.** *University of Melbourne.* Examples of categorical groups.

**Dec 18**

**Ana Ros Camacho.** *Utrecht University.* Strangely dual orbifold equivalence for unimodal and bimodal singularities and Galois groups.

## 4 Conferences and short courses

The following Conferences and Short Courses were organized or co-organized by members of the Center in 2017:

### **Iberian Strings 2017**

*Técnico, Lisbon, Portugal, 16-19 January 2017*

*Organizing committee:* Gabriel Cardoso (CAMGSD-IST), Michele Cirafici (CAMGSD-IST), Gianluca Inverso (CAMGSD-IST), Silvia Nagy (CAMGSD-IST), Suresh Nampuri (CAMGSD-IST), Ricardo Schiappa (CAMGSD-IST)

### **Quantum Spacetime '17**

*Porto, Portugal, 30 January – 3 February 2017*

*Organizing committee:* José Mourão (CAMGSD-IST), Miguel Costa (FCUP), Orfeu Bertolami (FCUP), Florbela Martins (FCUP), João Viana Lopes (FCUP)

### **Workshop on Operator Theory, Complex Analysis, and Applications 2017 / WOTCA 2017**

*Instituto Superior Técnico, Lisbon, Portugal, 3–6 July 2017*

*Organizing committee:* Cristina Câmara (CAMGSD-IST), Cristina Diogo (ISCTE-IUL and CAMGSD-IST) Teresa Malheiro (CMAT-UMinho), Ana Cristina Nata (IPT-Tomar and CMUC)

## **6th IST Lectures on Algebraic Geometry and Physics – 2017**

*Instituto Superior Técnico, Lisbon, Portugal, 10 - 12 July 2017*

*Organizing committee:* José Mourão (CAMGSD-IST), João Pimentel Nunes (CAMGSD-IST)

*Lectures:*

**Martin Schlichenmaier.** *University of Luxembourg* A review of Berezin-Toeplitz quantization - I (February 23).

**Martin Schlichenmaier.** *University of Luxembourg* A review of Berezin-Toeplitz quantization - II (February 24).

**Martin Schlichenmaier.** *University of Luxembourg* A review of Berezin-Toeplitz quantization - III (February 25).

## **Global Portuguese Mathematicians**

*Técnico, Lisbon, Portugal, 13 - 14 July 2017*

*Organizing committee:* Edgar Costa (Dartmouth College), José Mourão (CAMGSD-IST), Gonçalo Oliveira (Duke University)

## **Higher Structures Lisbon (deformation theory, operads, higher categories, developments & applications)**

*Instituto Superior Técnico, Lisbon, 24 - 27 July 2017*

*Organizing committee:* Aleksandar Mikovic (GFM/UL, and Universidade Lusófona), Benjamin Alarcón Heredia (CMA-UNL), Björn Gohla (GFM-UL), John Huerta (CAMGSD-IST), João Faria Martins (University of Leeds), Roger Picken (CAMGSD-IST)

## **6th Workshop of the Seminar on Representation Theory and Related Areas**

*University of Algarve, 2 September 2017*

*Organizing committee:* Marco Mackaay (CAMGSD-IST), Samuel Lopes (CMUP)

## **SiMBioS – Stochastic and Deterministic Mathematical Methods for Biological and Environmental Systems: Theory & Applications**

*Universidade da Madeira, 11-15 September 2017*

*Organizing committee:* Wolfgang Bock (Universität Kaiserslautern), Joaquim Correia (Universidade de Évora), Fernando P. da Costa (Universidade Aberta and CAMGSD-IST), José Luís da Silva (Universidade da Madeira), Michael Grinfeld (University of Strathclyde), Youcef Mammeri (Université Picardie Jules Verne)

## **CAMGSD–CMAFCIO Differential Equations Meeting**

*FCUL, 14-15 September 2017*

*Organizing committee:* Carlos Rocha (CAMGSD-IST), Luís Sanchez (CMAF-UL)

## **Entropy Methods in Particle Systems**

*Instituto Superior Técnico, Lisbon, Portugal, 13-16 November 2017*

*Organizer:* Patrícia Gonçalves (CAMGSD/IST)

*Lectures:*

**Milton Jara.** *IMPA, Rio de Janeiro.* Continuous time Markov chains (November 13).

**Milton Jara.** *IMPA, Rio de Janeiro.* Entropy inequality (November 14).

**Milton Jara.** *IMPA, Rio de Janeiro.* Feynmann-Kac's formula and variational methods (November 15).

**Milton Jara.** *IMPA, Rio de Janeiro.* Particle Systems (November 15).

**Milton Jara.** *IMPA, Rio de Janeiro.* Yau's method and hydrodynamic limits (November 16).

**Milton Jara.** *IMPA, Rio de Janeiro.* Menezes's inequality and fluctuations (November 16).

## **Particle Systems and Partial Differential Equations VI**

*Université Nice Sophia Antipolis, France, 27 November – 1 December 2017*

*Organizing committee:* Cédric Bernardin (UCA-Université Nice Sophia Antipolis), Maria Conceição Carvalho (CMAF-UL), Patrícia Gonçalves (CAMGSD-IST), Ana Jacinta Soares (CMAT-Universidade do Minho)

## 5 Seminars given by members of the Center

The following seminar talks, invited lectures or short courses were given by members of the Center in 2017:

Miguel Abreu, On the mean Euler characteristic of Gorenstein toric contact manifolds, Joint Symplectic Seminar IMPA-UFRJ-UFF-PUC, Rio de Janeiro, Brazil, March 27.

Miguel Abreu, On the mean Euler characteristic of Gorenstein toric contact manifolds, Session on Symplectic-Poisson Geometry, IV Joint Meeting RSME-SMM, Valladolid, Spain, June 19-22.

Miguel Abreu, Contact topology of Gorenstein toric isolated singularities, Workshop on Interactions of symplectic and algebraic geometry, University of Warwick, UK, July 31 - August 4

Miguel Abreu, Contact topology of Gorenstein toric isolated singularities, Workshop on Interactions of symplectic and algebraic geometry, Workshop on Conservative Dynamics and Symplectic Geometry, IMPA, Rio de Janeiro, Brazil, August 7-11.

João Ferreira Alves, Spectral Invariants of Markov Periodic Systems, PODE 2017 (Progress on Difference Equations), Università di Urbino, Italy, May 29.

Margarida Baía, A degenerate elliptic-parabolic system arising in competitive contaminant transport, Workshop on Mathematics in memory of Graça Carita, Universidade de Évora, March 3.

Pedro Boavida de Brito, Operads of genus zero curves and the Grothendieck-Teichmuller group, University of Copenhagen, Denmark, March 28.

Pedro Boavida de Brito, On  $En$ , Workshop on infinity-operads, Universität Osnabrueck, Germany, July 12-14.

Maria Cristina Câmara, Truncated Toeplitz operators, Mathematical aspects of the physics with non-self-adjoint operators, CIRM, Marseille, France, June 5-9.

Maria Cristina Câmara, Conjugations and asymmetric truncated Toeplitz operators, XIV Advanced Course in Operator Theory and Complex Analysis, Instituto de Ciencias Matemáticas, Madrid, Spain, June 19-22.

Maria Cristina Câmara, The Riemann-Hilbert method: from Toeplitz operators to black holes, Encontro Ciência 2017, Centro de Congressos de Lisboa, Lisbon, Portugal, July 4.

- Maria Cristina Câmara, Truncated Toeplitz operators and their spectra, ILAS 2017: MS-23 Toeplitz matrices and Riemann-Hilbert problems, Iowa State University, Ames, USA, July 24-28.
- Gabriel Lopes Cardoso, Exact results in the STU model, COST Workshop Quantum Spacetime '17, Porto, Portugal, January 30-February 3.
- Gabriel Lopes Cardoso, Exact results in the STU model, Eighth Joburg Workshop on String Theory, Johannesburg, South Africa, March 27-31.
- Gabriel Lopes Cardoso, A double copy for  $N=2$  supergravity in four dimensions, Supergravity 2017, Padova, Italy, May 18-19.
- Gabriel Lopes Cardoso, A Riemann-Hilbert approach to black hole solutions, CIRM Workshop Mathematical Aspects of the Physics with Non-Self-Adjoint Operators, Marseille, France, June 5-9.
- Gabriel Lopes Cardoso, A double copy for  $N=2$  supergravity in four dimensions, Workshop on Testing Fundamental Physics Principles, Corfu, Greece, September, 22-28.
- Gabriel Lopes Cardoso, Towards exact results for BPS black hole entropy in the STU model, KITP Program: Resurgent Asymptotics in Physics and Mathematics, Santa Barbara, USA, November 5-22.
- Michele Cirafici, Line defects in  $N = 2$  QFT and framed quivers, Workshop Young Researchers in String Mathematics, Max Planck Institute for Mathematics, Bonn, Germany, November 27-30.
- Michele Cirafici, Framed BPS quivers and line defects, University of Heidelberg, Heidelberg, Germany, March 20.
- Michele Cirafici, Line defects and their algebraic structures, Quantum Spacetime '17, Quantum Structure of Spacetime (QSpace) - 2nd COST MP1405 Meeting, Porto, Portugal, January 30 - February 3.
- Luís Filipe Costa, The gravitational Magnus effect, CFP Journal Club, Centro de Física do Porto, Universidade do Porto, Porto, Portugal, May 17.
- Luís Filipe Costa, The gravitational Magnus effect, Spanish-Portuguese Relativity Meeting 2017 (EREP2017), Málaga, Spain, September 12-15.
- Fernando Pestana da Costa, Some bifurcation problems in mathematical models of liquid crystals cells. 2017 International Science and Technology Cooperation Lecture, National Research Base of Intelligent Man-

ufacturing Service, Chongqing Technology and Business University, Chongqing, China, April.

Fernando Pestana da Costa, Sub-monolayer deposition models: similarity profiles and convergence rates, Stochastic and Deterministic Mathematical Methods for Biological and Environmental Systems: Theory & Applications, Universidade da Madeira, Funchal, September 11-15.

Fernando Pestana da Costa, Sub-monolayer deposition models: similarity profiles and convergence rates, CAMGSD - CMAFCIO Meeting on Differential Equations, FCUL, Lisbon, September 14-15.

Fernando Pestana da Costa, Coagulation-fragmentation equations: a brief overview, Erasme Meeting, Université de Picardie Jules Verne, Amiens, France, November.

Leonardo De Carlo, Orthogonal decomposition for the instantaneous current, Conference on Particles and PDE's-VI, University of Nice Sophia Antipolis, Nice, France, December 1.

Jorge Drumond Silva, Waves and Dispersion, Encontro Ciência 2017, Centro de Congressos de Lisboa, Lisbon, Portugal, July 4.

Anne Franzen, Strong Cosmic Censorship as seen from scalar waves in black hole interiors, Gravity seminars, University of Southampton, Southampton, United Kingdom, February 7.

Anne Franzen, Strong Cosmic Censorship as seen from scalar waves in black hole interiors, Seminar, University of Surrey, Surrey, United Kingdom, February 9.

Anne Franzen, Strong Cosmic Censorship as seen from scalar waves in black hole interiors, participating analysis seminar, University of California at Los Angeles, USA, April 4.

Anne Franzen, Strong Cosmic Censorship as seen from scalar waves in black hole interiors, Seminar, Imperial College, London, United Kingdom, May 19.

Pedro Girão, On the occurrence of mass inflation for the Einstein-Maxwell-scalar field system with a cosmological constant and an exponential Price law. CAMGSD - CMAFCIO Meeting on Differential Equations, FCUL, Lisbon, September 14-15.

Patrícia Gonçalves, Phase transition for the heat equation with boundary conditions, seminar, FCUL, Lisbon, Portugal, February 2.

Patrícia Gonçalves, From random walk to partial differential equations, seminar, CMAT, Braga, March 28.

- Patrícia Gonçalves, Hydrodynamic Limit for the symmetric exclusion in contact with reservoirs, IHP mini-course, trimester Stochastic dynamics out of equilibrium, Paris, May.
- Patrícia Gonçalves, Asymptotic behaviour of WASEP in contact with stochastic reservoirs, 39th Meeting in Stochastic Processes and their Applications, Moscow, Russia, July 24.
- Patrícia Gonçalves, From the random motion of particles to partial differential equations, IST, October 25.
- Rafael Luís, Local Stability in 3D Discrete Dynamical Systems: Application to population models, SiMBios (Stochastic and Deterministic Mathematical Methods for Biological and Environmental Systems: Theory & Applications), Universidade da Madeira, Portugal, September 11-15.
- Marco Mackaay, Certain subquotients of affine A2 Soergel bimodules and their simple transitive 2-representations, Workshop on Categorification, Representation theory and Symplectic Geometry, Hausdorff Research Institute for Mathematics, Bonn, Germany, November 27 – December 1.
- Marco Mackaay, A diagrammatic categorification of the higher level Heisenberg algebras, 2-Representation Theory Workshop, Uppsala University, Uppsala, Sweden, April 10-11.
- José Matias, Some results in the context of structured deformations, Fluids and Materials Seminar, School of Mathematics, University of Bristol, January 2017.
- José Matias, Dimension reduction in the context of first order structured deformations, Workshop on Mathematics in memory of Graça Carita, Universidade de Évora, March 2017.
- José Matias, Optimal Design of Fractured Media with Prescribed Macroscopic Strain, Congresso AIMETA - Associazione Italiana di Meccanica Teorica ed Applicata, Minisimposi in metodi variazionali e applicazioni nella meccanica dei solidi, Salerno, September 2017.
- José Mourão, Non-uniqueness of quantization, reality conditions, complex time evolution and coherent state transforms, 9th Mathematical Physics Meeting, Belgrade, Serbia, September 18-23.
- José Mourão, The role of positivity in generalized coherent state transforms, Oberwolfach Workshop on Reflection Positivity, November 26 - December 2.

- José Natário, Strong cosmic censorship in spherical symmetry, XXVI International Fall Workshop on Geometry and Physics, Braga, September 4-7.
- Lina Oliveira, An introduction to JB-algebras, Order Structures, Jordan Algebras and Geometry Workshop, Lorentz Center, Leiden, May 29-June 2.
- Lina Oliveira, Facial structure of the unit ball in a  $JB^*$ -triple, Functional Analysis Seminar, Mathematical Institute, University of Oxford, October 17.
- Lina Oliveira, A geometric glimpse of spaces of operators, WOTCA 2017, Workshop on Operator Theory, Complex Analysis and Applications, Instituto Superior Técnico, Lisboa, July 3-6.
- João Pimentel Nunes, Imaginary time in geometry and quantization, Encontro Ciência 2017, Centro de Congressos de Lisboa, Lisbon, Portugal, July 4.
- Pedro Resende, Groupoid quantales, 37th Linz Seminar on Fuzzy Set Theory - Enriched Category Theory and Related Topics, Bildungszentrum St. Magdalena, Linz, Austria, February 7-10.
- Pedro Resende, Quantales and Fell bundles, Workshop on Applications of operator algebras: order, disorder and symmetry, ICMS, Edinburgh, June 26-30.
- Carlos Rocha, Evolution Processes generated by Semilinear Parabolic Equations, Seminário de Análise e Equações Diferenciais, CMAFCIO, FCUL, Lisbon, April 27.
- Carlos Rocha, Morse-Smale evolution processes, Dynamical Systems and Geometric Mechanics, Technische Universität München, Germany, July 13.
- Carlos Rocha, Global Attractors for Non-autonomous Systems, Oberseminar, Institut für Mathematik I, Freie Universität Berlin, Germany, October 24.
- Carlos Rocha, Design of Sturm Global Attractors by Meander Templates, minicourse seminars, Institut für Mathematik I, Freie Universität Berlin, Germany, November 2 and 9.
- Rafael Sasportes, Self-similarity and convergence rates in a deposition model, Rencontre ERASME, UPJV, Amiens, France, November 21.



- Ricardo Schiappa, Resurgence in Large N Gauge and String Theory, STAG Research Center, Southampton University, Southampton, UK, February 15.
- Ricardo Schiappa, Resurgence in Large N Gauge and String Theory, Institute for Theoretical Physics, University of Bern, Switzerland, March 17.
- Ricardo Schiappa, Resurgence in Large N Gauge and String Theory, Department of Mathematics, King's College London, UK, March 22.
- Ricardo Schiappa, Resurgent Asymptotics in String Theory, Invited Talk @ Séminaire Itzykson: Colloquium Mathématiques et Physique, IHES, Paris, France, April 20.
- Ricardo Schiappa, Resurgence, Asymptotics and Transseries for Painlevé Equations, Laboratorio Fibonacci, Scuola Normale Superiore, Pisa, Italy, May 4.
- Ricardo Schiappa, Resurgent Transseries in String Theory, Invited Talk @ RIMS-iTHEMS International Workshop on Resurgence Theory, Kobe, Japan, September 7.
- Ricardo Schiappa, Introduction to Resurgent Transseries and Their Asymptotics, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, USA, October 17.
- Ricardo Schiappa, Resurgence and Transseries in String Theory, Department of Physics, California Institute of Technology, Pasadena, USA, December 1.
- Maria Esmeralda Sousa Dias, Maps from mutation periodic quivers:geometric structures and dynamics, XXVI International Fall Workshop in Geometry and Physics, Braga, Portugal, September 4-7.
- Hugo Tavares, Paths to uniqueness of critical points and applications to partial differential equations, University of Coimbra, February 17.
- Hugo Tavares, Paths to uniqueness of critical points and applications to partial differential equations, Universidade Nova de Lisboa, July 5.
- Hugo Tavares, Variational problems with long-range interaction, 14th International Conference on Free Boundary Problems, Theme Session 13: Further connections with other areas, Shanghai, China, Jiao Tong University, July 9-14.
- Hugo Tavares, Least energy nodal solutions of Hamiltonian elliptic systems with Neumann boundary conditions, First Belgium - Chile - Italy conference in PDEs. Université Libre de Bruxelles - Belgium, July 13-17.

Hugo Tavares, Some aspects about reaction-diffusion systems with cooperative or competitive interactions, CAMGSD-CMAFCIO Differential Equations Meeting, FCUL, Lisbon, September 14-15.

Maria Vaz Pinto, What is the Regularity of a Block in a Bipartite Graph?, IV Joint Meeting RSME-SMM, Special Session on Commutative Algebra and its interaction with other areas, Valladolid, Spain, June 20.

Juha Videman, Degenerate Elliptic-Parabolic System arising in Competitive Contaminant Transport, Analysis Seminar, Aalto University, Finland, October 4.

## 6 Postdoctoral program and research fellows

The Center started its own postdoctoral program in the 1998-99 academic year. Positions are granted for 12 months, with possibility for extension for a second year. Applicants must hold a PhD degree in mathematics, or in another field relevant to the research interests of the Center, awarded preferably less than two years before the opening date of the position. To be considered for a position, an applicant must show very strong research promise in one of the main areas of activities of the Center. No teaching duties are associated with these positions. The vacancies are advertised internationally in the European Commission Euroaxess, the European Mathematical Society and the American Mathematical Society web sites, leading yearly to about 100 applications.

The Center also hosts research fellows and postdocs funded by other programs. The list of all our postdoctoral trainees since 1998 is available at:

<http://camgsd.ist.utl.pt/posdoc.php.en>

The following postdoctoral students or research fellows were hosted by the Center in 2017:

**Artur Alho**, PhD in Mathematics, Universidade do Minho, 2012. Research areas: General Relativity – future and past asymptotics of cosmological models, spherically symmetric collapse with positive cosmological constant. Supported by an FCT postdoctoral grant (April 2013–March 2019).

**Thomas Baier**, PhD in Mathematics, Instituto Superior Técnico, 2009. Research areas: Kähler geometry and quantization. Supported by an FCT project grant (April 2016–March 2019).

**Pedro Boavida de Brito**, PhD in Mathematics, WWU-Münster & University of Aberdeen, 2014. Research areas: Algebraic Topology. Supported by an FCT postdoctoral grant (Dec. 2015–Nov. 2018).

**Farid Bozorgnia**, PhD in Applied Mathematics, Royal Institute of Technology, Stockholm, Sweden, 2009. Research Areas: partial differential equations, calculus of variations, spectral theory. Supported by the UT Austin/Portugal Program (August 2010–Nov. 2011) and by an FCT postdoctoral grant (June 2012–February 2017).

**Michele Cirafici**, PhD in Physics, SISSA Trieste, 2004. Research areas: string theory, quantum field theory, geometry. Supported by the CIÊNCIA 2008 Program (Sep. 2009–Aug. 2014), by CAMGSD (Oct.-Dec. 2015) and by an FCT Investigador Grant (Feb. 2015- Jan. 2020).

- Luís Filipe Costa**, PhD in Physics, Universidade do Porto, 2012. Research areas: General Relativity – gravitomagnetic effects, dynamics of extended test bodies, gravito-electromagnetic analogies. Supported by an FCT postdoctoral grant (May 2013–April 2019).
- Leonardo De Carlo**, PhD in Mathematics, Gran Sasso Science Institute, 2017. Research Areas: Interacting Particles Systems. Supported by an ERC project grant (Sept. 2017–Dec. 2017).
- João Esteves**, PhD in Physics, IST, 2011. Research area: Combinatorics and its applications to Topological Quantum Field Theory. Supported by a CAMGSD postdoctoral grant (Nov. 2011–Jan. 2012) and by an FCT postdoctoral grant (Feb. 2012–Jan. 2018).
- Anne Franzen**, PhD in Theoretical Physics, Utrecht University, 2015. Research areas: General Relativity: wave equation in black hole backgrounds, perturbations of black holes. Supported by a CAMGSD postdoctoral grant (Jan. 2016–Dec. 2017).
- John Huerta**, PhD in Mathematics, University of California, Riverside, 2011. Research areas: foundations of supersymmetry, applying higher gauge theory to superstrings, supermembranes and supergravity. Supported by a CAMGSD postdoctoral grant (Jan. 2013–June 2014) and by an FCT postdoctoral grant (July 2014–July 2020).
- Gianluca Inverso**, PhD in Physics, Università di Roma Tor Vergata, 2013. Research areas: String Theory. Supported by a CAMGSD postdoctoral grant (Sept. 2016–August 2017).
- Otávio de Macedo Menezes**, PhD in Mathematics, Instituto Nacional de Matemática Pura e Aplicada, 2017. Research Areas: Interacting Particles Systems. Supported by an ERC project grant (Nov. 2017–Nov. 2018).
- Silvia Nagy**, PhD in Physics, Imperial College London, 2015. Research areas: Mathematical Physics, String Theory. Supported by a CAMGSD postdoctoral grant (Sept. 2015–March 2017).
- Suresh Nampuri**, PhD in Physics, TIFR, 2012. Research areas: uncovering mathematical structures in the Hilbert space of quantum gravity. Supported by an FCT project grant (June 2015–May 2018).
- Moritz Reintjes**, PhD in Applied Mathematics, University of California at Davis, 2011. Research areas: General Relativity, Theory of Shock Waves, Mathematical Physics. Supported by an FCT project grant (Jan. 2017–Dec. 2017).

**Alberto Saldaña**, PhD in Mathematics, Frankfurt University, 2014. Research areas: Partial differential equations. Supported by a CAMGSD postdoctoral grant (August 2016–April 2017).

**Marco Stosic**, PhD in Mathematics, IST, 2006. Research areas: knot invariants and categorification. Supported by an ERC grant and by CAMGSD (Jan. 2015–Dec. 2017).

**Giorgio Trentinaglia**, PhD in Mathematics, Utrecht University, 2008. Research areas: complex analytic geometry, Hodge theory, Mumford-Tate groups, Lie groups and groupoids, orbifolds, foliations, differentiable stacks, representation theory, Tannaka duality, categorical algebra. Supported by an FCT postdoctoral grant (Oct. 2012–Sept. 2018).

## 7 Student supervision

### 7.1 Graduate students

The following graduate students were supported by CAMGSD or FCT project fellowships in 2017:

**Miguel Pereira** MSc student, fellowship supervised by João Pimentel Nunes (01/09/2016 - 31/08/2017)

**Frederico Toulson** MSc student, fellowship supervised by Juha Videman (15/11/2016 - 14/11/2017)

**Luís Duarte** MSc student, fellowship supervised by Lina Oliveira (15/11/2016 - 14/11/2017)

**Miguel Santos** LMAC student, fellowship supervised by Henrique Oliveira (12/12/2016 - 11/12/2017)

**Miguel Moreira** LMAC student, fellowship supervised by Miguel Abreu (12/12/2016 - 11/12/2017)

## 8 Publications in 2017

### 8.1 Publications which appeared in 2017

#### Books & Monographs

- [1] L. Barreira. *Lyapunov Exponents*. Birkhäuser, 2017. 273 p.
- [2] R. Luís. *Nonautonomous Periodic Difference Equations with Applications to Populations Dynamics and Economics*. Lambert Academic Publishing, 2017. 192 p.

#### Books (edited)

- [1] P. Gonçalves and A. J. Soares, editors. *From Particle Systems to Partial Differential Equations*, volume 209 of *Springer Proceedings in Mathematics & Statistics*. Springer, 2017. Conference Proceedings: PSPDE 2015.

#### Articles in refereed international journals

- [1] M. Abreu and A. Gadbled. Toric constructions of monotone Lagrangian submanifolds in  $\mathbb{C}P^2$  and  $\mathbb{C}P^1 \times \mathbb{C}P^1$ . *J. Symplectic Geom.*, 15(1):151–187, 2017. arXiv:1411.6564.
- [2] M. Abreu and L. Macarini. Multiplicity of periodic orbits for dynamically convex contact forms. *J Fix Point Theory A*, 19(1):175–204, 2017. arXiv:1509.08441.
- [3] M. Abreu and L. Macarini. Dynamical convexity and elliptic periodic orbits for Reeb flows. *Math. Ann.*, 369(1-2):331–386, 2017. arXiv:1411.2543.
- [4] A. Alho and S. Calogero. A stellar model with diffusion in general relativity. *J. Geom. Phys.*, 120:62–72, 2017. arXiv:1602.02663.
- [5] A. Alho, F. C. Mena, and J. A. Valiente Kroon. The Einstein-Friedrich nonlinear scalar field system and the stability of scalar field cosmologies. *Adv. Theor. Math. Phys.*, 21(4):857–899, 2017. arXiv:1006.3778.
- [6] A. Alho and C. Uggla. Inflationary  $\alpha$ -attractor cosmology: A global dynamical systems perspective. *Phys. Rev. D (3)*, 95(8:083517), 2017. arXiv:1702.00306.

- [7] A. Anastasiou, L. Borsten, M. J. Duff, M. J. Hughes, A. Marrani, S. Nagy, and M. Zoccali. Twin supergravities from Yang-Mills squared. *Phys. Rev. D (3)*, 96:026013, 2017. arXiv:1610.07192.
- [8] K. K. Andersen, B. Oliver, and J. Ventura. Reduced fusion systems over 2-groups of small order. *J. Algebra*, 489:310–372, 2017. arXiv:1606.05059.
- [9] S. Anjos and R. Leclercq. Noncontractible Hamiltonian loops in the kernel of Seidel’s representation. *Pacific J. Math.*, 290(2):257–272, 2017. arXiv:1602.05787.
- [10] A. Arakelyan and F. Bozorgnia. Uniqueness of limiting solution to a strongly competing system. *Electron. J. Differential Equations*, 2017(96):1–8, 2017. arXiv:1609.00986.
- [11] J. Araújo, J. P. Araújo, P. J. Cameron, T. Dobson, A. Hulpke, and P. Lopes. Imprimitive permutations in primitive groups. *J. Algebra*, 486:396–416, 2017. arXiv:1611.06450.
- [12] F. Balibrea, H. M. Oliveira, and J. C. Valverde. Topological equivalences for one-parameter bifurcations of scalar maps. *J. Nonlinear Sci.*, 27(2):661–685, 2017. arXiv:1503.03700.
- [13] L. Barreira, D. Dragičević, and C. Valls. Admissibility on the half line for evolution families. *J. Anal. Math.*, 132(1):157–176, 2017.
- [14] L. Barreira, D. Dragičević, and C. Valls. Lyapunov type characterization of hyperbolic behavior. *J. Differential Equations*, 263(5):3147–3173, 2017.
- [15] L. Barreira, D. Dragičević, and C. Valls. Existence of conjugacies and stable manifolds via suspensions. *Electron. J. Differential Equations*, 2017(172):1–11, 2017.
- [16] L. Barreira, D. Dragičević, and C. Valls. Nonuniform exponential dichotomies and Fredholm operators for flows. *Aequationes Math.*, 91(2):301–316, 2017.
- [17] L. Barreira, D. Dragičević, and C. Valls. Nonuniform spectrum on Banach spaces. *Adv. Math.*, 321:547–591, 2017.
- [18] L. Barreira, D. Dragičević, and C. Valls. Nonuniform spectrum on the half line and perturbations. *Results Math.*, 72(1-2):125–143, 2017.
- [19] L. Barreira, D. Dragičević, and C. Valls. Nonuniform stability of arbitrary difference equations. *Results Math.*, 71(1):333–346, 2017.

- [20] L. Barreira, D. Dragičević, and C. Valls. One-sided dichotomies versus two-sided dichotomies: arbitrary growth rates. *Quaest. Math.*, 40(3):381–390, 2017.
- [21] L. Barreira, D. Dragičević, and C. Valls. Strong nonuniform spectrum for arbitrary growth rates. *Commun. Contemp. Math.*, 19(2:1650008), 2017.
- [22] L. Barreira, D. Dragičević, and C. Valls. Nonuniform exponential dichotomies and Lyapunov functions. *Regul. Chaotic Dyn.*, 22(3):197–209, 2017.
- [23] L. Barreira, D. Dragičević, and C. Valls. A version of a theorem of Pliss for nonuniform and noninvertible dichotomies. *Proc. Roy. Soc. Edinburgh Sect. A*, 147(2):225–243, 2017.
- [24] L. Barreira, L. Popescu, and C. Valls. Generalized exponential behavior and topological equivalence. *Discrete Contin. Dyn. Syst. Ser. B*, 22(8):3023–3042, 2017.
- [25] L. Barreira and C. Valls. Lyapunov functions for dichotomies in mean. *Electron. J. Differential Equations*, 2017(252):1–12, 2017.
- [26] L. Barreira and C. Valls. Lyapunov regularity via singular values. *Trans. Amer. Math. Soc.*, 369(12):8409–8436, 2017.
- [27] L. Barreira and C. Valls. Non-uniform trichotomies and arbitrary growth rates. *Mathematika*, 63(2):518–537, 2017.
- [28] L. Barreira and C. Valls. Relations between regularity coefficients. *Math. Nachr.*, 290(5-6):672–686, 2017.
- [29] L. Barreira and C. Valls. Spectrum of a nonautonomous dynamics for growth rates. *Publ. Math. Debrecen*, 91(1-2):3, 2017.
- [30] L. Barreira and C. Valls. Stability of the Lyapunov exponents under perturbations. *Annal. Funct. Anal.*, 8(3):398–410, 2017.
- [31] L. Barreira and C. Valls. Strong and weak admissibility of  $L^\infty$  spaces. *Electron. J. Qual. Theory Differ. Equ.*, 2017(78):1–22, 2017.
- [32] A. C. Barroso, J. Matias, M. Morandotti, and D. R. Owen. Explicit formulas for relaxed disarrangement densities arising from structured deformations. *MEMOCS*, 5(2):163–189, 2017. arXiv:1508.06908.
- [33] A. C. Barroso, J. Matias, M. Morandotti, and D. R. Owen. Second-order structured deformations: relaxation, integral representation and applications. *Arch. Ration. Mech. Anal.*, 225(3):1025–1072, 2017. arXiv:1607.02311.



- [34] A. C. Barroso, J. Matias, and P. M. Santos. Differential inclusions and  $\mathcal{A}$ -quasiconvexity. *Mediterr. J. Math.*, 14(3:116), 2017. arXiv:1703.00270.
- [35] M. Baía, A. C. Barroso, and J. Matias. A model for phase transitions with competing terms. *Q. J. Math.*, 68(3):957–1000, 2017.
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- [41] M. C. Câmara. Toeplitz operators and Wiener-Hopf factorisation: an introduction. *Concr. Oper.*, 4(1):130–145, 2017. arXiv:1710.11572.
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- [44] M. C. Câmara and J. R. Partington. Asymmetric truncated Toeplitz operators and Toeplitz operators with matrix symbol. *J. Operator Theory*, 77(2):455–479, 2017. arXiv:1504.06446.
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### Book chapters

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## 9 Editorials

### Luís Barreira

- Chaos, Solitons & Fractals
- Dynamical Systems: An International Journal
- Revista Matemática Iberoamericana

### Pedro Lopes

- Journal of Knot Theory and Its Ramifications
- Open Mathematics

### Waldyr Oliva

- São Paulo Journal of Mathematical Sciences

### Pedro Resende

- Surveys in Mathematics and Applications

### Carlos Rocha

- Journal Proceedings of the Institute of Mathematics and Mechanics of the Academy of Azerbaijan.

### Claudia Valls

- Chaos, Solitons & Fractals
- Nonlinear Analysis: Real World Applications

### Juha Videman

- Fluids



## 10 Partnership and outreach

### Participation in the Programme *Novos Talentos em Matemática*

Supervision of research projects carried out by talented undergraduate students funded by ten month scholarships from the Gulbenkian Foundation.

### Participation in the IST Winter School for Undergraduates

*Escola de Inverno de Matemática 2017 (EIM2017)*, IST, February 6–8, 2017.

### Outreach activities by individual members

**Anne Franzen** lectured the course *General Relativity without Calculus* at the AstroCamp 2017 organized for high school students at the Centre for Environmental Education and Interpretation of the Corno de Bico in August 2017.

**Fernando Pestana da Costa** gave a short course on *Infinite-dimensional dynamical systems and coagulation-fragmentation equations* at the CIMPA School "Introduction to the mathematical analysis of differential equations and real-life applications", Centre Internationale de Mathématiques Pures et Appliquées, Nice, France / National University of Laos, Vientiane, Laos, January 2017.

**Fernando Pestana da Costa** delivered a short course *An introduction to ordinary differential equations* in the workshop "Training on Mathematics (TryMaths): an introduction to mathematical analysis with real life problems", Faculty of Natural Sciences / Faculty of Education, University of Savannakhet, Savannakhet, Laos, January 23-27, 2017.

**Fernando Pestana da Costa** gave a short course on *First order partial differential equations: method of characteristics and weak solutions*, Department of Mathematics, Faculty of Natural Sciences, National University of Laos, Vientiane, Laos, February 6-15, 2017.

**Fernando Pestana da Costa** gave a short course on *Bifurcation problems in liquid crystal cells*, Department of Mathematics, Faculty of Natural Sciences, National University of Laos, Vientiane, Laos, February 17-24, 2017.

**Fernando Pestana da Costa** gave a free course on *Harmonic Analysis and Applications*, Department of Mathematics, Faculty of Natural Sciences, National University of Laos, Vientiane, Laos, February 28 - May 5, 2017.

**Fernando Pestana da Costa** gave a free course (30 hours) on *Differential equations in population models*, Department of Mathematics, Faculty of Natural Sciences, National University of Laos, Vientiane, Laos, June 5 - July 14, 2017.

**Gustavo Granja**, member of the steering committee of the undergraduate research program *Novos Talentos em Matemática* sponsored by the Gulbenkian Foundation.

**Roger Picken** gave a workshop on Dance and Mathematics as part of the *Jornadas de Matemática*, organized by the IST mathematics students and dedicated to the theme Mathematics and the Seven Arts in April 2017.

**João Pimentel Nunes** gave the talk *O Teorema da Bola Cabeluda*, at the IST Summer Academy for the 7-10th grade students, in July 2017.

**Hugo Tavares** organized (jointly with Catarina Santa-Clara Gomes and Isabel Ferreira) the *Clube C-infinito*, a math club at FCUL-ULisboa.

**Hugo Tavares** acted as a consulting/scientific reviewer of the high school manuals of the Portuguese 7th grade students. Publishing House: Santillana.

## 11 Personal notes

**Miguel Abreu** visited the Universidade Federal do Rio de Janeiro, Brazil, from March 7 to March 30, 2017, as a Special Visiting Professor funded by a CNPq grant.

**Fernando Pestana da Costa** was elected by the Comissão Nacional de Matemática as the representative of Portugal to the International Commission on Mathematical Instruction of the International Mathematical Union.

**Fernando Pestana da Costa** visited the National University of Laos, Vientiane, Laos, from December 27, 2016, to July 14, 2017, as a postdoc funded by a Erasmus Mundus grant EMMA.

**Fernando Pestana da Costa** was a supervisor of two MSc theses in Applied Mathematics, completed at the Faculty of Natural Science of the National University of Laos, Vientiane, on 10 July 2017 by Kedtysack Xayxanadasy (Thesis title: Some ordinary differential equation problems in liquid crystal cells) and by Khankham Vongsavang, (Thesis title: Burger's equation and some applications).

**Fernando Pestana da Costa** is on sabbatical leave during the academic year 2017-18.

**Patrícia Gonçalves** is a member of the Scientific Council of IST.

**Patrícia Gonçalves** visited Institut Henri Poincaré in Paris from 12th April to 12th July.

**Patrícia Gonçalves** was selected as one of the Women in Science by Ciência Viva, Portuguese Agency promoting Science and Technology.

**Patrícia Gonçalves** co-organized the thematic session "Interacting Particle Systems" at the International conference 39th Meeting on Stochastic Processes and their Applications held in Moscow, Russia in 24-28 July 2017.

**Gustavo Granja** was a co-organizer of the Summer school on Algebraic Topology, Lisbon, July 24-28.

**José Natário** served as president of the Portuguese Society on Relativity and Gravitation.

**Roger Picken** was a member of the Scientific Committee of the XXVI International Fall Workshop on Geometry and Physics, Universidade do Minho, Braga, Portugal, September 4-7, 2017.

**Carlos Rocha** is a member of the Scientific Council of IST and the Senado da Universidade de Lisboa in the biennium 2017-19.

**Carlos Rocha** is on sabbatical leave during the academic year 2017-18.

**Carlos Rocha** was a Visiting Researcher in the Research Group on Nonlinear Dynamics, Freie Universität Berlin from October 15 to November 12, 2017.

**Carlos Rocha** coordinated (jointly with Luís Sanchez) the Mathematics Panel - Waves, Geometry, Dynamics, Operators and Models at the Ciência '17 Meeting, in July 3-5, 2017.

**Carlos Rocha** acted as an external reviewer for the PhD theses of Phillip Lappicy (Freie Universität Berlin) on April 28, and Hannes Stuke (Freie Universität Berlin) on May 29, 2017.

**Juha Videman** was a member of the Scientific Committee of MARINE 2017 – Seventh International ECCOMAS Conference on Computational Methods in Marine Engineering, Nantes, France, Maio 15–17, 2017.

**Juha Videman** visited the Department of Mathematics of the Aalto University, Finland, from September 10 to November 10, 2017, as a visiting scholar funded by a grant from the Finnish Society of Science and Letters.

**Juha Videman** is on sabbatical leave during the academic year 2017-18.