TÉCNICO LISBOA

Instituto Superior Técnico

CAMGSD

Center for Mathematical Analysis, Geometry, and Dynamical Systems

Report 2015

March 2016

Contents

1 Research Projects and Special Grants

The following research projects were coordinated by members of the Center in 2015:

Asymptotic study of reaction-diffusion systems with competition terms

(Started: 2/7/2014, duration 50 months)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: Exploratory research project associated to the "FCT Investigator" Program, Ref. IF/00584/2012

Researcher: Hugo Ricardo Nabais Tavares

Number of Participants: 1

The main aim of this project is to understand and characterize the solutions of a certain type of elliptic systems with competition terms. The questions addressed are the existence and multiplicity of solutions, its qualitative properties (symmetry, sign, regularity,...) and an asymptotic study when the competition becomes the prevailing phenomenon. Another aim is to show the connection between these systems and shape optimization problems.

Brazilian-European Partneship in dynamical systems

(Started 01/01/2013, duration 4 years)

Funding agency: EU - Marie Curie Action IRSES

Reference: PIRSES-GA-2012-318999

Coordinator: Jeroen S. W. Lamb (Imperial College)

Coordinator at IST: Miguel Abreu

Number of Participants: 21 european partners and 11 brazilian partners

CoLab Program UT Austin | Portugal

Funding agency: Fundação para a Ciência e a Tecnologia

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

Contact and symplectic topology

(Started January 27, 2010, duration 60 months)

Funding agency: European Science Foundation (Research Networking Programme)

Reference: CAST

Member of Steering Committee in Portugal: Sílvia Anjos

Other Members in the Steering Committee: Frédéric Bourgeois – Programme Chair, Vincent Colin, Kai Cieliebak, András Stipsicz, Michael Entov, Paolo Lisca, Robert Vandervorst, Aleksy Tralle, Francisco Presas, Tobias Ekholm, Felix Schlenk, Ivan Smith

The goal of this network is to stimulate exchange between researchers from all branches of contact and symplectic topology, in order to create a comprehensive perspective on the field and make progress on some of the basic open questions. The European scale of the network reflects the global nature of these questions as well as the European strength in the subject. The planned activities include workshops, research collaborations, and the exchange of PhD students and postdocs.

The research themes of CAST include: Fukaya categories and mirror symmetry, Floer homology and Hamiltonian dynamics, Symplectic field theory, Contact Topology, Complex geometry and Stein manifolds, Topology of symplectic manifolds, Groups of symplectomorphisms and contactomorphisms.

Defects: a bridge between Geometry and Physics

(Started 01 February 2015, duration 60 months)

Funding agency: Fundação para a Ciência e a Tecnologia

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

Researcher: Michele Cirafici

Number of Participants: 1

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.

Geometry and Mathematical Physics Project

(Started 01/05/2013, duration 3 years)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: EXCL/MAT-GEO/0222/2012

Principal investigator: Miguel Abreu

Number of participants: 30

This project aims at fostering the interaction of research in Geometry and Mathematical Physics within the Department of Mathematics of IST and throughout the country, through the stimuli for interaction among researchers, the reinforcement of international connections, the attraction of post-docs and doctoral students, and the organization of seminars, short courses and international meetings.

Hamiltonian Actions and Integrability in Geometry and Topology

(Started 01/03/2012, duration 36 months)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: PTDC/MAT/117762/2010

Principal investigator: Miguel Abreu

Number of participants: 17

Devoted to certain global aspects of symplectic, contact and Poisson geometries, where Hamiltonian actions and integrability questions are relevant. These aspects include: Kaehler metrics invariant inder Hamiltonian group actions; topology of certain Hamiltonian diffeomorphism groups; non-commutative integrable systems; polygon spaces and moduli spaces of bordered Riemann surfaces; Lagrangian intersection problems; Hamiltonian diffeomorphism groups of Poisson manifolds; complex hypersurfaces.

Higgs bundles and character varieties

(Started 01/03/2012, duration 36 months)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: PTDC/MAT/120411/2010

Principal investigator: Carlos Florentino

Number of participants: 6

This project deals with the geometry and topology of two classes of intimately related spaces: on one side, we have the moduli spaces of Higgs bundles or other holomorphic objects over a complex manifold, and on the other side we have character varieties, which are moduli spaces of representations of a finitely generated group into a Lie group.

In this project, we plan to address some of the facets of this profitable connection that are still undeveloped. Our approach will be a natural continuation of many important established results that were obtained in recent years by many mathematicians, including results from members of the project.

Phase Transitions and Free Boundary Problems

(Started 09/2014, duration 24 months)

Funding agency: FCT (through CoLab Program at UT Austin)

CAMGSD participants: Margarida Baía, Farid Bozorgnia, Léonard Monsaingeon and Juha Videman

Phase transitions and free boundary problems cover a wide range of applications, from segregation dynamics to the evolution of fluid liquid interfaces, tumor growth, ground pollution invasion with obstacles, gas, water and oil flow in porous media and adsorption processes in subsurface environments. This project brings together a significant effort of applied non-linear analysts and numerical and scientific computing experts in the areas of non-linear and non-local Partial Differential Equations. A close synergy between analysts and numerical experts is crucial for its success, which requires the development of new and non-standard numerical techniques for modeling the phenomena under study.

Portuguese Algebraic Geometry Community

(Started 25/1/2013, duration 27 months)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: PTDC/MAT-GEO/0675/2012

Principal investigator: Margarida Mendes Lopes

Number of participants: 15

This project aims to promote the interaction between algebraic geometers in Portugal and is focused on problems linked to moduli spaces and classification of objects of algebraic geometry.

Quantum Structure of Spacetime

(Started: 30/04/2015, duration 48 months)

Funding agency: EU

Reference: COST Action MP1405

Member of the Management Committee: José Mourão

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. In particular, NCG is related to a quantum theory of gravity and a possibly unified perspective on the fundamental forces of Nature. 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. It will achieve a wider and deeper understanding of theory/experiment connections to produce world-leading advances in quantum geometry, and applications to String Theory, Quantum Field Theory, Particle Physics, and Cosmology. This will be achieved through collaborations and scientific activities, which will in particular ensure fair gender representation and foster participation of early stage researchers. The Action will impact on science and society at large through the revolutionary understanding of fundamentals of space and time that it achieves, and through the organisation of a digital respository for NCG related resources.

Representations of Operator Algebras and Applications

(Started 25/5/2013, duration 24 months)

Funding agency: Fundação para a Ciência e a Tecnologia & CNRST-Morocco

Reference: Pº 441.00 CNRST - MOROCCO

Principal investigator: Paulo Pinto

Number of participants: 7

This project aims to promote the bilateral cooperation between researchers in Portugal and Morocco and is focused on problems linked to operator algebras and their relations with dynamical systems and mathematical physics.

Stability of nonautonomous dynamical systems

(Started 01/03/2012, duration 36 months)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: PTDC/MAT/117106/2010

Principal investigator: Claudia Valls

Number of participants: 3

The main objective of the project is to pursue several directions of research in dynamical systems and differential equations, with emphasis on the study of stability of nonautonomous dynamics, particularly in the presence of nonuniform hyperbolicity, and on the qualitative study of polynomial vector fields and equations of mathematical physics, including their integrability.

Toeplitz Operators and Riemann-Hilbert problems: at the crossroad of operator theory and complex analysis

(Started 01/02/2012, duration 36 months)

Funding agency: Fundação para a Ciência e a Tecnologia

Reference: PTDC/MAT/121837/2010

Principal investigator: Maria Cristina Câmara

Number of participants: 3

The central object of this project is the interplay between Toeplitz operators and Riemann-Hilbert problems. It aims to study various properties of Toeplitz operators and to develop new methods to solve Riemann-Hilbert problems that arise in many areas in mathematics, as well as in connection with a variety of problems in Physics and Engineering, showing that progress in one topic goes hand in hand with progress in the other.

Two Related Topics in Clifford Analysis

(Started: 01/01/2015, duration 36 months)

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

Reference: FDCT 099/2014/A2

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

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

2 Visitors

The following researchers visited the Center in 2015:

Armindo Costa, University of London, Jan. 31-Feb. 8

Angela Pistoia, La Sapienza Università di Roma, January 4-9

George Shabat, Moscow State University, January 4-15

Ana Ferreira, Universidade do Minho, January 27

João Miguel Nogueira, Universidade de Coimbra, February 3-7

João Nuno Tavares, Universidade do Porto, February 3-7

Miradain Atontsa Nguemo, Université catholique de Louvain, February 3-7

António Salgueiro, Universidade de Coimbra, February 3-7

Diego Mondejar Ruiz, Universidad Complutense de Madrid, February 3-7

Dimitry Feichtner-Kozlow, Universität Bremen, February 3-7

Lisbeth Fajstrup, Aalborg Universitet, February 3-7

Barbara Mejía, CINVESTAV-IPN (México), February 3-8

Marija Jelic, University of Belgrade, February 3-8

Ismail Mamouni, CRMEF Rabat, February 3-8

Mark Grant, University of Aberdeen, February 3-8

Brittany Terese, Tulane University, New Orleans, February 3-8

Sadok Kallel, American University of Sharjah (UAE), February 3-8

Antonio Rieser, Technion - Israel Institute of Technology, February 3-8

Lucile Vandembroucq, Universidade do Minho, February 3-8

Thomas Kahl, Universidade do Minho, February 3-8

Albertas Dvirnas, Kaunas University of Technology, February 3-8

Fernando Benavides, Universidad Nacional Autónoma de México, Feb. 3-8

Michael Farber, University of London, February 3-8

Ulrich Bauer, TU München, February 3-10

Piotr Sulkowski, Warsaw University, February 4-7

Jan Felix Senge, Universität Bremen, February 4-8

Ngaiming Mok, Hong Kong University, February 18-28

Saikat Chatterjee, Institut des Hautes Études Scientifiques, Feb. 23-27

Marko Vojinovic, GFM, Universidade de Lisboa, March 4, 18, 25

Rémi Leclercq, Université d'Orsay, March 9-21

Dimitri Chikhladze, Universidade de Coimbra, March 10-11

Janko Bracic, Ljubljana University, March 11-18

Nicole Soave, Justus-Liebig-Universität Gießen, March 15-21

José Isidro, Universitat Politècnica de València, March 16

Javier Martinez, Universidad Complutense de Madrid, March 23-27

Christopher Martin Edwards, Queen's College Oxford, April 9-16

Carl Tipler, Université de Bretagne Occidentale, April 13-18

Paolo Ghiggini, Université de Nantes, April 19-21

Sheila Sandon, Université de Strasbourg, April 20-24

Klaus Niederkrüger, Université Toulouse III, April 20-24

Carlo Maccaferri, Università di Torino, April 27

Antonio de Nicola, Universidade de Coimbra, April 28

Daniele Pranzetti, Universität Erlangen-Nürnberg, April 19-24

Jelle Hartong, Université Libre de Bruxelles, May 11

Gonçalo Oliveira, Duke University, May 12

Huseyin Koçak, University of Miami, May 19

Lode Wylleman, Universiteit Gent, May 26-June 6

Simão Correia, CMAF, Universidade de Lisboa, May 27

Louis Kauffman, University of Illinois at Chicago, May 30-June 7

John Bryden, Prince Mohammed University, Saudi Arabia, June 4-9

Róbert Szoke, Eötvös Loránd University, Budapest, June 4

Jonathan Weitsman, Northeastern University, Boston, June 5-9

Marina Logares, Instituto de Ciencias Matemáticas, Madrid, June 7-17

Ederson Moreira dos Santos, Universidade de São Paulo, June 7-20

Steven Bradlow, University of Illinois at Urbana-Champaign, June 8-17

Éveline Legendre, Université Toulouse III, June 8-12

Raul Curto, University of Iowa, June 9-14

Rongwei Yang, State University of New York at Albany, June 9-14

Bernold Silbermann, Technische Universität Chemnitz, June 9-14

Elizabeth Strouse, Université Bordeaux 1, June 9-14

Alexei Novikov, Penn State University, June 13-16

Kishore Marathe, City University of New York, June 13-16

Denis Bonheure, Université Libre de Bruxelles, June 13-19

Sean Lawton, George Mason University, June 13-19

Evgeny Panov, Novgorod State University, June 13-20

Bouasy Doungsavanh, Universidade de Évora, June 13-21

Souksada Tounsavathdy, Universidade de Évora, June 13-21

Jayrold Arcede, Caraga State University (Philippines), June 13-21

Khankham Vongsavang, Universidade de Évora, June 13-21

Henry Van Roessel, University of Alberta, June 13-28

Yael Karshon, University of Toronto, June 14-20

Martin Kruzik, Inst. Inform. Theory and Automation, Prague, June 14-23

Renato Vianna, Cambridge University, June 22-28

Paulo Amorim, Universidade Federal do Rio de Janeiro, June 24

Sheila Sandon, Université de Strasbourg, June 25

Marcel de Jeu, Universiteit Leiden, June 29-July 5

Juan Carles Naranjo, Universitat de Barcelona, June 30-July 4

Roberto Pignatelli, Università degli Studi di Trento, June 30-July 4

Ciro Ciliberto, Università di Roma Tor Vergata, June 30-July 4

Rita Pardini, Università di Pisa, June 30-July 4

Gian Pietro Pirola, Università di Pavia, June 30-July 5

Arnaud Beauville, Université de Nice, June 30-July 5

Miguel Ángel Barja, Universitat Politècnica de Catalunya, July 1-4

Rachid El Harti, Université Hassan 1$^{\text{er}}$, July 2

Sam Nelson, Claremont McKenna College (USA), July 6-11

Nick Sheridan, Princeton University, July 13

Lloyd Demetrius, Harvard University, July 14

K.R. Rajagopal, Texas A&M University, July 18-22

Marco Robalo, Université Pierre e Marie Curie, July 21

Rémi Leclercq, Université d'Orsay, July 22-August 3

Thomas Mohaupt, University of Liverpool, July 28

Tom Gustafsson, Aalto University, August 24-September 5

Valery Alexeev, University of Georgia, September 5-13

Shin Satoh, Kobe University, September 9-14

Takuji Nakamura, Osaka Electro-Communication University, Sept. 9-14

Bernold Fiedler, Universität Berlin, September 10-24

Jedrzej Swiezewski, University of Warsaw, September 15-18

Martin Pinsonnault, University of Toronto, September 19-October 17

Claes Uggla, Karlstads Universitet, September 20-29

Igor Salom, Institute of Physics Belgrade, September 30-October 2

Rui Loja Fernandes, Univ. Illinois Urbana-Champaign, Sept. 30-Oct. 7

Alexei Novikov, Penn State University, October 3-10

Antti Niemi, Aalto University, October 3-10

Clint Dawson, University of Texas at Austin, October 4-10

Tuomo Kuusi, Aalto University, October 4-10

Daryl Saddi, Universidade de Évora, October 4-10

Marim Misur, University of Zagreb, October 4-10

Marco Ponce de Léon, University of Minnesota, October 4-10

Tyson Loudon, University of Minnesota, October 4-10

Hadi Minbastian, Universität zu Köln, October 4-10

Mania Sabouri, Universität zu Köln, October 4-10

Anna Nikishova, ITMO University, St. Petersburg, October 4-10

Alice Nadeau, University of Minnesota, October 4-10

Prapti Neupane, University of Texas at Austin, October 4-10

Jens Oberlander, Universität Erlangen-Nürnberg, October 4-10

Andreas Rupp, Universität Erlangen-Nürnberg, October 4-10

Daniela Domingues, Universidade de Coimbra, October 4-10

Maryam Khaksar, Universidade de Coimbra, October 4-10

Rafayel Teymurazyan, Universidade de Coimbra, October 4-10

André Rodrigues, Universidade de Coimbra, October 4-10

Peter Knabner, Universität Erlangen-Nürnberg, October 4-11

K.R. Rajagopal, Texas A&M University, October 5-12

Benjamin Alarcón Heredia, Universidade Nova de Lisboa, October 9, 23

Simone Calogero, Chalmers University of Technology, October 10-17

Matias del Hoyo, IMPA, October 17-31

Sergey Naboko, Univ. Kent/St. Petersburg State Univ., Oct. 24-Nov. 6

Sigmund Selberg, Universitetet i Bergen, October 28

Dieter Lüst, Ludwig-Maximilians-Universität München, November 1-3

Regilene Oliveira, Universidade de São Paulo, November 3-14

Julien Meyer, Université Libre de Bruxelles, November 6-10

Alvaro Veliz Osório, University of Witwatersrand, November 8-13

Elizabeth Strouse, Université Bordeaux 1, November 11-14

Rui Loja Fernandes, University of Illinois Urbana-Champaign, Nov. 14-21

Edgar Costa, Dartmouth College, December 10

Murad Alim, Universität Göttingen, December 13-15

Marco Morandotti, SISSA, Trieste, December 14-21

G. Pacelli Bessa, Universidade Federal do Ceará, December 15

David Kinderlehrer, Carnegie-Mellon University, December 15-20

Alfonso Zamora, California State University Channel Islands, Dec. 17-22

3 Seminar Series & Working Seminars

3.1 Algebra

Dec 10

    Edgar Costa. *Dartmouth College.* Equidistributions in arithmetic geometry.

3.2 Analysis, Geometry, and Dynamical Systems

Feb 03

    Léonard Monsaingeon. *CAMGSD, Instituto Superior Técnico.* A Wasserstein gradient flow approach to Poisson-Nernst-Planck equations.

Mar 10

    Dimitri Chikhladze. *CMUC, Universidade de Coimbra.* Monads in a tricategory, a monoidal approach to bicategorical structures and generalized multicategories.

Apr 21

    Henrique Oliveira. *CAMGSD, Instituto Superior Técnico.* Topological equivalences for one-parameter bifurcations of maps.

May 12

    Henrique Oliveira. *CAMGSD, Instituto Superior Técnico.* Huygens synchronization of two clocks.

May 19

    Huseyin Kocak. *University of Miami.* Shadowing: Right results from wrong numbers.

Jun 02

    Louis Kauffman. *University of Illinois at Chicago.* Virtual knot cobordism.

Jun 30

    Marcel de Jeu. *Leiden University.* The Banach algebra associated with a topological dynamical system.

Jul 02

    Rachid El Harti. *University Hassan I.* Numerical range of adjointable operators on a Hilbert C^*-module and applications.

Jul 07

    Sam Nelson. *Claremont McKenna College.* Quantum Enhancements of Biquandle Counting Invariants.

Jul 14

> **Lloyd Demetrius**. *Harvard University.* The Etiology of Aging and Age Related diseases - an Entropic Perspective.

Jul 21

> **K.R. Rajagopal**. *Texas A&M University.* A hierarchy of models for the flow of fluids through porous solids.

Sep 22

> **Bernold Fiedler**. *Freie Universität Berlin.* The importance of being just late.

3.3   Autumn School in Nonlinear Science

Oct 05-09

> **Peter Knabner**. *Universität Erlangen-Nürnberg.* Flow, Transport and Multicomponent Reaction in Porous Media: Mathematical Modelling, Analysis and Simulation.

Oct 05-09

> **Tuomo Kuusi**. *Aalto University.* Aspects of nonlocal regularity theory.

Oct 05-09

> **Alexei Novikov**. *Penn State University.* Fisher-KPP equation in spatially and temporally inhomogeneous media.

Oct 05-09

> **Clint Dawson**. *University of Texas at Austin.* Numerical Methods for Conservation Laws.

Oct 06-09

> **K. R. Rajagopal**. *Texas A&M University.* Recent developments in continuum mechanics.

3.4   Geometria em Lisboa

Jan 13

> **George Shabat**. *Moscow State University, Russian State University for the Humanities.* On the geometry of Tod-Hitchin solutions of Einstein equations.

Jan 27

> **Ana Ferreira**. *Universidade do Minho.* The classification of naturally reductive homogeneous spaces in small dimensions.

Mar 03

Giorgio Trentinaglia. *CAMGSD, Instituto Superior Técnico.* A fast convergence theorem for nearly multiplicative connections on proper Lie groupoids.

Mar 12

Yunhyung Cho. *CAMGSD, Instituto Superior Técnico.* Symplectic circle actions with isolated fixed points.

Mar 31

Giorgio Trentinaglia. *CAMGSD, Instituto Superior Técnico.* Reduced smooth stacks?

Apr 14

Carl Tipler. *Université de Bretagne Occidentale.* An infinitesimal version of the Yau-Tian-Donaldson conjecture.

Apr 15

Javier Martinez. *Universidad Complutense de Madrid.* E-polynomials of SL$(2, \mathbb{C})$-character varieties.

Apr 21

Paolo Ghiggini. *Université de Nantes/CNRS.* An application of L^2 homology to symplectic topology.

Apr 23

Klaus Niederkrüger. *Université Paul Sabatier Toulouse III.* Examples of non-trivial elements in the contact mapping class group.

Apr 28

Antonio De Nicola. *CMUC, Universidade de Coimbra.* Hard Lefschetz Theorem for Sasakian manifolds.

May 12

Gonçalo Oliveira. *Duke University.* Monopoles in 3 Dimensions.

Jun 04

John Bryden. *Prince Mohammed University, Saudi Arabia.* The linking form theorem for 3-manifolds.

Jun 04

Robert Szoke. *Eötvös Loránd University (ELTE).* Adapted polarizations.

Jun 16

Yael Karshon. *University of Toronto.* An Invitation to Diffeology.

Jun 23

> **Renato Vianna**. *Cambridge University.* Infinitely many monotone Lagrangian Tori in $\mathbb{CP}^2$.

Jun 25

> **Sheila Sandon**. *CNRS/IRMA.* Floer homology for translated points.

Jul 09

> **Alfonso Zamora**. *Instituto Superior Técnico.* Stability conditions for (G, h)-constellations.

Jul 13

> **Nick Sheridan**. *Princeton University.* Counting curves using the Fukaya category.

Jul 21

> **Marco Robalo**. *Université Pierre-et-Marie-Curie at Jussieux.* Gromov-Witten invariants and Brane Actions.

Oct 13

> **Martin Pinsonnault**. *The University of Western Ontario.* Symplectic Rigidity and Asymptotics of C^k Toeplitz Operators.

Nov 10

> **Julien Meyer**. *Université Libre de Bruxelles.* Canonical quantisation of the Laplacian.

Nov 17

> **Rui Loja Fernandes**. *University of Illinois at Urbana-Champaign.* Symplectic gerbes.

Dec 10

> **Edgar Costa**. *Dartmouth College.* Equidistributions in arithmetic geometry.

Dec 15

> **G. Pacelli Bessa**. *Universidade Federal do Ceará.* On the radial spectrum of rotationally symmetric manifolds.

3.5   Partial Differential Equations

Jan 07

> **Angela Pistoia**. *La Sapienza Università di Roma.* Remarks on the profile of solutions to some singularly perturbed elliptic problems.

Mar 20

> **Nicola Soave**. *Justus Liebig University of Giessen.* Liouville-type

theorems for an elliptic system modelling phase-separation and optimal partition problems.

May 27

> **Simão Correia**. *FCUL, CMAF-CIO.* Existence and characterization of ground-states for a system of M coupled semilinear Schrödinger equations.

Jun 15

> **Alexei Novikov**. *Penn State University.* Diffusion in fluid flows.

Jun 16

> **Martin Kruzik**. *Institute of Information Theory and Automation, Academy of Sciences, Prague.* Minimization problems on orientation-preserving bi-Lipschitz maps.

Jun 18

> **Denis Bonheure**. *Université Libre de Bruxelles.* Some questions arising from the nonlinear theory of electromagnetism of Born-Infeld.

Jun 24

> **Paulo Amorim**. *Instituto de Matemática da Universidade Federal do Rio de Janeiro.* A Continuous Model of Ant Foraging with Pheromones and Trail Formation.

Sep 02

> **Tom Gustafsson**. *Aalto University.* Stabilized finite element methods for the obstacle problem.

Oct 14

> **Simone Calogero**. *Chalmers University of Technology.* Self-gravitating elastic bodies in Newtonian gravity and General Relativity.

Oct 28

> **Sigmund Selberg**. *University of Bergen.* Spatial analyticity for solutions of the dispersion-generalized KdV equation.

3.6 String Theory

Mar 16

> **José Isidro**. *Universitat Politècnica de València.* Quantum Mechanics as an Emergent Phenomenon.

Apr 27

> **Carlo Maccaferri**. *University of Torino.* Open string field theory and D-branes.

May 11

> **Jelle Hartong**. *Université Libre de Bruxelles.* Life on the Boundary of a Lifshitz Space-Time.

Jul 28

> **Thomas Mohaupt**. *University of Liverpool.* Non-extremal solutions in $N = 2$ supergravity with vector multiplets.

Nov 02

> **Dieter Lüst**. *Ludwig-Maximilians-Universität München.* Large N Graviton Scattering and Black Hole Production.

Nov 09

> **Alvaro Veliz-Osorio**. *University of Witwatersrand.* Entanglement and mutual information in 2d nonrelativistic field theories.

Dec 14

> **Murad Alim**. *University of Göttingen.* Geometric Hints of Non-perturbative Topological Strings.

3.7   Topological Quantum Field Theory

Feb 26

> **Saikat Chatterjee**. *Institut des Hautes Études Scientifiques, France.* Twisted actions of categorical groups.

Mar 04

> **Marko Vojinovic**. *GFM, Universidade de Lisboa.* Introduction to Loop Quantum Gravity (part 1).

Mar 18

> **Marko Vojinovic**. *GFM, Universidade de Lisboa.* Introduction to Loop Quantum Gravity (part 2).

Mar 25

> **Marko Vojinovic**. *GFM, Universidade de Lisboa.* Introduction to Loop Quantum Gravity (part 3).

Apr 22

> **Daniele Pranzetti**. *Universität Erlangen-Nürnberg.* Black hole entropy in loop quantum gravity.

Jun 15

> **Kishore Marathe**. *City University of New York.* Physical Mathematics: old and new.

Sep 17

> **Jedrzej Swiezewski**. *University of Warsaw.* Geometrical diffeomorphism invariant observables for General Relativity and their applications.

Oct 01

> **Igor Salom**. *Institute of Physics, Belgrade, Serbia.* Positive energy unitary irreducible representations of osp$(1|2n)$ superalgebras.

Oct 09

> **Benjamin Alarcón Heredia**. *Universidade Nova de Lisboa.* Homotopy theory using categories.

Oct 23

> **Benjamin Alarcón Heredia**. *Universidade Nova de Lisboa.* Bicategories, classifying spaces and homotopy pullbacks.

Nov 30

> **Roger Picken**. *CAMGSD, Instituto Superior Técnico.* Actions of 2-groups, moduli spaces in higher gauge theory, and TQFT's.

Dec 11

> **Marko Stosic**. *CAMGSD, Instituto Superior Técnico.* Homological knot invariants, A-polynomial and integrality properties.

4   Conferences and short courses

The following Conferences and Short Courses were organized or co-organized by members of the Center in 2015:

XXIst Oporto Meeting on Geometry, Topology and Physics, on the theme: Applications of Topology

Instituto Superior Técnico, Lisbon, Portugal, February 4 – 7, 2015

> *Organizing committee:* João Nuno Tavares (CMUP/UPorto), José Mourão (CAMGSD/IST), Lucile Vandembroucq (CMAT/UMinho), Marco Mackaay (CAMGSD/UAlgarve), Roger Picken (CAMGSD/IST)

> *Main speakers and the titles of their mini-courses:*

> **Dmitry Feichtner-Kozlov**. *Universität Bremen* Combinatorial Algebraic Topology and applications to Distributed Computing

> **Michael Farber**. *Queen Mary, University of London* Topological Robotics

Piotr Sulkowski. *University of Warsaw* Random matrices, topological recursion, and applications of topology to biomolecules

Ulrich Bauer. *TU München* Topological Data Analysis

IST Mathematics Winter Lectures

Instituto Superior Técnico, Lisbon, Portugal, February 23 – 25, 2015

Organizing committee: Margarida Mendes Lopes (CAMGSD/IST), José Mourão (CAMGSD/IST),

Lectures:

Ngaiming Mok. *University of Hong Kong* Complex geometry on bounded symmetric domains and their quotient spaces - I (February 23).

Ngaiming Mok. *University of Hong Kong* Complex geometry on bounded symmetric domains and their quotient spaces - II (February 24).

Ngaiming Mok. *University of Hong Kong* Complex geometry on bounded symmetric domains and their quotient spaces - III (February 25).

Topological Quantum Field Theory Mini Workshop 2015 – Mathematical Aspects of Quantization

Instituto Superior Técnico, Lisbon, Portugal, June 8, 2015

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

Lectures:

Jonathan Weitsman. *Northeastern University* Quantization of b-Poisson manifolds.

Brian Hall. *Notre Dame University* Heat equation and Segal-Bargmann transform on unitary groups in the large-N limit.

Carl Bender. *Washington University PT* symmetry and the taming of instabilities.

Special Session on Geometric Spectral Theory

Instituto Superior Técnico, Lisbon, Portugal, June 8 – 9, 2015

Organizing committee: Emily Dryden (Bucknell University), Rosa Sena-Dias (CAMGSD/IST)

Special Sessions at the **AMS**-**EMS**-**SPM** International Meeting

Universidade do Porto, Portugal, June 10-13, 2015

Categorification of Quantum groups, Representations and Knot Invariants. Organizers: Mikhail Khovanov (Columbia University), Marco Mackaay (CAMGSD), Pedro Vaz (Université Catholique de Louvain).

Cluster Evolution Equations: Coagulation, Fragmentation, and Related Systems. Organizers: Fernando Pestana da Costa (CAMGSD), Wilson Lamb (University of Strathclyde).

Complex Time in Quantum Physics and Geometry. Organizers: Brian Hall (University of Notre Dame), José Mourão (CAMGSD), João P. Nunes (CAMGSD), Alejandro Uribe (University of Michigan).

Contact and Symplectic Topology. Organizers: Miguel Abreu (CAMGSD), Basak Gurel (University of Central Florida), Francisco Presas (Instituto de Ciencias Matemáticas, Madrid).

Geometric Analysis. Organizers: André Neves (Imperial College), Rosa Sena-Dias (CAMGSD).

Geometric Aspects of Harmonic Analysis. Organizers: Jorge Drumond Silva (CAMGSD), Diogo Oliveira e Silva (Universität Bonn), Christoph Thiele (Universität Bonn).

Geometric Spectral Theory. Organizers: Emily Dryden (Bucknell University), Rosa Sena-Dias (CAMGSD).

Geometrical and Enumerative Structures in Supersymmetry. Organizers: Gabriel Lopes Cardoso (CAMGSD), Michele Cirafici (CAMGSD), Abhijit Gadde (Caltech), Sameer Murthy (King's College London).

Higgs Bundles and Character Varieties. Organizers: Steven Bradlow (University of Illinois at Urbana-Champaign), Carlos Florentino (CAMGSD), Peter Gothen (Universidade do Porto), André Gama Oliveira (UTAD).

Higher Dimensional Algebra in Geometry and Quantum Field Theory. Organizers: André Henriques (Universiteit Utrecht), João Faria Martins (UNL), Roger Picken (CAMGSD), James D. Stasheff (University of North Carolina at Chapel Hill).

Homological and Combinatorial Commutative Algebra. Organizers: Inês B. Henriques (University of Sheffield), Lars Winther Christensen (Texas Tech University), Maria Vaz Pinto (CAMGSD).

Hyperbolic Conservation Laws and Their Regularization. Organizers: Nabil Bedjaoui (Université de Picardie Jules Verne, Amiens), Joaquim M.C. Correia (Universidade de Évora), Michael Grinfeld (University of Strathclyde), Yousef Mammeri (Université de Picardie Jules Verne, Amiens), Rafael Sasportes (CAMGSD).

Linear Operators and Function Spaces. Organizers: M. Cristina Câmara (CAMGSD), Marek Ptak (University of Agriculture of Krakow), Ilya Spitkovsky (College of William and Mary).

Low Dimensional Topology and Its Relationships with Physics. Organizers: Louis H. Kauffman (University of Illinois at Chicago), Pedro Lopes (CAMGSD).

Mathematical Models for Materials. Organizers: Gurgen Hayrapetyan (Ohio University), José Matias (CAMGSD), Marco Morandotti (SISSA).

Mathematical Relativity. Organizers: Filipe Mena (Universidade do Minho), José Natário (CAMGSD).

Nonlinear Elliptic Systems and Applications. Organizers: Ederson Moreira dos Santos (Universidade de São Paulo), Benedetta Noris (Università degli Studi di Milano-Bicocca), Hugo Tavares (CAMGSD).

Second Graduate Summer School on Differential Equations

Instituto Superior Técnico, Lisbon, Portugal, June 15-19, 2015

Organizing committee: Joaquim Correia (UÉvora), Rafael Sasportes (UAberta/CAMGSD)

Trends in Non-Linear Analysis 2015

SISSA, Trieste, Italy - July 1-3, 2015

Organizing committee: José Matias (CAMGSD/IST), Marco Morandotti (SISSA/Trieste).

Conference on Algebraic Surfaces on the occasion of Margarida Mendes Lopes 60th birthday

Instituto Superior Técnico, Lisbon, Portugal, July 1 – 3, 2015

Organizing committee: Carlos Florentino (CAMGSD/IST), Peter Gothen (UPorto), Pedro Macias Marques (UÉvora), Jorge Neves (UCoimbra), Carlos Rito (CMUP/UTAD), Helena Soares (ISCTE/ULisboa)

IST Courses on Algebraic Geometry 2015

Instituto Superior Técnico, Lisbon, Portugal, September 7 – 9, 2015

Organizing committee: Margarida Mendes Lopes (CA;SGD/IST) and Carlos Rito (CMUP/UTAD)

Lectures:

> **Valery Alexeev**. *University of Georgia* Lectures on compactification of moduli spaces of surfaces I (September 7).
>
> **Valery Alexeev**. *University of Georgia* Lectures on compactification of moduli spaces of surfaces II (September 8).
>
> **Valery Alexeev**. *University of Georgia* Lectures on compactification of moduli spaces of surfaces III (September 8).
>
> **Valery Alexeev**. *University of Georgia* Lectures on compactification of moduli spaces of surfaces IV (September 9).

UT Austin | Portugal CoLab Program Autumn School in Nonlinear Science

Instituto Superior Técnico, Lisbon, Portugal, October 5 – 9, 2015

Organizing committee: Margarida Baía, Farid Bozorgnia, Leonard Monsaingeon, Juha Videman (CAMGSD/IST).

Calculus of Variations and its Applications on the occasion of Luísa Mascarenhas's 65th birthday

Universidade Nova de Lisboa, Caparica, Portugal, December 17 – 19, 2015

Organizing committee: Rita Ferreira (KAUST), Irene Fonseca (CMU) Oleksiy Karlovych (UNova), José Matias (CAMGSD/IST), Ana Ribeiro (UNova), Anca Toader (FCUL), Luís Trabucho (UNova).

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 2015:

Miguel Abreu, Kähler-Sasaki metrics on toric symplectic cones, Special Session on Geometric Analysis, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June 10-13.

Miguel Abreu, Kähler-Sasaki metrics on toric symplectic cones, Trends in Modern Geometry & the 10th Pacific Rim Complex Geometry Conference, University of Tokyo and Nasu, Japan, July 30-31.

Miguel Abreu, Multiplicity of periodic orbits for dynamically convex contact forms, Workshop on Conservative Dynamics and Symplectic Geometry, IMPA, Rio de Janeiro, Brazil, August 3-7.

Artur Alho, Scalar field deformations of Lambda-CDM cosmology, ERE 2015, University of the Balearic Islands, Relativity and Gravitation group, Palma de Mallorca, Spain, September 7.

Sílvia Anjos, Seidel's morphism of toric 4–manifolds, AMS–EMS–SPM Joint International Meeting, Porto, Portugal, June 11.

Sílvia Anjos, Seidel's morphism of toric 4–manifolds, CUHK Mathematics Seminar, The Chinese University of Hong Kong, November 18.

Pedro Boavida, Smooth embeddings and the little discs operad, Colloquium, Queen's University Belfast, UK, December 11.

Cristina Câmara, Truncated Toeplitz operators and their spectra, Department of Applied Mathematics, University of Agriculture in Kraków, Poland, May 18.

Cristina Câmara, Asymmetric truncated Toeplitz operators, Conference on Harmonic Analysis, Function Theory, Operator Theory and Applications, Bordeaux, France, June 1-4.

Cristina Câmara, Asymmetric truncated Toeplitz operators, Special Session on Operator Theory and Its Applications, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June 10-13.

Cristina Câmara, Spectral properties of truncated Toeplitz operators, Doppler Institute Seminar, Prague, Czech Republic, June 23.

Cristina Câmara, Q-classes of matrix functions and Toeplitz operators, Seminar, Department of Applied Mathematics, University of Agriculture in Kraków, Poland, June 26.

Michele Cirafici, Line defects in N = 2 QFT and framed BPS states, University of Genoa, Genoa, Italy, March 31.

Michele Cirafici, Framed quivers, line defects and BPS invariants, Institut Camille Jordan, Université Claude Bernard Lyon 1, Lyon, France, April 10.

Michele Cirafici, On Wilson-'t Hooft Lines in Theories of Class S, Iberian Strings 2015, University of Salamanca, Spain, May 28.

Michele Cirafici, Theories of class S and line defects, Institut des Hautes Études Scientifiques, Bures-Sur-Yvette, France, September 30.

Michele Cirafici, BPS invariants, quivers and line defects, Institut de Mathématiques de Bourgogne, Dijon, France, December 14.

João L. Costa, Global uniqueness in general relativity, Open day of CMAT, Braga, Portugal, March.

João L. Costa, Cosmic no-hair for a self-gravitating scalar field, AMS–EMS–SPM Joint International Meeting, Porto, June.

João L. Costa, On strong cosmic censorship with a cosmological constant, Singularities in General Relativity, Fields Institute, Toronto, Canada, June.

João L. Costa, On strong cosmic censorship with a cosmological constant, EquaDiff2015, Lyon, France, July.

João L. Costa, Global uniqueness for the Einstein-Maxwell-scalar field system with a cosmological constant, Recent Advances in Mathematical General Relativity, Institute Henri Poincaré, Paris, France, October.

L. Filipe Costa, Dynamics of extended test bodies in General Relativity — the problem of the representative worldline, Spanish Relativity Meeting 2015, Mallorca, Spain, September 7-11.

L. Filipe Costa, Gravitomagnetism and the significance of the curvature scalar invariants, Black Holes Workshop VIII, Lisbon, Portugal, December 21-22

Fernando P. da Costa, Introduction to problems and techniques in coagulation equations, Short course at the First Graduate Summer School, Universidade de Évora, June 2-5.

Ricardo Couso-Santamaria, On the resurgent asymptotics of topological string theory, Resurgence, Physics and Numbers, Centro de Ricerca Ennio de Georgi, Pisa, Italy, May 19.

Ricardo Couso-Santamaria, Resurgence in topological strings and matrix models, Iberian Strings, University of Salamanca, Spain, May 28.

Ricardo Couso-Santamaria, The theory of resurgence in matrix models and topological strings, AMS-EMS-SMP Joint International Meeting, Porto, Portugal, June 10.

Jorge Drumond Silva, On the Global Uniqueness for the Einstein-Maxwell-Scalar Field System With a Cosmological Constant, IM-UFRJ Instituto de Matemática, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, May 5.

Jorge Drumond Silva, On the Global Uniqueness for the Einstein-Maxwell-Scalar Field System With a Cosmological Constant, IMPA - Instituto de Matemática Pura e Aplicada, Rio de Janeiro, Brazil, May 7.

Jorge Drumond Silva, On the Global Uniqueness for the Einstein-Maxwell-Scalar Field System With a Cosmological Constant", AMS-EMS-SPM Joint International Meeting, Porto, June 6.

Jorge Drumond Silva, On the Global Uniqueness for the Einstein-Maxwell-Scalar Field System With a Cosmological Constant, Second Workshop in Nonlinear Dispersive Equations, in honor of Marcia Scialom's 70th birthday, IMECC - UNICAMP Universidade Estadual de Campinas, Campinas, Brazil, October 7.

Pedro Girão, Price's law and uniqueness for the Einstein-Maxwell-scalar field system with a cosmological constant, Special Session on Mathematical Relativity, AMS–EMS–SPM Joint International Meeting, Porto, June 10-13.

John Huerta, The Octonions, GFM, Universidade de Lisboa, January 28.

John Huerta, Trigroups and M-theory, AMS–EMS–SPM Joint International Meeting Porto, Portugal, June 11.

John Huerta, Division algebras and supersymmetry, Advances in Quantum Gravity 2015, Los Angeles, CA, November 24.

Pedro Lopes, The Delunification Process and Minimal Diagrams, XXIst Oporto Meeting on Geometry, Topology and Physics, IST, Lisbon, Portugal, February 4-7.

Pedro Lopes, Hard minimum number of colors, Special Session on Low Dimensional Topology and Its Relationships with Physics, AMS–EMS–SPM Joint International Meeting, Porto, June 10-13.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, XXIst Oporto Meeting on Geometry, Topology and Physics, IST, Lisbon, Portugal, February 4-7.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, String Theory Seminar: Ludwig-Maximilians-University, Munich, Germany, February 9.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, Albert-Einstein-Institute, Golm, Germany, April 14.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, CERN, Geneva, April 21.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, University of Amsterdam, May 19.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, Iberian Strings 2015, Salamanca, Spain, May 27-29.

Gabriel Lopes Cardoso, Deformations of Special Geometry and the Holomorphic Anomaly Equation, The String Theory Universe, 21st European String Workshop and 3rd COST MP1210 Meeting, Leuven, Belgium, September 7-11.

Gabriel Lopes Cardoso, Topological String Theory in a Scaling Limit and Logarithmic Corrections to BPS Black Hole Entropy, MITP Workshop Stringy Geometry, Mainz, Germany, September 14-25.

Rafael Luís, Global Stability of Higher Dimensional Monotone Models: Applications to Leslie-Gower and Ricker Competitions Models, 21st International Conference on Difference Equations and Applications, Bialystok, Poland, July 19-25.

Marco Mackaay, Web bimodules, skew Howe duality and Webster's knot homology in type A, Introductory workshop connected to the Representation Theory Program, Mittag-Leffler Institute, Uppsala University, Sweden, February 26-28.

Marco Mackaay, Web-bimodules over Webster's cyclotomic tensor algebras and comparison of knot homologies in type A, Special Session on New trends in representation theory, AMS-EMS-SPM Joint International Meeting, Universidade do Porto, Porto, June 10-13.

Marco Mackaay, Web bimodules, foams and Webster's knot homology in type A, Algebra, Geometry and Topology seminar, University of Melbourne, Australia, June 26.

Marco Mackaay, Categorification of quantum algebras, their representations and knot invariants, Algebra and Logic Seminar, Universidade Nova de Lisboa, December 9.

Pedro Martins Rodrigues, Periodic Paths on Non-autonomous Graphs, Dynamical Systems Seminar, Brigham Young University, Utah, USA, February 26.

José Matias, A dimension reduction result in the framework of structured deformations, AIMS-EMS-SPM Joint International meeting, Porto, June 10-13.

Margarida Mendes Lopes, Constraints on the invariants of irregular surfaces, Algebraic Geometry, Joint BMC/BAMC Colloquium, Cambridge, UK, March 30.

Margarida Mendes Lopes, The (algebraic) fundamental group of surfaces with small invariants, Geometry Seminar, FCUL, Universidade de Lisboa, October 16.

Margarida Mendes Lopes, On the algebraic fundamental group of surfaces of general type, I and II, School and Workshop on Algebraic surfaces and related topics, ICTS Bangalore, Bangalore, India, November 20-21.

Margarida Mendes Lopes, Algebraic surfaces of general type , Short Course, Tata Institute for Fundamental Research, November-December 2015.

Margarida Mendes Lopes, On fibrations of surfaces, IIT Bombay, Mumbai, India, December 7.

Margarida Mendes Lopes, Constraints on the invariants of irregular surfaces, Mathematics Colloquium, Tata Institute for Fundamental Research, Mumbai, India, December 10.

Léonard Monsaingeon, A Wasserstein gradient flow approach to Poisson-Nernst-Planck equations, Analysis seminar, CMUC, Universidade de Coimbra, February 6.

Léonard Monsaingeon, A new optimal transport distance between nonnegative measures and application to a model of population dynamics, Conference on Gradient flows in Paris, Université Pierre-et-Marie-Curie, Paris-Jussieu, France, June 23.

Léonard Monsaingeon, A new optimal transport distance between nonnegative measures, Conference on Trends in Non-Linear Analysis 2015, SISSA, Trieste, Italy, July 1.

Léonard Monsaingeon, A new optimal transport distance between nonnegative measures in R^d, International Workshop on Elliptic and Kinetic Partial Differential Equations, IMPA, Rio de Janeiro, Brasil, July 10.

Léonard Monsaingeon, A new optimal transport distance between nonnegative measures, Analysis seminar, Universidade Nova de Lisboa, Caparica, September 16.

Léonard Monsaingeon, A new optimal transport distance between nonnegative measures in R^d, International Workshop on Calculus of Variations and its Applications, Universidade Nova de Lisboa, Caparica, December 18.

José Mourão, Imaginary time in Kähler geometry, quantization and tropical amoebas (5-lecture minicourse), Université de Gèneve, Switzerland, October 27 - November 12.

José Mourão, Quantum Mechanics versus Complex Geometry, 5-lecture minicourse, Physics Department, Beijing Normal University, December 8-14.

José Mourão, Quantum Mechanics and Complex Observables, Colloquium, Physics Department, Beijing Normal University, December 17.

José Natário, Strong cosmic censorship in spherical symmetry, GR 100 years in Lisbon, IST, December.

João P. Nunes, Complex time evolution in geometry and quantization, Open Day CMAT, Universidado do Minho, Braga, March.

João P. Nunes, Complex time evolution in geometry and quantization, Geometry Seminar, CMAF, Universidade de Lisboa, November.

Henrique M. Oliveira, Huygens Synchronization of two clocks in the same wall. Theory and experiment, Seminario de Sistemas Dinâmicos, Universidade de Murcia, Spain, February 12, 2015

Henrique M. Oliveira, Topological equivalences for one-parameter bifurcations of maps, Mathematics Seminar, The University of Exeter, UK, March 16.

Henrique M. Oliveira, Huygens synchronization of two clocks - From general models to a particular case, GoLP VIP Seminar, IST, Universidade de Lisboa, October 8.

Lina Oliveira, Reflexive spaces of operators, Invited Mini Symposium (IMS3): Algebraic Methods in Operator Theory, MatTriad 2015 Conference on Matrix Analysis and its Applications, Universidade de Coimbra, September 7-11.

Lina Oliveira, On the geometry of the unit ball in a JB*-triple, Special Session on Nonassociative algebras and related topics, AMS-EMS-SPM Joint International Meeting 2015, Porto, Portugal, June 10-13.

Milena Pabiniak, Gromov width of polygon spaces,Geometry Seminar, IRMA Strasbourg, February 2.

Milena Pabiniak, On displaceability of pre-Lagrangians in toric contact manifolds, Bochum, Köln, Münster joint Seminar on Symplectic and Contact Geometry, March 27.

Milena Pabiniak, On displaceability of pre-Lagrangians in toric contact manifolds, Israel Mathematical Union, Israel, May 27-31.

Milena Pabiniak, On displaceability of pre-Lagrangians in toric contact manifolds, Special Session Contact and Symplectic Topology, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June 10-13.

Milena Pabiniak, Arnold Conjectures and introduction to the generating functions technique, Oberseminar Differentialgeometrie, Max Planck Institute for Mathematics, Bonn, November 12.

Carlos Rocha, Sturm global attractors as regular CW-complexes, Equadiff 2015, Lyon, France, July 6.

Rafael Sasportes, Self-similar behaviour in an island growth model with constant monomer input, Special Session on Cluster Evolution Equations: Coagulation, Fragmentation, and Related Systems, AMS–EMS–SPM International Meeting, Porto, June 11.

Rafael Sasportes, Rates of convergence to scaling profiles and the preservation of memory of the initial condition, Universidade Aberta, Lisbon, October 27.

Marko Stosic, HOMFLY homology of knots, I and II, two seminar talks at the Program Knot homologies, BPS states, and SUSY gauge theories, Simons Center for Geometry and Physics (SCGP), Stony Brook, USA, May.

Marko Stosic, Colored HOMFLY-PT homology of knots and links, and recursion relations, invited lecture, Workshop on Mathematics and physics of knot homologies, Simons Center for Geometry and Physics (SCGP), Stony Brook, USA, June 1-5.

Marko Stosic, Lie superalgebras and double affine Hecke algebras in colored HOMFLYPT knot invariants, Special Session on New Trends in Representation Theory, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June 10-13.

Marko Stosic, Homological Invariant of Knots and applications in number theory, invited Colloquium lecture, Mathematical Institute SANU, Belgrade, Serbia, April 24.

Marko Stosic, Equiangular Tight Frames, Mattriad 2015 Conference, Coimbra, September 7-11.

Hugo Tavares, Existence and symmetry of least energy nodal solutions for Hamiltonian elliptic systems, Minisymposia on New Trends on Concentration Phenomena in Nonlinear Elliptic Equations, Equadiff 2015, Lyon, France, June 6-10.

Hugo Tavares, Some aspects of cooperative and competitive gradient elliptic systems , Università di Roma La Sapienza, October 29.

Hugo Tavares, Semitrivial and fully nontrivial solutions for cubic Schrödinger systems, 1st joint meeting Brazil-Spain in Mathematics, Special Session on Elliptic Partial Differential Equations, Fortaleza, Brazil, December 7-10.

Hugo Tavares, Existence and regularity of solutions to optimal partition problems involving Laplacian eigenvalues, Workshop on Calculus of Variations and its Applications, on the occasion of Luísa Mascarenhas 65th birthday, FCT-UNL, Portugal, December 17-19.

João Teixeira, Global existence and regularity of periodic and stationary solutions of the n-dimensional Navier-Stokes equations via discretizations, Special Session on Nonstandard Analysis and Applications, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June 10-13.

Maria Vaz Pinto, Regularity of Vanishing Ideals associated to Graphs, Special Session on Commutative Artinian Algebras and their Deformations, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June 10-13.

Maria Vaz Pinto, Regularity of Vanishing Ideals associated to Bipartite Graphs, Special Session on Commutative Algebra, AMS Fall Eastern Sectional Meeting, New Brunswick, NJ, USA, November 14.

Juha Videman, On systems of PDEs modeling competitive contaminant transport in porous media, Analysis Seminar, Universidade Nova de Lisboa, Caparica, May 6.

Alfonso Zamora, GIT Characterizations of Harder-Narasimhan filtrations, Seminar, University of Heidelberg, Germany, April.

Alfonso Zamora, GIT Characterizations of Harder-Narasimhan filtrations, Seminar, Institute of Mathematics, Johannes Gutenberg University, Mainz, Germany, April.

Alfonso Zamora, GIT Characterizations of Harder-Narasimhan filtrations, Seminaire Geometrie, Dynamique et Topologie, Institut de Mathematiques de Marseille, France, April.

Alfonso Zamora, GIT Characterizations of Harder-Narasimhan filtrations, AMS-EMS-SPM Joint International Meeting, Porto, Portugal, June.

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 2015:

Artur Alho, PhD in Mathematics, Universidade do Minho, 2012. Research areas: General Relativity – future and past asymptotics of cosmological models, spherically symmetric collapse with positive cosmological constant. Supported by an FCT postdoctoral grant (Apr. 2013–Mar. 2016).

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

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

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

L. Filipe Costa, PhD in Physics, Universidade do Porto, 2012. Research areas: General Relativity – gravitomagnetic effects, dynamics of ex-

tended test bodies, gravito-electromagnetic analogies. Supported by an FCT postdoctoral grant (May 2013–Apr. 2016).

Yunhyung Cho, PhD in Mathematics, Korea Advanced Institute of Science and Technology, 2010. Research areas: equivariant symplectic geometry. Supported by an FCT project grant (Sep. 2014–Aug 2015).

Ricardo Couso-Santamaria, PhD in Physics, Universidad de Santiago de Compostela, 2014. Research areas: topological string theory, resurgence theory, matrix models and supersymmetric gauge theories. Supported by an FCT project grant (Nov. 2014–Oct 2015) and by CAMGSD (Nov. 2015-June 2016).

Gonçalo Aprá Dias, PhD in Theoretical Physics, IST, 2008. Research areas: fluid mechanics, water waves. Supported by an FCT postdoctoral grant (Oct. 2010–Sep. 2016).

João Esteves, PhD in Physics, IST, 2011. Research area: symplectic geometry, geometric quantization and mathematical physics. Supported by a CAMGSD postdoctoral grant (Nov. 2011–Jan. 2012) and by an FCT postdoctoral grant (Feb. 2012–Jan. 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 a CAMGSD postdoctoral grant (Jan. 2013–Jun. 2014) and by an FCT postdoctoral grant (Jul. 2014–Jun. 2017).

Leonard Monsaingeon, PhD in Mathematics, University of Toulouse 3, 2011. Research areas: elliptic-parabolic PDE's, free boundaries and wave propagation, reaction-diffusion, mass transport methods. Supported by an FCT postdoctoral grant (Sep. 2013–Sep.2016).

Silvia Nagy, PhD in Physics, Imperial College London, 2015. Research areas: mathematical physics, string theory. Supported by a CAMGSD postdoctoral grant (Sept. 2015-Aug. 2016).

Suresh Nampuri, PhD in Physics, TIFR, 2012. Research areas: uncovering mathematical structures in the Hilbert space of quantum gravity. Supported by an FCT project grant (June 2015–May 2016).

Milena Pabiniak, PhD in Mathematics, Cornell University, 2012. Research areas: equivariant cohomology for Hamiltonian group actions, Gromov width of coadjoint orbits, displaceable and non-displaceable Lagrangian subspaces. Supported by an FCT postdoctoral grant (Jan. 2013–Dec. 2016).

Hugo Tavares, PhD in Mathematics, Universidade de Lisboa, 2010. Research areas: partial differential equations, variational methods. Supported by the FCT Investigator 2012 Program through a Starting Grant (Sep. 2013–Aug. 2018)

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

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

Alfonso Zamora, PhD in Mathematics, Universidad Complutense de Madrid, 2013. Research areas: algebraic geometry, moduli spaces, GIT, stability conditions. Supported by FCT project grants (Nov. 2013–Jun. 2015).

7 Student supervision

7.1 Doctoral theses

The following doctoral theses were completed in 2015 under the supervision of members of the Center (the names of the student and the CAMGSD supervisor(s) are marked in **bold** characters):

Aleksandra Marinkovic. PhD in Mathematics, Instituto Superior Técnico. April 2015. *Displaceability and Fillability on Toric Symplectic and Contact Manifolds.* Supervised by **Miguel Tribolet de Abreu**, co-supervised by **Milena Dorota Pabiniak**.

Muna Khaled Khaleel Abu Alhalawa. PhD in Mathematics, Instituto Superior Técnico. July 2015. *Flip Bifurcations for P-Periodic Maps.* Supervised by **Henrique Manuel de Oliveira**.

7.2 Graduate students

The following graduate students were supported by FCT project fellowships in 2015:

João Pedro Paulos. MSc student, fellowship supervised by Paulo Pinto (01/06/2014 - 31/08/2015).

João Pedro Santos. MSc student, fellowship supervised by Maria Vaz Pinto (01/06/2014 - 31/08/2015).

Diana Macedo. MSc student, fellowship supervised by Rosa Sena-Dias (04/07/2015 - 30/04/2016).

Nuno Alves. MSc student, fellowship supervised by João Pimentel Nunes (05/07/2015 - 30/04/2016).

Rodrigo Vicente. MSc student, fellowship supervised by José Natário (01/07/2015 - 30/04/2016).

Azizeh Nozad. PhD student, fellowship supervised by Carlos Florentino (01/06/2015 - 30/04/2016).

8 Publications in 2015

8.1 Publications which appeared in 2015

Articles in refereed international journals

[1] M. Abbott and I. Aniceto. Macroscopic (and microscopic) massless modes. *Nuclear Phys. B*, 894:75–107, 2015. arXiv:1412.6380.

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8.3 Manuscripts submitted (but not yet accepted) in 2015

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[2] J. F. Alves and A. Bravo and H.M. Oliveira. Demographic parameters for Infinite Leslie matrices via kneading determinants. Submitted.

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[5] F. Balibrea, H. M. Oliveira, and J. C. Valverde. Topological equivalences for one-parameter bifurcations of maps. arXiv:1503.03700.

[6] A. C. Barroso, J. Matias, M. Morandotti, and D. R. Owen. Explicit formulas for relaxed disarrangement densities arising from structured deformations. arXiv:1508.06908.

[7] F. Bento and P. Lopes. The minimum number of Fox colors modulo 13 is 5. arXiv:1508.07559.

[8] F. Bozorgnia. Convergence of the inverse power method for the first eigenvalue of the p-Laplace operator. Submitted.

[9] F. Bozorgnia. Numerical investigation of the eigenfunctions of infinity Laplace operator. Submitted.

[10] F. Bozorgnia and K. Wang. Long range spatially segregation elliptic system. Submitted.

[11] D. Bragança and R. Picken. Invariants and TQFT's for cut cellular surfaces from finite groups. arXiv:1512.08263.

[12] E. B. Cabral, S. Elaydi, and R. Luís. Global stability of higher dimensional monotone maps. Submitted.

[13] F.S. Cal, G.A. S. Dias, B.M.M. Pereira, G.E. Pires, K.R. Rajagopal, and J.H. Videman. On the lubrication approximation for a class of viscoelastic fluids. Submitted.

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9 Partnership and outreach

Participation in the Programme Novos Talentos em Matemática

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

Participation in the IST Winter School for Undergraduates

Escola de Inverno de Matemática (EIM2015), IST, February 2–4, 2015.

Summer School for High School Students

Escola de Verão de Geometria: 100 anos de Relatividade Geral, IST, July 13–17, 2015.

Organizers: Sílvia Anjos, José Natário e João Pimentel Nunes (CAMGSD).

Outreach activities by individual members

L. Filipe Costa presented the oral communication "Teoria da Relatividade Geral" at the *I Jornadas de Ciência de Arouca*, December 18-19.

Fernando P. da Costa, "Os porquês da matemática", Colégio Militar, Lisbon, February 13.

Fernando P. da Costa, "Literacia financeira, matemática e inclusão social", talk at the conference *Financial literacy and social inclusion of youth*, Espaço Novo Banco, Lisbon, July 2.

Fernando P. da Costa writes the monthly opinion column "Intervalos" to the website *Clube de Matemática* of the Portuguese Mathematical Society.

Fernando P. da Costa was interviewed by TSF Radio about "Mathematical Anxiety" broadcast in the program *TSF Pais & Filhos*, June 19.

Hugo Tavares was scientific reviewer of the 11th grade high school Mathematics manual for the Publisher Santillana.

Hugo Tavares presented a talk at the workshop "Programas e Metas Curriculares de Matemática A - 10º ano" - Jornadas Pedagógicas Santillana, a workshop for high school teachers about the changes in the math curriculum, Lisbon, January 17; Porto, January 24.

10 Personal notes

Miguel Abreu visited the Universidade Federal do Rio de Janeiro, Brazil, from March 2 to March 25, 2015, as a Special Visiting Professor funded by a CNPq grant.

Miguel Abreu visited the Institute Mittag-Leffler, Sweden, from September 7 to December 11, as an invited participant of the research program Symplectic geometry and topology.

Sílvia Anjos was member of the Organizing Committee of the IX Workshop on Symplectic Geometry, Contact Geometry and Interactions, Lyon, France, January 29–31.

Cristina Câmara organized an Invited mini-symposium on *Algebraic Methods in Operator Theory* at the MAT TRIAD 2015 Conference, Coimbra, Portugal, September 7-11.

Michele Cirafici will be supported by the FCT Investigator 2014 Programme Development Grant from February 2015 to January 2020.

Fernando P. da Costa is the current president of the Portuguese Mathematical Society.

Margarida Mendes Lopes acted as visiting professor at the Tata Institute for Fundamental Research, Mumbai, India, from November 10 to December 15.

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

Lina Oliveira's article (with C.M. Edwards) *Local facial structure and norm-exposed faces of the unit ball in a JB*-triple*, was picked by the Journal of Mathematical Analysis and Applications as Editors' choice.

Roger Picken was a member of the Scientific Committee of the XXIV International Fall Workshop on Geometry and Physics, Zaragoza, Spain September 1-4.

Marco Mackaay, José Mourão and Roger Picken, together with two co-organisers, were granted 10.000€ by the European Science Foundation through the Applied and Computational Algebraic Topology network to organize the XXI Oporto Meeting on Geometry, Topology and Physics in February, devoted to the theme Applications of Topology.

Rafael Sasportes organized the First Graduate Summer School at the Universidade de Évora, June 2-5.

Marko Stosic organized an Invited Mini-Symposium on *Matrix Theory, applications and engineering* at the MAT TRIAD 2015 conference, Coimbra, Portugal, September 11.

Marko Stosic visited the American Institute of Mathematics (AIM), San Jose, California, USA, within the scope of the AIM SQuaRE research program.

Hugo Tavares organized a Thematic Session on *Higher order PDEs and systems* at the Workshop in Nonlinear PDEs, Brussels, Belgium, September 7–11.

João Teixeira Pinto was part of a University of Lisbon Committee in charge of organizing exhibitions, conferences and social gatherings to celebrate the Centennial of José Sebastião e Silva.

Juha Videman was a member of the Scientific Committee of the Sixth International ECCOMAS Conference on Computational Methods in Marine Engineering, Rome, Italy, June 15–17.