CRM
CENTRE DE RECERCA MATEMÀTICA

EXCELENCIA MARÍA DE MAEZTU
2022 - 2025

ANNUAL REPORT

2024

Institut d'Estudis Catalans

Generalitat de Catalunya

CERCA Centres de Recerca de Catalunya

UAB Universitat Autònoma de Barcelona

CONTENTS 2024

CONTRIBUTIONS: CRM management, research staff, administrative staff, and the communications team.
GRAPHIC DESIGN AND LAYOUT: CRM Comm
IMAGES: Property of the Centre de Recerca Matemàtica (CRM)
COVER AND BACK COVER: CRM Comm

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DIRECTOR'S FOREWORD

Taking on the role of Director of the Centre de Recerca Matemàtica (CRM) in 2024 has been both an honour and a challenge, especially at a crucial moment in the center's history. This year, we celebrated the 40th anniversary of the CRM, a milestone that invites both reflection and ambition.

A key step forward this year has been the renewal of affiliations for researchers from the Universitat Autònoma de Barcelona (UAB), the Universitat de Barcelona (UB), and the Universitat Politècnica de Catalunya (UPC). This process has strengthened our ties with the Catalan university system, ensuring a solid foundation for the future. In parallel, we have also initiated the process of formally including the UB and UPC in the CRM's Board of Trustees, a decisive step toward deeper institutional integration.

Beyond these structural developments, 2024 has been a year of outstanding scientific activity. CRM researchers have published over 120 papers this year, further advancing mathematical knowledge and reinforcing our role as a leading research centre. The research schools organised by CRM researchers and aimed at young mathematicians —the Hypatia Graduate School, BIMR, JISD, and BAMB—have continued to expand, attracting early-career researchers and providing them with an environment where they can develop their careers. The SIJIMat seminar series has also gained momentum, hosting nine sessions and serving as a valuable platform for our young researchers to exchange ideas.

One of the year's standout moments was welcoming Terence Tao for the annual CRM Colloquium, a visit that underscored the global reach of mathematics and the importance of keeping the CRM as a hub for intellectual conversation. Another highlight was the recognition of Xavier Tolsa, who received the Premio Nacional de Investigación, celebrating his contributions to mathematics.

Our Knowledge Transfer Unit (KTU) has secured competitive projects in collaboration with institutions, ensuring that CRM research remains at the forefront of real-world applications. We have also formalised a collaboration agreement with the Centre for Genomic Regulation (CRG), opening new avenues for interdisciplinary research at the interface of mathematics and life sciences.

Looking ahead, I see a centre that remains well-connected to both the local academic ecosystem and the global research community. While challenges persist, the talent, vision, and dedication that define the CRM continue to be strong. I want to thank everyone who has contributed to making 2024 a remarkable year.

CARME CASCANTE
CRM Director

01 THE CRM

INTRODUCTION

The Centre de Recerca Matemàtica was established in 1984 by Professor Manuel Castellet as a centre of the l'Institut d'Estudis Catalans (IEC, the Catalan Academy), in the premises of the Universitat Autònoma de Barcelona (UAB). It is the oldest mathematics research institute in Spain. Presently, the CRM is a consortium between the Generalitat de Catalunya (the Catalan Government), represented by its Minister of Enterprise and Knowledge, the IEC and the UAB. The CRM belongs to the CERCA Agency of Research Centres sponsored by the Catalan Government, and is a member of ERCOM (European Research Centres in Mathematics), a committee of the European Mathematical Society, together with other European centres of a similar nature. The CRM is currently the managing institution of the Barcelona Graduate School of Mathematics (BGSMath).

Since 2009, the CRM's budget has been part of the public budget of the Catalan Government. Core funding is provided by the Catalan government through yearly contracts. Other funding is obtained through competitive calls of the European Union, the Spanish Ministries or the Generalitat. The CRM was awarded in the year 2000 with the Narcis de Monturiol Plate Award to Scientific and Technological Merit. In 2016 the CRM received the María de Maeztu Unit of Excellence award from the Spanish Research Agency (AEI), a prestigious accolade that recognizes research institutions with highly competitive strategic programs operating at the frontiers of knowledge. In 2020 the CRM received the award for the second time. Since 2015, the CRM has held the HR Excellence in Research Award, granted by the European Commission to give public recognition to research institutions that have made progress in aligning their human resource policies with the principles set out in the "Charter & Code".

One of the core roles of the CRM is the organisation of international research programmes on selected topics in the field of mathematics, mathematical sciences and all its applications. The CRM hosts every year a number of leading researchers from all around the world to interact with local researchers over extended periods. The CRM, as a member of the CERCA network of research centres in Catalunya, is strongly committed to fostering and enhancing research throughout the country. Each research program held at the CRM spawns new collaborations among researchers from different backgrounds and levels of expertise during the lectures, seminars and informal interaction, which the CRM building has been designed specifically to encourage.

CRM's Mission Statement

The remit of the Centre de Recerca Matemàtica is to be a resource of excellence in mathematical research and training at international level. Its specific aims are:

1. High-quality research of international standing in mathematics, including a special emphasis on real-world applications carried out in a collaborative or interdisciplinary context.
2. Knowledge transfer based on validated mathematical research, with special emphasis on concrete implementations of justified models that address emergent problems with societal impact.
3. Advanced training in the field of mathematics, through collaboration and synergies with other research institutions.
4. Dissemination of the advances in mathematics within both the wider academic community and society in general.

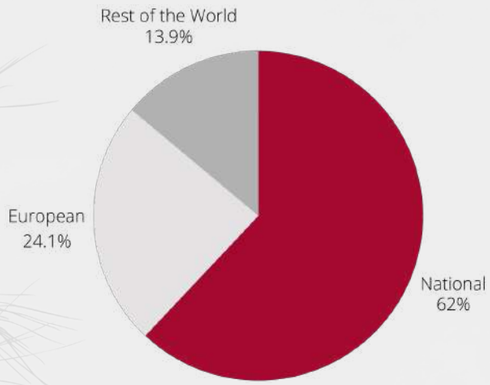
CRM IN NUMBERS

CRM PEOPLE

174

♂ 70%

♀ 30%



SCIENTIFIC PAPERS

123

DOCTORAL THESES

10

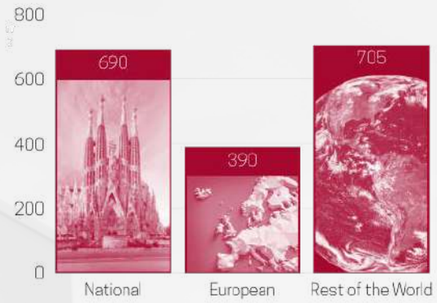
FUNDING 2024

SCIENTIFIC ACTIVITIES

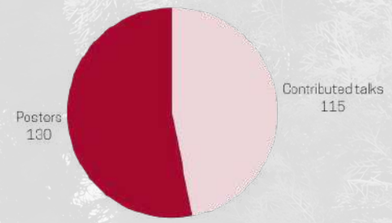
41

TOTAL PARTICIPANTS

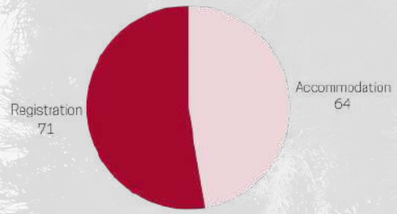
1.988



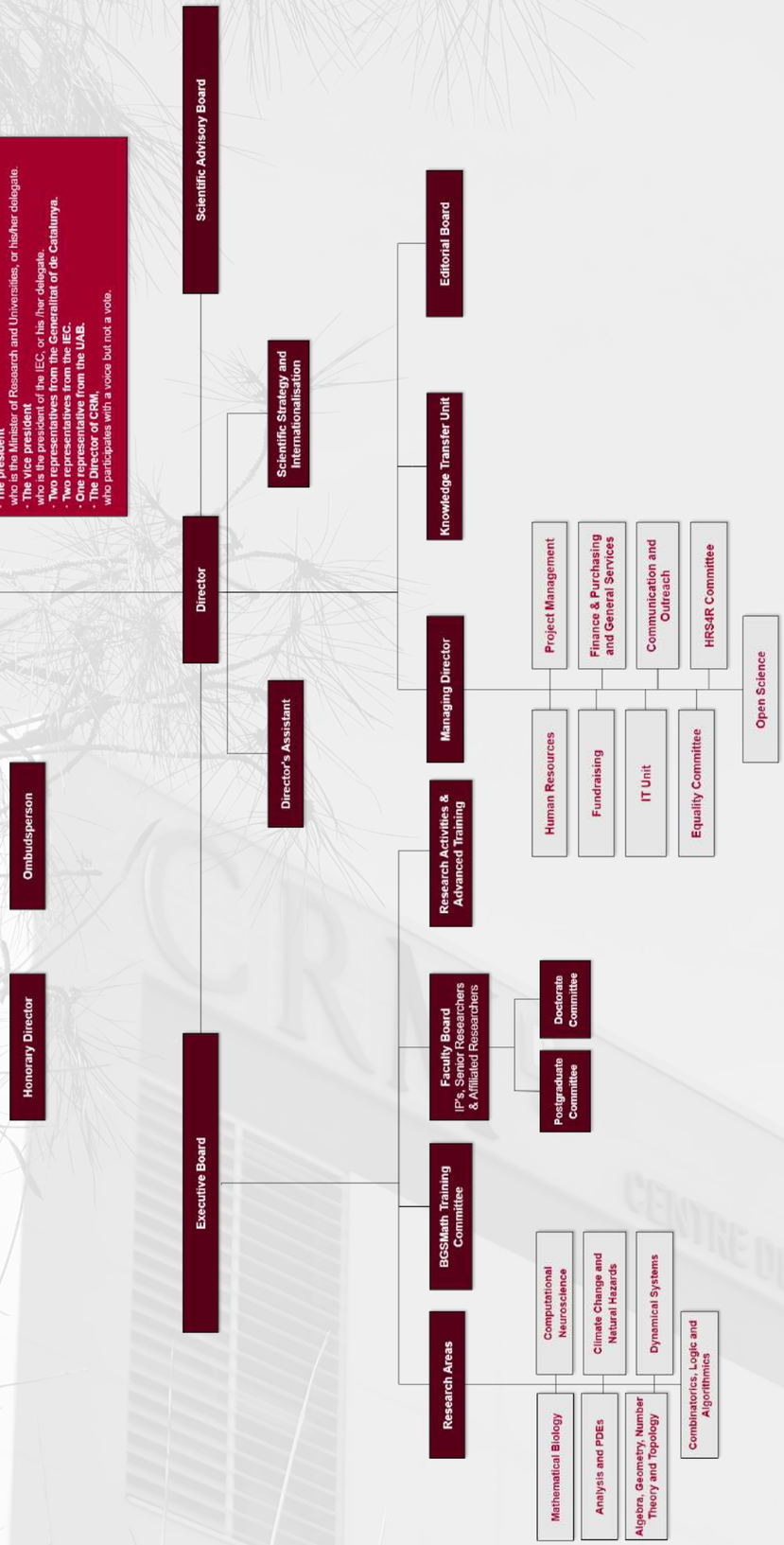
CONTRIBUTIONS



GRANTS



ORGANIZATIONAL CHART



CRM Consortium

CERCA Centres de Recerca de Catalunya · Generalitat de Catalunya · Institut d'Estudis Catalans · UAB Universitat Autònoma de Barcelona

Governing Board

The Governing Board, the highest level of decision and management of the CRM, is responsible for overseeing the centre's activity. It's also responsible of electing a Director to serve for a period of four years.

The board consists of:

- The president, who is the Minister of Research and Universities of the **Generalitat de Catalunya**, or its delegate.
- The vice president, who is the president of the **Institut d'Estudis Catalans**, or its delegate.
- Three representatives from the **Generalitat of de Catalunya**.
- Two representatives from the **Institut d'Estudis Catalans**.
- One representative from the **Universitat Autònoma de Barcelona**.
- The **Director of CRM**, who participates with a voice but not a vote.

The current Director of the CRM is Professor **Carme Cascante**, who was elected for the period from 2024 to 2028 in the meeting of the Governing Board on July 2024. Professor **Manuel Castellet**, who was the director of the CRM since its creation in 1984 until 2007, is the CRM Honorary Director.

Scientific Advisory Board

Scientific Advisory Board is the organ responsible of defining the strategic direction of the centre and in advising on and shaping its scientific programme. It consists of prestigious personalities within the scientific scope of the Centre, appointed by the Governing Board, after proposal by the Director.

Professor **Nicolas Brunel**, from the Duke University

Professor **Helen Byrne**, from the Oxford University

Professor **Albert Cohen**, from the Université Pierre et Marie Curie

Professor **Kathryn Hess**, from the École Polytechnique Fédérale de Lausanne

Professor **Ari Laptev** from the Imperial College London

Professor **Gábor Lugosi**, from the Universitat Pompeu Fabra

Professor **Robert MacKay**, from the University of Warwick (Chairman)

Professor **Alessandra Micheletti**, from the Università degli Studi di Milano

Professor **Carmen Miguel** from the Universitat de Barcelona

Professor **Peregrina Quintela**, from the Universidad de Santiago de Compostela

Professor **Mikhail Sodin**, from the Tel Aviv University

Professor **Katrin Wendland** from the Freiburg University

Executive Board

The Executive Board is the body responsible for advising and providing support in the planning, organization, and management of the center. It is composed, at the proposal of the director, of the following researchers:

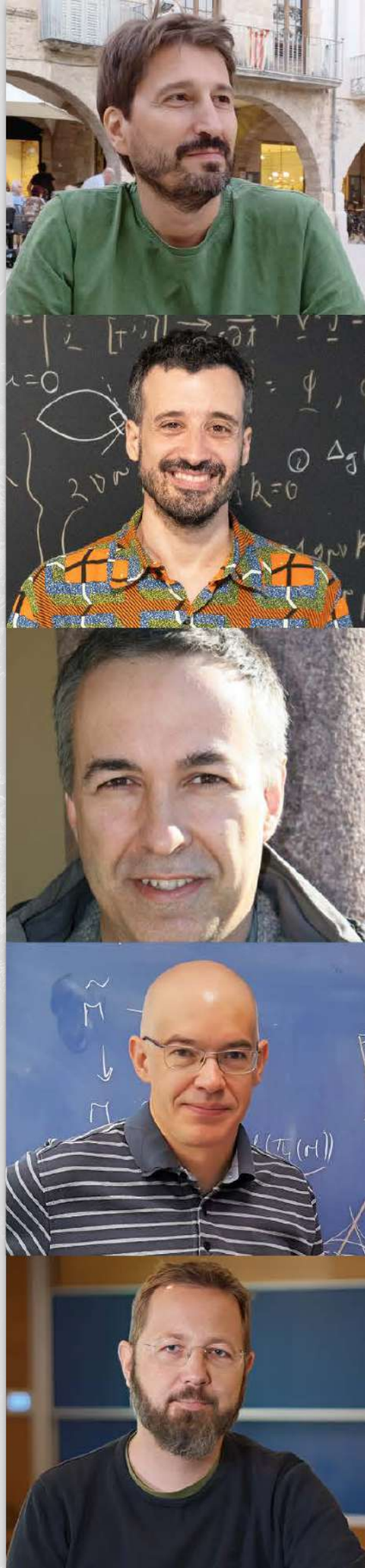
Josep Alvarez (UPC) – Responsible for BGSMath Training Unit

Marcel Guardia (UB) – Scientific Director of the Centre de Recerca Matemàtica

Joaquim Ortega (UB) – Responsible for Research Activities

Joan Porti (UAB) – Responsible for Visiting Programmes

Klaus Wimmer (CRM) – Responsible for Communication & Outreach



MARIA DE MAEZTU UNIT OF EXCELLENCE

The CRM was awarded by The State Research Agency (AEI) as a María de Maeztu Excellence Unit in the 2020 call. It was the second time that the CRM has hold the distinction. In 2022 the first batch of PhD candidates and postdoctoral researchers hired within the MdM project joined the institution.

The Centres and Units of Excellence 'Severo Ochoa' and Maria de Maeztu' programme aim to recognise public research organizations, in any scientific area, that stand out due to the relevance and impact of the results obtained during the previous reference period at an international level.

Consequently, the CRM is part of the SOMMa Alliance, to internationally promote, strengthen and maximise the value of the ground-breaking research produced by the Spanish 'Severo Ochoa' Centres and 'María de Maeztu' Units of Excellence and the scientific, and the social and economic impact it generates.

The Award provides two million euros for the proposed strategic research plan, aimed at consolidating CRM scientific capacities and boosting its talent attraction capacity for the duration of the project. It is obtained following a rigorous evaluation process performed by an international committee comprised of world-class scientists, in accordance with the most demanding standards.

The MdM programme is driven by the changes experienced by the CRM in recent years, aimed at tackling challenges presented by society and the need of blending pure and applied techniques to advance at the Frontiers of science. With the affiliations of more than sixty mathematicians from three renowned universities in Barcelona, the CRM has dramatically improved the quality and scope of the research carried out at the center, serving as a mathematical hub.

The scientific goals of the MdM structure are fundamental open problems which will be explored by the CRM research groups in the period 2021-2024. They are topics at the frontier of the current knowledge, which will rely on the training and recruitment actions to be achieved. The scientific direction of the project is led by its Scientific Director, Marcel Guardia. Each area has several coordinators combining the different teams at CRM together with recently affiliated researchers. The best research is done across different fields, leaving the comfort zone and thinking outside the box. This research can only be done through crossfertilization.

The CRM does and will continue fostering such approach in the period 2021-2024.

EXCELENCIA MARÍA DE MAEZTU

SOMM EXCELLENCE ALLIANCE

Partner Institutions

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

UNIVERSITAT DE BARCELONA

bcam basque center for applied mathematics

imus instituto de matemáticas universidad de sevilla

ICMAT INSTITUTO DE CIENCIAS MATEMÁTICAS

INSTITUTE FOR INTEGRATIVE SYSTEMS BIOLOGY

Universitat Pompeu Fabra Barcelona

IMAG INSTITUTO DE MATEMÁTICAS Universidad de Granada

Sponsorship

AGENCIA ESTATAL DE INVESTIGACIÓN

AGAUR Agència de Gestió d'Ajuts Universitaris i de Recerca

BBVA

European Commission

Unió Europea Fons europeu de desenvolupament regional

Fundació "la Caixa"

ICREA

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

Awards

HR EXCELLENCE IN RESEARCH

EXCELENCIA MARÍA DE MAEZTU

NETWORKS & INSTITUTIONAL COLLABORATIONS

European Mathematical Society

The European Mathematical Society (EMS) promotes the development of all aspects of mathematics in Europe, in particular mathematical research, the links between mathematics and society, the relations among European institutions, and mathematical education.

ERCOM

ERCOM is the acronym of the European Research Centers on Mathematics committee of the European Mathematical Society (EMS), composed by the scientific directors of European research centers in mathematics. The CRM has been a member of ERCOM since its foundation in 1997.

ICREA

The Catalan Institution for Research and Advanced Studies (ICREA) is a foundation supported by the Catalan Government whose aim is to recruit top scientists for the Catalan R & D system. The CRM participates actively in all the ICREA calls by presenting renowned mathematical researchers as candidates for ICREA positions.

SCM

The Catalan Mathematics Society (SCM) is a branch of the Institut d'Estudis Catalans (IEC). The main objective of the SCM is to cultivate mathematical science in a broad sense. That means and spreading the knowledge to Catalan society, promote its teaching and both theoretical and applied research. It is done by publishing all kinds of work that are oriented toward these goals.

REM

The Red Estratégica en Matemáticas (REM) was established in 2017 as a network made up of all the relevant nodes of research and mathematical transfer in Spain, effectively integrating the entire research community in this field, and taking advantage of its structure. The following challenges are proposed for Spanish mathematics in the next two years (2020-2021).

MATH-IN

The Spanish Mathematics-Industry Network (math-in) was born, as a private non-profit association, on September 30, 2011 with the signing of its Constitution Act in Santiago de Compostela. The network is currently made up of around forty research groups belonging to twenty Spanish universities and research centres. math-in focuses its activity on promoting and carrying out mathematical technology transfer to companies, organisations and institutions, thus fostering an increase in the competitiveness of both the research groups involved and the industry itself.

SOMMa

SOMMa's mission is to internationally promote, strengthen and maximise the value of the ground-breaking research produced by the Spanish 'Severo Ochoa' Centres and 'María de Maeztu' Units of Excellence and the scientific, social and economic impact it generates.

CoARA

The Centre de Recerca Matemàtica (CRM) has joined the Coalition for Advancing Research Assessment (CoARA), committing to fairer and more inclusive research evaluation. Rejecting flawed metrics like the Journal Impact Factor, the CRM embraces CoARA's principles, which prioritize qualitative peer review, recognize diverse research contributions, and promote transparency and ethical standards.

CELEBRATING FOUR DECADES OF THE CENTRE DE RECERCA MATEMÀTICA

The Centre de Recerca Matemàtica (CRM) marked four decades of excellence in 2024, celebrating its role as a leading institution dedicated to advancing mathematical research, international collaboration, and training young researchers in Catalonia.

On May 9th, the Centre de Recerca Matemàtica (CRM) commemorated its 40th anniversary with a distinguished event hosted at the Institut d'Estudis Catalans (IEC). The celebration included an insightful lecture by Madhu Sudan, a prominent mathematician from Harvard University, alongside addresses by significant institutional representatives and the three directors who have steered the CRM since its foundation. This anniversary provided a reflective pause, tracing the CRM's trajectory and acknowledging key moments and transformations over the past four decades.

Established in 1984 under the leadership of Manuel Castellet, professor at the Universitat Autònoma de Barcelona (UAB), CRM was created to elevate mathematical research capacity in Catalonia, promote dissemination, and foster international collaboration. Currently structured as a consortium comprising the Generalitat de Catalunya, IEC, and UAB, CRM is the oldest institution within the CERCA research network supported by the Catalan government and is a member of the European Research Centres on Mathematics (ERCOM). Over these years, CRM's excellence has been acknowledged through prestigious awards, such as the Narcís Monturiol Award and twice the María de Maeztu Unit of Excellence recognition.

Before CRM's founding, mathematical research in Catalonia was primarily university-based, limited to individual academic settings. The late 1970s and early 1980s saw significant improvements in the local research landscape, marked by increased international publications, high-profile visits, and strong doctoral outputs. Responding to this vibrant growth, CRM emerged as Spain's first institute solely dedicated to mathematics, uniting research efforts across Catalan universities. Its inception greatly enhanced cooperation among researchers, fostering a robust mathematical community in the region.

From its outset, CRM recognized the critical role human interaction plays in advancing mathematics, establishing itself as a central hub for international collaboration. Its facilities at UAB are specifically designed to facilitate productive exchanges of ideas, regularly hosting global events including advanced courses, seminars, and workshops. Each year, CRM welcomes numerous international visitors through initiatives such as the Lluís Santaló Scholarship and the Research in Pairs program, emphasizing collaborative engagement and long-term research stays.

CRM's enduring dedication to nurturing young talent is evident in its consistent support of early-career mathematicians and its commitment to diverse and inclusive research practices. Initiated in 1988, CRM's PhD fellowship program has steadily grown, aligning with the centre's expanded research framework established in 2008, which now spans eight research groups addressing fundamental and applied mathematical fields. With 126 affiliated researchers—including faculty from UAB, Universitat de Barcelona (UB), and Universitat Politècnica de Catalunya (UPC)—the CRM maintains a dynamic and inclusive environment, poised to continue its trajectory of impactful research and innovation into the future.

02 RESEARCH

NEUROSCIENCE

ANALYSIS AND PDE's

DYNAMICAL SYSTEMS

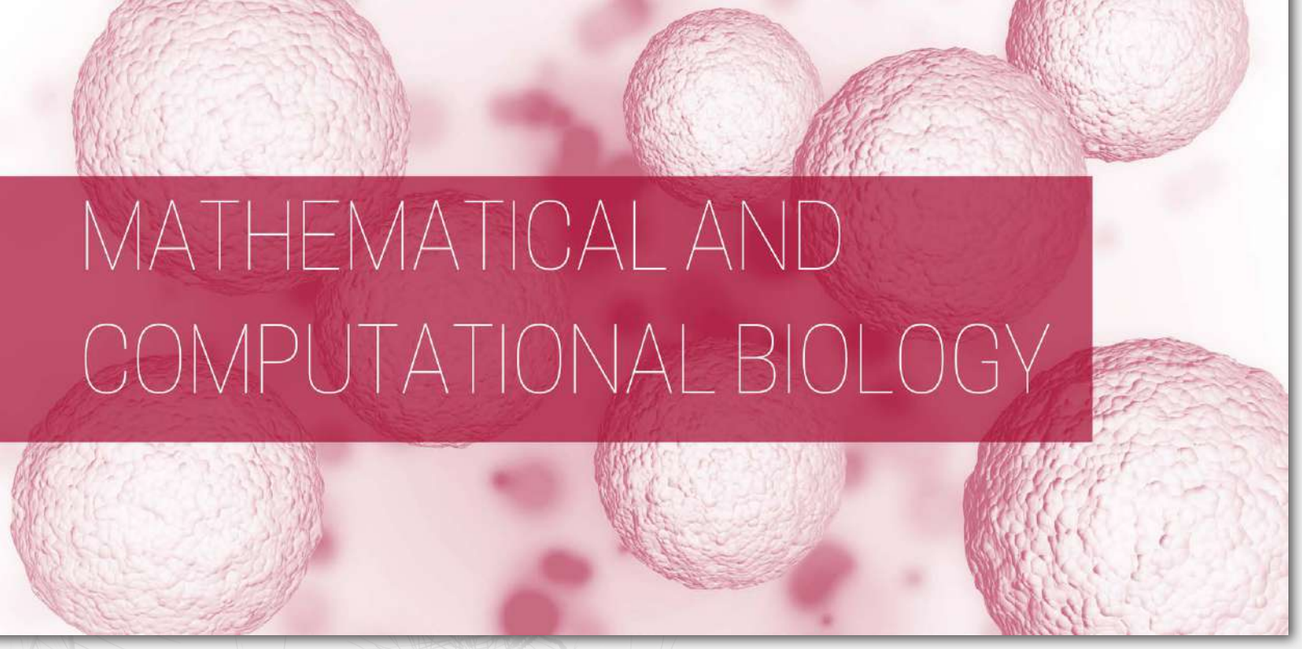
ALGEBRA, GEOMETRY AND NUMBER THEORY

COMBINATORICS, LOGIC AND ALGORITHMICS

COMPUTATIONAL AND MATHEMATICAL BIOLOGY

PHYLOGENETICS

CLIMATE CHANGE AND NATURAL HAZARDS



MATHEMATICAL AND COMPUTATIONAL BIOLOGY

The dynamics of biological systems is driven by interactions between many elements at a given level of biological organisation (e.g. molecular, cellular, organism), but also by the couplings that exist between said levels (e.g. from molecules to cells to populations). Such couplings are highly non-linear and make the analysis of complex biological systems extremely challenging. The remit of the Mathematical and Computational Biology is the development of new theory, models, techniques, and tools that are relevant to biologists and clinicians. For this purpose we use a plethora of mathematical techniques including stochastic multiscale models, dynamical systems theory, singular perturbation analysis, bifurcation analysis, morphometrics, dimensional reduction tools and efficient simulation methods, as well as statistics, machine learning or optimization. We tackle issues such as understanding how genetic variation leads to variation in the characteristics of organisms, the so-called genotype-phenotype map, the arising of such map in embryonic development, its influence in the direction of phenotypic evolution. We also formulate new models of virus evolution and therapies that account for intrinsic heterogeneity and noise, we study the design of new strategies to avoid drug resistance induced by cancer-cell heterogeneity and analyze the mechanisms of ageing. Our research is collaborative in nature and we make an effort to keep close collaborations with both biologists and medical practitioners.

MEMBERS

Senior Researchers: Tomás Alarcon | Silvia Cuadrado | Gissell Estrada-Rodriguez | Josep Sardanyés

Postdoctoral Researchers: Ielyaas Cloete | Filip Ivancic | Daria Stepanova

PhD Students: Juan Arellano | Oriol Llopis | Kevin Martínez | Stefano Pedarra | Amaia Vielba

ASSOCIATED RESEARCH UNITS

Dynamical Systems and Computational Virology, DysCoVir
i2SysBio - CRM CSIC Associated Unit

PUBLICATIONS

Sardanyés, J., Ivancic, F., & Vidiella, B. (2024). *Identifying regime shifts, transients and late warning signals for proactive ecosystem management*. Biological Conservation, 290, 110433. https://doi.org/10.1016/j.biocon.2023.110433

Lázaro, J. T., Albó, A., Alarcón, T., Elena, S. F., & Sardanyés, J. (2024). *No two without three: Modeling dynamics of the trio RNA virus-defective interfering genomes-satellite RNAs*. Communications in Nonlinear Science and Numerical Simulation, 133, 107987. https://doi.org/10.1016/j.cnsns.2024.107987

Jorba-Cuscó, M., Oliva-Zúniga, R. I., Sardanyés, J., & Pérez-Palau, D. (2024). *Optimal dispersal and diffusion-enhanced robustness in two-patch metapopulations: origin's saddle-source nature matters*. Theory in Biosciences, 143(1), 79–95. https://doi.org/10.1007/s12064-023-00411-2

Fontich, E., Guillamon, A., Perona, J., & Sardanyés, J. (2024). *Functional shift-induced degenerate transcritical Neimark-Sacker bifurcation in a discrete hypercycle*. International Journal of Bifurcation and Chaos, 34, 2450045. https://doi.org/10.1142/S0218127424500457

Cuyàs, E., Pedarra, S., Verdura, S., Pardo, M. A., Garcia, R. E., Serrano-Hervás, E., Llop-Hernández, A., Teixidor, E., Bosch-Barrera, J., López-Bonet, E., Martin-Castillo, B., Lupu, R., Pujana, M. A., Sardanyés, J., Alarcón, T., & Menendez, J. A. (2024). *Fatty acid synthase (FASN) is a tumor-cell-intrinsic metabolic checkpoint restricting T-cell immunity*. Cell Death Discovery, 10, 417. https://doi.org/10.1038/s41420-024-02184-z

Conte, M., Fernandez, V. C., Oliver, F. J., Alarcón, T., & Soler, J. (2024). *Emergence of cyclic hypoxia and the impact of PARP inhibitors on tumor progression.* NPJ Systems Biology and Applications, 10, 1. https://doi.org/10.1038/s41540-024-00453-2

NEUROSCIENCE

The computational neuroscience unit at the CRM was founded in 2012 and is made up of six Principal Investigators and their groups. The unit is an active member of a larger, Barcelona-wide Neuroscience community which includes theoretical, experimental and clinical groups located in a variety of university departments and research centers (www.barccsyn.org). Research in the computational neuroscience unit is largely focused on systems-level neuroscience. Broadly speaking, this involves investigating how large assemblies of interacting neurons give rise to animal and human behavior. Our approach is generally to combine computational modeling with data analysis.

MEMBERS

Senior Researchers: Toni Guillamon | Gemma Huguet | Alexandre Hyafil | Adrián Ponce | Alex Roxin | Klaus Wimmer

Postdoctoral Researchers: Gloria Cecchini | María da Fonseca | Jens-Bastian Eppler | Katerina Kalou | Martijn Wokke

PhD Students: Alexandra Antoniadou | Lucía Arancibia | Alexandre Garcia-Durán Castilla | Citlalli Vivar | Pan Ye

PROJECTS

PID2023-147627OB-I00
Neural network mechanisms underlying perceptual decision making and working memory
Principal Investigator: Klaus Wimmer
Funded by: MICINN

PUBLICATIONS

Fisco-Compte, P., Aquilué-Llorens, D., Roqueiro, N., Fossas, E., & Guillamon, A. (2024). *Empirical modeling and prediction of neuronal dynamics*. Biological Cybernetics. https://doi.org/10.1007/s00422-024-00986-z

Ortiz, A. J., Martin, V., Romero, D., Guillamon, A., & Giraldo, J. (2024). *Time-dependent ligand-receptor binding kinetics and functionality in a heterodimeric receptor model*. Biochemical Pharmacology, 225, 116299. https://doi.org/10.1016/j.bcp.2024.116299

Orieux, M., Guillamon, A., & Huguet, G. (2024). *Optimal control of oscillatory neuronal models with applications to communication through coherence.* Physica D: Nonlinear Phenomena, 467, 134267. https://doi.org/10.1016/j.physd.2024.134267

Ibañez, S., Sengupta, N., Luebke, J., Wimmer, K., & Weaver, C. M. (2024). *Myelin dystrophy impairs signal transmission and working memory in a multiscale model of the aging prefrontal cortex*. eLife, 12, RP90964. https://doi.org/10.7554/eLife.90964

Molano-Mazón, M., Garcia-Duran, A., Pastor-Ciurana, J., Hernández-Navarro, L., Bektic, L., Lombardo, D., de la Rocha, J., & Hyafil, A. (2024). *Rapid, systematic updating of movement by accumulated decision evidence.* Nature Communications, 15, 10583. https://doi.org/10.1038/s41467-024-53586-7

DEFENDED THESES

The Role of Behavioral Timescale Synaptic Plasticity for Memory Storage in Neural Networks
Student: Ye Li, Pan
Supervisor: Alex Roxin

SCIENTIFIC ACTIVITIES

Barcelona Summer School for Advanced Modeling of Behavior (BAMB!) 2024
15-24 July

OUTREACH

Klaus Wimmer
Neural Code
Festa de la ciència
June 7-9, 2024

PHYLOGENETICS

Our research group develops and improves methods of phylogenetic reconstruction based on mathematical tools, especially algebraic, semi-algebraic and geometrical tools. This involves studying molecular substitution models from a mathematical point of view to guarantee parameter identifiability and to provide model selection tools (including both the evolutionary model and the tree or network selection). Our research lies at the borders of phylogenetic reconstruction, algebraic statistics, algebraic geometry and computational algebra.

MEMBERS

Senior Researchers: Marta Casanellas | Jesús Fernández

Postdoctoral Researchers: Roser Homs

PUBLICATIONS

Casanellas, M., Garrote-López, M., & Zwiernik, P. (2024). Identifiability in robust estimation of tree structured models. Bernoulli. http://hdl.handle.net/2072/537452

SCIENTIFIC ACTIVITIES

Workshop in Women in Algebraic Statistics
8 – 18 July 2024
St John's College, University of Oxford

Colloquium, Department of Mathematics, UC3M
November 5, 2024

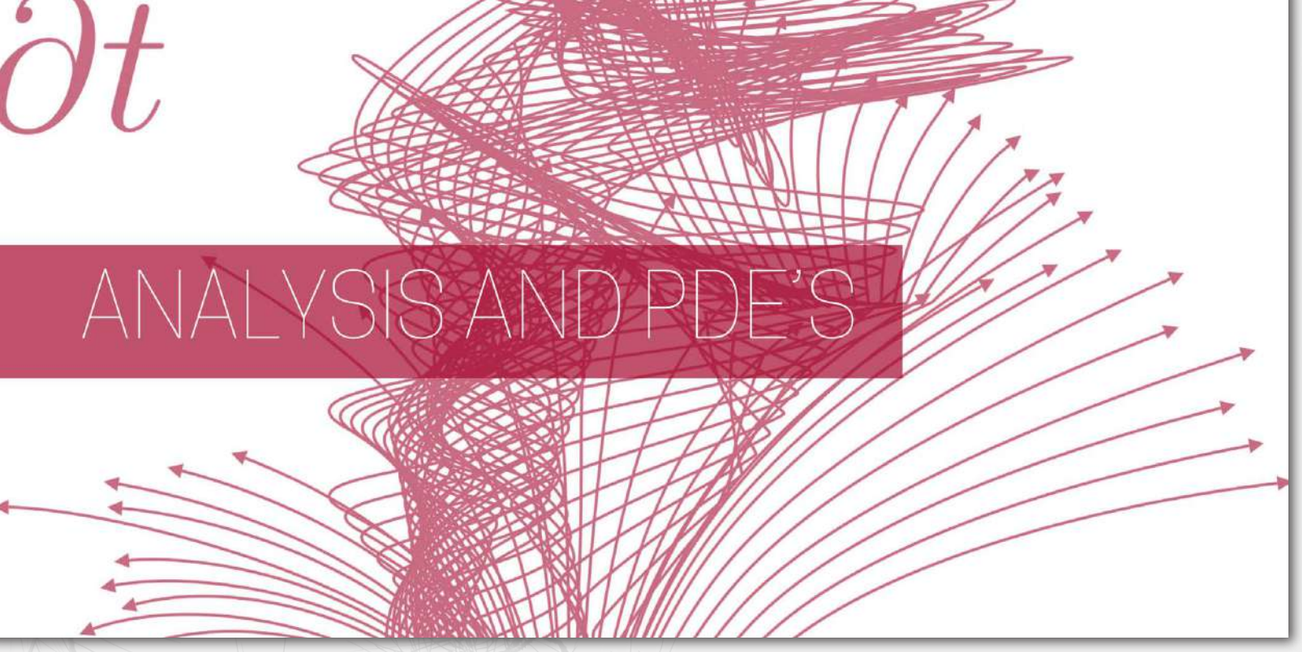
SIJIMat Semina Series

OUTREACH

Roser Homs
Participated in the 'Ments Meravelloses' podcast at CRM

Talk during the European Researchers' Night

(In)visibles i (O)cultes project closing talk
Museum of Natural Sciences of Barcelona



The research in Analysis and Partial Differential Equations at the CRM covers a broad range of topics, from classical function theory in one and several complex variables to the study of Banach spaces and its operators. The interplay between singular operators and geometric function theory has been very succesful. On PDE's the research is centered around reaction-diffusion and integro-differential equations (regularity and qualitative properties of solutions), population dynamics and biological evolution, as well as several wave problems in mathematical physics and mathematical modelling.

MEMBERS

Senior Researchers: Xavier Cabré | Carme Cascante | Albert Clop | Gyula Csato | Jordi Marzo | Albert Mas Blesa | Joan Mateu | Artur Nicolau | Joaquim Ortega | Jordi Pau | Xavier Ros Oton | Olli Saari | Tomás Sanz | Sergey Tikhonov | Xavier Tolsa

Postdoctoral Researchers: Egor Kosov | Alberto Maione | Niyaz Tokmagambetov

PhD Students: Joaquim Duran | Miquel Saucedo

PROJECTS

PID2023-150984NB-I00
Uncertainty principles, discretization, and related topics
Principal Investigator: Sergey Tikhonov
Funded by: MICINN

ERC-2023-COG 101123223
Stable solutions and nonstandard diffusions: PDE questions arising in Mathematical Physics (SSNSD)
Principal Investigator: Xavier Ros-Otón
Funded by: European Research Council

PUBLICATIONS

Torre, V. D. L., & Marzo, J. (2024). *Expected energy of zeros of elliptic polynomials*. Constructive Approximation. https://doi.org/10.1007/s00365-024-09684-2

Lv, X., & Pau, J. (2024). *Tent Carleson measures for Hardy spaces.* Journal of Functional Analysis, 287, 110459. https://doi.org/10.1016/j.jfa.2024.110459

Bellavita, C., & Nicolau, A. (2024). *One component bounded functions*. Computational Methods and Function Theory, 24, 121–148. https://doi.org/10.1007/s40315-023-00477-5

Gogatishvili, A., Opic, B., Tikhonov, S., & Trebels, W. (2024). *A unified approach to inequalities for K-functionals and moduli of smoothness*. Mathematische Zeitschrift, 307(24). https://doi.org/10.1007/s00209-024-03484-x

Aleman, A., Cascante, C., Fàbrega, J., Pascuas, D., & Peláez, J. (2024). *Words of analytic paraproducts on Hardy and weighted Bergman spaces.* Journal De Mathématiques Pures Et Appliquées, 188, 179–214. https://doi.org/10.1016/j.matpur.2024.05.002

Mourgoglou, M., & Tolsa, X. (2024). *The regularity problem for the Laplace equation in rough domains*. Duke Mathematical Journal, 173(9). https://doi.org/10.1215/00127094-2023-0044

Pinos, A. D., Nursultanov, E., & Tikhonov, S. (2024). *Fourier inequalities in Morrey and Campanato spaces*. Journal of Functional Analysis, 207(7). https://doi.org/10.1016/j.jfa.2024.110522

Bortz, S., Poggi, B., Tapiola, O., & Tolsa, X. (2024). *The A∞ condition, ε-approximators, and Varopoulos extensions in uniform domains*. Journal of Geometric Analysis, 34(7). https://doi.org/10.1007/s12220-024-01666-x

Lv, X. F., & Pau, J. (2024). *Tent Carleson measures for Hardy spaces*. Journal of Functional Analysis, 287, 110459. https://doi.org/10.1016/j.jfa.2024.110459

Duran, J., & Mas, A. (2024). *Convergence of generalized MIT bag models to Dirac operators with zigzag boundary conditions*. Analysis and Mathematical Physics, 14(4). https://doi.org/10.1007/s13324-024-00946-7

Saari, O., Wang, H. Y., & Wei, Y. H. (2024). *Sparse gradient bounds for divergence form elliptic equations*. Journal of Differential Equations, 413, 606–631. https://doi.org/10.1016/j.jde.2024.08.048

Cascante, C., Fàbrega, J., Pascuas, D., & Peláez, J. A. (2024). *On the radicality property for spaces of symbols of bounded Volterra operators*. Journal of Functional Analysis, 287(12). https://doi.org/10.1016/j.jfa.2024.110658

Brevig, O. F., Chirre, A., Ortega-Cerdà, J., & Seip, K. (2024). *Point evaluation in Paley-Wiener spaces.* Journal d'Analyse Mathématique, 153(2), 595–670. https://doi.org/10.1007/s11854-024-0338-z

Domínguez, O., & Tikhonov, S. (2024). *Truncated smooth function spaces*. Transactions of the American Mathematical Society, 377(12), 8877–8934. https://doi.org/10.1090/tran/9259

Domínguez, O., Li, Y. Q., Tikhonov, S., Yang, D. C., & Yuan, W. (2024). *A unified approach to self-improving property via K-functionals*. Calculus of Variations and Partial Differential Equations, 63(9). https://doi.org/10.1007/s00526-024-02833-2

Ivrii, O., & Nicolau, A. (2024). Analytic mappings of the unit disk which almost preserve hyperbolic area. Proceedings of the London Mathematical Society, 129(5). https://doi.org/10.1112/plms.70001

Ferreira, G. R., & Nicolau, A. (2024). Mixing and ergodicity of compositions of inner functions. Discrete and Continuous Dynamical Systems. https://doi.org/10.3934/dcds.2024157

DEFENDED THESES

Regularity theory for obstacle problems and boundary Harnack inequalities
Student: Clara Torres Latorre
Supervisor: Xavier Ros Oton

SCIENTIFIC ACTIVITIES

Math SOMMA Junior Meeting
CRM, October 2-4, 2024

Barcelona Analysis Conference 2024
Barcelona, June 3-7, 2024

Barcelona Introduction to Mathematical Research 2024
Barcelona, July 2024

OUTREACH

Xavier Ros Oton
Public lecture for the Universitat de l'Experiència, Barcelona (November 2024)

COMBINATORICS, LOGIC AND ALGORITHMICS

The combinatorics group explores discrete mathematics, a fundamental area in modern research due to its deep connections with theoretical computer science. Their work spans multiple disciplines, including probability, number theory, group theory, logic, and algorithm design.

A central focus is the study of random discrete structures, particularly random graphs and sets, using Erdos' probabilistic methods. These techniques allow for the analysis of typical behaviors, limiting properties, and real-world applications, such as understanding large networks. Another key interest lies in pseudorandomness and its role in computation. The hardness-vs-randomness trade-off, exemplified by Nisan and Wigderson's work, has reshaped algorithm design. The group examines whether hardness in symmetric computation models could help derandomize certain algorithms, a concept that played a crucial role in proving PRIMES is in P through the AKS algorithm.

Their research also delves into constrained random graphs and logic limit laws. By combining combinatorial, probabilistic, and logical methods, they study the enumeration of structured planar graphs and the limiting probabilities of graph properties in first-order logic, analyzing the width of thresholds for random graph properties. Arithmetic combinatorics is another major area of interest, particularly in number-theoretical problems related to abelian and non-abelian groups. Recent advancements in ergodic theory, functional analysis, and extremal combinatorics have fueled this field's growth. By applying modern combinatorial techniques, such as regularity methods, hypergraph containers, and arithmetic removal lemmas, the group aims to refine the understanding of maximal densities in sets that avoid specific patterns, as well as quasirandomness in Cayley graphs and the stationary behavior of random walks on these structures.

MEMBERS

Senior Researchers: Albert Atserias | Kolja Knauer | Marc Noy | Arnau Padrol | Guillem Perarnau | Vincent Pilaud | Juan José Rué | Oriol Serra

Postdoctoral Researchers: Tássio Naia

PhD Students: Jordi Castellvi

PROJECTS

PID2023-147202NB-I00
COntemporary COmbinatorics and Applications (COCOA)
Principal Investigator: Guillem Perarnau
Funded by: MICINN

PUBLICATIONS

Lichev, L., Mitsche, D., & Perarnau, G. (2024). *Percolation on dense random graphs with given degrees.* Journal of Combinatorial Theory, Series B, 167, 250–282. https://doi.org/10.1016/j.jctb.2024.03.002

Noy, M., Requilé, C., & Rué, J. (2024). *Enumeration of rooted 3-connected bipartite planar maps; [Énumération des cartes planaires enracinées biparties et 3-connexes]*. Comptes Rendus Mathématique, 362, 143–158. https://doi.org/10.5802/crmath.548

Castellví, J., Drmota, M., Noy, M., & Requilé, C. (2024). *Chordal graphs with bounded tree-width*. Advances in Applied Mathematics, 157, 102700. https://doi.org/10.1016/j.aam.2024.102700

Benedetti-Velásquez, C., & Knauer, K. (2024). *Lattice path matroids and quotients*. Combinatorica. https://doi.org/10.1007/s00493-024-00085-4

Ortega, M., Rué, J., & Serra, O. (2024). *Product-free sets in the free group.* Mathematika, 70, 12255. https://doi.org/10.1112/mtk.12255

Atserias, A., Buss, S., & Müller, M. (2024). *On the consistency of circuit lower bounds for non-deterministic time.* Journal of Mathematical Logic, 24, 500235. https://doi.org/10.1142/S0219061324500235

DEFENDED THESES

Geometric realizations using regular subdivisions: Construction of many polytopes, sweep polytopes, s-permutahedraorks
Student: Eva Philippe
Supervisor: Arnau Padrol

SCIENTIFIC ACTIVITIES

VI Encuentro Conjunto RSME-SMM
Valencia, July 2024

Exploratory Workshop: Interplays between algebra, combinatorics and proof formalization
CRM, July 2024

Santander Workshop on Geometric and Algebraic Combinatorics'
Santander 15-19/1/2024

OUTREACH

Guillem Perarnau / Juan José Rué
Podcast CRM-Ments meravelloses: Paul Erdös

DYNAMICAL SYSTEMS

Dynamical systems theory looks for the milestones that organize dynamics, essentially their invariant objects and their connections. In this ambitious goal, the group has a recognized track record and a leading role, addressing it through, among others, analytical, geometrical, topological, or numerical tools, which, complemented, also contribute to a deeper understanding of the dynamics of a system. The dynamics of the systems studied, which are real or complex, can be both discrete and continuous, their dimensions are low or high, depending very much on the specific applications.

In low-dimensional systems, the search for periodic orbits and their repercussions on global dynamics is of paramount importance, especially as a result of the associated symbolic, topological, and combinatorial dynamics. The computational and numerical implementation for looking the phase portraits and bifurcation diagrams is also widely used in modelization and other applications.

In high-dimensional systems, the search for invariant tori and their disposition into normally hyperbolic invariant objects is studied especially to describe the skeleton from which emanates global dynamics, such as KAM theory, Arnold diffusion, and associated exponentially small phenomena, with special attention to applications in Celestial Mechanics, Astrodynamics, Neuroscience, and Chemistry.

MEMBERS

Senior Researchers: Lluís Alsedà i Soler | Inmaculada Baldomá | Andrew Clarke Jezabel Curbelo | Amadeu Delshams Kostiantyn Drach | Núria Fagella | Ernest Fontich | Armengol Gasull | Marcel Guàrdia Alejandro Haro | Xavier Jarque | Àngel Jorba Marc Jorba | José Tomás Lázaro | Pau Martin Maria Teresa Martínez-Seara | Josep Masdemont Mercè Ollé | Joan Torregrosa | Arturo Vieiro

Postdoctoral Researchers: Gustavo Rodrigues-Ferreira | Frank Trujillo

PhD Students: Dídac Gil Rams

PROJECTS

FA8655-24-1-7059
Dynamics near the L3 point of the Earth-Moon system: Invariant manifolds and connections with other libration points.
Principal Investigator: Àngel Jorba
Funded by: AFOR - Air Force Office of Scientific Research (USA)

PID2023-147252NB-I00
Dominios errantes, rigidez, y algoritmos de búsqueda de ceros en dinámica holomorfa
Principal Investigator: Kostiantyn Drach & Núria Fagella
Funded by: MICINN

CNS2023-144360

Dinámica no lineal y mezcla en flujos geofísicos

Principal Investigator: Jezabel Curbelo

Funded by: Agencia Estatal de Investigación

PUBLICATIONS

Giné, J., Romanovski, V. G., & Torregrosa, J. (2024). *Time-reversibility and integrability of p:−q resonant vector fields*. AIMS Mathematics, 9, 73-88. https://doi.org/10.3934/math.2024005

De Maesschalck, P., & Torregrosa, J. (2024). *Critical periods in planar polynomial centers near a maximum number of cusps*. Journal of Differential Equations, 380, 181-197. https://doi.org/10.1016/j.jde.2023.10.034

Acosta-Humánez, P., Lázaro, J. T., Morales-Ruiz, J. J., & Pantazi, C. (2024). *Semiclassical quantification of some two degree of freedom potentials: A differential Galois approach*. Journal of Mathematical Physics, 65(12106). https://doi.org/10.1063/5.0169069

Fernandez-Mora, A., Haro, A., & Mondelo, J. M. (2024). *Flow Map Parameterization Methods for Invariant Tori in Quasi-Periodic Hamiltonian Systems*. SIAM Journal on Applied Dynamical Systems, 23, 127-166. https://doi.org/10.1137/23M1561257

Figueras, J.-L., & Haro, A. (2024). *A modified parameterization method for invariant Lagrangian tori for partially integrable Hamiltonian systems*. Physica D: Nonlinear Phenomena, 462(134127). https://doi.org/10.1016/j.physd.2024.134127

Lázaro, J. T., Albó, A., Alarcón, T., Elena, S. F., & Sardanyés, J. (2024). *No two without three: Modeling dynamics of the trio RNA virus-defective interfering genomes-satellite RNAs*. Communications in Nonlinear Science and Numerical Simulation, 133(107987). https://doi.org/10.1016/j.cnsns.2024.107987

Cufí-Cabré, C., & Fontich, E. (2024). *Invariant manifolds of maps and vector fields with nilpotent parabolic tori*. Journal of Differential Equations, 396, 314-362. https://doi.org/10.1016/j.jde.2024.03.030

Kazakov, A., Murillo, A., Vieiro, A., & Zaichikov, K. (2024). *Numerical Study of Discrete Lorenz-Like Attractors*. Regular and Chaotic Dynamics, 29, 78-99. https://doi.org/10.1134/S1560354724010064

Clarke, A., Fejoz, J., & Guardia, M. (2024). *A Counterexample to the Theorem of Laplace–Lagrange on the Stability of Semimajor Axes*. Archive for Rational Mechanics and Analysis, 248(19). https://doi.org/10.1007/s00205-024-01960-6

Jorba-Cuscó, M., Oliva-Zúniga, R. I., Sardanyés, J., & Pérez-Palau, D. (2024). *Optimal dispersal and diffusion-enhanced robustness in two-patch metapopulations: origin's saddle-source nature matters*. Theory in Biosciences, 143, 79-95. https://doi.org/10.1007/s12064-023-00411-2

Fontich, E., Guillamon, A., Perona, J., & Sardanyés, J. (2024). *Functional Shift-Induced Degenerate Transcritical Neimark-Sacker Bifurcation in a Discrete Hypercycle*. International Journal of Bifurcation and Chaos, 34(2450045). https://doi.org/10.1142/S0218127424500457

Benini, A. M., Evdoridou, V., Fagella, N., Rippon, P. J., & Stallard, G. M. (2024). *Boundary dynamics for holomorphic sequences, non-autonomous dynamical systems and wandering domains*. Advances in Mathematics, 446(109673). https://doi.org/10.1016/j.aim.2024.109673

Ortiz, A. J., Martin, V., Romero, D., Guillamon, A., & Giraldo, J. (2024). *Time-dependent ligand-receptor binding kinetics and functionality in a heterodimeric receptor model*. Biochemical Pharmacology, 225(116299). https://doi.org/10.1016/j.bcp.2024.116299

Delshams, A., Granados, A., & Schaefer, R. G. (2024). *Arnold diffusion for an a priori unstable Hamiltonian system with 3 + 1/2 degrees of freedom*. Chaos, 34(63118). https://doi.org/10.1063/5.0185044

Gimeno, J., Jorba, A., Jorba-Cuscó, M., & Nicolás, B. (2024). *On the effect of the sun on Kordylewski clouds*. Celestial Mechanics & Dynamical Astronomy, 136(23). https://doi.org/10.1007/s10569-024-10188-1

SCIENTIFIC ACTIVITIES

School on Interactions between Dynamical Systems and Partial Differential Equations (JISD2024)
July 8–12, 2024

Conference: Parameter spaces in complex dynamics and related topics.
May 27-31, 2024.
Centro di Ricerca Matematica Ennio De Giorgi, Pisa

Mini-symposium "MS5: Computer assisted proofs in dynamics" at the international conference
June 10–14, 2024
Equadiff, Karlstad (Sweden).

OUTREACH

Núria Fagella
Exotic topology in complex dynamics (6h course)
Part of the Barcelona Introduction to Mathematical Research (BIMR24).

OTHER ACTIVITIES

Núria Fagella
Panel member of the US National Science Foundation, 2024.
New Editorial Boards:
Associate Editor of Bulletin of the LMS and Journal of the LMS (2024–present).
Associate Editor of Qualitative Theory of Dynamical Systems (2024–present).
Invited Plenary Talks in Conferences:
Geometric complexity of Julia sets V – Banach Center, Bedlewo, Poland. July 2024.
Complex analysis, geometry and dynamics III – Portoroz, Slovenia. June 2024.

Our goal is to use mathematical and statistical techniques to deal with natural hazards and tackle environmental challenges, including issues from the forecasting of extreme weather events to carbon capture. Extreme natural hazards are a great societal problem, not only in underdeveloped countries, and are negatively affected by climate change. Their physics is poorly understood, and a lack of reliable statistics hinders risk assessment or identification of signatures of climate change. We will address the study of atmospheric and oceanic phenomena enhancing sub-seasonal predictability of weather events, and in particular their extremes. In a broader context, we will perform different statistical analysis of natural-hazard occurrence.

Tackling environmental challenges is this generation's defining task (EC Green Deal 2020). One such challenge, holding global warming to 2°C, can only be achieved through the extraction of greenhouse gases and emission reductions, among others. A toxic free environment requires the removal of a multitude of contaminants. We will focus on topics related to the elimination of pollutants, including the removal of environmental contaminants such as C02, volatile organic compounds and pharmaceuticals via adsorption techniques, the role of green roofs and also the use of direct absorption solar cells.

MEMBERS

Senior Researchers: Álvaro Corral | David Moriña | Timothy G. Myers | Pere Puig

Postdoctoral Researchers: Lucy Auton | Marc Calvo | Álvaro González

PROJECTS

PID2023-146332OB-C21
Mathematical modelling of the capture of environmental contaminants by adsorption
Principal Investigator: Tim Myers
Funded by: MICINN

PUBLICATIONS

Valverde A.; Cabrera-Codony A.; Calvo-Schwarzwalder M.; Myers T.G. (2024). *Investigating the impact of adsorbent particle size on column adsorption kinetics through a mathematical model*. International Journal of Heat and Mass Transfer, 218, -. doi:10.1016/j.ijheatmasstransfer.2023.124724

Puig P.; Valero J.; Fernández-Fontelo A. (2024). *Some mechanisms leading to underdispersion: Old and new proposals*. Scandinavian Journal of Statistics, 51, 245-267. doi:10.1111/sjos.12677

Ben Amar M.; Mallek M.; Valverde A.; Monclús H.; Myers T.G.; Salvadó V.; Cabrera-Codony A. (2024). *Competitive heavy metal adsorption on pinecone shells: Mathematical modelling of fixed-bed column and surface interaction insights*. Science of the Total Environment, 917, -. doi:10.1016/j.scitotenv.2024.170398

Gómez-García Á.M.; González Á.; Cacace M.; Scheck-Wenderoth M.; Monsalve G. (2024). *Thermal structure of the southern Caribbean and northwestern South America: implications for seismogenesis.* Solid Earth, 15, 281-303. doi:10.5194/se-15-281-2024

Auton L.C.; Aguareles M.; Valverde A.; Myers T.G.; Calvo-Schwarzwalder M. (2024). *An analytical investigation into solute transport and sorption via intra-particle diffusion in the dual-porosity limit*. Applied Mathematical Modelling, 130, 827-851. doi:10.1016/j.apm.2024.03.023

Corral Á. (2024). *Moments of undersampled distributions: Application to the size of epidemics.* Chaos, Solitons and Fractals, 181, -. doi:10.1016/j.chaos.2024.114690

Mlynarczyk, D.; Puig, P.; Barquinero, J. F.; Armero, C.; Gómez-Rubio, V. (2024). *Comparative analysis of the yields of dicentrics and chromosomal translocations.* International Journal Of Radiation Biology, 100(8), 1193-1201. doi:10.1080/09553002.2024.2369077

Myers, T. G. (2024). *Is it time to move on from the Bohart-Adams model for column adsorption?.* International Communications In Heat And Mass Transfer, 159, -. doi:10.1016/j.icheatmasstransfer.2024.108062

Agis, D.; Tur, J.; Moriña, D.; Puig, P.; Fernández-Fontelo, A. (2024). *good: An R package for modelling count data.* Methods In Ecology And Evolution, -, -. doi:10.1111/2041-210X.14387

SCIENTIFIC ACTIVITIES

European Consortium for Mathematics in Industry Council and Board meeting
April 2024

Minisymposium, "Mathematical models to combat environmental challenges", CEDYA, Bilbao
May 2024

OUTREACH

Tim Myers

Bojos per les matematiques, seminar *Matematica que fluye* y *The Wrong Talk*, CRM, September 2024

International Centre for Mathematical Sciences, Graduate Modelling Camp, Problem Presenter and Student Mentor. Edinburgh, April 2024

Supervisor for two high school student projects "Instituto Joaquim Pla i Farreras", Sant Cugat

Supervisor 4 TFMs, 1 TFG UAB

OTHER ACTIVITIES

Tim Myers

Co-ordinator for European Study Groups with Industry.

European Consortium for Mathematics in Industry (ECMI), Board Member and Member Research and Innovation Committee.

Editor ECMI Annual Report.

Co-ordinator ECMI Special Interest Group on Sustainable Energies.

Editorial Board, Mathematics in Industry Reports, Cambridge University Press.

Editorial Board Member, Real Sociedad Matemática Española Book Series.

Reviewer for Grant Proposals for: COST (European Cooperation in Science and Technology) and consensus panel; AGAUR, Spain; NRF South Africa

ECMI Representative on Advisory Committee for Eastern Africa Universities Mathematics Programme, currently funded through Africa-Europe Cluster of Research Excellence in Mathematics

Member European Mathematics Society Committee for Developing Countries

PhD Examiner: University of Limerick; Queensland University of Technology

Seminar/Colloquia: University of Limerick (Ireland); Karlstad University (Sweden); Simon Fraser University (Canada)

Invited International Expert, Mathematics in Industry Study Group, U. Witwatersrand, South Africa; Mathematics meets Industry Day (MiMM), Sweden

Lecturer, Models Matemàtics de la Tecnologia, UPC

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ALGEBRA, GEOMETRY, NUMBER THEORY AND TOPOLOGY

This research group covers a wide range of fields, including number theory, algebraic and arithmetic geometry, operator algebras, algebraic topology, and differential and symplectic geometry. These areas interact both internally and with other mathematical disciplines at CRM, such as dynamics and analysis of PDEs.

In algebra, the focus is on classification aspects of C*-algebras, C*-dynamical systems, and Leavitt path algebras.

Key tools include the Cuntz semigroup and K-theory, with applications to Z-stability and Hazrat's conjecture. In geometry, the group works on symplectic, algebraic, integral, and complex geometry. Contributions include singularities in symplectic geometry, fluid dynamics related to the Navier-Stokes problem, classification of irregular varieties in algebraic geometry, and convexity and valuation theory in integral geometry.

In number theory, research addresses arithmetic properties of integers, Diophantine equations, and integer-valued functions, with connections to analysis, algebra, topology, and logic. Specific topics include Galois theory, the Langlands program, abelian and Shimura varieties, and L-functions.

In algebraic topology, the group studies homotopy methods and their applications to combinatorial and algebraic structures, such as posets, decomposition spaces, incidence algebras, and representation theory. This interdisciplinary approach fosters interactions across mathematical domains, enhancing the depth and impact of the research.

MEMBERS

Senior Researchers: Jaume Amorós | Josep Álvarez | Ramon Antoine | Pere Ara | Florent Balacheff | Miguel Angel Barja | Francesc Bars | Paloma Bengoechea | Carles Broto | Robert Cardona | Natàlia Castellana | Joana Cirici | Laura Costa | Carlos Antonio d'Andrea | Luis Dieulefait | Immaculada Gálvez | Francesc Fité | Javier J. Gutiérrez | Xavier Guitart | Dolors Herbera | Martí Lahoz | David Marín | Simone Marchesi | Marc Masdeu | Marta Mazzocco | Rosa Maria Miró | Eva Miranda | Ignasi Mundet | Joan Carles Naranjo | Francesc Perera | Joan Porti | Víctor Rotger | Albert Ruiz | Gil Solanes | Martin Sombra

Postdoctoral Researchers: Michele Fornea | Alfonso Gadir Garmendia González | Irene Spelta

PhD Students: Søren Dyhr | Javier Guillán | Luís Llàcer | Pablo Nicolàs

PROJECTS

PID2023-146936NB-I00
Interacciones de Geometría con Álgebra y aplicaciones (INTERGAP)
Principal Investigator: Eva Miranda
Funded by: MICINN

SymHyCon
Interactions between symplectic topology, hydrodynamics, and conservative flows |
Principal Investigator: Robert Cardona
Funded by: Spanish Ministry of Science

PUBLICATIONS

Fontana-McNally, J., Miranda, E., & Peralta-Salas, D. (2024). *An equivariant Reeb–Beltrami correspondence and the Kepler–Euler flow*. Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences.

Fité, F. (2024). *On a local-global principle for quadratic twists of abelian varieties*. Mathematische Annalen.

Antoine, R., Perera, F., Robert, L., & Thiel, H. (2024). *Traces on ultrapowers of C*-algebras*. Journal of Functional Analysis.

Mundet i Riera, I. (2024). *Discrete Degree of Symmetry of Manifolds*. Transformation Groups.

Barja, M. Á., & Stoppino, L. (2024). *New slope inequalities for families of complete intersections*. Revista Matematica Iberoamericana.

Barja, M. Á. (2024). *Slope inequalities for higher dimensional irregular fibrations.* Annali della Scuola Normale Superiore di Pisa - Classe di Scienze.

Ara, P., & Claramunt, J. (2024). *A correspondence between surjective local homeomorphisms and a family of separated graphs.* Discrete and Continuous Dynamical Systems - Series A.

Brugués, J., Miranda, E., & Oms, C. (2024). *The Arnold conjecture for singular symplectic manifolds*. Journal of Fixed Point Theory and Applications.

Fité, F. (2024). *Ordinary primes for some varieties with extra endomorphisms*. Publicacions Matemàtiques

Naranjo, J. C., Ortega, A., & Spelta, I. (2024). Cyclic coverings of genus curves of Sophie Germain type. Forum of Mathematics, Sigma.

Solanes, G., & Trillo, J. A. (2024). *Tube formulas for valuations in complex space forms*. Mathematische Annalen.

Bedrouni, S., & Marin, D. (2024). *A criterion for the holomorphy of the curvature of smooth planar webs and applications to dual webs of homogeneous foliations on PC^2*. Mathematische Nachrichten.

Mundet i Riera, I. (2024). *Actions of large finite groups on manifolds*. International Journal of Mathematics.

M-Seara, T., Silva, L. V. M. F., & Villanueva, J. (2024). *On the boundedness of solutions of a forced discontinuous oscillator.* Journal of Differential Equations.

Miranda, E., & Weitsman, J. (2024). Darboux, *Moser and Weinstein theorems for prequantum systems and applications to geometric quantization*. Journal of Geometry and Physics.

Herbera, D., Príhoda, P., & Wiegand, R. (2024). *Big pure projective modules over commutative noetherian rings: Comparison with the completion*. Forum Mathematicum.

Billerey, N., Chen, I. M., Dieulefait, L., & Freitas, N. (2024). *On Darmon's program for the generalized Fermat equation, II*. Mathematics of Computation.

Barthel, T., Castellana, N., Heard, D., & Sanders, B. (2024). *On surjectivity in tensor triangular geometry*. Mathematische Zeitschrift.

Fontana-McNally, J., Miranda, E., Oms, C., & Peralta-Salas, D. (2024). *A counterexample to the singular Weinstein conjecture.* Advances in Mathematics.

Carando, D., D'Andrea, C., Torres, L. A., & Turco, P. (2024). *Entropy numbers and box dimension of polynomials and holomorphic functions.* Mathematische Nachrichten.

Barthel, T., Castellana, N., Heard, D., Naumann, N., & Pol, L. (2024). *Quillen stratification in equivariant homotopy theory.* Inventiones Mathematicae.

Antoine, R., Ara, P., Bosa, J., Perera, F., & Vilalta, E. (2024). *The Cuntz semigroup of a ring*. Selecta Mathematica (New Series).

SCIENTIFIC ACTIVITIES

CAVARET "Curves, Abelian VArieties and RElated Topics"
June 17 - 21, 2024

Conference 'Métodos Categóricos y Homotópicos en Álgebra, Geometría, Topología y Análisis Funcional 2024', held at La Cristalera
June 14 to 15, 2024.

Higher Algebra, Geometry, and Topology
May 6-10, 2024.

Workshop Operadic Methods in Geometry II
October 8-10, 2024.

GEOMETRY, ALGEBRA AND TOPOLOGY IN MACHINE LEARNING, ARTIFICIAL INTELLIGENCE AND BIG DATA (GATMAID)
June 25-29, 2024,

JOINT PERSPECTIVES IN GEOMETRY, ALGEBRA AND TOPOLOGY
July 1-5, 2024.

Barcelona LEAN Seminar
February-June 2024.

OUTREACH ACTIVITIES

Natalia Castellana Vila
BIYSC at CRM
Bojos per les Matemàtiques.
7deMates at UPC-Manresa.

Joana Cirici
Organized and moderated a roundtable discussion: Investigadores de la FMI (March 8, 2024).

Dolors Herbera
Participated in the Ments Meravelloses podcast.
Currently serves as coordinator of the Emmy Noether Prize, awarded by the Societat Catalana de Matemàtiques for the best undergraduate thesis in mathematics.

Simone Marchesi
Gave a talk and workshop titled Fins al regle i el compàs, i més enllà, at the University of Barcelona (UB).

Marc Masdeu Sabaté
Co-organized the Barcelona Introduction to Mathematical Research 2024.

HIGHLIGHTED PUBLICATIONS

The Centre de Recerca Matemàtica (CRM) remains at the forefront of mathematical research, with recent contributions spanning PDEs, dynamical systems, mathematical biology, and neuroscience. From breakthroughs in the Stefan problem to advances in computational models of decision-making, these studies highlight the depth and impact of CRM's work across disciplines. Below is a selection of publications by CRM researchers from 2024.

Fatty acid synthase (FASN) is a tumor-cell-intrinsic metabolic checkpoint restricting T-cell immunity

Authors: Verdura, S., Pedarra, S., Pardo, M. A., Espin-Garcia, R., Serrano-Hervás, E., Llop-Hernández, A., Teixidor, E., Bosch-Barrera, J., López-Bonet, E., Martin-Castillo, B., Lupu, R., Sardanyès, J., Pujana, M. A., Alarcón, T., Cuyàs, E., & Menendez, J. A.

Abstract: Fatty acid synthase (FASN)-catalyzed endogenous lipogenesis is a hallmark of cancer metabolism. However, whether FASN functions as an intrinsic mechanism of tumor cell defense against T-cell immunity remains unexplored. This study integrates bioinformatic analysis, CRISPR/Cas9-based FASN knockout models, and mathematical evaluations to demonstrate that FASN expression negatively correlates with immune cell infiltration, cytolytic activity, and HLA-I expression. Loss of FASN enhances T-cell-mediated cytolysis, reduces mitochondrial OXPHOS, and suppresses PD-L1 expression via post-translational regulation. These findings establish FASN as a metabolic checkpoint in tumor immunity, with potential implications for improving T-cell-based immunotherapies.

Citation: Verdura, S., Pedarra, S., Pardo, M. A., et al. (2024). Cell Death Discovery, 10, 417. https://doi.org/10.1038/s41420-024-02184-z

The singular set in the Stefan problem

Authors: Figalli, A., Ros-Oton, X., & Serra, J.

Abstract: In this paper we analyze the singular set in the Stefan problem and prove the following results:

- The singular set has parabolic Hausdorff dimension at most n — 1
- The solution admits a C∞ -expansion at all singular points, up to a set of parabolic Hausdorff dimension at most n — 2
- In R3, the free boundary is smooth for almost every time t, and the set of singular times S C R has Hausdorff dimension at most 1/2

These results provide us with a refined understanding of the Stefan problem's singularities and answer some long-standing open questions in the field.

Citation: Figalli, A., Ros-Oton, X., & Serra, J. (2024). Journal of the American Mathematical Society, 37(2), 305-389.

The regularity problem for the Laplace equation in rough domains

Authors: Mourgoglou, M., & Tolsa, X.

Abstract: Let $\Omega \subset \mathbb{R}^{n+1}$, $n \geq 2$, be a bounded open and connected set satisfying the corkscrew condition with uniformly n-rectifiable boundary. In this paper we study the connection between the solvability of (Dp'), the Dirichlet problem for the Laplacian with boundary data in $L^{p'}(\partial\Omega)$, and (Rp) (resp. (R~p)), the regularity problem for the Laplacian with boundary data in the Hajłasz Sobolev space $W^{1,p}(\partial\Omega)$ (resp. $W\tilde{}^{1,p}(\partial\Omega)$, the usual Sobolev space in terms of the tangential derivative), where $p \in (1,2+E)$ and $1/p+1/p'=1$. Our main result shows that (Dp') is solvable if and only if so is (Rp). Under additional geometric assumptions (two-sided local John condition or weak Poincaré inequality on the boundary), we prove that (Dp') $\longrightarrow$ (R~p). In particular, we deduce that in bounded chord-arc domains (resp. two-sided chord-arc domains) there exists $p0 \in (1,2+\in)$ so that (Rp0) (resp. (R~p0)) is solvable. We also extend the results to unbounded domains with compact boundary and show that in two-sided corkscrew domains with n-Ahlfors-David regular boundaries the single layer potential operator is invertible from $L^p(\partial\Omega)$ to the inhomogeneous Sobolev space $W^{1,p}(\partial\Omega)$. Finally, we provide a counterexample of a chord-arc domain $\Omega 0 \subset \mathbb{R}^{n+1}$, $n \geq 3$, so that (R~p) is not solvable for any $p \in [1,\infty)$.

Citation: Mourgoglou, M., & Tolsa, X. (2024). Duke Mathematical Journal, 173(9), 1731-1837.

Myelin dystrophy impairs signal transmission and working memory in a multiscale model of the aging prefrontal cortex

Authors: Ibañez, S., Sengupta, N., Luebke, J. I., Wimmer, K., & Weaver, C. M.

Abstract: Normal aging leads to myelin alterations in the rhesus monkey dorsolateral prefrontal cortex (dlPFC), which are positively correlated with degree of cognitive impairment. It is hypothesized that remyelination with shorter and thinner myelin sheaths partially compensates for myelin degradation, but computational modeling has not yet explored these two phenomena together systematically. Here, we used a two-pronged modeling approach to determine how age-related myelin changes affect a core cognitive function: spatial working memory. First, we built a multicompartment pyramidal neuron model fit to monkey dlPFC empirical data, with an axon including myelinated segments having paranodes, juxtaparanodes, internodes, and tight junctions. This model was used to quantify conduction velocity (CV) changes and action potential (AP) failures after demyelination and subsequent remyelination. Next, we incorporated the single neuron results into a spiking neural network model of working memory. While complete remyelination nearly recovered axonal transmission and network function to unperturbed levels, our models predict that biologically plausible levels of myelin dystrophy, if uncompensated by other factors, can account for substantial working memory impairment with aging. The present computational study unites empirical data from ultrastructure up to behavior during normal aging, and has broader implications for many demyelinating conditions, such as multiple sclerosis or schizophrenia.

Citation: Ibañez, S., Sengupta, N., Luebke, J. I., et al. (2024). eLife, 12, RP90964.

Rapid, systematic updating of movement by accumulated decision evidence

Authors: Molano-Mazón, M., Garcia-Duran, A., Pastor-Ciurana, J., HernándezNavarro, L., Bektic, L., Lombardo, D., de la Rocha, J., & Hyafil, A.

Abstract: Acting in the natural world requires not only deciding among multiple options but also converting decisions into motor commands. How the dynamics of decision formation influence the fine kinematics

of response movement remains, however, poorly understood. Here we investigate how the accumulation of decision evidence shapes the response orienting trajectories in a task where freely-moving rats combine prior expectations and auditory information to select between two possible options. Response trajectories and their motor vigor are initially determined by the prior. Rats movements then incorporate sensory information in less than 100 ms after stimulus onset by accelerating or slowing depending on how much the stimulus supports their initial choice. When the stimulus evidence is in strong contradiction, rats change their mind and reverse their initial trajectory. Human subjects performing an equivalent task display a remarkably similar behavior. We encapsulate these results in a computational model that maps the decision variable onto the movement kinematics at discrete time points, capturing subjects' choices, trajectories and changes of mind. Our results show that motor responses are not ballistic. Instead, they are systematically and rapidly updated, as they smoothly unfold over time, by the parallel dynamics of the underlying decision process.

Citation: Molano-Mazón, M., Garcia-Duran, A., Pastor-Ciurana, J., et al. (2024). Nature Communications, 15(1), 1-19.

Why are inner planets not inclined?

Authors: Clarke, A., Fejoz, J., & Guardia, M.

Abstract: Poincaré's work more than one century ago, or Laskar's numerical simulations from the 1990's on, have irrevocably impaired the long-held belief that the Solar System should be stable. But mathematical mechanisms explaining this instability have remained mysterious. In 1968, Arnold conjectured the existence of "Arnold diffusion" in celestial mechanics. We prove Arnold's conjecture in the planetary spatial 4-body problem as well as in the corresponding hierarchical problem (where the bodies are increasingly separated), and show that this diffusion leads, on a long time interval, to some large-scale instability. Along the diffusive orbits, the mutual inclination of the two inner planets is close to $\pi/2$, which hints at why even marginal stability in planetary systems may exist only when inner planets are not inclined. More precisely, consider the normalised angular momentum of the second planet, obtained by rescaling the angular momentum by the square root of its semimajor axis and by an adequate mass factor (its direction and norm give the plane of revolution and the eccentricity of the second planet). It is a vector of the unit 3-ball. We show that any finite sequence in this ball may be realised, up to an arbitrary precision, as a sequence of values of the normalised angular momentum in the 4-body problem. For example, the second planet may flip from prograde nearly horizontal revolutions to retrograde ones. As a consequence of the proof, the non-recurrent set of any finite-order secular normal form accumulates on circular motions – a weak form of a celebrated conjecture of Herman.

Citation: Clarke, A., Fejoz, J., & Guardia, M. (2024). Publ. Math. IHES. https://doi.org/10.1007/s10240-024-00151-z

Invariant Manifolds of Degenerate Tori and Double Parabolic Orbits to Infinity in the -Body Problem

Authors: Baldomá, I., Fontich, E., & Martín, P.

Abstract: There are many interesting dynamical systems in which degenerate invariant tori appear. We give conditions under which these degenerate tori have stable and unstable invariant manifolds, with stable and unstable directions having arbitrary finite dimension. The setting in which the dimension is larger than one was not previously considered and is technically more involved because in such case the invariant manifolds do not have, in general, polynomial approximations. As an example, we apply our theorem to prove that there are motions in the (n+2)-body problem in which the distances among

the first n bodies remain bounded for all time, while the relative distances between the first n-bodies and the last two and the distances between the last bodies tend to infinity, when time goes to infinity. Moreover, we prove that the final motion of the first n bodies corresponds to a KAM torus of the n-body problem.

Citation: Baldomá, I., Fontich, E., & Martín, P. (2024). Invariant Manifolds of Degenerate Tori and Double Parabolic Orbits to Infinity in the -Body Problem. Archive for Rational Mechanics and Analysis, 248(3), 52.

Boundary dynamics for holomorphic sequences, non-autonomous dynamical systems and wandering domains

Authors: Benini, A. M., Evdoridou, V., Fagella, N., Rippon, P. J., & Stallard, G. M

Abstract: There are many classical results, related to the Denjoy--Wolff Theorem, concerning the relationship between orbits of interior points and orbits of boundary points under iterates of holomorphic self-maps of the unit disc. Here, for the first time, we address such questions in the very general setting of sequences (Fn) of holomorphic maps between simply connected domains. We show that, while some classical results can be generalised, with an interesting dependence on the geometry of the domains, a much richer variety of behaviours is possible. Some of our results are new even in the classical setting.

Our methods apply in particular to non-autonomous dynamical systems, when (Fn) are forward compositions of holomorphic maps, and to the study of wandering domains in holomorphic dynamics.

The proofs use techniques from geometric function theory, measure theory and ergodic theory, and the construction of examples involves a `weak independence' version of the second Borel--Cantelli lemma and the concept from ergodic theory of `shrinking targets'.

Citation: Benini, A. M., Evdoridou, V., Fagella, N., Rippon, P. J., & Stallard, G. M. (2024). Boundary dynamics for holomorphic sequences, non-autonomous dynamical systems and wandering domains. Advances in Mathematics, 446, 109673.

A counterexample to the singular Weinstein conjecture

Authors: Fontana-McNally, J., Miranda, E., Oms, C., & Peralta-Salas, D.

Abstract: This paper constructs counterexamples to the singular Weinstein conjecture in dimension 3 by analyzing Reeb vector fields on b-contact manifolds. The findings challenge assumptions about periodic orbits and escape orbits, reshaping the understanding of singular Hamiltonian dynamics.

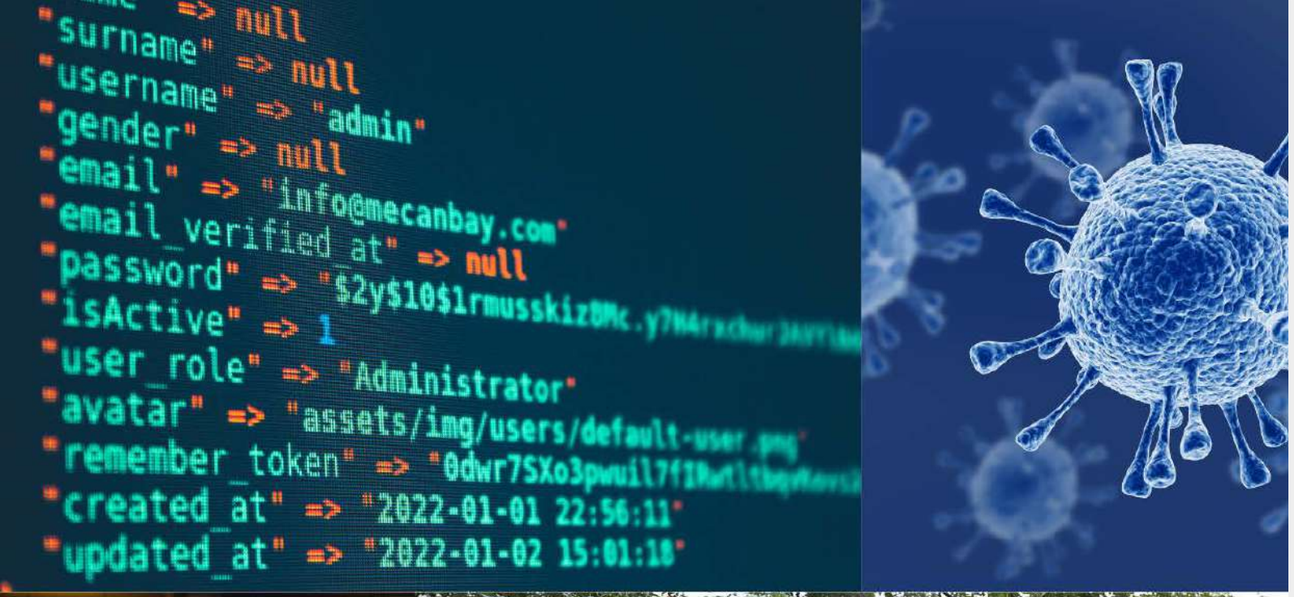
Citation: Fontana-McNally, J., Miranda, E., Oms, C., & Peralta-Salas, D. (2024). Advances in Mathematics, 458, 109998.

good: An R package for modeling count data

Authors: Agis, D., Tur, J., Moriña, D., Puig, P., & Fernández-Fontelo, A.

Abstract: The Good distribution provides a flexible model for count data exhibiting overdispersion or underdispersion, which the Poisson distribution cannot capture. This paper introduces good, an R package for working with the Good distribution, offering functions for probability calculations, random sampling, and regression modeling.

Citation: Agis, D., Tur, J., Moriña, D., et al. (2024). Methods in Ecology and Evolution, 15(12), 2192-2197.



03 KTU

INNOVATE AND EXCEL WITH MATHEMATICAL EXPERTISE

One of the cornerstones of the CRM, as explicitly stated in its statutes, is the transfer of research conducted within the centre. Disseminating both the knowledge obtained and the methodologies used is considered essential to maximize social impact. To this end, the CRM works together with other research centres, the private sector, institutions, SMEs or industries (society at large). The Knowledge Transfer Unit (KTU) is a link for these entities with the CRM to foster collaborations.

The KTU collaborates with CRM projects and society to address socially impactful challenges by developing tailored mathematical solutions, while also managing the protection and valorisation of the center's research results. These solutions are designed to be clear, accurate, and user-friendly, benefiting from the synergy between the KTU and the research groups within the centre.

The CRM, along with CERCA and SOMMa institutions and their researchers, is deeply committed to applying knowledge practically. There are numerous opportunities to apply CRM research findings to societal development. The KTU identifies viable results, connects researchers with companies, and offers consulting services to facilitate this process.

Knowledge Transer with Mathematical Roots

Because we are at CRM, the KTU:

> Knows (mainly) mathematical tools and, moreover, collaborates with people who know cutting-edge mathematical tools that can be transferred to practical challenges.

> brings the (mathematical) research, knowledge and know-how that is developed at the CRM back to society.

> given a problem from society, KTU identifies (mathematical) viable results and connects researchers (if needed) with entities.

To tackle these challenges we:

> Take advantage of being a mathematical hub.

> Conduct practical research.

> Act as a training unit.

The combination of our deep understanding of mathematical tools, collaborative efforts with experts, and our thorough problem analysis ensures that the KTU is exceptionally skilled in modeling, simulation, optimization, and data science.

MEMBERS IN 2024

Albert Escolà Soles (Impact Officer), **Fernando Gaston Codony** (Research Technician), **Basile Charles Xavier Guth** (Impact Officer), **Axel Masó Puigdellosas** (Scientific Software), **Marcel Morillas Rozas** (Research Technician), **Pau Reig Llunell** (Scientific Software Developer), **David Romero Sánchez** (Head of the KTU), and **Andrea Suárez Segarra** (Scientific Software Developer).

THE PROJECTS

Throughout 2024, the KTU has developed and supported a diverse portfolio of projects—both public and private—working closely with institutions, companies, and individuals to address complex challenges through custom mathematical approaches. This collaborative spirit has led to fruitful partnerships with renowned research centres such as ICFO and ICM, among many others. The following is a selection of the projects carried out during the year, reflecting the growing impact and reach of the KTU's work across sectors.

BISTECH: For this project, the KTU is exploring and improving a mathematical model for cooking a wide range of foods using a new device. The unit is also creating an interface for the program to provide a more user-friendly experience.

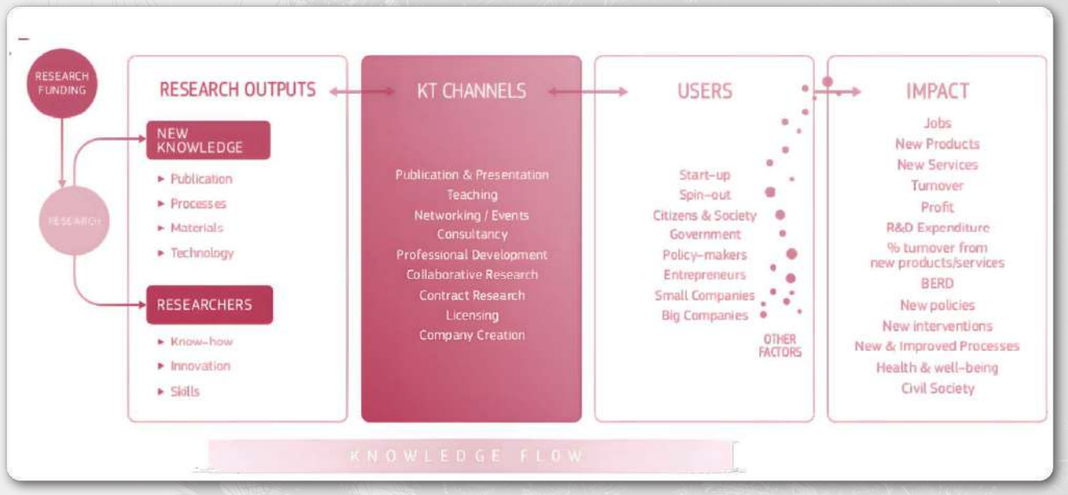
DYSEDAS (Data shrinking method enabled by Dynamical Systems for resources saving) aims to develop a lossless data compression method, that increases compression rates well beyond the current state-of-the-art. This project is a collaboration between the CRM – KTU and the ALBA Synchrotron, who will be the final user of the developed data compression method.

LICSAI: This project focuses on cybersecurity. The KTU developed a model to quantify the uncertainty of an artificial intelligence algorithm developed by I2Cat to determine the risk of an individual being a victim of a phishing attack.

TIPSAVIR (Therapeutic Interfering ParticleS as AntiVIRal therapy) In this project we simulate the infection of a virus on a tissue at the level of RNA replication. This enables us to study different aspects of virus evolution in silico in low computation time. The goal of the project is to find the correct RNA sequence (generated by replication of the wild-type virus) that can stop the infection.

eBRT20230: Climate change and air pollution are pressing global concerns, and public transport plays a key role in promoting sustainable urban mobility. eBRT2030 brings together 49 partners from Europe and beyond to develop and demonstrate a new generation of electric Bus Rapid Transit (eBRT) systems that are economically viable, automated, and connected. By testing these solutions in real-life settings, the project aims to reduce emissions, pollution, and congestion while improving passenger experience and accessibility—particularly in underserved areas. In collaboration with public transport operators, manufacturers, researchers, and end-users, eBRT2030 seeks to make sustainable, zero-emission transport a reality in both European cities and developing regions worldwide. This is a European project funded by the The Clean Energy Transition Partnership.

ENHANCE EUROPE, a Horizon Europe project in which the KTU is a partner, focuses on integrating an energy-harvesting system using asphalt solar collectors embedded in road pavement. These collectors extract heat from solar radiation, generating renewable energy to support nearby buildings. The system lowers road surface temperatures, mitigating the urban heat island effect while aligning with urban planning regulations. Its installation seamlessly integrates into cityscapes without disrupting cultural heritage. By repurposing solar energy from transport infrastructure, the project promotes clean energy use, reducing the operational costs of large buildings and supporting digital twin platforms for energy transition.



PARTICIPATIONS AND COLLABORATIONS

David Romero, from the KTU, is a member of the Severo Ochoa - María de Maeztu (SOMMa) workgroup Narrative and Impact. This group aims to expand and refine the definition of transference, aligning it with the international landscape and emphasizing social impact. A key objective is also to develop a more inclusive set of indicators that better capture the impact of research across all disciplines and a wider range of outcomes.

Additionally, the KTU is an active participant in the Math-In network. Recently, it has been involved in projects within the logistics sector, fostering synergies with institutions such as the Galician Centre for Mathematical Research and Technology (CITMAGA). The unit also takes part in CERCA meetings, reinforcing its commitment to collaboration and knowledge exchange at a broader institutional level.

In 2024, the KTU organised a session titled *TransLink: Transferring Mathematical Insights through Theory and Simulation – Spotlight on CRM* during the Congreso Bienal de la Sociedad Española de Matemática Aplicada (CEDYA), held in Bilbao from 24 to 28 June. Later that summer, David Romero attended the European Mathematical Society Congress, held in Seville from 15 to 19 July, where CRM participated with a joint stand alongside Math-In and SEMA to showcase its transfer activities and connect with the wider mathematical community.

EU MATHS-IN & MATH-INDUSTRY DAY

The KTU played a pivotal role in organizing the **EU-MATHS-IN & Math-Industry Day** held on November 25–26, 2024. This event aimed to bridge the gap between mathematical research and industrial applications, fostering collaboration and innovation.

As the main liaison between CRM and industry, the KTU facilitated interactions that led to the development of ad hoc research initiatives addressing challenges with significant societal impact. During the Math-Industry Day, the KTU coordinated sessions where researchers and industry professionals discussed potential collaborations, showcased successful case studies, and explored new avenues for applying mathematical solutions to real-world problems.

Through these efforts, the KTU reinforced CRM's commitment to knowledge transfer, ensuring that advancements in mathematics contribute effectively to industrial innovation and societal well-being.

KNOWLEDGE TRANSFER & OUTREACH

Knowledge transfer to society takes many forms, and at the Centre de Recerca Matemàtica (CRM), outreach is a key component of this mission. The Knowledge Transfer Unit (KTU) actively participates in initiatives that disseminate mathematics and inspire future generations to explore careers in this field. By connecting researchers with students, educators, and the wider public, the KTU helps make mathematical research more accessible and relevant to society.

Among the outreach activities where the KTU plays a key role:

> **EspaiCiència**: As part of this science fair, the KTU participated to engage young students with interactive mathematical demonstrations and hands-on activities. These events help bridge the gap between advanced research and public understanding, showing the creative and practical sides of mathematics.

> **Career Guidance for Mathematics Graduates**: The KTU participated in the roundtable *And After the Degree, What?*, held at the Universidad de La Rioja during the Conference of Deans of Mathematics, where professionals discussed diverse career paths for mathematics graduates. These session provided students with real-world insights into how mathematical skills apply across various industries.

> **BIYSC at CRM & Joves i Ciència**: As part of the Barcelona International Youth Science Challenge (BIYSC), CRM hosted ten international high school students for an immersive experience in advanced mathematics. The KTU contributed with a special session led by David Romero, focusing on the transfer of mathematical knowledge and tools to real-world applications. Additionally, the KTU hosted a student as part of Phase 2 of the "Joves i Ciència" program, reinforcing CRM's commitment to mentoring young talent in mathematical sciences.

> **Premis extraordinaris de batxillerat**: This year, the KTU hosted two recipients of the Premis Extraordinaris de Batxillerat awarded by the Government of Catalonia. Over the course of a week, the students experienced first-hand how the unit applies mathematics to real-world challenges through collaborations with public and private partners.

Through these and other initiatives, the KTU strengthens the link between mathematical research and society, ensuring that mathematics continues to inspire, innovate, and impact the world beyond academia.

MIDMAT 2024

JORNADA DE METODOLOGIES I INNOVACIÓ DOCENTS PER A JOVES MATEMÀTICS

February 6, 2024

DESCRIPTION

This workshop was designed to provide basic tools for effective teaching of Mathematics at the university level in the current context. It was aimed at young researchers who had already started teaching or were about to do so, such as PhD students in Mathematics, postdocs, and early-career lecturers. The event included three talks on various teaching-related topics and a round table to discuss the challenges participants might face in the early stages of their academic careers.

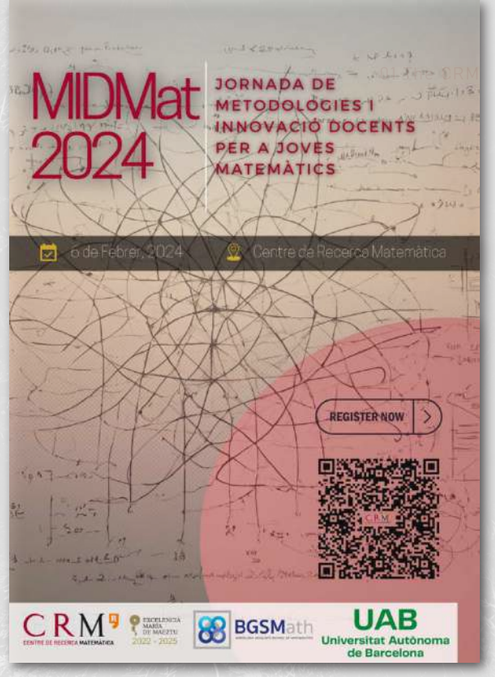
This cross-disciplinary training aimed to support young researchers in their transition to university teaching, providing them with the necessary tools to approach their first classes with confidence and excellence, or to improve their teaching practices. Unlike other more general training sessions, this workshop focused on specific teaching and learning strategies for Mathematics and related subjects.

ORGANIZERS

Giulia Binotto | Universitat Autònoma de Barcelona
Juan Carlos Cantero | Universitat de Barcelona

LECTURERS

Berta Barquero Farràs | Universitat de Barcelona
Daniel Pérez-Palau | Universitat Politècnica de Catalunya
Roberto Rubio | Universitat Autònoma de Barcelona



PANELLISTS

Judit Chamorro | Universitat Autònoma de Barcelona
Clara Cufí | Universitat Autònoma de Barcelona
Odí Soler | Universitat Politècnica de Catalunya

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

WORKSHOP ON PERIODIC ORBITS – OP2024

February 7 - 9, 2024

DESCRIPTION

The aim of this "Workshop on Periodic Orbits" is to present the recent advances and open problems in this research line. This is the second edition, the first was held in Tossa in 2008.

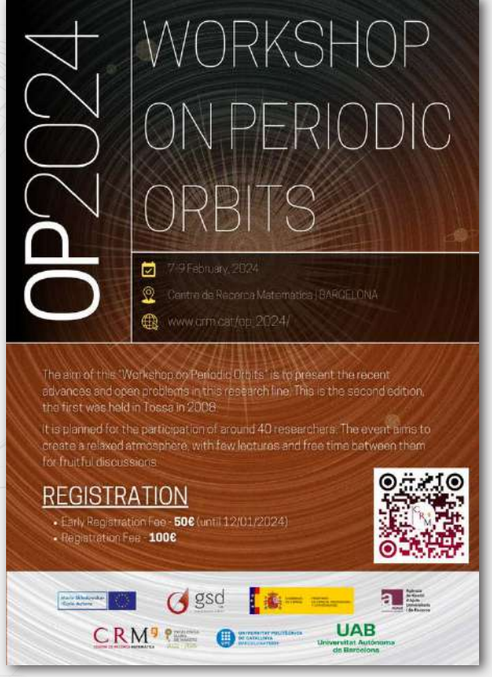
It is planned for the participation of around 40 researchers. The event aims to create a relaxed atmosphere, with few lectures and free time between them for fruitful discussions.

ORGANIZERS

Armengol Gasull | Universitat Autònoma de Barcelona
Victor Mañosa | Universitat Politècnica de Catalunya
Joan Torregrosa | Universitat Autònoma de Barcelona
Jordi Villadelprat | Universitat Autònoma de Barcelona

INVITED TALKS

Maria J. Álvarez | Universitat de les Illes Balears
Jose Luis Bravo | Universidad de Extremadura
Victoriano Carmona | Universidad de Sevilla
Anna Cima | Universitat Autònoma de Barcelona
Fátima Drubi | Universidad de Oviedo
Isaac García | Universitat de Lleida
Antonio Linero | Universidad de Murcia
Rafael Ortega | Universidad de Granada
Jesús Palacián | Universidad Pública de Navarra
David Rojas | Universitat de Girona
Pedro Torres | Universidad de Granada
Patricia Yanguas | Universidad Pública de Navarra



CONTRIBUTED TALKS

Claudio Buzzi | Universidade Estadual Paulista
Tiago Carvalho | Universidade de Sao Paulo
Ernest Fontich | Universitat de Barcelona
Armengol Gasull | Universidad Autònoma de Barcelona
Toni Guillamon | Universitat Politècnica de Catalunya
Alex Haro | Universitat de Barcelona
Jaume Llibre | Universitat Autònoma de Barcelona
David Marin | Universitat Autònoma de Barcelona
Pavao Mardesic | Université de Bourgogne
Luis F. Mello | Universidade Federal de Itajubá

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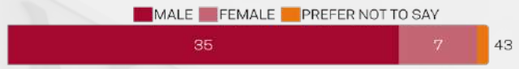


GEOGRAPHIC DISTRIBUTION

2ND MEETING OF THE SPANISH CHAPTER OF THE COMPLEX SYSTEMS SOCIETY CS3

February 22 - 23, 2024

DESCRIPTION

During the 2022 International Conference on Complex Systems celebrated in Palma de Mallorca, the Complex Systems Society approved the creation of its Spanish Chapter.

The main goal of the Spanish Chapter is to gather researchers in complex systems and other areas of potential interaction in an annual meeting celebrated somewhere in Spain.

The meeting will have the format of a two-day workshop with about 5 invited talks (30 min) and a number of contributed talks (15 or 20 min).

SPEAKERS

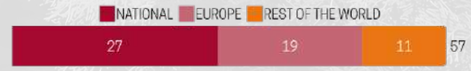
Celia Anteneodo | PUC-Rio de Janeiro
Antonio Cabrales | Universidad Carlos III de Madrid
Eva Miranda | Universitat Politècnica de Catalunya – CRM
Miguel Ángel Muñoz | Universidad de Granada
Marta Sales Pardo | Universitat Rovira i Virgili
Sergi Valverde | Institut de Biologia Evolutiva (CSIC-UPF)

ORGANISING COMMITTEE

Álvaro Corral | CRM
Josep Sardanyés | CRM

GENDER BALANCE

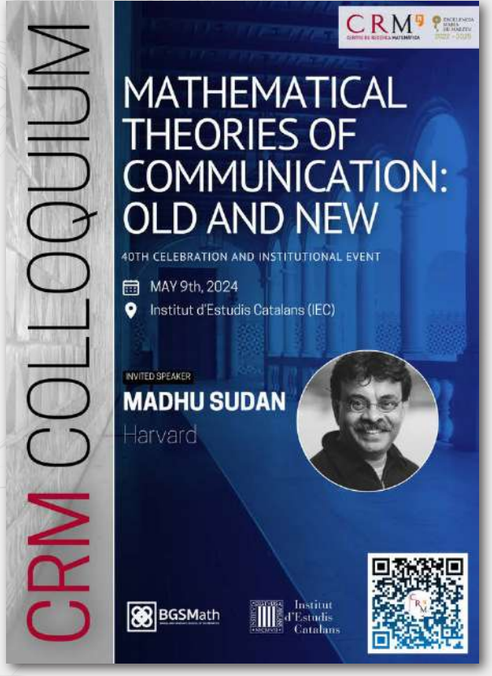
GEOGRAPHIC DISTRIBUTION



CRM COLLOQUIUM

MATHEMATICAL THEORIES OF COMMUNICATION: OLD AND NEW

May 1, 2024



DESCRIPTION

Reliable and efficient digital communication is possible today largely due to some wonderful successes in mathematical modelling and analysis. A legendary figure in this space is Claude Shannon (1916-2001) who laid out the mathematical foundations of communication in his seminal 1948 treatise, where among other contributions he gave a mathematical definition of "entropy" and coined the now ubiquitous term "bit" (for binary digit). But Shannon's theory is not the last word in communication. Communication extends to settings well beyond the carefully designed full information exchange model explored in Shannon's work. In this talk I will try to describe some of the many extensions that have been explored in the interim period including communication complexity (Yao 1980) that explores how it might be possible to achieve effective communication without a full exchange; interactive communication (Schulman 1992) which explores how to cope with errors in an interactive setting, and some of our own work on uncertain communication, which explores how shared context can make communication more effective, even if the context is shared only loosely.

SPEAKERS

Madhu Sudan | Harvard

MDM ANNUAL WORKSHOP

May 23, 2024

DESCRIPTION

In 2021, the Spanish Research Agency recognised the Centre de Recerca Matemàtica (CRM) with the "Unit of Excellence Maria de Maeztu" Award for the second time. This award acknowledges CRM's significant contributions to mathematics, encompassing both applied and fundamental research, with an interdisciplinary perspective.

The Maria de Maeztu Annual Workshop is organized as an opportunity for the CRM Community to learn about the research lines started and/or reinforced thanks to the boost that MdM Award represents for the centre. It serves as a forum to meet and discuss on their recent results and current plans.

The workshop will include presentations by post-doctoral researchers and a special keynote address by a newly affiliated researcher at CRM.

SPEAKERS

Michele Fornea | CRM
Alberto Maione | CRM
Arnau Padrol | CRM
Irene Spelta | CRM
Daria Stepanova | CRM

CONFERENCE:
CIEM24

MAY 27 - 29, 2024

DESCRIPTION

In a rapidly changing world, understanding the intricate relationships between climate and ecosystems has become more critical than ever. The "Climate-Inclusive Ecosystem Modeling: Understanding the Dynamics of Ecosystems in a Changing World (CIEM-24)" conference seeks to bring together researchers, scientists and stakeholders to explore and discuss cutting-edge approaches in modeling ecosystems, taking into account the profound influence of climate factors. The conference aims to address a wide range of topics, including theoretical ecology, ordinary and partial differential equations, autonomous and non-autonomous dynamical systems, multi-scale modelling, stochastic systems, among others, providing a comprehensive understanding of how climate change affects ecosystems and how ecosystem modeling can be enhanced to incorporate these effects.

This conference aims to stimulate vibrant discussions, facilitate interdisciplinary collaborations, and promote the development of innovative methodologies and scientific works that consider climate as a pivotal factor in ecosystem dynamics. By uniting diverse perspectives and expertise, this conference endeavors to contribute significantly to the growing body of knowledge addressing the urgent need for sustainable management of ecosystems in an ever-changing world.

ORGANISING COMMITTEE

Álvaro Corral | CRM
Marc Jorba | Universitat Politècnica de Catalunya – CRM
Josep Sardanyés | CRM

SCIENTIFIC COMMITTEE

Camila Artana | Sorbonne University
Marta Coll | Institut de Ciències del Mar
Álvaro Corral | CRM
Jezabel Curbelo | Universitat Politècnica de Catalunya – CRM
Ernest Fontich | Universitat de Barcelona – CRM
Josep Sardanyés | CRM
Blai Vidiella | CSIC-Universitat Pompeu Fabra

SPEAKERS

David Alonso | Center for Advanced Studies Blanes, CEAB
Susanne Ditlevsen | University of Copenhagen
Alan Hastings | University of California
Daniel Oro | Center for Advanced Studies Blanes, CEAB
Martin Rasmussen | Imperial College London
Natacha Roux | CRIOBE
Juan G. Rubalcaba | Universidad Complutense de Madrid
Hugo Saiz | EPS-IUCA Universidad de Zaragoza
Giulio Tirabassi | Universitat Politècnica de Catalunya

GENDER BALANCE

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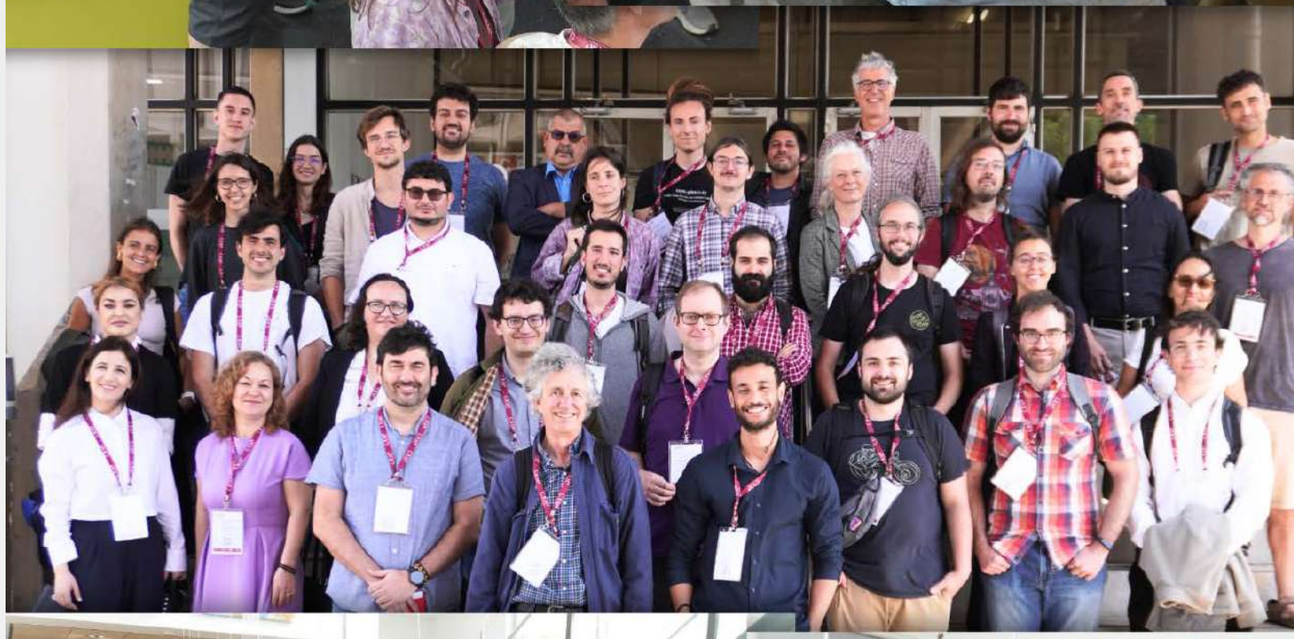


BARCCSYN 2024

BARCELONA COMPUTATIONAL, COGNITIVE AND SYSTEMS NEUROSCIENCE

May 30-31, 2024

DESCRIPTION

The annual Barcelona Computational, Cognitive and Systems Neuroscience (BARCCSYN) meeting is about bringing together researchers from computational, systems and cognitive neuroscience. Our goal is to provide a forum for lively discussion and promote active collaboration between Barcelona-based research groups, especially between theorists and experimentalists.

This is the 12th annual Barccsyn conference. The conference will be held on May 30 and 31, 2024, at the Institut d'Estudis Catalans. Each day we will have 8-10 brief oral presentations from local researchers, a poster session and two longer keynote lectures from two renowned researchers from abroad.

BARCCSYN 2024 is the second edition organised by the section Neurociència computacional i de sistemes that belongs to the Societat Catalana de Biologia and Societat Catalana de Matemàtiques.

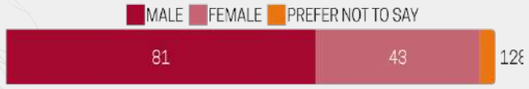
ORGANIZERS

Gloria Cecchini | Centre de Recerca Matemàtica
Ignasi Cos | Universitat de Barcelona
Thomas Gener | IIBB-CSIC
Victoria Puig | IIBB-CSIC
Melina Timplalexi | Universitat Internacional de Catalunya

SPEAKERS

Jean Daunizeau | Institut du Cerveau, INSERM
Julie Duqué | Université Catholique de Louvain

GENDER BALANCE



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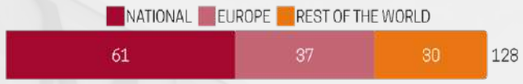

GRADUATE SUMMER SCHOOL

HYPATIA 2024

June 3-6, 2024

DESCRIPTION

This summer school series aims at training their participants in key strategic problems in mathematics and their applications, with the core idea that theory and applications strengthen each other. The school is focused in training of young researchers whilst opening new fields for senior ones.

The Hypatia Graduate Summer School will consist in two keynote courses on subjects of exceptional promise and scientific importance delivered by highly distinguished speakers in the area plus a high-level colloquium on a complementary subject.

The Hypatia Graduate Summer School will be developed in an informal atmosphere based on discussions, exchange of ideas and critical analysis of results. Moreover, to honour its namesake, it is committed to work under a friendly gender perspective that highlights the role of women in mathematics and encourages and helps the participation and promotion of young female researchers at a professional level.

LECTURERS

Alicia Dickenstein | Universidad de Buenos Aires
Elisenda Feliu | University of Copenhagen
Ezra Miller | Duke University
Roderic Guigó | Centre de Regulació Genòmica (CRG)

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

BAC24

BARCELONA ANALYSIS CONFERENCE

June 3-7, 2024

DESCRIPTION

This is the fourth edition of the Barcelona Analysis Conference organized by the Barcelona Analysis Seminar.

The Analysis Seminar of Barcelona is integrated by the different research groups in Mathematical Analysis of the Universitat Autònoma de Barcelona (UAB), Universitat de Barcelona (UB) and Universitat Politècnica de Catalunya (UPC). The main objectives of the congress are to promote research work in Mathematical Analysis, which in Catalonia has great scientific prestige, to promote the exchange of knowledge and results with the most important researchers at the international level, and facilitate the dissemination of the latest advances obtained in the field of Mathematical Analysis.

It is intended to encourage the participation of young researchers, to whom the conference is specially addressed.

ORGANIZERS

Santi Boza | UPC
Juan Carlos Cantero | UB
Albert Clop | UB-CRM
Julià Cufí | UAB
Matteo Levi | UAB-UB
Laura Prat | UAB-CRM – Chair
Olli Saari | UPC

SCIENTIFIC COMMITTEE

Alexandru Aleman | Lund University
Almut Burchard | University of Toronto
Javier Gómez Serrano | Brown University
Eugenia Malinnikova | Stanford University
Svitlana Mayboroda | University of Minnesota
Tuomas Orponen | University of Jyväskylä
Xavier Ros-Oton | ICREA-UB-CRM – Chair

SPEAKERS

Scott Armstrong | Courant Institute
David Bate | University of Warwick
Elia Brue | Bocconi University
Gonzalo Cao Labora | Massachusetts Institute of Technology
Rupert L. Frank | LMU Munich
Rachel Greenfeld | Institute for Advanced Study
Jonas Hirsch | Universität Leipzig
Annalisa Massaccesi | University of Padova
Camil Muscalu | Cornell University Ithaca

Andrea R. Nahmod | University of Massachusetts
Robin Neumayer | Carnegie Mellon University
Jose Ángel Peláez | Universidad de Málaga
Danylo Radchenko | ETH Zürich
Anna Skorobogatova | Princeton University

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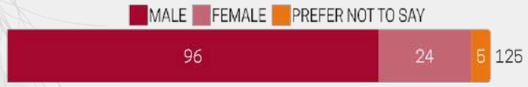

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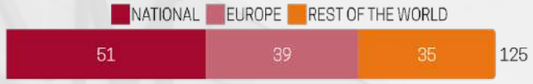
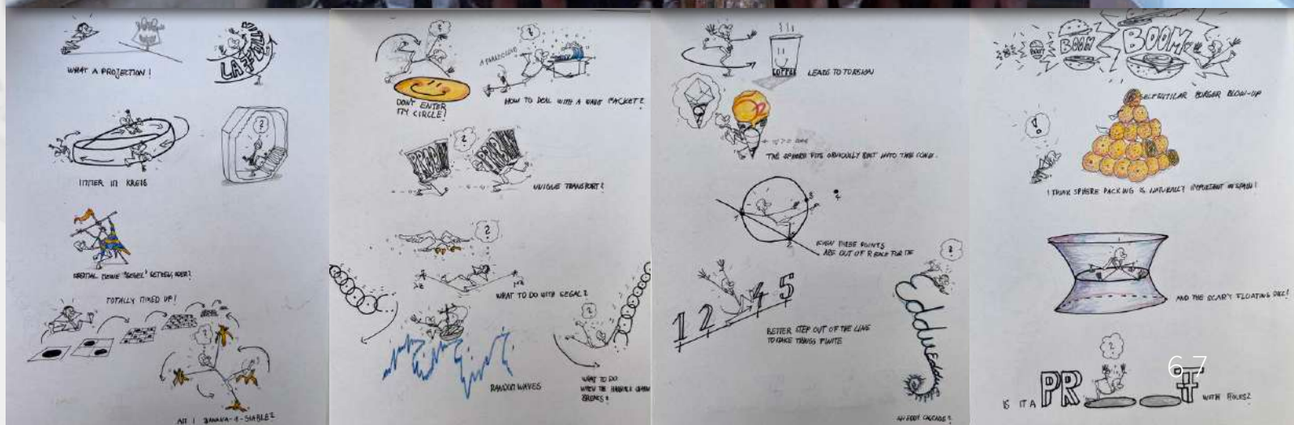




INDRUM 2024

INTERNATIONAL NETWORK FOR DIDACTIC RESEARCH IN UNIVERSITY MATHEMATICS

June 10-14, 2024

DESCRIPTION

This conference is an activity of the International Network for Didactic Research in University Mathematics (INDRUM), which aims to contribute to the development of research in didactics of mathematics at all levels of tertiary education, with a particular focus on supporting new researchers in the field and on a dialogue between the communities of Mathematics and Mathematics Education.

The themes to be addressed at INDRUM2024 will build on those addressed at the previous INDRUM conferences: INDRUM2016 in Montpellier (France); INDRUM2018 in Kristiansand (Norway); INDRUM2020 online from Bizerte (Tunisia); and INDRUM2022 in Hannover (Germany). The target audience of this conference are researchers in the didactics of mathematics, mathematicians, as well as teachers and researchers who are interested in these issues.

The conference programme will include a plenary lecture by Marianna Bosch (University of Barcelona, Spain); an expert panel discussion on the theme "Mathematics for non-specialists"; about six thematic working groups; a poster exhibition; and an early career researcher event. Pre-conference proceedings will be distributed to registered participants. The final version of the proceedings will be posted on the open archive HAL (https://hal.archives-ouvertes.fr/INDRUM).

We anticipate up to 150 participants, plus a number of local attendees. The main language of the conference is English. There is the possibility to submit and present a paper in Spanish provided the presenter considers how to address the conference audience in its linguistic diversity through slides or a handout in English.

INTERNATIONAL PROGRAMME COMMITTEE

Berta Barquero | University of Barcelona
Matija Bašic | University of Zagreb
Laura Branchetti | University of Milan
Ignasi Florensa | Univiversitat Autònoma de Barcelona
Erik Hanke | University of Hannover
Thomas Hausberger | University of Montpellier
Mitsuru Kawazoe | Osaka Metropolitan University
Elena Nardi | University of East Anglia
Frode Rønning | Norwegian University of Science
Heidi Strømskag | Norwegian University of Science
María Trigueros | Universidad Autónoma de Puebla
Olov Viirman | Uppsala University

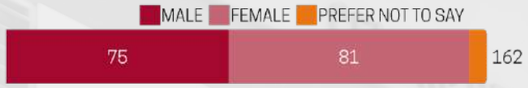
LOCAL ORGANISING COMMITTEE

Ignasi Florensa | Escola Universitària Salesians de Sarrià
Jordi Cuadros | IQS – Univ. Ramon Llull
Laura Fernández-Ruano | IQS – Univ. Ramon Llull
Iria Fraga | Escola Universitària Salesians de Sarrià
María Josep Freixanet | Universitat Politécnica de Catalunya
Nathan Lombard | Escola Universitària Salesians de Sarrià
Kristina Markulin | Escola Universitària Salesians de Sarrià
Víctor Martínez-Junza | Escola Universitària Salesians de Sarrià
Noemí Ruiz-Munzón | Escola Universitària Salesians de Sarrià
Lídia Serrano | Universidad de Deusto

SPEAKERS

Marianna Bosch | Universitat de Barcelona

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

CAVARET

CURVES, ABELIAN VARIETIES AND RELATED TOPICS

June 17 - 21, 2024

DESCRIPTION

The conference focuses on algebraic curves, their Jacobians, and abelian varieties, which are classical topics in mathematics. These subjects are connected to various areas and have seen significant advances, such as the Weil estimates, the Mordell-Weil theorem, Faltings' theorem, and Wiles' proof of Fermat's Last Theorem. Current research addresses both arithmetic and geometric aspects, with different flavors depending on the field of definition (complex numbers, real numbers, finite fields, or number fields).

The conference aims to provide insights into these topics and foster exchanges between experts from different backgrounds. Discussions will cover cohomologies, motives, algebraic cycles, explicit methods for counting points, classification of endomorphism rings, modular forms, moduli spaces, Shimura varieties, perverse sheaves, and monodromy groups.

ORGANIZING COMMITTEE

Emiliano Ambrosi | Centre National de la Recherche Scientifique
Giuseppe Ancona | Université de Strasbourg
Francesc Fité | Universitat de Barcelona - CRM
Xavier Guitart | Universitat de Barcelona - CRM

SCIENTIFIC COMMITTEE

Gregorio Baldi | Universidad de Oxford
Yuri Bilu | Universidad de Burdeos
Olivier Fouquet | Universidad de París-Saclay
Charles Vial | Universidad de Cambridge

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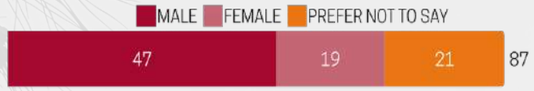


EMS SUMMER SCHOOL

GATMAID

GEOMETRY, ALGEBRA AND TOPOLOGY IN MACHINES LEARNING, ARTIFICIAL INTELLIGENCE AND BIG DATA

June 25 - 29, 2024

DESCRIPTION

The Summer School focuses on how abstract mathematics like Geometry, Algebra, and Topology (GAT) are being applied to fields such as Machine Learning, Big Data, and Artificial Intelligence. It also explores how these fields are challenging GAT researchers to develop new tools

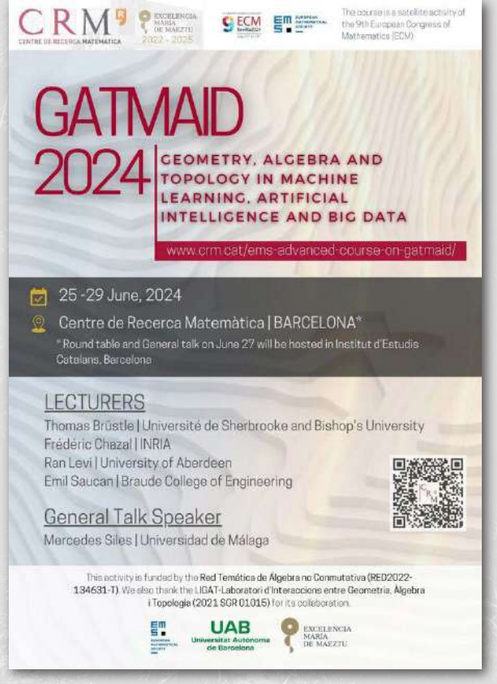
The main topic is Topological Data Analysis (TDA) and its applications. The school includes three courses: basic framework of TDA, Algebra topics influenced by TDA, and Geometry topics influenced by TDA

Each course covers mathematical background and applications. There will be tutorials, research talks, a poster session, and a public discussion on AI ethics and the transition from pure research to technological transfer

The event is ideal for early PhD and Master students and will feature international participants and speakers, mainly from Europe. It serves as a prelude to the Conference LIGAT

LECTURERS

Thomas Brüstle | Université de Sherbrooke
Frédéric Chazal | INRIA
Ran Levi | University of Aberdeen
Emil Saucan | Braude College of Engineering
Mercedes Siles Molina | Universidad de Málaga



GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

JOINT PERSPECTIVES IN GEOMETRY, ALGEBRA AND TOPOLOGY

July 1-5, 2024

DESCRIPTION

This conference is an effort to gather researchers from Geometry, Algebra and Topology (GAT) and reinforce the growing interdisciplinarity between these fields of research. Geometry and Topology rely on increasingly advanced algebraic tools, while geometric and topological insights are becoming more and more important to structure the development of Algebra.

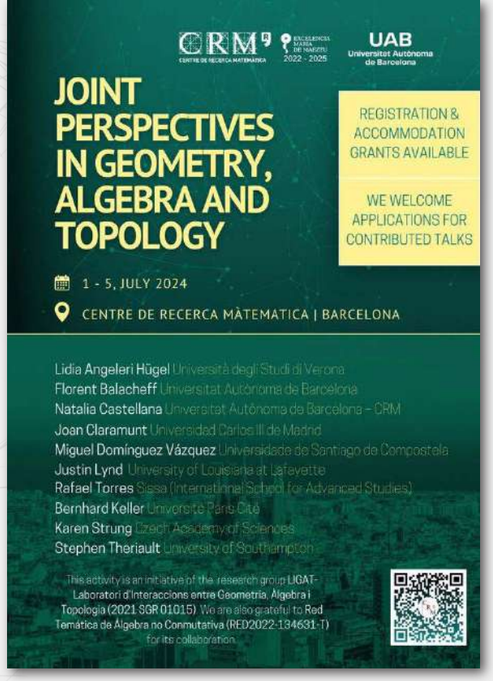
The talks in the conference aim to show different aspects of such interactions and will be addressed to a wide mathematical audience.

ORGANIZERS

Laurent Cantier | Czech Academy of Sciences - UAB
Dolors Herbera Chair | Universitat Autònoma de Barcelona - CRM
Roberto Rubio | Universitat Autònoma de Barcelona
Simone Virili | Universitat Autònoma de Barcelona
Antonio Viruel | Universidad de Málaga

SPEAKERS

Lidia Angeleri Hügel | Università degli Studi di Verona
Florent Balacheff | Universitat Autònoma de Barcelona
Natalia Castellana | Universitat Autònoma de Barcelona – CRM
Joan Claramunt | Universidad Carlos III de Madrid
Miguel Domínguez Vázquez | Universidade de Santiago de Compostela
Bernhard Keller | Université Paris Cité
Justin Lynd | University of Louisiana at Lafayette
Karen Strung | Czech Academy of Sciences
Stephen Theriault | University of Southampton
Rafael Torres | Sissa



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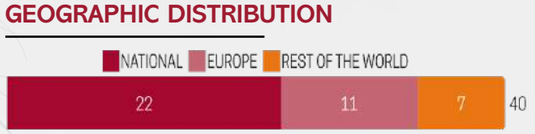

BAMB! 2023

BARCELONA SUMMER SCHOOL FOR ADVANCED MODELING OF BEHAVIOUR

July 16 - 25, 2024

DESCRIPTION

BAMB! teaches advanced techniques in model-based analysis of behavior (humans and other species) to cognitive and computational neuroscientists at PhD and early career levels. This will be achieved through structured lectures, talks, hands-on tutorials and group project aimed at making knowledge obtained directly applicable to the participants' own research. We want the trainees to acquire both the conceptual bases and the technical skills that will enable them to pursue a full modelling approach on their own when they come back to their lab.

The course is intended for PhD students and postdocs in cognitive and computational neuroscience with solid background in computational/quantitative analysis to benefit maximally from the advanced training offered by the course. Proficiency in either Python or Matlab is also required. We will seek a nice blend of experimentalists (cognitive psychology / neuroscience) and theoreticians (with or without experience in cognitive modeling).

Scientists from underrepresented groups and countries are especially encouraged to apply.

ORGANIZERS

Alex Hyafil | Centre de Recerca Matemàtica
Marion Rouault | Paris Brain Institute
Heike Stein | Ecole Normale Supérieure Paris
Chris Summerfield | Oxford University / Deepmind
Klaus Wimmer | Centre de Recerca Matemàtica

LECTURERS

Kenji Doya | OIST Okinawa
Maria Eckstein | Deepmind
Alex Hyafil | CRM
Jakob Macke | Tübingen University
Yael Niv | Princeton University
Heike Stein | ENS Paris
Chris Summerfield | Oxford University / Deepmind
Anne Urai | Leiden University
Klaus Wimmer | CRM

TEACHING ASSISTANTS

Tarryn Balsdon | ENS Paris
Diksha Gupta | SWC London
Manuel Molano-Mazón | IDIBAPS Barcelona
Nisheet Patel | University of Geneva
Max Shinn | UCL London

GENDER BALANCE

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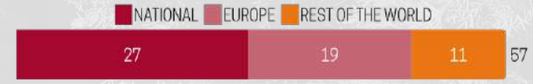


BIMR 2024 - BARCELONA INTRODUCTION TO MATHEMATICAL RESEARCH

July 1 - 26, 2024

DESCRIPTION

This new edition of the 'Barcelona Introduction to Mathematical Research' Summer School, now under the BGSMath aims to attract students in Mathematics (mainly in their 3rd or 4th year), from any University (in Barcelona or elsewhere).

The students will participate in the following activities: Working on a research project in Mathematics during the month of July. This will be done under the supervision of an Advisor/Tutor, and may consist of reading one or a few research papers (or book chapters), or working on a small open problem.

Attendance to the Minicourses (4 short courses of 4 or 5 hours long) that will take place during the weeks of July 1-4 and 8-11. The courses are given by professors from catalan universities research centers covering a wide range of areas in mathematics. Still to be decided by the organization committee.

Attendance to the Round Table: 'Academic career in mathematical research: what to do and when' and a General Public talk, that will take place during the afternoon in mid-July.

ORGANIZERS

Gemma Huguet | Universitat Politècnica de Catalunya - CRM
Marc Masdéu | Universitat Autònoma de Barcelona - CRM
Xavier Ros-Oton | ICREA-UB-CRM
Olli Saari | Universitat Politècnica de Catalunya - CRM

LECTURERS

Gissell Estrada | Universitat Politècnica de Catalunya - CRM
Núria Fagella | Universitat de Barcelona - CRM
Joaquim Ortega | Universitat de Barcelona - CRM
Francesc Perera | Universitat Autònoma de Barcelona - CRM

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

JISD 2024

July 01 - 05, 2024

DESCRIPTION

The School on Interactions between Dynamical Systems and Partial Differential Equations (JISD) is an international summer school held annually at the Universitat Politècnica de Catalunya (UPC) since 2002, with recent editions at the Centre de Recerca Matemàtica (CRM). It brings together experts and young researchers in Dynamical Systems and PDEs to exchange knowledge and methods, aiming to advance cutting-edge mathematical problems and foster interaction among participants.

The symposium includes four advanced courses (about 7 hours each) and a poster session for young researchers. Attendance ranges from 60 to 100 participants, mostly international. JISD focuses on attracting talented young researchers, especially from developing countries, to present posters and benefit from exposure to world-leading experts, helping them establish critical working relationships for their careers.

ORGANISING COMMITTEE

Xavier Cabré | ICREA - UPC - CRM
Gyula Csato | Universitat de Barcelona - CRM
Amadeu Delshams | Universitat Politècnica de Catalunya - CRM
Marcel Guàrdia | Universitat de Barcelona – CRM
Tere M. Seara | Universitat Politècnica de Catalunya – CRM

SCIENTIFIC COMMITTEE

Scott Armstrong | Courant Institute, New York University
Jean Pierre Eckmann | Université de Genève
Jean-Michel Roquejoffre | Paul Sabatier University
Susanna Terracini | Università de Torino

LECTURERS

Marie-Claude Arnaud | Université Paris Cité
Giovanni Catino | Politecnico di Milano
Xavier Ros-Oton | ICREA – UB – CRM
Dmitry Turaev | Imperial College London

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

CRM EXPLORATORY WORKSHOP

July 15, 2024

DESCRIPTION

Since the 1960s, combinatorics has evolved into a significant branch of modern mathematics, thanks to the foundational work of MIT professors Gian-Carlo Rota and Richard Stanley. A key problem in this field has been the Rota-Hero-Welsh Conjecture, which connects the combinatorial structure of matroids with the algebraic structure of projective varieties through the Hodge Riemann relations. Despite extensive efforts, this conjecture remained unresolved for decades.

June Huh made a groundbreaking contribution by proving Rota's Conjecture using techniques from algebraic geometry, combinatorics, and homological algebra. His work revealed deep connections between matroids and algebraic varieties, confirming the Hodge Riemann relations and opening new research avenues in combinatorial algebraic geometry.

Huh's collaboration with Karim Adiprasito and Eric Katz further explored the interplay between combinatorial structures and algebraic geometry, leading to new insights in areas such as toric varieties, matroid theory, and tropical geometry.

Additionally, the formal logic system LEAN has gained popularity for formalizing mathematical proofs, showcasing its versatility and wide range of applications. This tool is increasingly recognized and used within the mathematical community.

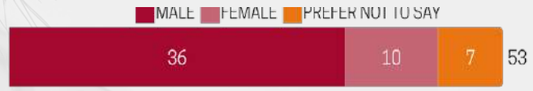
ORGANISING COMMITTEE

Marc Masdeu | Universitat Autònoma de Barcelona - CRM
Juanjo Rué | Univeristat Politècnica de Catalunya - CRM

LECTURERS

Anna de Mier | Universitat Politècnica de Catalunya
Julian Pfeifle | Universitat Politècnica de Catalunya
Souvik Goswami | Universitat de Barcelona
Sebastià Xambó | Universitat Politècnica de Catalunya
María Inés de Frutos Fernández | Universidad Autónoma de Madrid
Yaël Dillies | University of Cambridge
Riccardo Brasca | Université Paris Cité

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

MATHEMATICAL ASPECTS OF LEARNING THEORY- 20 YEARS LATER

September 9 - 13, 2024

DESCRIPTION

Learning theory is one of the main research directions devoted to the study of the theory of data science. The focus of learning theory is on the nontrivial connections between all facets of information extraction and high dimensional phenomena; specifically on the way such phenomena are manifested in applications in statistics, optimization, and complexity theory.

By now it is understood that key questions in learning theory lead to deep problems in pure mathematics and in theoretical computer science. The goal of the proposed conference is to bring together researchers from all over the world who are interested in mathematical aspects of learning theory.

In 2004 CRM hosted a tremendously successful meeting on the mathematical foundations of learning theory. The key to success was to bring together leading mathematicians working in probability and high-dimensional geometry with researchers on theoretical machine learning. We hope to repeat the same formula 20 years later, after witnessing an explosion of the subject that nobody foresaw 20 years ago.

ORGANIZERS

Peter Bartlett | UC Berkeley and Google Research
Liza Levina | University of Michigan
Gábor Lugosi | ICREA & Pompeu Fabra University
Shahar Mendelson | Australian National University
Roman Vershynin | UC Irvine

SPEAKERS

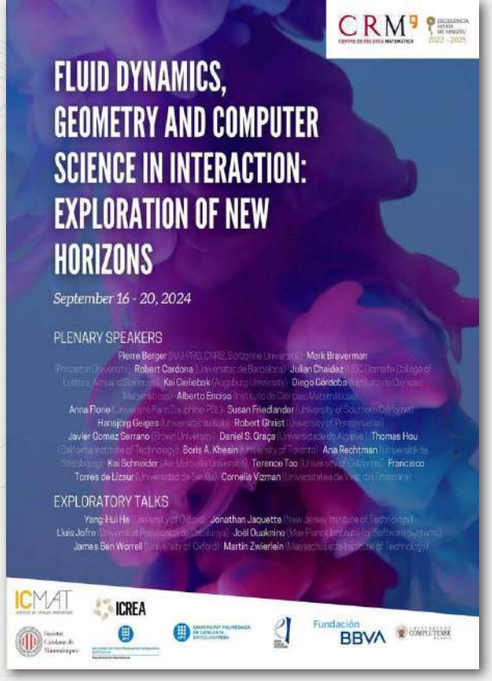
Emmanuel Abbe | École Polytechnique Fédérale de Lausanne
Morgane Austerne | Harvard University
Afonso Bandeira | ETH Zürich
Sebastien Bubeck | Microsoft Research
Emmanuel Candès | Stanford University
Nicolò Cesa-Bianchi | University of Milan
Luc Devroye | McGill University
Jian Ding | Peking University
Ronen Eldan | Microsoft Research
Christophe Giraud | Institut de Mathématiques d'Orsay
Olga Klopp | ESSEC Business School
Vladimir Koltchinskii | Georgia Institute of Technology
Shay Moran | Technion – Israel Institute of Technology
Jelani Nelson | UC Berkeley
Gergely Neu | Universitat Pompeu Fabra
Alexander Rakhlin | MIT
Tselil Schramm | Stanford University
Daniel Spielman | Yale University
Suvrit Sra | MIT
Alexandre Tsybakov | CREST-ENSAE
Martin Wainwright | MIT
Amir Yehudayoff | Technion – Israel Institute of Technology
Nikita Zhivotovskiy | UC Berkeley
Piotr Zwiernik | University of Toronto

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

FLUID DYNAMICS, GEOMETRY AND COMPUTER SCIENCE IN INTERACTION EXPLORATION OF NEW HORIZONS

September 16 - 20, 2024



DESCRIPTION

Learning theory is one of the main research directions devoted to the study of the theory of data science. The focus of learning theory is on the nontrivial connections between all facets of information extraction and high dimensional phenomena; specifically on the way such phenomena are manifested in applications in statistics, optimization, and complexity theory.

By now it is understood that key questions in learning theory lead to deep problems in pure mathematics and in theoretical computer science. The goal of the proposed conference is to bring together researchers from all over the world who are interested in mathematical aspects of learning theory.

In 2004 CRM hosted a tremendously successful meeting on the mathematical foundations of learning theory. The key to success was to bring together leading mathematicians working in probability and high-dimensional geometry with researchers on theoretical machine learning. We hope to repeat the same formula 20 years later, after witnessing an explosion of the subject that nobody foresaw 20 years ago.

ORGANIZERS

Ángel González Prieto | Universidad Complutense de Madrid
Eva Miranda | Universitat Politècnica de Catalunya - CRM
Daniel Peralta-Salas | ICMAT - CSIC

SPEAKERS

Pilar Bayer Isant | Universitat de Barcelona
Pierre Berger | IMJ-PRG, CNRS, Sorbonne Université
Robert Cardona | Universitat de Barcelona - CRM
Julian Chaidez | USC Dornsife College
Kai Cieliebak | Augsburg University
Diego Córdoba | Instituto de Ciencias Matemáticas
Alberto Enciso | Instituto de Ciencias Matemáticas
Anna Florio | Université Paris Dauphine-PSL
Hansjörg Geiges | Universität zu Köln
Robert Ghrist | University of Pennsylvania
Javier Gomez Serrano | Brown University
Daniel S. Graça | Universidade do Algarve
Thomas Hou | California Institute of Technology
Boris A. Khesin | University of Toronto
Ana Rechtman | Universidad de Grenoble
Kai Schneider | Aix-Marseille Université
Terence Tao | University of California
Francisco Torres de Lizaur | Universidad de Sevilla
Cornelia Vizman | Universitatea de Vest din Timisoara
Yang-Hui He | University of Oxford
Jonathan Jaquette | New Jersey Institute of Technology
Lluís Jofre | Universitat Politècnica de Catalunya
Joël Ouaknine | Max Planck Institute
James Ben Worrell | University of Oxford
Martin Zwierlein | Massachusetts Institute of Technology
Marta Sanz-Solé | University of Barcelona
Carme Torras | IRI-CSIC

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

CRM COLLOQUIUM

MACHINE ASSISTED PROOFS

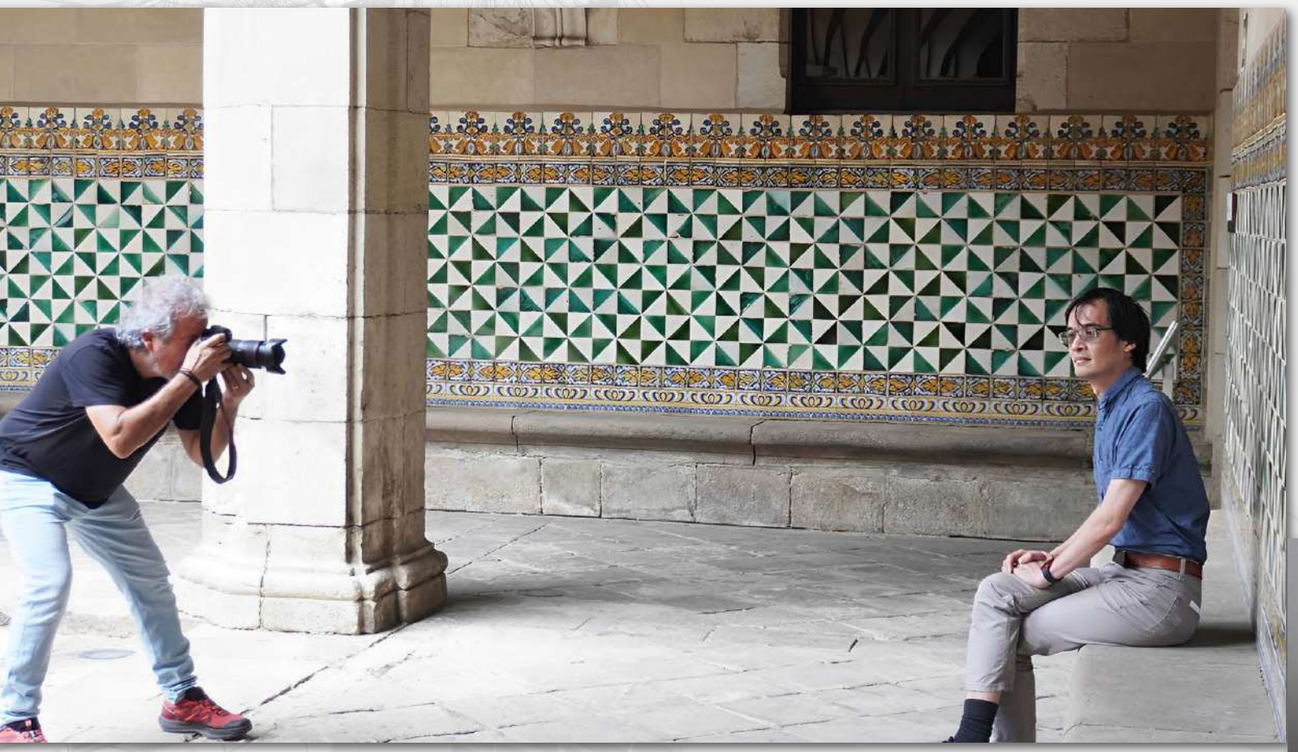
September 18, 2024

DESCRIPTION

For centuries, mathematicians have relied on computers to perform calculations, to suggest conjectures, and as components of mathematical proofs. In the light of more modern tools such as interactive theorem provers, machine learning algorithms, and generative AI, we are beginning to see machines used in more creative and substantive ways in our work. In this talk we survey some historical and recent developments, and speculate on the future roles of machine assistance in mathematics.

SPEAKERS

Terence Tao | University of California



MATH SOMMA JUNIOR MEETING

October 2 - 4, 2024

DESCRIPTION

Welcome to the Math SOMMa Junior Meeting 2024. This event is dedicated to early-career researchers, including predoctoral and postdoctoral researchers, and aims to enhance collaboration among the prestigious Severo Ochoa and Maria de Maeztu research institutions in mathematics; the Basque Centre for Applied Mathematics (BCAM), Instituto de Ciencias Matemáticas (ICMAT), Instituto de Matemáticas de la Universidad de Granada (IMAG), Centre Internacional de Mètodes Numèrics a l'Enginyeria (CIMNE), and the Centre de Recerca Matemàtica (CRM).

Our diverse program is designed to stimulate intellectual exchange and networking. It features a mix of plenary sessions, contributed talks, and a dynamic poster session. Alongside these, we have planned a series of complementary activities to foster networking and collaboration.

ORGANIZERS

Javier de la Bodega | BCAM
Alex Ferrer | CIMNE
María Ángeles García Ferrero | ICMAT
Roser Homs | CRM
Anna Jové | UB
Tomás Sanz Perela | UB
Niccolò Tassi | IMAG

SCIENTIFIC COMMITTEE

Patricio Almirón | IMAG
Paloma Bengoechea | UB-CRM (Chairwoman)
Daniel Eceizabarrena | University of Massachusetts
Mario García Fernández | UAM-ICMAT
Matteo Giacomini | CIMNE
Hristo Inouzhe | BCAM
Tamar Mesablishvili | IMAG
Guillem Perarnau | UPC-CRM
Pedro Tradacete | ICMAT

SPEAKERS

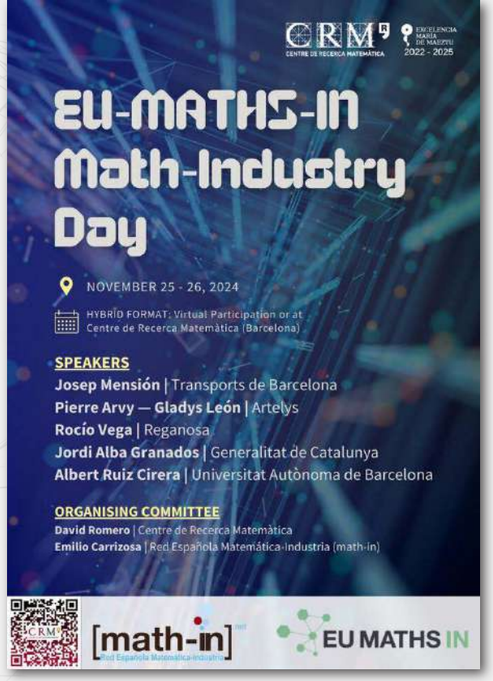
Fabiola Cavaliere | SEAT-CIMNE
Kostiantyn Drach | UB-CRM
José Manuel Conde | UAM-ICMAT
Lilia Mehidi | IMAG
Tomás Teijeiro Campo | BCAM

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION

EU-MATHS-IN & MATH-INDUSTRY DAY

November 25 - 26, 2024



DESCRIPTION

Mathematical insight is key to understanding the world around us and our impact on it. The CRM is excited to propose hosting a two-day event comprising an EU-MATHS-IN Council Meeting and a Math Industry Day. On the first day, the afternoon will be devoted to the EU-MATHS-IN Council Meeting. The EU-MATHS-IN network is composed of national networks across Europe and European organizations that share a common set of objectives towards developing the interface between mathematics and industry. EU-MATHS-IN delivers results to the demands of industry, providing added value and being a driving force for innovation.

The second day will focus on the Math Industry Day, aimed at demonstrating the career opportunities within fundamental mathematics and its synergies with the job market and modern society's needs. This event aims to establish communication channels with industry to explore partnerships, joint projects, and grant opportunities.

We invite you to participate in the Math Industry Day, which will take place at the Centre de Recerca Matemàtica on November 26. This event aims to promote collaboration between industry and research in the field of mathematics. This year, the central theme will be transport in all its forms, including the transportation of people, goods, energy, and the resolution of optimization problems. Nevertheless, the event is open to all audiences and sectors, as mathematical solutions can add value across a wide range of fields.

ORGANIZERS

David Romero | Centre de Recerca Matemàtica
Emilio Carrizosa | Red Española Matemática-Industria

SPEAKERS

Josep Mensión | Transports de Barcelona
Pierre Arvy | Artelys
Gladys León | Artelys
Rocío Vega | Reganosa
Jordi Alba Granados | Generalitat de Catalunya
Albert Ruiz Cirera | Universitat Autònoma de Barcelona

10TH COMPUTATIONAL AND SYSTEMS NEUROSCIENCE RETREAT

November 28 - 30, 2024

DESCRIPTION

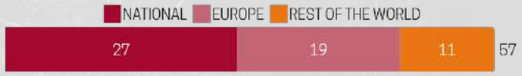
The retreat is an annual event for researchers working in computational, systems and cognitive neuroscience in the Barcelona area. The event will consist of a series of scientific, community and social activities: the detailed program will be soon available.

ORGANIZERS

Lucia Arancibia | Centre de Recerca Matemàtica
Caterina Barezzi | IDIBAPS
Alexis Cerván | IDIBAPS
Demetrio Ferro | Universitat Pompeu Fabra
Rubén Moreno | Universitat Pompeu Fabra
Marta Picco | Hospital del Mar Research Institute

GENDER BALANCE

GEOGRAPHIC DISTRIBUTION



NEUROCHATS

DESCRIPTION

The goal of the Neurochats seminar aims to bring together young researchers from Barcelona and to encourage interaction among the various research centers in the city and its surroundings. The event counts with the pleasure of free pizza and the excitement of scientific discovery, creating a relaxed and engaging atmosphere for knowledge exchange. The format includes informal talks lasting 45 minutes followed by a 15-minute discussion, allowing masters, PhD students, and postdoctoral fellows to familiarize themselves with their colleagues' research.

ORGANIZERS

Caterina Barezzi | Idibaps
Tomás Berjaga | UPF
Alexandre Garcia-Duran Castilla | CRM

SPEAKERS

Pan Ye | CRM
Lucía Arancibia | CRM
Tomás Berjaga | UPF
Marta Boscaglia | University of Leicester
Alexandre Mahrach | IDIBAPS
Alessio Borriero | Università degli Studi di Torino
Balma Serrano | IDIBAPS

SIJIMAT

SEMINARI INTERDISCIPLINARI PER A JOVES INVESTIGADORS EN MATEMÀTIQUES

DESCRIPTION

The aim of the SIJIMAT seminar is to bring together young researchers from the Centre de Recerca Matemàtica in order to promote the interaction between the different research areas present at the centre. Through informal talks of 45 minutes plus a 15 minutes discussion, PhD students and postdoctoral fellows will have the opportunity to learn about the research done by their colleagues.

All talks are expected to have an introductory section that helps non-expert participants understand the main questions and goals of the field in which the speaker works. A second section might introduce the main tools used by the speaker to tackle those questions. Finally, in the last section, the speaker will provide a brief summary of her current research project.

ORGANIZERS

Lucía Arancibia | CRM
Juan Arellano | CRM
Alfonso Garmendia | CRM
Dídac Gil | CRM
Roser Homs | CRM

SPEAKERS

Tássio Naia | CRM
Álvaro González | CRM
Axel Masó | CRM
Francesco Cattafi | Julius Maximilians Universität
Jagna Wisniewska | UPC
Alfonso Garmendia | CRM
José Lamas Rodriguez | UPC
Albert Solà Vilalta | UPC
Marina Garrote-López | Max Planck Institute
Irene Spelta | CRM
Gloria Cecchini | CRM

JORNADA COLLABORATORIUM CRM-CRG

DESCRIPTION

This inaugural meeting is intended as a first step toward building stronger connections between research groups from the CRG, EMBL Barcelona, and the CRM. The goal is to foster collaboration, explore shared interests, and lay the groundwork for a series of regular, topic-focused meetings to follow—roughly one per quarter.

The event will begin with brief institutional introductions by the directors of the three centers, followed by short flash talks from group leaders to introduce their research. The morning will continue with a series of scientific presentations from selected speakers, and the session will close with an open discussion and informal networking over lunch.

Future meetings are expected to alternate between the Collaboratorium (PRBB) and the CRM (UAB campus).

ORGANIZERS

Tomás Alarcón | CRM

SPEAKERS

Adel Al Jord | CRG
Vikas Trivedi | EMBL
Eric Latorre | CRM–CRG
Mara Dierssen | CRG
Gissell Estrada | CRM–UPC

05 BGSMATH

BGSMath
BARCELONA GRADUATE SCHOOL OF MATHEMATICS

BGSMATH MISSION

The Barcelona Graduate School of Mathematics (BGSMath) was created in 2014 as a collaborative initiative of the research groups in mathematics of four main universities, and an international research centre located in the Barcelona area:

- University of Barcelona (UB)
- Autonomous University of Barcelona (UAB)
- Pompeu Fabra University (UPF)
- Catalan Polytechnic University (UPC)
- Mathematical Research Centre (CRM)

Its primary objective is to provide doctoral and postdoctoral training at the highest level in an international environment.

In 2015, BGSMath was awarded a “Unit of Excellence Maria de Maeztu” distinction by the Spanish Government. These recognitions are meant to fund “highly competitive strategic research programmes in the frontiers of knowledge” that “are among the best in the world in their respective scientific areas”. The financial support over 4 years was for a total of 2,000,000€. During that period, BGSMath was the only unit in mathematics in Spain holding this distinction.

With the completion of the Maria de Maeztu programme in 2019, the BGSMath became a delegated committee of the Centre de Recerca Matemàtica (CRM).

UAB Universitat Autònoma de Barcelona

upf. Universitat Pompeu Fabra Barcelona

Universitat de Barcelona
IMUB Institut de Matemàtica

UPC Universitat Politècnica de Catalunya Barcelona
Departament de Matemàtiques

CRM Centre de Recerca Matemàtica

GRADUATE COURSE

VALUATION THEORY AND THE OM ALGORITHM

January 15-19, 2024

DESCRIPTION

The aim of this course is to analyze a computational resolution of the extension problem given by the OM-algorithm, named after Ore, Mac Lane, Okutsu and Montes. This algorithm uses a routine of polynomial factorization over finite extensions of the residue class field k of the initial valuation v as an essential ingredient. As a consequence, it is specially efficient when k is a finite field, as is the case for number fields and curves over finite fields.

Recent advances in the Mac Lane–Vaquié theory of key polynomials of valuations over the ring K[x] will be reviewed. These tools will be used to reformulate the algorithm in a more elegant and comprehensive way. Some ideas to extend the algorithm beyond the classical rank-one discrete case will be presented too.

ORGANIZERS

Maria Alberich | Universitat Politècnica de Catalunya)
Jordi Guàrdia | Universitat Politècnica de Catalunya – CRM)
Enric Nart | Universtat Autònoma de Barcelona)
Joaquim Roé | Universtat Autònoma de Barcelona)

LECTURERS

Maria Alberich | Universitat Politècnica de Catalunya
Jordi Guàrdia | Universitat Politècnica de Catalunya
Enric Nart | Universitat Autònoma de Barcelona
Sebastian Pauli | University of North Carolina Greensboro
Adrien Poteaux | Université Lille
Joaquim Roé | Universitat Autònoma de Barcelona
Martin Weimann | Université de Caen-Normandie

GRADUATE COURSE

MODERN THEORY OF CUNTZ SEMIGROUPS

February 13 - March 07, 2024

DESCRIPTION

The Cuntz semigroup, introduced by Joachim Cuntz in the late 1970s, is a significant invariant for C*-algebras. It is constructed from the positive elements of a C*-algebra, similar to the projection semigroup, but with a more complex structure as an abelian semigroup with a non-algebraic order. This order was crucial for distinguishing two C*-algebras in 2008, which were otherwise identical under K-Theory and other invariants, thus boosting the classification program of simple, separable, nuclear C*-algebras initiated by G. A. Elliott. The Cuntz semigroup is now seen as a classifying invariant equivalent to the Elliott invariant.

Over time, the Cuntz semigroup has become essential in understanding the structural properties of C*-algebras. Its order, interpretable through suitable functionals, is a key component of the Toms-Winter conjecture, which posits the equivalence of three seemingly disparate conditions. The category of the Cuntz semigroup has been extensively analyzed, with constructions in this category reflecting back to C*-algebras and preserving many properties. These techniques have advanced our understanding of C*-algebras of stable rank one and solved open problems. Recently, the Cuntz semigroup has also been crucial in describing crossed products by certain group actions, making it a vibrant and expanding area of research.

ORGANIZERS

Ramon Antoine | UAB – CRM
Laurent Cantier | UAB – Czech Academy of Sciences
Francesc Perera | UAB – CRM

GRADUATE COURSE

HIGHLIGHTS OF ALGORITHMIC CODING THEORY

May 6-8, 2024

DESCRIPTION

In this series of lectures, we will quickly introduce the mathemtical notions of an error-correcting code, and the associated notions of Encoding and Decoding Algorithms. After reviewing some of the classical results on the existence, construction and limits on error-correcting codes, we will zoom in on two results in the field.

1) The construction of capacity achieving codes (based on Folded Reed Solomon Codes) over large alphabets and their encoding and decoding:

Given any error parameter delta in [0,1] and epsilon > 0, these codes achieve a rate 1-delta-epsilon and correct delta fraction of adversarial errors with alphabet size growing only with epsilon.

2) The construction of binary error correcting codes (Polar codes) that achieve Shannon capacity at small block lengths: I.e, given delta in [0,1/2] and epsilon > 0 correct delta fraction of random errors with rate 1- h(delta) – epsilon at lengths poly(1/epsilon). [Here h(p) = -p

log_2 p – (1-p) log_2 (1-p) is the binary entropy function].

SPEAKER

Madhu Sudan | Harvard University

GRADUATE COURSE

Γ-CONVERGENCE: A 50 YEARS LONG STORY

November 5 - December 5, 2024

DESCRIPTION

In these series of advanced lectures, we devote ourselves both to the theoretical aspects of Γ -convergence, through the famous monograph by Dal Maso, and to the most famous and relevant applications in mechanics, through the monographs by Braides and Braides-Defranceschi. Lecture notes are also provided, aimed to recalling all the results discussed in class.

The main topic of the first part of the course is the Fundamental theorem of Γ-convergence by De Giorgi and Franzoni, which guarantees the good behaviour of sequences of minimizers and minima in the topology of the Γ-convergence. As an application of this result, in the second part of the course we will study problems ranging from the theory of elliptic partial differential equations (G-convergence and H-convergence), to applications in the mathematical theory of composite materials, with particular interest in the theory of periodic homogenization, and in the pioneering result of Modica and Mortola for the mathematical treatment of phase transition problems. For this now classic result, we refer to a detailed survey by Giovanni Alberti.

These lectures are recommended for students in Mathematics and early-career researchers who wish to specialise in the field of analysis. They are also intended for an audience of experienced mathematicians with some background and interest in PDEs and applications in material science.

ORGANIZERS AND SPEAKERS

Alberto Maione | CRM

JUNIOR MEETING

BMS-BGSMATH JUNIOR MEETING 2024

JUNE 26-28, 2024

DESCRIPTION

This event is a significant gathering for young researchers in mathematics, providing a platform to discuss cutting-edge topics and foster collaboration. Renowned mathematicians will present on subjects such as Partial Differential Equations, Dynamical Systems, Symplectic Geometry, and Discrete Geometry. Young researchers will share their work through 20-minute talks, covering a wide range of mathematical fields, and engaging "elevator talks" will introduce various research topics, encouraging lively discussions and networking. Social events, including a conference dinner, will enhance the sense of community. This meeting emphasizes the importance of diverse perspectives and innovative approaches in advancing mathematical research.

ORGANIZERS

Ana Belén de Felipe | Universitat Politècnica de Catalunya
Judit Chamorro | Universitat Politècnica de Catalunya
Robert Cardona | Universitat Politècnica de Catalunya
Fawzy Hegab | Humboldt-Universität zu Berlin
Gerard Bargalló i Gómez | Humboldt-Universität zu Berlin
Georgi Mitsov | Humboldt-Universität zu Berlin
Kartikey Sharma | Technische Universität Berlin
Nicolas Weiss | Technische Universität Berlin
Nikola Sadovek | Technische Universität Berlin
Sandro Roch | Technische Universität Berlin

LECTURERS

María Ángeles García | Instituto de Ciencias Matemáticas
Frank Trujillo | CRM
Thibaut Mazuir | Humboldt Universität zu Berlin
Apratim Choudhury | Humboldt-Universität zu Berlin
Alexandra Wesolek | Technische Universität Berlin
Michael Rothgang | HU Berlin
Sandro Roch |Technische Universität Berlin
Clara Torres-Latorre | Universitat de Barcelona,
Joaquim Duran | CRM
Laura González | Universitat Politècnica de Catalunya
Dante Luber | TU Berlin
Salvador Borrós Cullell | Universitat Autònoma de Barcelona
Pablo Nicolas | CRM
Marco Antonio Flores | HU Berlin
Tássio Naia | CRM
Eloi Torrents | Universitat Autònoma de Barcelona
Dorota Mlynarczyk | Universitat Autònoma de Barcelona
Jagna Janina Wisniewska | Universitat Politècnica de Catalunya
Georgi Mitsov | Humboldt University

GRADUATE COURSE

THRESHOLD PHENOMENA IN RANDOM STRUCTURES

DECEMBER 10 - DECEMBER 19, 2024

DESCRIPTION

In this course we will present the notion of threshold, a phenomenon consisting on a sudden behavioural change in the random structure produced by a small increase of the modelling parameter (temperature, energy, probability…). We will survey the most recent advances in the area as well as explore applications in other fields such as Sociology, Biology, Statistics and Computer Science. The last part of the course will be devoted to covering two very recent breakthroughs in the area.

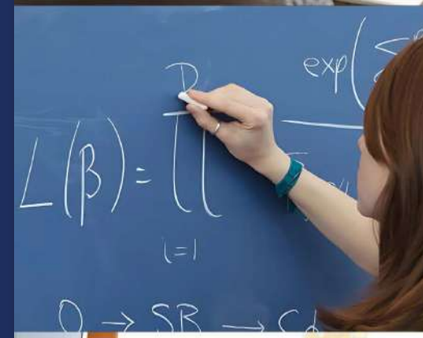
(1) the Kahn-Kalai conjecture, now Park-Pham theorem, asserting that thresholds can not differ too much from expected thresholds [10]. We plan to give a full proof of it.

(2) The satisfiability conjecture, now the Ding-Sly-Sun theorem, that pins down the threshold for a random k-SAT formula being satisfiable [4]. The proof is this theorem is highly non-trivial, but we plan to do an overview on the topic and explain the main connections with (1).

The course is aimed at master and doctoral students, and at postdoctoral researchers in the areas of Mathematics, Computer Science and Physics, but is also open to all early career researchers and faculty in other areas that are interested in the fundamentals of threshold phenomena and its applications to different disciplines.

ORGANIZERS AND SPEAKERS

Patrick Morris | Universitat Politècnica de Catalunya
Tássio Naia dos Santos | CRM
Guillem Perarnau | Umiversitat Politècnica de Catalunya - CRM


06 COMM & OUTREACH

The CRM's mission emphasizes the integration of advanced mathematical research into society by fostering a deeper scientific culture through strategic communication and outreach. We see communication as integral to research—not merely for transparency but as a powerful means to engage diverse audiences, enriching the broader scientific dialogue and laying the groundwork for productive collaborations. Equally important is empowering researchers with effective tools to clearly communicate their findings, enhancing research quality, fostering cooperation among peers, and promoting widespread knowledge exchange.

Historically, CRM's outreach has concentrated on educational initiatives, particularly through targeted programs for talented students. Moving forward, CRM is broadening its approach to reach wider audiences, enhancing the effectiveness of educational activities, engaging more students, and increasing its overall societal impact.

CRM remains firmly dedicated to increasing awareness among students, educators, researchers, and the general public about the fundamental role mathematics plays in advancing Catalan society as a whole.

The primary goal of CRM's outreach team is to illuminate the diverse career paths available in mathematics and to actively support students in their educational journeys. Through engaging talks, interactive school visits, practical workshops, and compelling exhibitions at science festivals, we strive to reveal mathematics as a fascinating, creative, and inspiring discipline, deeply woven into the fabric of daily life.

“MATHEMATICS MUST BE ON THE MENU”

EL GEGANT DEL π

The Centre de Recerca Matemàtica (CRM) has launched an engaging blog called **El Gegant del π**. This platform is designed to make complex mathematical theories accessible and interesting for a wide audience, including students, educators, enthusiasts, and the curious. In essence, it offers a window into how mathematics permeates our daily lives.

Contributions from CRM researchers ensure that the content is both accurate and engaging, aiming to foster a passion for mathematics among all readers. This blog is a wonderful resource for anyone looking to explore the beauty, complexity, and relevance of mathematics in the world around us.

MENTS MERAVELLOSES PODCAST

Ments Meravelloses is a mathematics outreach podcast that explores the lives and works of extraordinary individuals who have profoundly influenced the history of mathematics and science. Through episodes dedicated to figures such as Pythagoras, Hypatia of Alexandria, Évariste Galois, Al-Khwarizmi, Srinivasa Ramanujan, Katherine Johnson, Paul Erdös, or Maryam Mirzakhani, the podcast showcases both their scientific impact and their human dimension, offering an intimate and accessible view of the figures who have shaped the development of the discipline.

Each episode includes conversations with mathematical experts, helping us better understand the legacy of these pioneers, along with fascinating anecdotes about their lives.

With this podcast, we aim to break stereotypes about mathematics, making it accessible and inspiring for all audiences, especially younger ones.

With the support of the **Catalan Foundation for Research and Innovation (Joan Oró 2024 Call)**.

Ments Meravelloses
AjutsOró 2024
fcri Fundació Catalana per a la Recerca i la Innovació

BARCELONA INTERNATIONAL YOUTH SCIENCE CHALLENGE (BIYSC)

The Centre de Recerca Matemàtica (CRM) recently hosted ten students as part of the Barcelona International Youth Science Challenge (BIYSC), an annual event organized by the **Fundació Catalunya-La Pedrera**. This event gathers high school students from around the world for an intensive and inspiring scientific experience. The participants in CRM's mathematics program, coming from diverse countries such as the United Kingdom, Kazakhstan, El Salvador, Saudi Arabia, and Spain, engaged in a hands-on project that explored various facets of mathematics. The project was structured around three main courses, aimed at appealing to both theoretical and practical interests, ensuring that each participant could find their niche within the mathematical sciences.

The program included courses by Antoni Guillamon, Carlos d'Andrea and Natalia Castellana. A special session on knowledge transfer, led by David Romero, emphasized real-life optimization problems, showcasing collaborations between CRM and various institutions. Additionally, CRM's Knowledge Transfer Unit hosted Maria Rosinach as part of the "Joves i Ciència" program.

"MATES I A XALAR" ON THE RADIO: POPULAR MATH TALKS IN THE TERRES DE L'EBRE

The event "Mates i a xalar," organized by the Centre de Recerca Matemàtica (CRM) in collaboration with the Centre d'Estudis de la Ribera d'Ebre (CERE), took place at the Julio Antonio Institute in Móra d'Ebre, offering an engaging series of workshops and talks designed to make mathematics more accessible and enjoyable, especially for audiences in rural areas. Participants attended various interactive activities, including a modeling workshop led by PhD students Stefano Pedarra and Amaia Vielba, which showcased how mathematical modeling can describe everyday phenomena, such as predicting the number of dogs flowing into animal shelters. In another session, Fernando Gastón and Mariona Fucho-Rius introduced participants to mathematical proofs through vivid demonstrations, notably a visual proof of the Pythagorean theorem and an accessible explanation of proof by contradiction. A hands-on game focusing on graph theory challenged attendees to apply the Four Color Theorem, exploring how to color a graph using the fewest colors possible without neighboring vertices sharing the same color. The event concluded with a plenary talk by Dr. Josep Sardanyés, who discussed nonlinear phenomena and chaos theory, illustrating these complex concepts with relatable examples, such as the erratic flight patterns of seagulls in the Ebro Delta and the famously unpredictable motion of a double pendulum.

1ST VISIBLE FIGURES CONTEST

In celebration of February 11th, the International Day of Women and Girls in Science, the Centre de Recerca Matemàtica organized the 1st Visible Figures Contest – Women in Mathematics. In this contest, participants had to find the different roll-ups and posters distributed throughout the Faculty of Sciences along with the CRM and, based on the information provided about each mathematician, answer a brief questionnaire.

CRM PARTICIPATES IN EXPORECERCA JOVE BY AWARDING A SPECIAL PRIZE

From March 6th to 9th, the Centre de Recerca Matemàtica (CRM) participated in the annual edition of Exporecerca Jove, an international research fair aimed at secondary and high school students. The projects were evaluated by a qualified jury. As a sponsoring entity, the CRM awarded for the first time a special prize for the best work in mathematics or with mathematical content.

EXHIBITION ON EARTHQUAKES AND TSUNAMIS AT THE UAB SCIENCE LIBRARY

The Science and Technology Library at UAB hosted the exhibition "Earthquakes and Tsunamis: A Mathematical Perspective," organized by Álvaro González from the CRM. Running until April 12th, the exhibition explored the complexity of these natural phenomena through images, texts, simulations, and ancient maps. It highlighted the role of mathematics in understanding and mitigating their effects.

INTERNATIONAL DAY OF WOMEN AND GIRLS IN SCIENCE

Interviews with:

- Dr. Gloria Cecchini, a postdoctoral researcher in the CRM's neuroscience group.
- Dr. Daria Stepanova, a postdoctoral researcher in the Mathematical and Computational Biology group
- Dra. Jezabel Curbelo, investigadora Ramón y Cajal de la Universitat Politècnica de Catalunya, miembro del IMTechy, del Centre de Recerca Matemàtica y Guest Investigador del Woods Hole Oceanographic Institution

CRM PARTICIPATION IN ESPAICIÈNCIA

On March 13th, Andrea Suárez, Fernando Gastón, and Marcel Morillas from the Knowledge Transfer Unit (KTU) of the CRM, along with Pau Varela and Mariona Fucho from communication and outreach, participated in EspaiCiència as part of the Saló de l'Ensenyament.

During the event, they conducted two workshops. The first, led by Andrea Suárez, Fernando Gastón, and Mariona Fucho, consisted of a practical session on the use of cryptography for efficient data compression and transmission. The second workshop, conducted by Andrea Suárez, Marcel Morillas, and Pau Varela, explained the concept of uncertainty, specifically applied to artificial intelligence models.

STUDENTS FROM LA VALL DEL TENES INSTITUTE IN BARCELONA VISIT THE CRM

On March 21st, more than fifty students from La Vall del Tenes Institute in Barcelona visited the Centre de Recerca Matemàtica (CRM) as part of their participation in the Cangur tests. During the visit, three predoctoral researchers from the CRM (Juan Arellano, PhD student in the Mathematical and Computational Biology Research Group; Lucía Arancibia, PhD student in the Neuroscience Research Group, and Dídac Gil, from the Dynamical Systems Research Group shared their knowledge in mathematical biology, neuroscience, and dynamic systems. This activity complemented the students' participation in the Cangur tests, a competition aimed at sparking interest in mathematics among young people.

SETMANA DE LA CIÈNCIA 2024

The Centre de Recerca Matemàtica (CRM) participated in the Science Day at Schools, held on November 13, 2024. The event, part of Science Week, included interactive activities and workshops led by members of the CRM's communication and outreach team, such as Mariona Fucho and Pau Varela, to bring mathematics closer to secondary and high school students.

NIT DE LA RECERCA 2024

The Centre de Recerca Matemàtica (CRM) actively participated in the European Researchers' Night with a lecture by Marc Calvo Schwarzälder and an educational video on phylogenetics by Roser Homs. Additionally, the CRM hosted a session of the "Bojos per les Matemàtiques" program, led by Tim Myers and Marc Calvo, aimed at talented mathematics students.

THE CRM HOLDS ITS FIRST PILISH POETRY

The Centre de Recerca Matemàtica (CRM) held its first Pilish poetry contest on the occasion of the International Day of Mathematics. Violant Martí was the winner of this first edition, chosen through a popular vote on the CRM's social media.

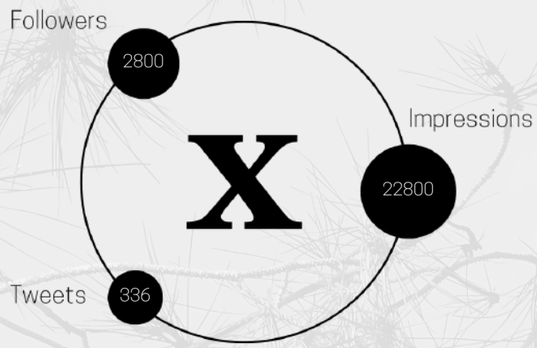
Pilish is a unique form of writing that restricts the length of words according to the digits of π. The contest, organized by the CRM, saw the participation of six individuals who combined their passion for literature and mathematics through their texts.

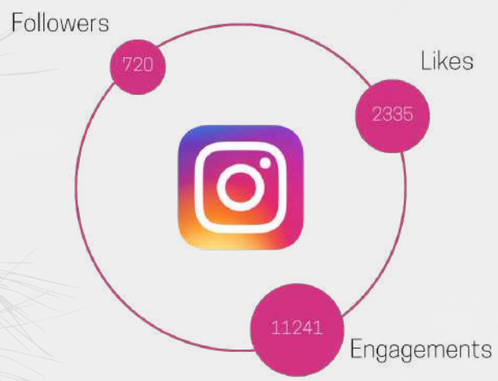
FESTA DE LA CIÈNCIA 2024

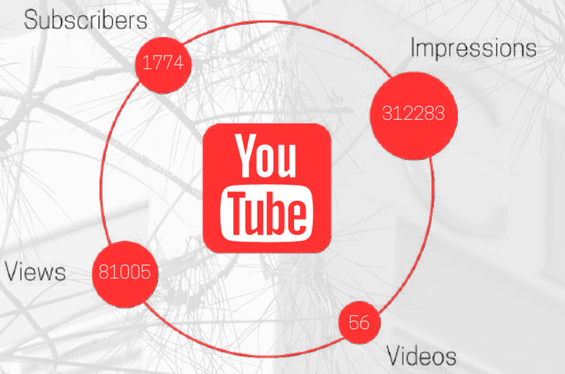
The Centre de Recerca Matemàtica (CRM) participated in the 17th Science Festival with two workshops: "La La Lambda: The Mathematics of Music," which explored the relationship between mathematics and music, and "Neural Code," which introduced attendees to the world of neuroscience. The event, held on June 8th and 9th at the Centre de Cultura i Memòria del Born in Barcelona, gathered over 20,000 people and featured nearly 140 participating entities.

The workshop "La La Lambda: The Mathematics of Music," led by Daniel Ramos, demonstrated how sound waves, musical scales, and rhythmic patterns are rooted in mathematical concepts. Klaus Wimmer and Alexandre Garcia-Durán from the CRM, as well as researchers from IDIBAPS, also participated.

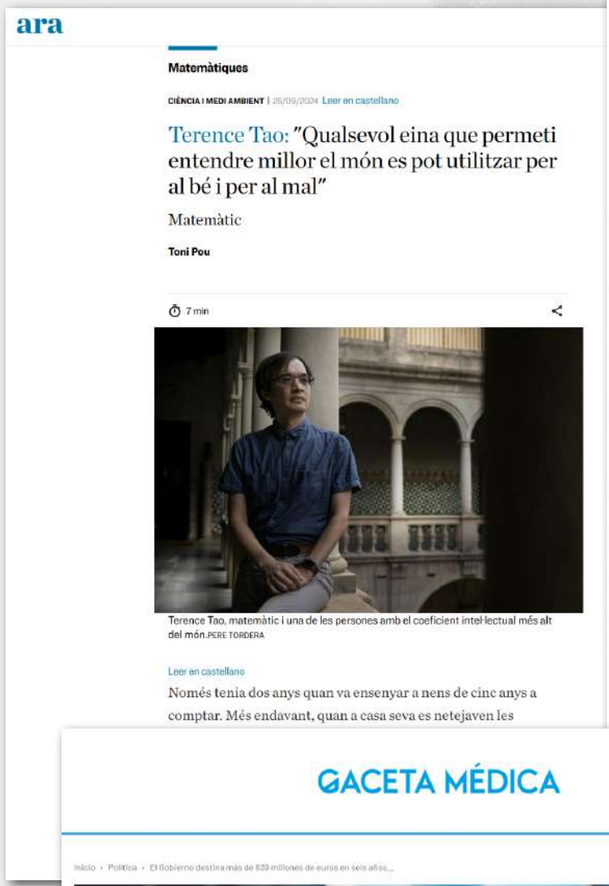
SOCIAL MEDIA







CRM IN THE SPOTLIGHT: PUBLIC IMPACT



ara

Matemàtiques

CIÈNCIA I MEDI AMBIENT | 25/09/2024 Leer en castellano

Terence Tao: "Qualsevol eina que permeti entendre millor el món es pot utilitzar per al bé i per al mal"

Matemàtic

Toni Pou

7 min

Terence Tao, matemàtic i una de les persones amb el coeficient intel·lectual més alt del món.PERE TORDERA

Leer en castellano

Només tenia dos anys quan va ensenyar a nens de cinc anys a comptar. Més endavant, quan a casa seva es netejaven les

CERDANYA

RECERCA

Eva Miranda parla a Puigcerdà "D'Alan Turing a les computadores d'aigua i més enllà"

Eva Miranda és doctora en Matemàtiques, catedràtica i directora del Laboratori de Geometria i Sistem Dinàmics i la líder del grup de recerca en Geometria de la UPC.

Dra. Eva Miranda

GACETA MÉDICA

Inicio › Política › El Gobierno destina más de 839 millones de euros en seis años...

POLÍTICA

El Gobierno destina más de 839 millones de euros en seis años a proyectos de investigación contra el cáncer

Esto ha permitido a más de 1.100 estudios desarrollar nuevas terapias y enfoques para mejorar la prevención, diagnóstico y tratamiento de los tumores

Por **Patricia Córdoba Jiménez** - 24 septiembre 2024

SÍGUENOS

4,863 Fans

1,280 Seguidores

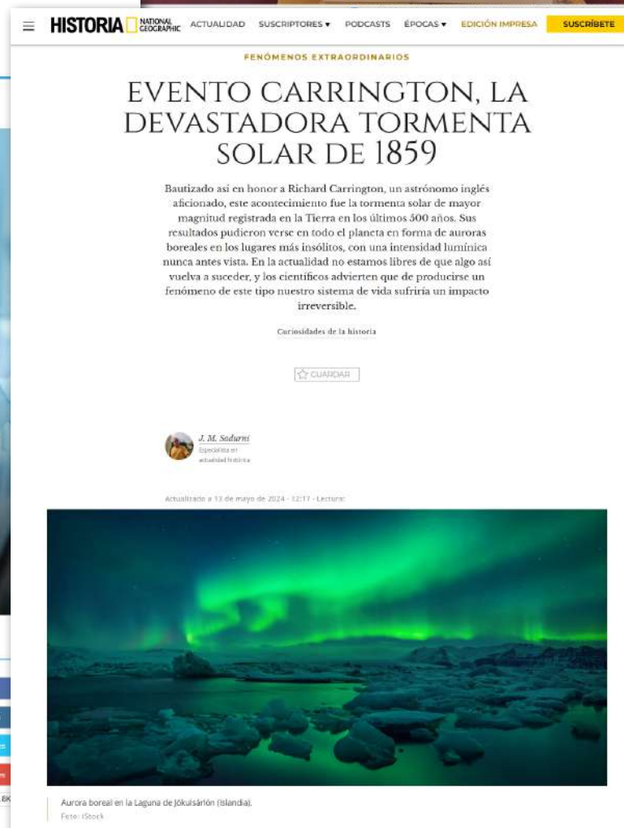
54,782 Seguidores

3,900 Suscriptores

SUSCRIBIRSE 17.6K

La ministra de Ciencia, Innovación y Universidades, Diana Morant, ha anunciado que **se han destinado 839,2 millones de euros desde 2018 para financiar proyectos de investigación e innovación enfocados a la lucha contra el cáncer**. Según ha señalado la ministra, "el Gobierno de España está haciendo una apuesta sin precedentes por mejorar la salud de las personas a través de la ciencia, apoyando nuevos avances en la prevención, la detección, el diagnóstico precoz y el tratamiento de esta enfermedad".

El Ministerio de Ciencia, Innovación y Universidades **está gestionando esta inversión a través de sus tres principales organismos financiadores de la I+D+i**: el Instituto de Salud Carlos III (ISCIII), la Agencia Estatal de Investigación (AEI) y el Centro para el Desarrollo Tecnológico y la Innovación (CDTI). A esta cifra se suma la financiación ordinaria destinada a organismos públicos



HISTORIA NATIONAL GEOGRAPHIC ACTUALIDAD SUSCRIPTORES PODCASTS ÉPOCAS EDICIÓN IMPRESA SUSCRÍBETE

FENÓMENOS EXTRAORDINARIOS

EVENTO CARRINGTON, LA DEVASTADORA TORMENTA SOLAR DE 1859

Bautizado así en honor a Richard Carrington, un astrónomo inglés aficionado, este acontecimiento fue la tormenta solar de mayor magnitud registrada en la Tierra en los últimos 500 años. Sus resultados pudieron verse en todo el planeta en forma de auroras boreales en los lugares más insólitos, con una intensidad lumínica nunca antes vista. En la actualidad no estamos libres de que algo así vuelva a suceder, y los científicos advierten que de producirse un fenómeno de este tipo nuestro sistema de vida sufriría un impacto irreversible.

Curiosidades de la historia

GUARDAR

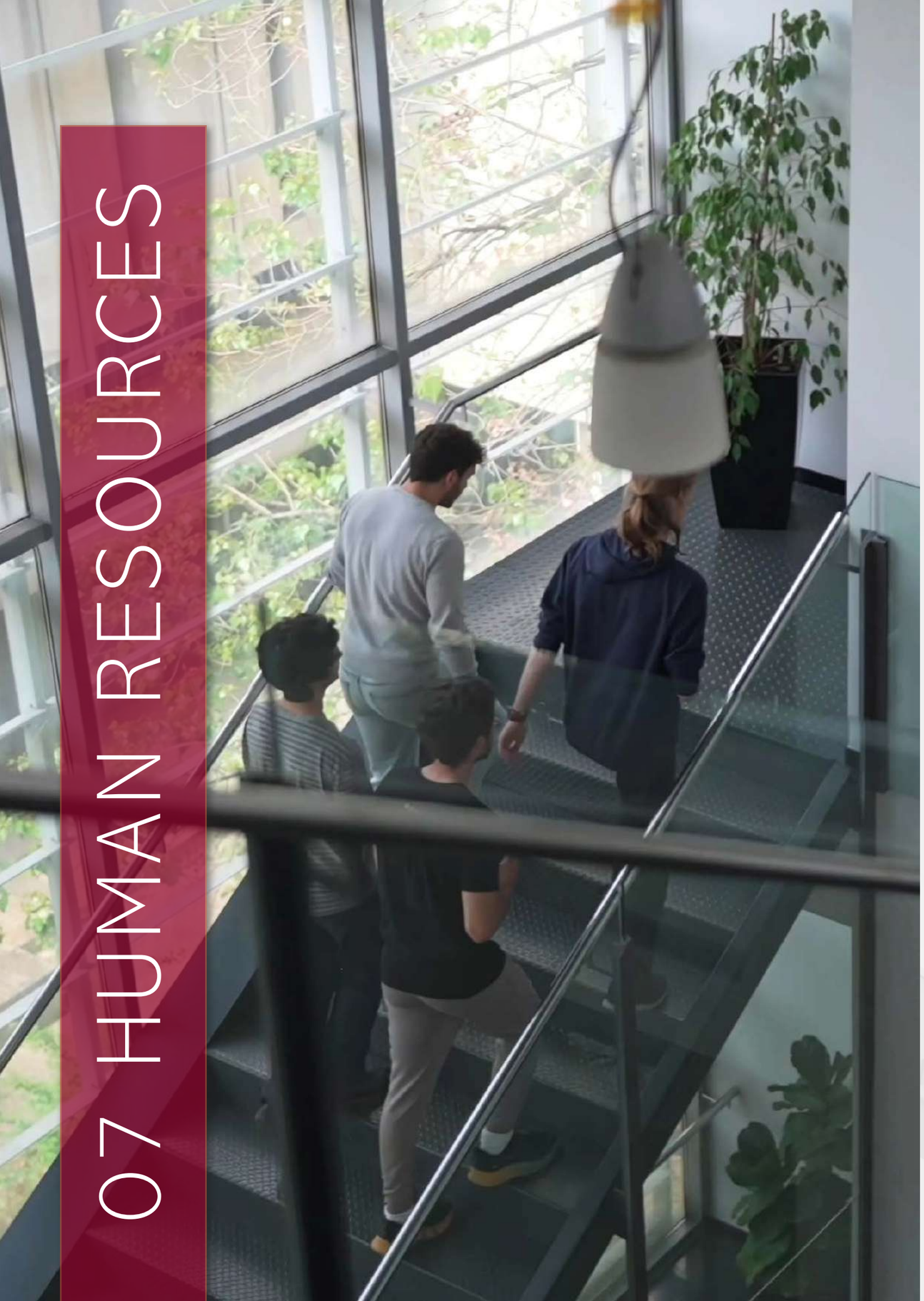
J. M. Sidurni

Especialista en actualidad histórica

Actualizado a 13 de mayo de 2024 - 12:17 - Lectura:

Aurora boreal en la Laguna de Jökulsárlón (Islandia).

Foto: iStock



07 HUMAN RESOURCES

HR EXCELLENCE IN RESEARCH

euraxess RESEARCHERS IN MOTION

The Human Resources Strategy for Researchers (HRS4R), launched in 2008, supports institutions in implementing The European Charter for Researchers and The Code of Conduct for Recruitment. This strategy aims to enhance the relationship between researchers and employers, fostering successful knowledge generation, transfer, and career development.

The HR Excellence in Research award recognizes institutions aligning their HR policies with the Charter & Code principles, signifying a commitment to fair and transparent recruitment and appraisal. The European Commission (EC) has outlined a five-step process for this:

I. Conduct a Gap Analysis.
II. Publish the institution's strategy (Action Plan) online.
III. Seek EC evaluation and approval.
IV. Continuously apply and self-assess.
V. Undergo an external evaluation by the EC after five years.

The Centre de Recerca Matemàtica (CRM) committed to the Charter & Code in February 2014 and conducted a Gap Analysis in May 2014. Since July 2015, CRM has held the HR Excellence in Research award, working to improve professional welfare, skills, and career development.

In 2017, a stricter application process was introduced, emphasizing Open, Transparent, Merit-based Recruitment(OTM-R). CRM's interim assessment in 2018 showed robust implementation of its Action Plan, confirmed by the EC. In March 2023, CRM hosted an onsite EC assessment, resulting in the renewal of the HRS4R award.

CRM's commitment to these standards demonstrates its dedication to creating a supportive, transparent, and progressive research environment, contributing to the European Research Area.

AURA FOUNDATION

Aura Foundation, created in October 1989, is a non-profit organization initially formed as an association and that since 2004 has operated as a private foundation. It pioneered the «Supported Employment» program in Spain by implementing and developing its' methodology. Aura aims to improve the quality of life of people with intellectual disability by helping to integrate them into society and find them employment.

The CRM collaborates with the Aura Foundation since the year 2006 through the hiring of Mari Paz Valero as Administrative Assistant in our center.

AURA
FUNDACIÓ

PEOPLE

SENIOR RESEARCHERS

ALARCÓN, TOMÁS	CRM-ICREA	Mathematical & Computational Biology
ALSEDÀ, LLUÍS	UAB-CRM	Dynamical Systems
ÁLVAREZ, JOSEP	UPC-CRM	Algebra, Geometry, Number Theory & Topology
AMORÓS, JAUME	UPC-CRM	Algebra, Geometry, Number Theory & Topology
ANTOINE, RAMON	UAB-CRM	Algebra, Geometry, Number Theory & Topology
ARA, PERE	UAB-CRM	Algebra, Geometry, Number Theory & Topology
ATSERIAS, ALBERT	UPC-CRM	Combinatorics, Logic & Algorithmics
BALACHEFF, FLORENT	UAB-CRM	Algebra, Geometry, Number Theory and Topology
BALDOMÁ, INMACULADA	UPC-CRM	Dynamical Systems
BARJA, MIGUEL ANGEL	UPC-CRM	Algebra, Geometry, Number Theory & Topology
BARS, FRANCESC	UAB-CRM	Algebra, Geometry, Number Theory and Topology
BENGOECHEA, PALOMA	UB-CRM	Algebra, Geometry, Number Theory & Topology
BROTO, CARLES	UAB-CRM	Algebra, Geometry, Number Theory & Topology
CABRÉ, XAVIER	UPC-ICREA-CRM	Analysis & Partial Differential Equations
CALSINA, ÀNGEL	UAB-CRM	Analysis & Partial Differential Equations
CARDONA, ROBERT	UB-CRM	Algebra, Geometry, Number Theory and Topology
CASANELLAS, MARTA	UPC-CRM	BIO-GEOMAP
CASCANTE, CARME	UB-CRM	Analysis & Partial Differential Equations
CASTELLANA, NATÀLIA	UAB-CRM	Algebra, Geometry, Number Theory & Topology
CIRICI, JOANA	UB-CRM	Algebra, Geometry, Number Theory & Topology
CLARKE, ANDREW	UPC-CRM	Dynamical Systems
CLOP, ALBERT	UB-CRM	Analysis & Partial Differential Equations
CORRAL, ÁLVARO	CRM	Climate Change & Natural Hazards
COSTA, LAURA	UB-CRM	Algebra, Geometry, Number Theory & Topology
CSATO, GYULA	UB-CRM	Analysis & Partial Differential Equations
CURBELO, JEZABEL	UPC-CRM	Dynamical Systems
D'ANDREA, CARLOS	UB-CRM	Algebra, Geometry, Number Theory & Topology
DELSHAMS, AMADEU	UPC-CRM	Dynamical Systems
DIEULEFAIT, LUIS	UB-CRM	Algebra, Geometry, Number Theory & Topology
DONAIRE, JUAN JESÚS	UAB-CRM	Analysis & Partial Differential Equations

DRACH, KOSTIANTYN	UB-CRM	Dynamical Systems
ESTRADA, GISSELL	UPC-CRM	Mathematical & Computational Biology
FAGELLA, NÚRIA	UB-CRM	Dynamical Systems
FERNÁNDEZ, JESÚS	UPC-CRM	BIO-GEOMAP
FITÉ, FRANCESC	UB - CRM	Algebra, Geometry, Number Theory & Topology
FONTICH, ERNEST	UB-CRM	Dynamical Systems
GÁLVEZ, IMMACULADA	UPC-CRM	Algebra, Geometry, Number Theory & Topology
GASULL, ARMENGOL	UAB-CRM	Dynamical Systems
GUÀRDIA, MARCEL	UB-CRM	Dynamical Systems
GUILLAMON, ANTONI	UPC-CRM	Neuroscience
GUITART, XAVIER	UB-CRM	Algebra, Geometry, Number Theory & Topology
GUTIÉRREZ, JAVIER J.	UB-CRM	Algebra, Geometry, Number Theory & Topology
HARO, ALEJANDRO	UB-CRM	Dynamical Systems
HERBERA, DOLORS	UAB-CRM	Algebra, Geometry, Number Theory & Topology
HUGUET, GEMMA	UPC-CRM	Neuroscience
HYAFIL, ALEXANDRE	CRM	Neuroscience
JARQUE, XAVIER	UB-CRM	Dynamical Systems
JORBA, ÀNGEL	UB-CRM	Dynamical Systems
JORBA, MARC	UPC-CRM	Dynamical Systems
KNAUER, KOLJA	UB-CRM	Combinatorics, Logic & Algorithmics
LAHOZ, MARTÍ	UB-CRM	Algebra, Geometry, Number Theory & Topology
LATORRE, ERIC	CRM	Mathematical & Computational Biology
LÁZARO, JOSÉ TOMÁS	UPC-CRM	Dynamical Systems
MARCHESI, SIMONE	UB-CRM	Algebra, Geometry, Number Theory & Topology
MARÍN, DAVID	UAB-CRM	Algebra, Geometry, Number Theory & Topology
MARTIN, PAU	UPC-CRM	Dynamical Systems
MARTÍNEZ-SEARA, TERESA	UPC-CRM	Dynamical Systems
MARZO, JORDI	UB-CRM	Analysis & Partial Differential Equations
MAS, ALBERT	UPC-CRM	Analysis & Partial Differential Equations
MASDEMONT, JOSEP	UPC-CRM	Dynamical Systems
MASDEU, MARC	UAB-CRM	Algebra, Geometry, Number Theory & Topology
MATEU, JOAN E.	UAB-CRM	Analysis & Partial Differential Equations
MIRANDA, EVA	UPC-CRM	Algebra, Geometry, Number Theory & Topology
MIRÓ, ROSA MARIA	UB-CRM	Algebra, Geometry, Number Theory & Topology
MORIÑA, DAVID	UAB-CRM	Climate Change and Natural Hazards
MUNDET, IGNASI	UB-CRM	Algebra, Geometry, Number Theory & Topology
MYERS, TIMOTHY G.	CRM	Climate Change & Natural Hazards
NARANJO, JOAN CARLES	UB-CRM	Algebra, Geometry, Number Theory & Topology
NICOLAU, ARTUR	UAB-CRM	Analysis & Partial Differential Equations
NOY, MARC	UPC-CRM	Combinatorics, Logic & Algorithmics
OLLE, MERCÈ	UPC-CRM	Dynamical Systems
OROBITG, JOAN	UAB-CRM	Analysis & Partial Differential Equations
ORTEGA, JOAQUIM	UB-CRM	Analysis & Partial Differential Equations
PADROL, ARNAU	UB-CRM	Combinatorics, Logic & Algorithmics
PAU, JORDI	UB-CRM	Analysis & Partial Differential Equations
PERARNAU, GUILLEM	UPC-CRM	Combinatorics, Logic & Algorithmics
PERERA, FRANCESC	UAB-CRM	Algebra, Geometry, Number Theory & Topology
PILAUD, VINCENT	UB-CRM	Combinatorics, Logic and Algorithmics
PONCE, ADRIÁN	UPC-CRM	Neuroscience
PORTI, JOAN	UAB-CRM	Algebra, Geometry, Number Theory & Topology
PRAT, LAURA	UAB-CRM	Analysis & Partial Differential Equations
PRATS, MARTÍ	UAB-CRM	Analysis & Partial Differential Equations
PUIG, PERE	UAB-CRM	Climate Change & Natural Hazards
ROS-OTON, XAVIER	UB-ICREA-CRM	Analysis & Partial Differential Equations
ROTGER, VÍCTOR	UPC-CRM	Algebra, Geometry, Number Theory & Topology
ROXIN, ALEX	CRM	Neuroscience

RUÉ, JUAN JOSÉ	UPC-CRM	Combinatorics, Logic & Algorithmics
RUIZ, ALBERT	UAB-CRM	Algebra, Geometry, Number Theory & Topology
SAARI, OLLI	UPC-CRM	Analysis & Partial Differential Equations
SALAZAR CIUDAD, ISAAC	CRM	Mathematical & Computational Biology
SANZ, TOMÁS	UB-CRM	Analysis and Partial Differential Equations
SARDANYÉS, JOSEP	CRM	Mathematical & Computational Biology
SERNA, SUSANA	UAB-CRM	Analysis & Partial Differential Equations
SERRA, ORIOL	UPC-CRM	Combinatorics, Logic & Algorithmics
SOLANES, GIL	UAB-CRM	Algebra, Geometry, Number Theory & Topology
SOMBRA, MARTÍN	UB-ICREA-CRM	Algebra, Geometry, Number Theory & Topology
TIKHONOV, SERGEY	CRM-ICREA	Analysis & Partial Differential Equations
TOLSA, XAVIER	UAB-ICREA-CRM	Analysis & Partial Differential Equations
TORREGROSA, JOAN	UAB-CRM	Dynamical Systems
VIEIRO, ARTURO	UB-CRM	Dynamical Systems
WIMMER, KLAUS	CRM	Neuroscience

POSTDOCTORAL RESEARCHERS

AUTON, LUCY CHARLOTTE	Climate Change & Natural Hazards
CALVO, MARC	Climate Change & Natural Hazards
CECCHINI, GLORIA	Neuroscience
CLOETE, IELYAAS	Mathematical and Computational Biology
DA FONSECA, MARIA	Neuroscience
EPPLER , JENS BASTIAN	Neuroscience
FORNEA, MICHELE	Algebra, Geometry, Number Theory & Topology
GARMENDIA, ALFONSO	Algebra, Geometry, Number Theory & Topology
GONZALEZ GOMEZ, ALVARO	Climate Change & Natural Hazards
HOMS PONS, ROSER	Bio-Geomap
IBAÑEZ SOLAS, SARA	Neuroscience
IVANCIC, FILIP	Mathematical and Computational Biology
KALOU, AIKATERNI	Neuroscience
KOSOV, EGOR	Analysis & Partial Differential Equations
MAIONE, ALBERTO	Analysis & Partial Differential Equations
MEL, GABRIEL	Mathematical and Computational Biology
NAIA DOS SANTOS, TÁSSIO	Combinatorics, logic & algorithmics
RODRIGUES FERREIRA, GUSTAVO	Dynamical Systems
SPELTA, IRENE	Algebra, Geometry, Number Theory & Topology
STEPANOVA, DARIA	Mathematical and Computational Biology
TOKMAGAMBETOV, NIYAZ	Analysis & Partial Differential Equations
TRUJILLO AMEZQUITA, FRANK	Dynamical Systems
WOKKE, MARTIJN	Neuroscience

PREDOCTORAL RESEARCHERS

ANTONIADOU , ALEXANDRA	Computational Neuroscience
ARELLANO TINTO, JUAN	Mathematical and Computational Biology
CASTELLVI FOGUET, JORDI	Combinatorics, logic & algorithmics
DE ARANCIBIA CASILLAS, LUCIA	Neuroscience
DURAN LAMIEL, JOAQUIM	Analysis & Partial Differential Equations
DYHR, SOREN ISTVAN ADORJAN	Algebra, Geometry, Number Theory & Topology
GARCIA-DURAN CASTILLA, ALEXANDRE	Neuroscience
GIL RAMS, DIDAC	Dynamical Systems
GUILLAN RIAL, JAVIER	Algebra, Geometry, Number Theory & Topology
LLACER SANSALONI, LLUIS	Algebra, Geometry, Number Theory & Topology
LLOPIS ALMELA, ORIOL	Mathematical and Computational Biology

MARTINEZ AÑON, KEVIN	Mathematical and Computational Biology
NICOLAS MARTINEZ, PABLO	Algebra, Geometry, Number Theory & Topology
PEDARRA, STEFANO	Mathematical and Computational Biology
POLLAN HAUER, NICOLAS	Neuroscience
SAUCEDO CUESTA, MIQUEL	Analysis & Partial Differential Equations
VIELBA TRILLO, AMAIA	Mathematical and Computational Biology
VIVAR ABURTO, CITLALLI	Neuroscience
YE, PAN	Neuroscience

RESEARCH ASSISTANT

ORRIT VIÑETS, LAURA	Mathematical and Computational Biology
POU AMENGUAL, NEUS	Computational Neuroscience
WILSON GANZABAL, ANNA	Computational Neuroscience

KNOWLEDGE TRANSFER UNIT

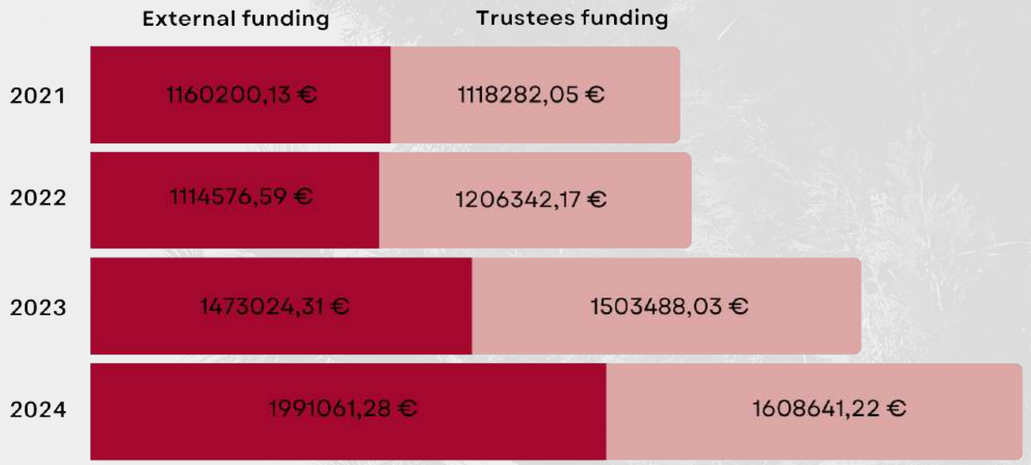
ESCOLÀ SOLES, ALBERT	Impact Officer
GASTON CODONY, FERNANDO	Researcher Technician
GUTH, BASILE CHARLES XAVIER	Impact Officer
MASÓ PUIGDELLOSAS, AXEL	Scientific Software
MORILLAS ROZAS, MARCEL	Researcher Technician
REIG LLUNELL, PAU	Scientific Software Developer
ROMERO SANCHEZ, DAVID	Responsable KTU
SUÁREZ SEGARRA, ANDREA	Scientific Software Developer

RESEARCH SUPPORT STAFF

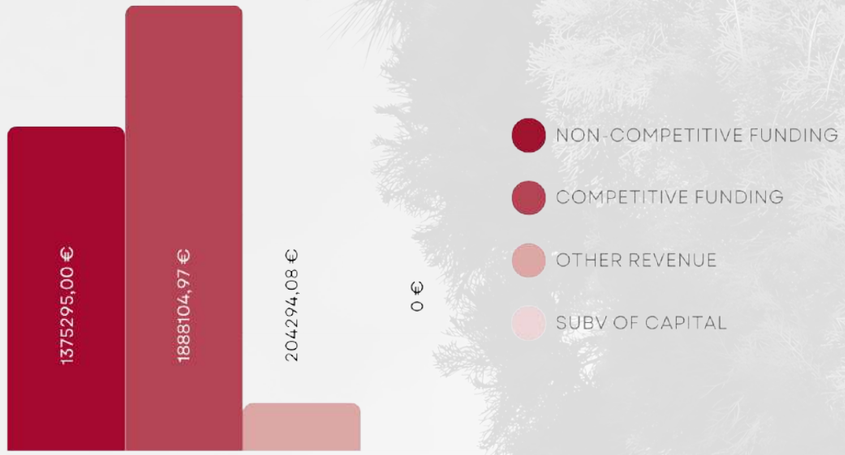
ALVES, PATRICIA	Accountant
CAÑAMERO, IVAN	IT Technician
COSTA, PAU	Scientific Activities Technician
CUNI, JORDI	HR Team
FUCHO, MARIONA	Communications Technician
GUTIÉRREZ, ARIADNA	Data Steward
GUTIERREZ, GERARD	Data Steward
HERNANDEZ, NURIA	Scientific Activities Coordinator
MARTINEZ, GEMMA	Manager
MULLOR, JORDI	IT Manager
RAMIREZ, VANESSA	Scientific Activities Technician
RENTER, ANNA	HR Team
ROCA, CONSOL	Management Assistant
ROS, CLAUDIA	Project Manager
SÁNCHEZ, VANESSA	HR Team
SANZ, ARANZAZU	Head of Strategy
VALERO, MARIA PAZ	Administration Assistant
VALLINA, NATALIA	Communications Technician
VARELA, PAU	Communications Technician

08 FUNDING

The following charts portray the expenditure and income that the CRM has carried out during the 2021-2024 period. To begin with, in 2024 the CRM continues with the trend to balance external funds (competitive funding and other revenue) with funds contributed by the trustees (non-competitive funding and subversion of capital).

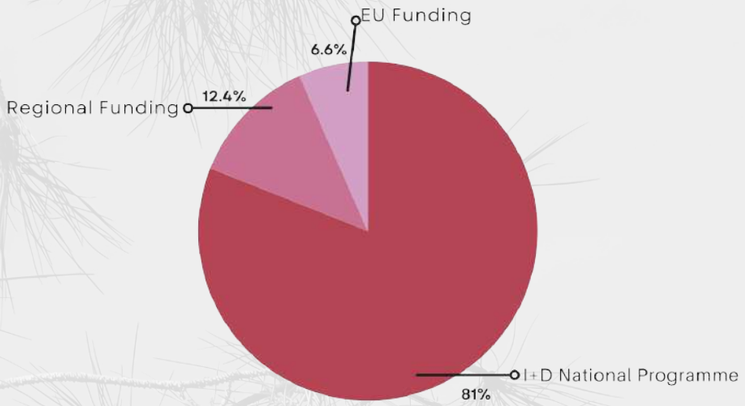


More clearly, the funding comes from the following kind of sources:

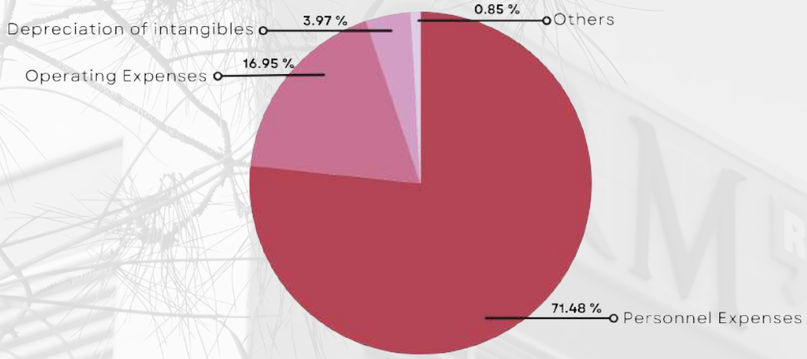


A 38,21% of the funds come from the Generalitat de Catalunya (Non-competitive Funding), of which 44,38% was used for the operation of the center.

52,45% of the resources are obtained through competitive calls and of these, 81,03% come from the Spanish State through the Spanish Research Agency (I+D National Programme), 12,36% from autonomous bodies of the Generalitat de Catalunya, mainly the AGAUR (Regional Funding), and 6,61% from the European Union (EU Funding).



Of all these revenues, the vast majority are allocated to Personnel Expenses (71,48%), and a 16,95% to Operating Expenses (material, cleaning, telephone, maintenance, subsistence allowances and travel and training, among others).



CENTRE DE RECERCA MATEMÀTICA

EXCELENCIA MARÍA DE MAEZTU 2022 - 2025

Generalitat de Catalunya

Institut d'Estudis Catalans

UAB Universitat Autònoma de Barcelona

CERCA Centres de Recerca de Catalunya

Centre de Recerca Matemàtica | CRM
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Barcelona
www.crm.cat