Contents

1 Research Projects and Special Grants 3

2 Visitors 10

3 Seminar Series and Working Seminars 13
   3.1 Algebra .................................................. 13
   3.2 Analysis, Geometry, and Dynamical Systems ............. 13
   3.3 Geometria em Lisboa .................................... 14
   3.4 Mathematical Relativity ................................ 15
   3.5 Partial Differential Equations .......................... 17
   3.6 String Theory .......................................... 18
   3.7 Topological Quantum Field Theory ....................... 19

4 Conferences and short courses 20

5 Seminars given by members of the Center 22

6 Postdoctoral program and research fellows 30

7 Student supervision 32
   7.1 Doctoral theses ......................................... 32
   7.2 Graduate students ..................................... 33

8 Publications in 2018 34
   8.1 Publications which appeared in 2018 .................... 34
   8.2 Accepted publications (submitted or accepted in 2018) 42
   8.3 Manuscripts submitted (but not yet accepted) in 2018 46

9 Editorialships 49

10 Partnership and outreach 51

11 Personal notes 52
1 Research Projects and Special Grants

The following research projects were coordinated by CAMGSD members in 2018:

**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 UT Austin | Portugal CoLab Programme in Applied Mathematics was started in 2008 and ran until the end of 2018. Over the years, it has been remarkably successful in promoting research collaboration and providing mobility opportunities for faculty members, as well as in hosting doctoral and post-doctoral students, especially in the field of applied PDEs. 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.

**CMU Portugal Program**

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

The Center for Mathematical Analysis, Geometry, and Dynamical Systems has been participating in this partnership between Portuguese institutions and the Carnegie Mellon University since the program was launched in 2006. The program offers PhD Scholarships in Applied Mathematics and supports a Visiting Faculty and Researchers Program.
Defects: a bridge between Geometry and Physics
(Started: February 1, 2015, duration: 36 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)

Number of participants: 8

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:* 10

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.

**Geometrical and Algebraic Structures on the Space of Quantum Theories**

(Started: October 1, 2018, duration: 3 years)

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

*Reference:* FCT 02/SAICT/2017/28784

*Principal investigator:* Ricardo Schiappa

*Number of participants:* 6

This project addresses mathematical structures in the space of all possible quantum theories. The space of all QFTs is infinite-dimensional, with CFT fixed-points linked by paths corresponding to RG flows. These CFTs are the building blocks of all possible quantum theories (including theories of quantum gravity and black holes). Our goal is to understand the space of all theories by first understanding some special subsets. We use complementary approaches, such as Resurgent Analysis, Bootstrap Techniques, and Localisation. These approaches solve quantum theories described by random matrix models, CFTs in diverse dimensions, and quantum theories with localisable observables. The very same theory may be approachable using these different techniques, leading to complementary information. By solving different special sets of quantum theories, we expect to describe geometrical and algebraic structures on local patches of the full space of quantum theories.
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.

Higher Structures and Applications
(Started: July 1, 2018, duration: 3 years)

Funding agency: Fundação para a Ciência e a Tecnologia
Reference: PTDC/MAT-PUR/31089/2017
Principal investigator: Roger Picken
Number of CAMGSD participants: 8

This project uses higher algebraic structures to obtain new results in topology, geometry and algebra, and to develop applications in related areas of physics and in topological quantum computation.

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
Number of participants: 8
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.

**Modeling and Analysis of Coastal Hydrodynamics and Erosion**

(Started: November 1, 2018, duration: 12 months)

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

*Reference:* UTAP-EXPL/MAT/0017/2017

*Principal investigator:* Juha Videman

*Number of CAMGSD participants:* 3

Coastal ocean regions around the world are threatened by a variety of factors and the increasing risk and associated impacts have catalysed efforts to increase our understanding of the coastal ocean environment and our ability to make quantitative predictions of coastal hydrodynamics. In this project, we propose to build a numerical code based on hybridised discontinuous finite element methods for studying coastal hydrodynamics and sediment erosion with specific emphasis on regions of the Texas-U.S and Portuguese coasts. Our goal is to develop, analyse and implement high-order finite element methods on unstructured meshes which include appropriate wave physics at various wave-lengths and wave numbers. This allows for capturing multi-scale wave physics from deep ocean basins to the continental shelf to complex coastal systems including barrier islands, inlet, bays, and estuaries.

**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 fields and knot homologies**

(Started: December 1, 2013, duration 72 months)

*Funding agency:* European Research Council  
*Reference:* ERC Starting Grant ID:335739  
*Principal Investigator:* Piotr Sułkowski (Warsaw University, Poland)  
*Local Coordinator at IST:* Marko Stošić  
*Number of CAMGSD participants:* 2

This project is concerned with fundamental problems arising at the interface of quantum field theory, string theory, knot theory, and the theory of random matrices. The main aim of the project is to understand two of the most profound phenomena in physics and mathematics, namely quantization and categorification, and to establish an explicit and rigorous framework where they come into play in an interrelated fashion. The project and its aims focus on the following areas: knot homologies, super-A-polynomials, 3-dimensional supersymmetric gauge theories, topological recursion and quantization. All these research areas are connected via remarkable dualities unraveled very recently by physicists and mathematicians. The project is interdisciplinary and aims to reach the above goals by taking advantage of these dualities, in collaboration with renowned experts in each of those fields.

**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  
*Principal investigator:* Rosa Sena-Dias  
*Number of CAMGSD participants:* 2

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?

**Symplectic Geometry and Conservative Dynamics**

(Started: October 1, 2018, duration: 36 months)

*Funding agency:* Fundação para a Ciência e a Tecnologia  
*Reference:* PTDC/MAT-PUR/29447/2017  
*Principal investigator:* Miguel Abreu  
*Number of CAMGSD participants:* 5

This project brings together experts in different aspects of the area of Symplectic Geometry and its applications, and aims at building bridges between different techniques, creating novel enhancements and stimulating new developments in the field. The area of application of Symplectic Geometry that better represents the unifying theme of this project is Conservative Dynamics, considered in a broader context, focusing on its links with symplectic and contact topology, toric actions, Seidel’s morphism and Gromov-Witten theory, Poisson geometry and integrable systems.
2 Visitors

The following researchers visited the Center in 2018:

January

Charles Fefferman. Princeton University.
Zuoqin Wang. USTC, Heifei, China.
Paul Todd. St John’s College, University of Oxford.
Montserrat Corbera. Universitat de Vic, Barcelona.

February

Alessia Mandini. PUC (Rio de Janeiro).
Oguzhan Kaya. Galatasaray University, Istanbul.
Joachim Hilgert. Universität Paderborn.

March

John Blake Temple. University of California at Davis.
Christopher Martin Edwards. Queen’s College, University of Oxford.
Katharina Radermacher. KTH Royal Institute of Technology.
Emma d’Aniello. Università degli studi della Campania.
Janko Bracic. University of Ljubljana.

April

Olga Papadoulaki. University of Southampton.
Masazumi Honda. Weizmann Institute of Science, Israel.
Matias Del Hoyo. Universidade Federal Fluminense, Brasil.
Panagiotis Betzios. University of Crete.
Oliver Lindblad Petersen. Universität Hamburg.
Julien Ducoulombier. ETH Zurich.
Inès Aniceto. University of Southampton.
Marko Djikic. University of Niš, Serbia.
Marcel Vonk. University of Amsterdam.
Tertuliano Franco. Universidade Federal da Bahia, Brasil
Panagiota Birmpa. University of Sussex.

**May**

Vicente Muñoz. Universidad Complutense de Madrid.
Melanie Graf. University of Vienna.
Eveline Legendre. Institut de Mathématiques de Toulouse.
Cyril Lecuire. Centre National de la Recherche Scientifique, Toulouse.
Elvira Zappale. Università degli Studi di Salerno.
Alessandro Ghigi. Università di Pavia.

**June**

Nikolai Makarov. Caltech, USA.
Mark V. Lawson. Heriot-Watt University, Edinburgh.
Heinrich Freistühler. Universität Konstanz.
Paulo Lima Filho. Texas A&M University.
Frank Ferrari. Université Libre de Bruxelles.
Marcel de Jeu. Leiden University.
Lino Amorim. Kansas State University.
Pablo Padilla. Universidad Nacional Autónoma de México.
Boris Mityagin. Ohio State University.
Dijana Ilisevic. University of Zagreb.

**July**

Vladislav Kupriyanov. Ludwig-Maximilians-Universität München.
Jesus Oliver. California State University, East Bay.
Bruno Oliveira. University of Miami.
Ankik Kumar Giri. IIT Roorkee, India.
Rajesh Kumar. BITS Pilani, India.
Jun Li. University of Minnesota, Minneapolis.
Martin Pinsonnault. University of Western Ontario, Canada.

**August**

Marco Morandotti. Technische Universität München.
September
Milton Jara. IMPA, Brasil.
Arick Shao. Queen Mary University of London.
Levi Lima. Universidade Federal do Ceará, Brasil.
Volker Schlue. Sorbonne Université.
Felipe Linares. IMPA, Brasil.
Marko Djikic. University of Niš, Serbia.
Igor Salom. Institute of Physics, Belgrade.

October
Adriana Neumann. Universidade Federal do Rio Grande do Sul, Brasil
Rolf Stenberg. Aalto University, Finland.
Abhiram Kidambi. Technische Universität Wien.
Franco Severo. Institut des Hautes Études Scientifiques.
Eric Ragoucy. LAPTH-CNRS, Annecy-le-Vieux, France.
Antonio Lloyd Demetrius. Max Planck Institute.

November
Jeremie Szeftel. Université Pierre et Marie Curie.
Zhihao Duan. École Normale Supérieure Paris.
Yohanna Martínez. Universitat Autònoma de Barcelona.
Montserrat Corbera. Universitat de Vic, Barcelona.
Alexandre Belin. University of Amsterdam.
Dan Avritzer. Universidade Federal de Minas Gerais, Brasil.
Dijana Ilisevic. University of Zagreb, Croatia.

December
Claudio Landim. IMPA, Brasil.
Gonçalo Oliveira. Universidade Federal Fluminense, Brasil.
Regilene Oliveira. Universidade de São Paulo, Brasil.
Daniel Gonçalves. Universidade Federal de Santa Catarina, Brasil.
Benito Frazão Pires. Universidade de São Paulo, Brasil.
3 Seminar Series and Working Seminars

3.1 Algebra

Apr 19
Julien Ducoulombier. ETH Zurich. Swiss Cheese operad and applications to embedding spaces.

3.2 Analysis, Geometry, and Dynamical Systems

Apr 12
Anastasiia Panchuk. Academia Nacional das Ciências de Kiev. A piecewise linear map with two discontinuities: bifurcation structures in the chaotic domain.

May 29
Elvira Zappale. Università degli Studi di Salerno. Optimal design problems for energies with nonstandard growth.

Jun 19
Marcel de Jeu. Leiden University. Banach lattice algebra representations in harmonic analysis.

Jul 04
Ankik K. Giri. IIT Roorkee, India. Recent developments in the theory of coagulation-fragmentation models.

Jul 04
Rajesh Kumar. BITS Pilani, India. Convergence analysis of finite volume scheme for solving coagulation-fragmentation equations.

Aug 28
Marco Morandotti. TUM, Munique. Spatially inhomogeneous evolutionary games.

Oct 09

Dec 17

Dec 18
Benito Frazão Pires. Universidade de São Paulo. Symbolic dynamics of piecewise contractions.
3.3 Geometria em Lisboa

Jan 23
Zuoqin Wang. *University of Science and Technology of China Heifei.* Equivariant Eigenvalues on Manifolds with Large Symmetry.

Mar 20
Pedro Boavida. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa.* Spaces of smooth embeddings and the little disks operad.

Apr 24
Matias Del Hoyo. *Universidade Federal Fluminense.* Discrete dynamics and differentiable stacks.

Apr 27
Pedro Freitas. *Instituto Superior Técnico, Universidade de Lisboa.* The spectral determinant of the quantum harmonic oscillator in arbitrary dimensions.

May 07
Cyril Lecuire. *Centre National de la Recherche Scientifique.* Geometry in groups.

May 08
Alessandro Ghigi. *Università di Pavia.* Compactifying automorphism groups of Kaehler manifolds.

Jun 12
Nitu Kitchloo. *Johns Hopkins University.* The Stable Symplectic Category and a Conjecture of Kontsevich.

Jun 19
Lino Amorim. *Kansas State University.* Closed mirror symmetry for orbifold spheres.

Jun 28
José Mourão. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa.* Imaginary time Hamiltonian flows and applications to Kahler geometry, Kahler reduction and representation theory.

Jul 11
Bruno Oliveira. *University of Miami.* Hyperbolicity of projective manifolds.

Jul 17
Jun Li. *University of Minnesota, Minneapolis.* The symplectomorphism groups of rational surfaces.
Jul 24

Jul 26

Sep 25
Levi Lima. Universidade Federal do Ceará. The mass of asymptotically hyperbolic manifolds with a noncompact boundary.

Nov 29

Dec 19

3.4 **Mathematical Relativity**

Jan 17

Jan 30

Feb 07
David Hilditch. Instituto Superior Técnico, Universidade de Lisboa. Free-evolution formulations of GR for numerical relativity.

Feb 28
Pedro Oliveira. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Cosmic no-hair in spherically symmetric black hole spacetimes.

Mar 07

Mar 09
Katharina Radermacher. KTH Royal Institute of Technology. On the Cosmic No-Hair Conjecture in $T^2$-symmetric non-linear scalar field spacetimes.
Apr 18
Oliver Lindblad Petersen. *University of Potsdam*. Wave equations with initial data on compact Cauchy horizons.

May 02
Melanie Graf. *University of Vienna*. The Hawking-Penrose singularity theorem for $C^{1,1}$-Lorentzian metrics.

May 18
Rodrigo Vicente. *Instituto Superior Técnico, Universidade de Lisboa*. Test fields cannot destroy extremal black holes.

Jun 28

Jul 06
Jesus Oliver. *California State University, East Bay*. Boundedness of energy for the Wake Klein-Gordon model.

Jul 11
Moritz Reintjes. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa*. The quantised Dirac field and the fermionic signature operator.

Jul 13
Moritz Reintjes. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa*. The quantised Dirac field and the fermionic signature operator.

Jul 18
Moritz Reintjes. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa*. The quantised Dirac field and the fermionic signature operator.

Sep 05
Arick Shao. *Queen Mary University of London*. Correspondence and Rigidity Results on Asymptotically Anti-de Sitter Spacetimes.

Sep 06
Arick Shao. *Queen Mary University of London*. Correspondence and Rigidity Results on Asymptotically Anti-de Sitter Spacetimes.

Sep 19
Volker Schlue. *Sorbonne Université*. On some stability and instability problems for hard stars in spherical symmetry.
Sep 28

Oct 19
Moritz Reintjes. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Optimal metric regularity in General Relativity follows from the RT-equations by elliptic regularity theory.

Nov 09

Nov 12

Nov 16

Nov 30

Dec 07

Dec 10

3.5 Partial Differential Equations

Jun 08
Pablo Padilla. Universidad Nacional Autónoma de México. Bifurcation theory for non autonomous systems.

Sep 26
Felipe Linares. IMPA. Global well-posedness for the generalized Korteweg-de Vries equation.

Oct 24
3.6 String Theory

Apr 09
Roberto Vega. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Introduction to resurgence.

Apr 16
Masazumi Honda. Weizmann Institute of Science. Resurgent transseries and Lefschetz thimble in 3d $\mathcal{N} = 2$ supersymmetric Chern-Simons matter theories.

Apr 23
Olga Papadoulaki. University of Southampton. FZZT branes and non-singlets of Matrix Quantum Mechanics.

Apr 24

Apr 30
Maximilian Schwick. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Introduction to resurgence.

May 28
Salvatore Baldino. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Introduction to resurgence.

Jun 04
Frank Ferrari. Université Libre de Bruxelles. On Melonic Matrix Models and SYK-like Black Holes.

Jul 09
Vladislav Kupriyanov. Ludwig-Maximilians-Universität München. $L_\infty$ bootstrap approach to non-commutative gauge theories.

Oct 01
Abhiram Kidambi. Technical University of Vienna. $\Gamma_0(N)$, quantum black holes and wall crossing.

Oct 03
Abhiram Kidambi. Technical University of Vienna. BPS algebras and Moonshine.

Nov 05
Nov 12
Alexandre Belin. University of Amsterdam. Siegel Modular Forms in AdS/CFT.

Nov 26
Davide Polini. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Counting formulae for extremal black holes in an STU-model.

3.7 Topological Quantum Field Theory

May 02
Marko Stosic. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Knots-quivers correspondence and applications.

May 23

Jun 06
Marco Mackaay. CAMGSD, Universidade do Algarve. 2-representation theory.

Jun 20
Ricardo Schiappa. CAMGSD, Instituto Superior Técnico, Universidade de Lisboa. Co-equational (i.e. Parametric) Resurgence and Topological Strings.

Jul 04

Oct 17
Björn Gohla. Grupo de Fisica Matematica, Universidade de Lisboa. Monoids, Monads and Simplicial Objects.

Oct 31
Leonardo Santilli. Grupo de Fisica Matematica, Universidade de Lisboa. A Chern-Simons view on noncommutative scalar field theory.

Nov 21

Dec 05
4 Conferences and short courses

The following Conferences and Short Courses were organized or co-organized by members of the Center in 2018:

**7th IST Lectures on Algebraic Geometry and Physics – 2018**

*Instituto Superior Técnico, Lisbon, Portugal, February 14–16, 2018*

*Organizing committee:* Thomas Baier (CAMGSD), José Mourão (CAMGSD), João Pimentel Nunes (CAMGSD)

*Short courses:*

- **Joachim Hilgert.** *Universität Paderborn.* Dynamics on locally symmetric spaces (February 14-16).
- **Johan Martens.** *University of Edinburgh.* Equivariant degenerations and applications (February 14-16).

**Workshop on Operator Theory, Complex Analysis, and Applications 2018 / WOTCA 2018**

*Universidade do Minho, Braga, Portugal, June 25–28, 2018*

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

**7th IST-IME Meeting**

*IMS, Universidade de São Paulo, Brasil, July 23–27, 2018*

*Organizers:* Clodoaldo Grotta-Ragazzo (IME-USP), Orlando Lopes (IME-USP), Sérgio M. Oliva (IME-USP), Marcone Pereira (IME-USP), Paolo Piccione (IME-USP), Pedro A. S. Salomão (IME-USP), Gaetano Siciliano (IME-USP)

**Advances in Applied Mathematical Analysis and Numerical Methods: Ten Years of CoLab**

*ICES, UT Austin, USA, November 5–8, 2018*

*Organizers:* Luis Caffarelli (The University of Texas at Austin), Irene M. Gamba (The University of Texas at Austin), José Miguel Urbano (Universidade de Coimbra), Juha Videman (CAMGSD)
Particle Systems and Partial Differential Equations

University of Palermo, Palermo, Italy, November 18-23, 2018

Organizers: Patrícia Gonçalves (CAMGSD), Ana Jacinta Soares (CMAT), Valeria Ricci (Palermo University), François Golse (École Polytechnique Paris)

Scaling limits and SPDEs: recent developments and future directions

Newton Institute, Cambridge, December 10-14, 2018

Organizers: Patrícia Gonçalves (CAMGSD), Jeremy Quastel (Toronto University), Antti Kupiainen (Helsinki University), Felix Otto (Max Plank Institute)
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 2018:

Miguel Abreu, Applications of symplectic/contact invariants to conservative dynamics, XXXVII Workshop on Geometric Methods in Physics, Bialowieza, Poland, 1-7 July 2018.

Miguel Abreu, Applications of symplectic/contact invariants to conservative dynamics, 7th IST-IME Meeting, USP, São Paulo, Brazil, 23-27 July 2018.


Miguel Abreu, A toric geometry road from Kähler metrics to contact topology, Short course, Colima Workshop on Geometry, University of Colima, Mexico, 16-19 October 2018.

Artur Alho, Generic blow up for solutions of the wave equation towards Big Bang singularities, Analysis and Probability Seminar, Department of Mathematical Sciences, Chalmers University of Technology Gothenburg, Sweden, May 24, 2018.

Artur Alho, Generic blow up for solutions of the wave equation towards Big Bang singularities, working seminar, KTH Royal Institute of Technology, Stockholm, Sweden, June 4, 2018.

Sílvia Anjos, Some results on the homotopy type of symplectomorphism groups, Mini-Workshop on Symmetries of Symplectic 4-manifolds and Pseudo-holomorphic Curves, University of Minnesota, USA, May 7-11, 2018.

Sílvia Anjos, Some results on the homotopy type of symplectomorphism groups, Geometry and Mathematical Physics Seminar at SISSA, Trieste, Italy, July 4, 2018.


Pedro Boavida de Brito, GT, little disks and knots, Workshop on Factorisation Algebras and Homology and the Cobordism Hypothesis, Saint-Etienne de Tinée, France, February 5, 2018.
Pedro Boavida de Brito, Presentations of configuration categories, Conference on Graph Complexes, Configuration Spaces and Manifold Calculus, PIMS Vancouver, Canada, May 23, 2018.

Pedro Boavida de Brito, Smooth embeddings of a triangulated manifold, Topologie meeting, Oberwolfach, July 3, 2018.

Pedro Boavida de Brito, Galois actions on the little disks operad and knot spaces, Utrecht Topology Feest, Netherlands, August 27, 2018.

Cristina Câmara, From Toeplitz matrices to black holes, and beyond, Mathematics Colloquium, IST, March 8, 2018.

Cristina Câmara, From Toeplitz matrices to black holes, and beyond, Recent Trends in Operator Theory and Applications, Memphis, USA, May 3-5, 2018.


Cristina Câmara, From Toeplitz operators to black holes, and beyond, Doppler Institute Seminar, Prague, Czech Republic, May 22, 2018.

Cristina Câmara, Scalar type kernels for block Toeplitz operators, Operator Theory 27, Timisoara, Romania, July 2-6, 2018.

Cristina Câmara, Completions of partial operator matrices, 6th Summer Workshop on Operator Theory, Krakow, Poland, July 9-13, 2018.


Cristina Câmara, Multipliers for model spaces and Toeplitz kernels, Linear operator theory and applications - EWM General Meeting, Graz, Austria, September 3-7, 2018.

Cristina Câmara, Multipliers between Toeplitz kernels, 7th Iberian Mathematical Meeting, Harmonic and Complex Analysis, Évora, Portugal, October 12-14, 2018.

Gabriel Lopes Cardoso, Towards exact results for the STU model, Iberian Strings 2018, Granada, Spain, January 24, 2018.


Gabriel Lopes Cardoso, Exact results and microstate counting formulae for BPS black holes in the N=2 STU model, Indian Strings Meeting 2018, Trivandrum, India, December 21, 2018.

João L. Costa, Cosmic no-hair in spherically symmetric black hole spacetimes, ICMP, Montreal, July 2018.

Cristina Diogo, Sets of operators determined by the numerical range, Encontro Nacional da Sociedade Portuguesa de Matemática, Bragança, Portugal, July 2018.

Cristina Diogo, Faces of sets of operators with numerical range in a prescribed polyhedron, Workshop on Numerical Ranges and Numerical Radii, Munich, Germany, June 2018.


Jorge Drumond Silva, Mass inflation and strong cosmic censorship for the spherically symmetric Einstein-Maxwell-scalar field system with a cosmological constant and an exponential Price law, 7th IST-IME meeting in honor of Prof. Paulo Cordaro, USP, São Paulo, Brasil, July 27, 2018.


Anne Franzen, Flat Friedmann-Lemaître-Robertson-Walker and Kasner Big Bang singularities analyzed on the level of scalar waves, Theoretical Physics Seminar, University of Cologne, Cologne, Germany, December 18, 2018.

Anne Franzen, Flat Friedmann-Lemaître-Robertson-Walker and Kasner Big Bang singularities analyzed on the level of scalar waves, Seminar, University of Bonn, Bonn, Germany, December 21, 2018.

Patrícia Gonçalves, Non-equilibrium fluctuations for the slow boundary symmetric exclusion, Workshop on Quantum field theory, renormalisation and stochastic partial differential equations Newton Institute, Cambridge, UK, October 22, 2018.

Patrícia Gonçalves, Deriving the (fractional) heat equation from the random motion of particles, Seminar, FCT-UNL, Lisbon, Portugal, November 7, 2018.

Patrícia Gonçalves, From the random motion of particles to partial differential equations, Seminar, IST, Lisbon, Portugal, December 19, 2018.

Pedro Lopes, The Hyperfinite Algorithm for Sequences of Knots, Invited Talk, Workshop on Topological Structures in Mathematics, Physics, and Biology, Laboratory of Topology and Dynamics, Novosibirsk State University and Center Poncelet, Novosibirsk, Russia, September 14-18, 2018 (invited speaker).

Pedro Lopes, Quandles of Cyclic Type with Several Fixed Points, Plenary Talk, Geometry Days in Novosibirsk, 2018, Novosibirsk State University and Sobolev Institute of Mathematics, Novosibirsk, Russia, September 19-22, 2018.


Leonardo Macarini, Periodic orbits on symmetric spheres and dynamical convexity, Symplectic Geometry Seminar, IMPA, Rio de Janeiro, Brazil, August 14, 2018.

José Matias, Differential Inclusions and A-quasiconvexity, Technische Universität München, Germany, June 28, 2018.


Otávio Menezes, Relative entropy and scaling limits of interacting particle systems, ENSPM, Instituto Politécnico de Bragança, Bragança, Portugal, July 10, 2018.

Otávio Menezes, Invariance principle for a slowed random walk driven by symmetric exclusion, Probability Seminar, Universidad de Chile, Santiago, Chile, August 7, 2018.


Lina Oliveira, JB*-triples and linear preservers, Conference on Preservers: Modern aspects and new directions, Queen’s University Belfast, June 18 - 21, 2018.


Fernando Pestana da Costa, Playing with pendula, Department Colloquia, Department of Mathematics and Statistics, University of Strathclyde, Glasgow, United Kingdom, April 2018.

Fernando Pestana da Costa, Bifurcation problems in liquid crystal cells, Analysis Seminar, Maxwell Institute for Mathematical Sciences, Heriot-Watt University, Edinburgh, United Kingdom, May 2018.
Fernando Pestana da Costa, Similarity behaviour in a system of differential equations modelling sub-monolayer deposition, Pure and Applied Mathematics Colloquium, Open University, Milton Keynes, United Kingdom, May 2018.

Fernando Pestana da Costa, Sub-monolayer deposition models: similarity profiles and convergence rates, Nonlinear analysis and the physical and biological sciences (in honour of Jack Carr), International Centre for Mathematical Sciences, Edinburgh, United Kingdom, May 2018.


João Pimentel Nunes, Geodesics on the space of Kähler metrics: construction and applications to quantization, Seminar, CMUP, Porto, Portugal, January 2018.


Moritz Reintjes, An elliptic mechanism for metric smoothing, PDE Seminar, Universidade Federal do Rio de Janeiro, Brasil, March 2018.


Ricardo Schiappa, Resurgence and Transseries in Gauge and String Theory, Invited Talk, Non-Perturbative Effects in Supersymmetric Field Theories, International Institute of Physics, Natal, Brazil, 2018.

Ricardo Schiappa, Resurgence and Transseries in Gauge and String Theories, Department of Physics, Universidade Federal de Itajubá, Itajubá, Brazil, 2018.


Ricardo Schiappa, Coequational/Parametric Resurgence and Topological Strings, Invited Talk, Universality of Resurgence in Quantization Theories, Pisa, Italy, 2018.


Ricardo Schiappa, Resurgence and Transseries in String and Gauge Theory, School of Theoretical Physics, Dublin Institute for Advanced Studies, Dublin, Ireland, 2018.


Rosa Sena-Dias, Extremizing the ground state under symmetries, CQM seminar and introductory seminar, Centre for Quantum Geometry of Moduli Spaces Aarhus, Denmark, April 2018.

Rosa Sena-Dias, Complete extremal Kähler metrics on non-compact manifolds: an (incomplete) overview and Toric scalar-flat Kähler metrics on non-compact surfaces, Rencontre EMARKS, Université Paris Sud, Jussieu, Paris, France, September 2018.


Giorgio Trentinaglia, Obstruction problems for geometric structures of compact type, Mathematische Gesellschaft Kolloquium, Mathematisches Institut, Universität Göttingen, Germany, May 24, 2018.


Maria Vaz Pinto, Parameterized Linear Codes Associated to Graphs, Investigating Linear Codes via Commutative Algebra Workshop, BIRS, Canada, July 22-29, 2018.


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:


The following postdoctoral students or research fellows were hosted by the Center in 2018:


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 the CAMGSD postdoctoral program (Jan. 2013–June 2014) and by FCT via postdoctoral grant (July 2014–Oct. 2018) and through the DL 57/2016 researcher program (since Nov. 2018).


Suresh Nampuri, PhD in Physics, Tata Institute of Fundamental Research, 2012. Research areas: uncovering mathematical structures in the Hilbert space of quantum gravity. Supported by FCT via project grant (June 2015–May 2018) and through the DL 57/2016 researcher program (since Nov. 2018).


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 FCT via postdoctoral grant (Oct. 2012–Sept. 2018) and through the DL 57/2016 researcher program (since Nov. 2018).

7 Student supervision

7.1 Doctoral theses

The following doctoral theses were completed in 2018 under the supervision of members of the Center (the name of the student and of the CAMGSD advisor(s) are marked in bold characters):


7.2 Graduate students

The following graduate students were supported by CAMGSD or FCT project fellowships in 2018:

**Rodrigo Serrão**  LMAC student, supervised by Leonor Godinho (01/02/2018 - 31/12/2018)

**Luis Duarte**  MSc student, supervised by Maria Vaz Pinto (06/03/2018 - 31/12/2018)

**Miguel Santos**  MSc student, supervised by Miguel Abreu (06/03/2018 - 31/12/2018)

**Rafael Gomes**  MSc student, supervised by Gustavo Granja (06/03/2018 - 31/12/2018)

**Miguel Pereira**  MSc student, supervised by José Mourão (01/02/2018 - 31/03/2018)
8 Publications in 2018

8.1 Publications which appeared in 2018

Books & Monographs


Articles in refereed international journals


[76] H. M. Oliveira. Bifurcation equations for periodic orbits of implicit
arXiv:1608.01898

[77] M. Panfil, M. Stošić, and P. Sulkowski. Donaldson-Thomas invariants,
arXiv:1802.04573

[78] M. Reintjes. A note on incompressibility of relativistic fluids and the


[80] P. Resende. The many groupoids of a stably Gelfand quantale. *J.


[82] A. Saldaña and H. Tavares. Least energy nodal solutions of Hamilto-
nian elliptic systems with Neumann boundary conditions. *J. Differen-


[84] G. Trentinaglia. Regular Cartan groupoids and longitudinal representa-

[85] C. Valls. Algebraic traveling wave solutions, Darboux polynomials and

Book chapters


Communications in refereed proceedings


Other publications


8.2 Accepted publications (submitted or accepted in 2018)

Books & Monographs


Articles in refereed international journals


Book chapters


Other publications


8.3 Manuscripts submitted (but not yet accepted) in 2018


9 Editorialships

Miguel Abreu
- Portugaliae Mathematica

Luís Barreira
- Chaos, Solitons & Fractals
- Dynamical Systems: An International Journal
- Khayyam Journal of Mathematics
- Nonlinear Analysis: Real World Applications
- Revista Matemática Iberoamericana

Patrícia Gonçalves
- ALEA - Latin American Journal of Probability and Mathematical Statistics
- Annals of Applied Probability
- Electronic Journal of Probability and Electronic Communications in Probability

Pedro Lopes
- Journal of Knot Theory and Its Ramifications
- Open Mathematics

Waldyr Oliva
- São Paulo Journal of Mathematical Sciences

Fernando Pestana da Costa
- Newsletter of the European Mathematical Society

Pedro Resende
- Surveys in Mathematics and Applications

Carlos Rocha
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 Mathematics Winter School for Undergraduates


Outreach activities by individual members

Miguel Abreu gave the talk Ciência e Universidade(s) no Século XXI at the International Conference A Ciência na Sociedade Atual: novos públicos e novas questões, Calouste Gulbenkian Foundation, Lisbon, 29 October 2018.

Filipe Costa participated as a member/speaker in the panel Conversas com Ciência at the Fórum Arouca – Inovação, empreendedorismo e conhecimento, Arouca, Portugal, 12-16 November 2018.

José Natário gave the talk Perguntas de Matemática at the IST Summer Academy, for 5-8th grade students, July 2018.

Fernando Pestana da Costa received a grant from the Volunteer Lecturer Program of the International Mathematical Union, to lecture an MSc course on Ordinary Differential Equations in the MSc in Applied Mathematics of the National University of Laos, Vientiane, Laos (January-February 2018).

Fernando Pestana da Costa was invited to lecture an MSc course on Differential Equations in the AIMS South Africa Structured Masters Programme, African Institute for Mathematical Sciences, Muizenberg, Cape Town, South Africa (November 2018).

Roger Picken gave a lecture Máquina de Calcular de Duas Cordas in the one-day event for high-school students Matemática no Técnico: Vem conhecer as melhores profissões do mundo..., June 27, 2018.

Roger Picken participated, as a tutor, in the Programme Novos Talentos em Tecnologias Quânticas funded by the Gulbenkian Foundation.
11 Personal notes

Miguel Abreu co-organized the conference Geometric methods in symplectic and contact topology in honor of Yakov Eliashberg, Stanford University and Asilomar Conference Grounds, California, USA, 19-24 August, 2018.

João L. Costa coauthored the article Quasinormal Modes and Strong Cosmic Censorship which was considered an Editor’s Choice with a Viewpoint in the journal Physical Review Letters.

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

Margarida Mendes Lopes organised together with Francisco Montserrat the special session Algebraic surfaces at the Seventh Iberoamerican Congress on Geometry, Valladolid, Spain, January 22-26, 2018.

Margarida Mendes Lopes acted as a member of the PhD thesis committee of Margarita Castaneda Salazar for the joint PhD program UNAM-UMSNH, Mexico.

José Natário served in 2018 as vice-president of the Portuguese Society on Relativity and Gravitation.

Fernando Pestana da Costa was the recipient of a Sir David Anderson Research Professorship of the University of Strathclyde, Glasgow, United Kingdom (April and May 2018).

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

Roger Picken was a member of the Scientific Committee of the XXVII International Fall Workshop on Geometry and Physics, University of Seville, Spain, September 3-7, 2018.

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 was on sabbatical leave during the academic year 2017-18.

Ricardo Schiappa co-authored the article Resurgence matches quantisation that was selected as one of the best papers published in 2017 in the Journal of Physics A: Mathematical and Theoretical.

Ricardo Schiappa was part of the team whose project proposal Recursive and Exact New Quantum Theory was awarded with EUR 9.815.468,00 ERC Synergy Grant by the European Research Council.
**Rosa Sena-Dias** co-organized the meeting [Constant Scalar Curvature Metrics in Kähler and Sasaki Geometry](#), Luminy, France, January 15-19, 2018.

**Rosa Sena-Dias** co-organized the [EMARKS Summer Session 2018](#), Université Sorbonne, Paris, France, September 5-7, 2018.

**Juha Videman** visited the Department of Mathematics of the Aalto University, Finland, from April 20 to June 22, 2018, as a visiting scholar funded by a grant from the Finnish Society of Science and Letters.

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