Instituto Superior Técnico

Center for Mathematical Analysis, Geometry, and Dynamical Systems

Report 2018

March 2019

Contents

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

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

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.

Claes Uggla. Karlstads Universitet, Sweden.

February

Alessia Mandini. PUC (Rio de Janeiro).

Johan Martens. University of Edinburgh.

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.

K.R. Rajagopal. Texas A&M University.

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.

Anastasiia Panchuk. Kiev National Academy of Sciences.

Inês Aniceto. University of Southampton.

Marko Djikic. University of Niš, Serbia.

Marcel Vonk. University of Amsterdam.

Adriana Neumann. Universidade Federal do Rio Grande do Sul, Brasil.

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.

Chris Heunen. University of Edinburgh.

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.

Nitya Kitchloo. Johns Hopkins 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.

Maxime Van de Moortel. University of Cambridge.

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

> **Franco Severo**. *Institut des Hautes Études Scientifiques.* Existence of phase transition for percolation on general graphs.

Dec 17

> **Daniel Gonçalves**. *Universidade Federal de Santa Catarina, Brasil.* Infinite alphabet ultragraph edge shift spaces: relations to C^*-algebras and chaos.

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

    Martin Pinsonnault. *University of Western Ontario.* Stability of Symplectomorphism Groups of Small Rational Surfaces.

Jul 26

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

Sep 25

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

Nov 29

    Dan Avritzer. *Universidade Federal de Minas Gerais.* Classical Geometry and the Moduli Space of Higgs bundles.

Dec 19

    Gonçalo Oliveira. *Universidade Federal Fluminense.* Yang-Mills flow and calibrated geometry.

3.4   Mathematical Relativity

Jan 17

    Moritz Reintjes. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa.* The Question of Essential Metric Regularity at General Relativistic Shock Waves.

Jan 30

    Claes Uggla. *Karlstads Universitet.* Aspects of cosmological perturbation theory.

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

    Masashi Kimura. *Instituto Superior Técnico, Universidade de Lisboa.* Mass Ladder Operators.

Mar 09

    Katharina Radermacher. *KTH Royal Institute of Technology.* On the Cosmic No-Hair Conjecture in $\mathbb{T}^2$-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

    Edgar Gasperin. *CENTRA, Instituto Superior Técnico, Universidade de Lisboa.* Perturbations of the asymptotic region of the Schwarzschild-de Sitter spacetime.

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

> **Maxime Van de Moortel**. *University of Cambridge.* Stability and instability in spherical symmetry of Reissner-Nordström black holes for the Einstein-Maxwell-Klein-Gordon model.

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

> **Moritz Reintjes**. *Instituto Superior Técnico, Universidade de Lisboa.* Introduction to the Theory of Shock Waves.

Nov 12

> **Jeremie Szeftel**. *Laboratoire Jacques-Louis Lions de l'Université Pierre et Marie Curie.* The nonlinear stability of Schwarzschild.

Nov 16

> **Moritz Reintjes**. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa.* Introduction to the Theory of Shock Waves.

Nov 30

> **Moritz Reintjes**. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa.* Introduction to the Theory of Shock Waves.

Dec 07

> **Moritz Reintjes**. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa.* Introduction to the Theory of Shock Waves.

Dec 10

> **Moritz Reintjes**. *CAMGSD, Instituto Superior Técnico, Universidade de Lisboa..* IIntroduction to the Theory of Shock Waves.

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

> **Rolf Stenberg**. *Aalto University, Finland.* Stabilised Finite Element Methods for Variational Inequalities.

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

> **Panagiotis Betzios**. *University of Crete.* Matrix Quantum Mechanics and the $S^1/\mathbb{Z}_2$ orbifold.

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_∞ bootstrap approach to non-commutative gauge theories.

Oct 01

> **Abhiram Kidambi**. *Tecnical 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

> **Zhihao Duan**. *École Normale Supérieure Paris.* Instantons in the Hofstadter butterfly: resurgence and quantum mirror curves.

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

> **Ana Bela Cruzeiro**. *Departamento de Matemática, Instituto Superior Técnico, Universidade de Lisboa.* Stochastic Clebsch variational principles.

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

> **Björn Gohla**. *Grupo de Fisica Matematica, Universidade de Lisboa.* A Categorical Model for the Hopf Fibration.

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

> **Björn Gohla**. *Grupo de Fisica Matematica, Universidade de Lisboa.* Internal Strictification.

Dec 05

> **Miguel Tierz**. *Grupo de Fisica Matematica, Universidade de Lisboa.* Random matrix theory in topological gauge theories.

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 Câmara (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 Politechnique 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, Conference Modern Trends in Differential Geometry, 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.

Margarida Baía, A degenerate elliptic-parabolic system arising in competitive contaminant transport, Analysis Seminar, FCT/UNL, November 21, 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, Multipliers and equivalences between Toeplitz kernels, 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 and equivalences between Toeplitz kernels, IWOTA 2018, Shanghai, China, July 23-27, 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, Weyl space-times and Riemann-Hilbert factorization, Doppler Institute Seminar, Prague, Czech Republic, May 22, 2018.

Gabriel Lopes Cardoso, Weyl space-times and Riemann-Hilbert factorization, WOTCA 2018, Guimarães, Portugal, June 26, 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 space-times, 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

Cristina Diogo, Set of operators with numerical range in a prescribed set, Functional Analysis and Applications Seminar, Aveiro, Portugal, May 2018

Jorge Drumond Silva, The Interplay Between Dispersive Partial Differential Equations and Fourier Analysis, Mathematics Colloquium, IST, June 14, 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, Kerr black hole interior stability for scalar waves. Conference on Field equations on Lorentzian spacetimes, Hamburg, Germany, March 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, Hydrodynamics for symmetric exclusion in contact with reservoirs, 40th Meeting in Stochastic Processes and their Applications, Gothenburg, Sweden, June 15, 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.

Rafael Luís, Stability and Bifurcation in Discrete Dynamical Systems: Application to Competition Population Models, ICMA – International Conference on Mathematical and Applications, Funchal, Madeira, Portugal, July 9-11, 2018.

Leonardo Macarini, Multiplicity of periodic orbits on prequantization bundles, Workshop on Symplectic Dynamics and Celestial Mechanics, Seoul, South Korea, February 19-23, 2018.

Leonardo Macarini, Periodic orbits on symmetric spheres and dynamical convexity, Workshop on Groups, Geometry and Dynamics, Montevideo, Uruguay, July 23-27, 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.

José Matias, Dimension reduction in the context of A-quasiconvexity, SIMAI 2018 Conference, Rome, Italy, July 4, 2018.

Otávio Menezes, Invariance principle for a slowed random walk driven by symmetric exclusion, Inhomogeneous Random Systems, Institute Henri Poincaré, Paris, France, January 23, 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.

Suresh Nampuri, Hot Attractors, Iberian Strings 2018, Granada, Spain, January 2018.

Suresh Nampuri, Modular Forms and Black Hole Microstate Counting, Invited Talk, Workshop on Universality of Resurgence in Quantization Theories, Pisa, Italy, June 13-15, 2018.

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

Lina Oliveira, Decomposability in operator algebra modules, WOTCA 2018, Workshop on Operator Theory, Complex Analysis and Applications, Universidade do Minho, Guimarães, June 25-28, 2018.

Lina Oliveira, Invariant subspace lattices and kernel maps, SWOT 2018 - 6th Summer Workshop on Operator Theory, University of Agriculture in Krakow, Poland, July 9-13, 2018.

Pedro F. C. Oliveira, A Cosmic No-Hair Theorem for Spherically Symmetric Black Hole Spacetimes, LisMath Seminar Day, Faculdade de Ciências, Universidade de Lisboa, Portugal, June 26, 2018.

Pedro F. C. Oliveira, A Cosmic No-Hair Theorem for Spherically Symmetric Black Hole Spacetimes, Centro de Matemática, Escola de Ciências, Universidade do Minho, Portugal, September 26, 2018.

Fernando Pestana da Costa, Some ordinary differential equation problems in liquid crystal cells, department of Mathematics, National University of Laos, Vientiane, Laos, February 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.

Fernando Pestana da Costa, Bifurcations in liquid crystals cells. Encontro Ciência 2018, Centro de Congressos de Lisboa, Lisbon, Portugal, July 2018.

Roger Picken, Higher gauge theory moduli spaces, surface transport and applications, Workshop on Higher Gauge Theory: Where should we look for higher gauge matter?, University of Leeds, UK, February 28 - March 2, 2018.

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

Moritz Reintjes, Introduction to General Relativity, Mini-course, IMPA, Rio de Janeiro, Brasil, February 2018.

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

Pedro Resende, Quanta and qualia, Workshop on Combining Viewpoints in Quantum Theory, ICMS, Edinburgh, 19-22 March 2018.

Pedro Resende, A quantale model of cognition, Workshop on Algebra, Logic and Topology, CMUC, Universidade de Coimbra, 27-29 September 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, Introduction to Resurgent Transseries and Their Asymptotics Invited Lecture Series, Physics-Mathematics Program, Universidade Federal de Itajubá, Itajubá, Brazil, 2018.

Ricardo Schiappa, Resurgence and Topological Strings, Invited Talk, Workshop on Resurgent Asymptotics in Physics and Mathematics, Kolymbari, Crete, 2018.

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

Ricardo Schiappa, Painlevé Equations, Resurgence, and Quantization, Invited Talk, Complex ODEs: Asymptotics, Orthog. Polynomials & Random Matrices, 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.

Ricardo Schiappa, Resurgence and Transseries in String Theory Invited Talk, ICTS-TIFR Program: Nonperturbative and Numerical Approaches to Quantum Gravity, String Theory and Holography, Bangalore, India, 2018.

Ricardo Schiappa, Resurgence and Transseries in String Theory Invited Talk, Second Mandelstam Theoretical Physics Workshop, Durban, South Africa, 2018.

Ricardo Schiappa, Introduction to Resurgent Asymptotics Invited Lecture Series, Second Mandelstam Theoretical Physics School, Johannesburg, South Africa, 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.

Esmeralda Sousa Dias, Geometry and dynamics of maps from mutation-periodic quivers, International Workshop From Stochastic Geometric Mechanics to Mass Transportation, FCUL, University of Lisbon, September 3-6, 2018.

M. Stošić, Knots-quivers correspondence, torus knots and lattice paths, at Categorification and Higher Representation Theory conference, Institute Mittag-Leffler, Djursholm, Sweden, July 9 – 13, 2018.

M. Stošić, Knots-quivers correspondence, lattice paths, and rational knots, at Quantum Fields, Knots, and Strings conference, Warsaw, Poland, September 24 – 28, 2018.

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

Giorgio Trentinaglia, Higher vector bundles and representations up to homotopy, Higher Differential Geometry Seminar, MPI Mathematik, Bonn, Germany, May 30, 2018.

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

Juha Videman, Stabilized Finite Element Methods for Contact Problems, Encontro Ciência 2018, Centro de Congressos de Lisboa, Lisbon, Portugal, July 2, 2018.

Juha Videman, Stabilized Finite Element Methods for Variational Inequalities, 13th World Congress on Computational Mechanics, NYC, USA, July 22-27, 2018.

Juha Videman, Stabilized Finite Element Methods for Contact Problems, ICES Seminar, UT Austin, USA, September 4, 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:

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

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

Artur Alho, PhD in Mathematics, Universidade do Minho, 2012. Research areas: General Relativity – Dynamical Systems in Cosmology and Astrophysics. Supported by FCT via postdoctoral grant (April 2013–Oct. 2018) and through the DL 57/2016 researcher program (since Nov. 2018).

Thomas Baier, PhD in Mathematics, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2009. Research areas: Kähler geometry and quantization. Supported by FCT via project grant (April 2016–Oct. 2018) and through the DL 57/2016 researcher program (since Nov. 2018).

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. 2021).

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 FCT via postdoctoral grant (June 2012–Feb. 2017, August–Dec. 2018) and through the DL 57/2016 researcher program (since Jan. 2019).

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. 2014) and by an FCT Investigador Grant (Feb. 2015- Feb. 2018).

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 FCT via postdoctoral grant (May 2013–Oct. 2018) and through the DL 57/2016 researcher program (since Nov. 2018).

João Esteves, PhD in Physics, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011. Research area: Combinatorics and its applications to Topological Quantum Field Theory. Supported by the CAMGSD postdoctoral program (Nov. 2011–Jan. 2012) and by FCT via postdoctoral grant (Feb. 2012–Jan. 2018, June-Oct. 2018) and through the DL 57/2016 researcher program (since Nov. 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 the CAMGSD postdoctoral program (Jan. 2016–Dec. 2017) and by an FCT postdoctoral grant (Jan. 2018–Dec. 2020).

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).

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. 2019).

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).

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. 2018).

Marco Stošić, PhD in Mathematics, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2006. Research areas: knot invariants and categorification. Supported by an ERC grant and by CAMGSD (Jan. 2015-Dec. 2016) and by an FCT Investigador Grant (Jan. 2017-Dec. 2021).

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):

Byron Jymenez-Oviedo. *Exclusion Process with Long Jumps in Contact with Reservoirs*, PhD in Mathematics awarded by the University of Nice, France. January 2018. Advised by Cedric Bernardin and **Patrícia Gonçalves**.

Jaime Silva. *Mixed Hodge Structures of Character Varieties*. PhD in Mathematics awarded by Instituto Superior Técnico. April 2018. Advised by Carlos Florentino.

Tom Gustafsson. *Finite Element Methods for Contact Problems*. PhD in Mathematics awarded by the Aalto University, Finland. June 2018. Advised by Rolf Stenberg and **Juha Videman**.

Juan Quijano. *Sheaves and Functoriality of Groupoid Quantales*. PhD in Mathematics awarded by Instituto Superior Técnico. June 2018. Advised by **Pedro Resende**.

Pedro Oliveira. *Cosmic No-Hair for Spherically Symmetric Black Hole Spacetimes*. PhD in Mathematics awarded by Instituto Superior Técnico. November 2018. Advised by **José Natário**, co-advised by **João Lopes Costa**.

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

[1] L. Barreira, D. Dragicevic, and C. Valls. *Admissibility and Hyperbolicity.* Springer Briefs in Mathematics. Springer, 2018.

Articles in refereed international journals

[1] A. Anastasiou, L. Borsten, M. J. Duff, A. Marrani, S. Nagy, and M. Zoccali. Are all supergravity theories Yang-Mills squared? *Nuclear Phys. B*, 934:606–633, 2018. arXiv:1707.03234.

[2] S. Anjos and R. Leclercq. Seidel's morphism of toric 4-manifolds. *J. Symplectic Geom.*, 16(1):1–68, 2018. arXiv:1406.7641.

[3] M. Araújo and G. Granja. Symplectic embeddings in infinite codimension. *J. Homotopy Relat. Struct.*, 13(2):461–480, 2018. arXiv:1404.2433.

[4] J.C. Artés, J. Llibre, and C. Valls. Dynamics of the Higgins-Selkov and Selkov systems. *Chaos Solitons Fractals*, 114:145–150, 2018.

[5] M. Baía, F. Bozorgnia, L. Monsaingeon, and J. Videman. A degenerate elliptic-parabolic system arising in competitive contaminant transport. *J. Math. Anal. Appl.*, 457(1):77–103, 2018.

[6] M. Baía, S. Krömer, and M. Kružík. Generalized $W^{1,1}$-Young measures and relaxation of problems with linear growth. *SIAM J. Math. Anal.*, 50(1):1076-1119, 2018.

[7] L. Barreira, J. Li, and C. Valls. Topological entropy of irregular sets. *Rev. Mat. Iberoamericana*, 34(2):853–878, 2018.

[8] L. Barreira, J. Llibre, and C. Valls. Limit cycles bifurcating from a zero-Hopf singularity in arbitrary dimension. *Nonlinear Dynam.*, 92(3):1159–1166, 2018.

[9] L. Barreira and C. Valls. Lower bounds along stable manifolds. *Glasg. Math. J.*, 60(3):527–537, 2018.

[10] L. Barreira and C. Valls. On two notions of exponential dichotomy. *Dyn. Syst.*, 33(4):708–721, 2018.

[11] L. Barreira and C. Valls. Spectral theory for invertible cocycles under nonuniform hyperbolicity. *São Paulo J. Math. Sci.*, 12(1):6–17, 2018.

[12] L. Barreira and C. Valls. Stable invariant manifolds for delay equations with piecewise constant argument. *J. Difference Equ. Appl.*, 24(1):148–163, 2018.

[13] L. Barreira and C. Valls. Stable manifolds for perturbations of exponential dichotomies in mean. *Stoch. Dyn.*, 18(3:1850022):31 p., 2018.

[14] L. Barreira and C. Valls. Tempered exponential behavior for a dynamics in upper triangular form. *Electron. J. Qual. Theory Differ. Equ.*, 77:1–22, 2018.

[15] L. Barreira and C. Valls. Transformations preserving the Lyapunov exponents. *Commun. Contemp. Math.*, 20(4:1750027):22 p., 2018.

[16] C. Bernardin, P. Gonçalves, M. Jara, and M. Simon. Nonlinear perturbation of a noisy Hamiltonian lattice field model: Universality persistence. *Comm. Math. Phys.*, 361(2):605–659, 2018. arXiv:1703.06711.

[17] C. Bernardin, P. Goncalves, and M. Jara. Weakly harmonic oscillators perturbed by a conservative noise. *Ann. Appl. Probab.*, 28(3):1315–1355, 2018. arXiv:1611.02849.

[18] C. Bernardin, P. Gonçalves, M. Jara, and M. Simon. Interpolation process between standard diffusion and fractional diffusion. *Ann. Inst. H. Poincare Probab. Statist.*, 54(3):1731–1757, 2018. arXiv:1607.07238.

[19] P. Boavida de Brito and M.S. Weiss. Spaces of smooth embeddings and configuration categories. *J. Topol.*, 11(1):65–143, 2018. arXiv:1502.01640.

[20] P. Boavida de Brito and M.S. Weiss. The configuration category of a product. *Proc. Amer. Math. Soc.*, 146(10):4497–4512, 2018. arXiv:1701.06987.

[21] D. Bonheure, J. Földes, E. Moreira dos Santos, A. Saldaña, and H. Tavares. Paths to uniqueness of critical points and applications to partial differential equations. *Trans. Amer. Math. Soc.*, 370(10):7081–7127, 2018. arXiv:1607.05638.

[22] F. Bozorgnia. Uniqueness result for long range spatially segregation elliptic system. *Acta Appl. Math.*, 154(1):1–14, 2018. arXiv:1606.01035.

[23] J. Bračič, C. Diogo, and M. Zajac. Reflexive sets of operators. *Banach J. Math. Anal.*, 12(3):751–771, 2018.

[24] J. Bračič and L. Oliveira. A characterization of reflexive spaces of operators. *Czechoslovak Math. J.*, 68(1):257–266, 2018. arXiv:1511.08014.

[25] M.C. Câmara, K. Klis-Garlicka, and M. Ptak. Asymmetric truncated Toeplitz operators and its characterizations by rank two operators. *RIMS Kôkyûroku*, 2073:1–10, 2018.

[26] M.C. Câmara and J.R. Partington. Multipliers and equivalences between Toeplitz kernels. *J. Math. Anal. Appl.*, 465(1):557–570, 2018. arXiv:1611.08429.

[27] M.R. Cândido, J. Llibre, and C. Valls. Invariant algebraic surfaces and Hopf bifurcation of a finance model. *Internat. J. Bifur. Chaos Appl. Sci. Engrg.*, 28(12):1850150, 2018.

[28] G.L. Cardoso and J.C. Serra. New gravitational solutions via a Riemann-Hilbert approach. *J. High Energy Phys.*, 2018(3:80), 2018. arXiv:1711.01113.

[29] V. Cardoso, J. L. Costa, K. Destounis, P. Hintz, and A. Jansen. Quasinormal modes and strong cosmic censorship. *Phys. Rev. Lett.*, 120(3):031103, 2018.

[30] V. Cardoso, J. L. Costa, K. Destounis, P. Hintz, and A. Jansen. Strong cosmic censorship in charged black-hole spacetimes: still subtle. *Phys. Rev. D (3)*, 98(104007), 2018. arXiv:1808.03631.

[31] G. Carita, J. Matias, M. Morandotti, and D.R. Owen. Dimension reduction in the context of structured deformations. *J. Elasticity*, 133(1):1–35, 2018. arXiv:1709.02869.

[32] E. Carrasquinha, C. Amado, A. M. Pires, and L. Oliveira. Image reconstruction based on circulant matrices. *Signal Process:Image*, 63:72–80, 2018.

[33] C.-H. Chu and L. Oliveira. Tits-Kantor-Koecher Lie algebras of JB*-triples. *J. Algebra*, 512:465–492, 2018.

[34] M. Cirafici. Quivers, line defects and framed BPS invariants. *Ann. Henri Poincare*, 19(1):1–70, 2018. arXiv:1703.06449.

[35] M. Corbera, J. Llibre, and C. Valls. Periodic orbits of perturbed non-axially symmetric potentials in 1:1:1 and 1:1:2 resonances. *Discrete Contin. Dyn. Syst. Ser. B*, 23(6):2299–2337, 2018.

[36] J. L. Costa, P. M. Girão, J. Natário, and J. Drumond Silva. On the occurrence of mass inflation for the Einstein-Maxwell-scalar field system with a cosmological constant and an exponential Price law. *Comm. Math. Phys.*, 361(1):289–341, 2018. arXiv:1707.08975.

[37] L.F.O. Costa, R. Franco, and V. Cardoso. Gravitational Magnus effect. *Phys. Rev. D (3)*, 98(2):024026, 2018. arXiv:1805.01097.

[38] L.F.O. Costa, G. Lukes-Gerakopoulos, and O. Semerák. Spinning particles in general relativity: momentum-velocity relation for the Mathisson-Pirani spin condition. *Phys. Rev. D (3)*, 97(8):084023, 2018. arXiv:1712.07281.

[39] I. Cruz, H. Mena-Matos, and M.E. Sousa-Dias. Multiple reductions, foliations and the dynamics of cluster maps. *Regul. Chaotic Dyn.*, 23(1):102–119, 2018. arXiv:1607.03664.

[40] F. P. da Costa, J. T. Pinto, and R. Sasportes. On the convergence to critical scaling profiles in submonolayer deposition models. *Kinet. Relat. Models*, 11(6):1359–1376, 2018. arXiv:1707.02529.

[41] P. Dang, J.P. Nunes, J. Mourão, and T. Qian. Clifford coherent state transforms on spheres. *J. Geom. Phys.*, 124:225–232, 2018. arXiv:1612.01319.

[42] F.S. Dias, J. Llibre, and C. Valls. Polynomial Hamiltonian systems of degree 3 with symmetric nilpotent centers. *Math. Comput. Simulation*, 144:60–77, 2018.

[43] J. Duarte, C. Januário, N. Martins, C. Correia Ramos, C. Rodrigues, and J. Sardanyés. Optimal homotopy analysis of a chaotic HIV-1 model incorporating AIDS-related cancer cells. *Numer. Algorithms*, 77(1):261–288, 2018.

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[45] A. Ferragut and C. Valls. Phase portraits of Abel quadratic differential systems of second kind. *Dyn. Syst.*, 33(4):581–601, 2018.

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Book chapters

[1] P. Boavida de Brito. Segal objects and the Grothendieck construction. In C. Ausoni, K. Hess, B. Johnson, I. Moerdijk, and J. Scherer, editors, *An Alpine Bouquet of Algebraic Topology*, volume 708 of *Contemporary Mathematics*, pages 19–44. American Mathematical Society, 2018. arXiv:1605.00706.

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Communications in refereed proceedings

[1] G. L. Cardoso, G. Inverso, S. Nagy, and S. Nampuri. Comments on the double copy construction for gravitational theories. In M. Agathos and (et al.), editors, *Corfu Summer Institute 2017 "Schools and Workshops on Elementary Particle Physics and Gravity" (CORFU2017) - Workshop on Testing Fundamental Physics Principles*, volume 316 of *Proceedings of Science*, 14 p. SISSA, 2018. arXiv:1803.07670.

Other publications

[1] P.J. Freitas and H. Tavares. Dividing the circle. *College Math. J.*, 49(3):187–194, 2018. arXiv:1507.07970.

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8.2 Accepted publications (submitted or accepted in 2018)

Books & Monographs

[1] L. Barreira and C. Valls. *Dynamical Systems by Example.* Problem Books in Mathematics. Springer. To appear.

Articles in refereed international journals

[1] M. Abreu and L. Macarini. On the mean Euler characteristic of Gorenstein toric contact manifolds. *Int. Math. Res. Not.* To appear. arXiv:1611.00735.

[2] A. Alho and S. Calogero. Multi-body spherically symmetric steady states of Newtonian self-gravitating elastic matter. *Comm. Math. Phys.* To appear. arXiv:1807.03062.

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[6] S. Anjos and S. Eden. The homotopy Lie algebra of symplectomorphism groups of 3-fold blow-ups of $(S^2 \times S^2, \sigma_{\text{std}} \oplus \sigma_{\text{std}})$. *Michigan Math. J.* To appear. arXiv:1702.03572.

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[16] M. Bohner, A. Gasull, and C. Valls. Periodic solutions of linear, Riccati, and Abel dynamic equations. *J. Math. Anal. Appl.* To appear.

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[27] B. Fiedler and C. Rocha. Sturm 3-ball global attractors 2: Design of Thom-Smale complexes. *J. Dynam. Differential Equations.* To appear. arXiv:1704.00344.

[28] T. Franco, P. Gonçalves, and A. Neumann. Non-equilibrium and stationary fluctuations of a slowed boundary symmetric exclusion. *Stochastic Process. Appl.* To appear. arXiv:1608.04317.

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[48] C. Valls. Liouvillian integrability of some quadratic Liénard polynomial differential systems. *Rend. Circ. Mat. Palermo (2)*. To appear.

Book chapters

[1] T. Gustafsson, R. Stenberg, and J. Videman. Nitsche's method for the obstacle problem of clamped Kirchhoff plates. In A. F. Radu, K. Kumar, I. Berre, J. M. Nordbotten, and I. S. Pop, editors, *Numerical Mathematics and Advanced Applications - ENUMATH 2017*, volume 126 of *Lecture Notes in Computational Science and Engineering*, pages 407–415. Springer. To appear.

[2] P. Gonçalves. Hydrodynamics for symmetric exclusion in contact with reservoirs. In G. Giacomin, S. Olla, E. Saada, H. Spohn, and G. Stoltz, editors, *Stochastic Dynamics out of Equilibrium*, Springer Proceedings in Mathematics & Statistics. Springer. To appear. arXiv:1803.11460.

[3] P. Lopes. Knot Colorings. In L. Kauffman, et al., editors, *A Concise Encyclopedia of Knot Theory*. CRC Press. To appear.

Other publications

[1] D. Bragança and R. Picken. Invariants and TQFT's for cut cellular surfaces from finite 2-groups. *Bol. Soc. Port. Mat.* To appear. arXiv:1710.02390.

8.3   Manuscripts submitted (but not yet accepted) in 2018

[1] M. Abreu, L. Macarini, and M. Moreira. On contact invariants of non-simply connected Gorenstein toric contact manifolds. arXiv:1812.10361.

[2] A. Alho, G. Fournodavlos, and A.T. Franzen. The wave equation near flat Friedmann-Lemaître-Robertson-Walker and Kasner Big Bang singularities. arXiv:1805.12558.

[3] C. Bernardin, P. Gonçalves, and B. Oviedo. A microscopic model for a one parameter class of fractional Laplacians with Dirichlet boundary conditions. arXiv:1803.00792.

[4] M.C. Câmara and J.R. Partington. Scalar-type kernels for block Toeplitz operators. arXiv:1810.09789.

[5] M.C. Câmara, K. Kils-Garlick, and M. Ptak. Complex symmetric completions of partial operator matrices. Submitted.

[6] R.P. Carpentier and R. Picken. Some properties of Bowlin and Brin's color graphs. arXiv:1804.08397.

[7] S. M. Cooper, A. Seceleanu, S. O. Tohaneanu, M. Vaz Pinto, and R. H. Villarreal. GMD functions for scheme-based linear codes and algebraic invariants of Geramita ideals. arXiv:1812.06529.

[8] J. L. Costa and J. Natário. Elastic shocks in relativistic rigid rods and balls. arXiv:1811.12424.

[9] J. L. Costa, P. Oliveira, and J. Natário. Cosmic no-hair in spherically symmetric black hole spacetimes. arXiv:1801.06549.

[10] M. de Jeu and P. R. Pinto. The structure of doubly non-commuting isometries. arXiv:1801.09716.

[11] B. Fiedler and C. Rocha. Boundary orders and geometry of the signed Thom-Smale complex for Sturm global attractors. arXiv:1811.04206.

[12] K. Goldstein, V. Jejjala, J. J. Mashiyane, and S. Nampuri. Generalized hot attractors. arXiv:1811.04963.

[13] P. Gonçalves, M. Jara, O. Menezes, and A. Neumann. Non-equilibrium and stationary fluctuations for the SSEP with slow boundary. arXiv:1810.05015.

[14] T. Gustafsson, R. Stenberg, and J. Videman. Error analysis of Nitsche's mortar method. arXiv:1802.10430.

[15] J. Huerta, H. Sati, and U. Schreiber. Real ADE-equivariant (co)homotopy and Super M-branes. arXiv:1805.05987.

[16] M. Jara and O. Menezes. Symmetric exclusion as a random environment: invariance principle. arXiv:1807.05414.

[17] M. Jara and O. Menezes. Non-equilibrium fluctuations for a reaction-diffusion model via relative entropy. arXiv:1810.03418.

[18] M. Jara and O. Menezes. Non-equilibrium fluctuations of interacting particle systems. arXiv:1810.09526.

[19] A. Lages and P. Lopes. Quandles of cyclic type with several fixed points. arXiv:1803.10487.

[20] M. Mackaay, V. Mazorchuk, V. Miemietz, and D. Tubbenhauer. Trihedral Soergel bimodules. arXiv:1804.08920.

[21] J. P. Quijano and P. Resende. Functoriality of groupoid quantales. II. arXiv:1803.01075.

[22] M. Reintjes and B. Temple. The regularity transformation equations: An elliptic mechanism for smoothing gravitational metrics in general relativity. arXiv:1805.01004.

[23] M. Reintjes and B. Temple. Optimal metric regularity in General Relativity follows from the RT-equations by elliptic regularity theory in Lp-spaces. arXiv:1808.06455.

[24] M. Reintjes and B. Temple. The regularity transformation equations: How to smooth a crinkled map of spacetime. arXiv:1812.06795.

[25] J. P. Santos. The codual quotient vector bundle. arXiv:1808.01164.

[26] A. Shafie and F. Bozorgnia. Existence result for generalized variational equality. arXiv:1812.06820.

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 Probablity
- 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

- 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 Mathematics Winter School for Undergraduates

Escola de Inverno de Matemática 2018 (EIM2018), IST, February 6–8, 2018.

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.