CRM

CENTRE DE RECERCA MATEMÀTICA

ANNUAL REPORT 2025

Generalitat de Catalunya

CERCA Centres de Recerca de Catalunya

Institut d'Estudis Catalans

UAB Universitat Autònoma de Barcelona

Universitat de Barcelona

UPC Universitat Politècnica de Catalunya BarcelonaTech

CONTENTS 2025

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

This annual report brings together the Centre de Recerca Matemàtica's research activities, highlights, and institutional milestones from 2025, along with our work in training, outreach, and knowledge transfer.

2025 was a productive year for our research. It produced 140 publications and 24 defended PhD theses, and we ran 54 research activities (conferences, workshops, colloquia, advanced courses, and BGSMath graduate courses) that together drew over 1,400 participants from over 60 countries.

Several recognitions marked the year. Jezabel Curbelo (UPC-CRM) received the 2025 National Research Award for Young Researchers in Mathematics and ICT. Three of our affiliated researchers, Xavier Tolsa (ICREA-UAB-CRM), Joaquim Ortega-Cerdà (UB-CRM), and Xavier Cabré (ICREA-UPC-CRM), were invited to speak at the International Congress of Mathematicians (ICM 2026) in Philadelphia, with Xavier Tolsa as a plenary speaker.

During 2025 we also prepared our new 2026–2030 Strategic Plan, approved by the Scientific Advisory Board in July and by the Governing Board in January 2026. It sets out where the institution is heading across core research, advanced training, and our relationship with the wider scientific community. Under the plan, our scientific programme is organised around four core areas: algebra and geometry; analysis and PDEs together with dynamical systems; mathematical modelling; and combinatorics. It also introduces four flagship initiatives, among them work at the intersection of artificial intelligence and mathematics, and multiscale modelling for problems in biology, climate change, and public health.

Part of our mission is to turn abstract mathematical results into real-world applications. Through our Knowledge Transfer Unit, we continued to expand collaborations across the public and private sectors. In education, our aim for the coming years is to develop the Barcelona Graduate School of Mathematics into an international reference for doctoral and postdoctoral training.

In December 2025, the centre successfully completed its four-year CERCA evaluation, conducted by an international committee. We also continued our work on talent attraction and diversity. We launched the CRM-MdM Chair of Excellence, a call to host senior women researchers for short stays and strengthen collaboration with role models and leading figures in mathematics. We opened the MdM Focused Research Programme on Combinatorial Geometries & Geometric Combinatorics, and welcomed a new ATRAE researcher in September.

Two platforms carried our public engagement in 2025. Our podcast, Ments Meravelloses, continued to share the human stories behind mathematical discoveries. Our outreach blog, El Gegant del π, published 28 posts that drew over 2,000 views; during the year it launched an interactive mathematical fiction series and introduced "Diari de doctorat" (PhD Diary), which follows the daily lives of our predoctoral community.

All of this has been possible thanks to the commitment and hard work of everyone at the CRM. I am grateful to both our academic community and our administrative staff, whose daily effort is essential to the centre's success.

I invite you to read the report to see what our community has achieved, and where we are heading next.

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 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 Research and Universities, 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

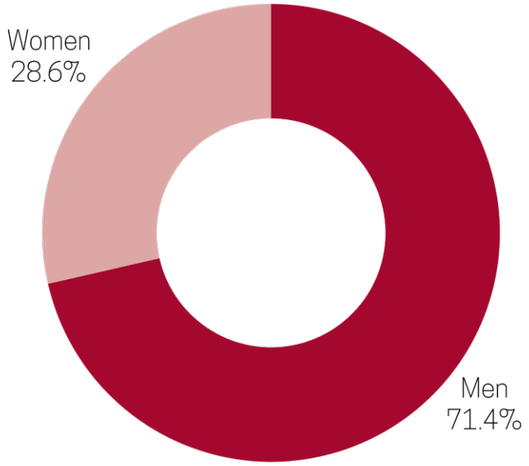
The remit of the Centre de Recerca Matemàtica is to be a resource of excellence in mathematical research and training at international level. Its specific aims are:

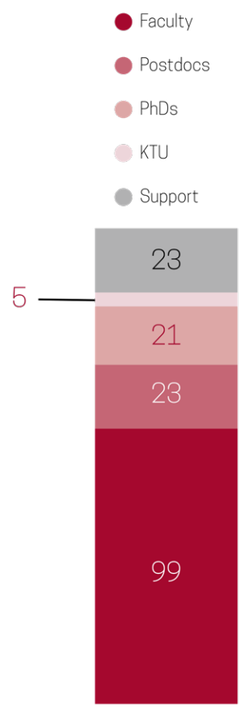
1. High-quality research of international standing in mathematics, including a special emphasis on real-world applications carried out in a collaborative or interdisciplinary context.
2. Knowledge transfer based on validated mathematical research, with emphasis on concrete implementations of justified 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 2025

171





SCIENTIFIC PAPERS

140

DOCTORAL THESES

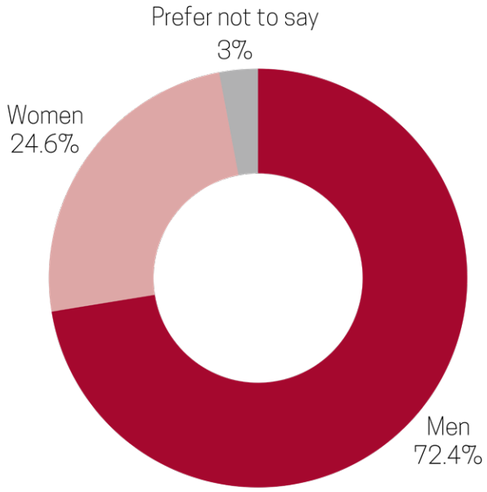
24

CRM ACTIVITIES 2025

54

TOTAL PARTICIPANTS

1.397

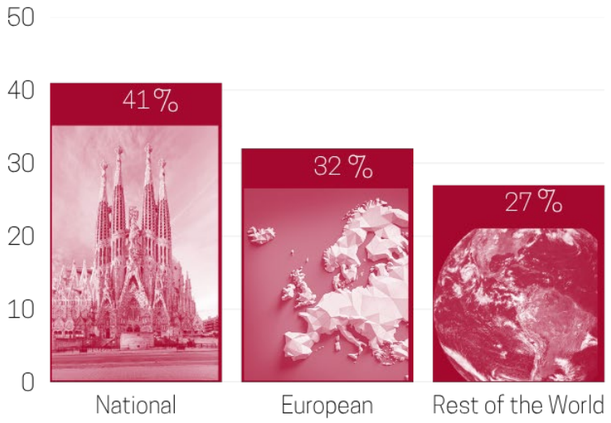


Participant Engagement

213	134
Posters presented	Talks delivered

Financial Support Provided

137	86
Accommodation support	Registration grants

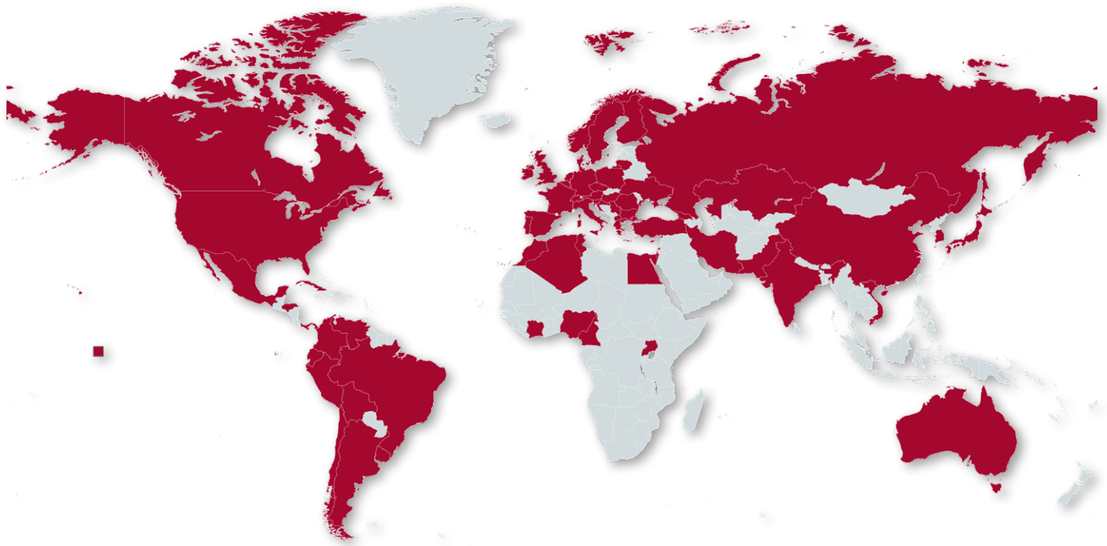


Top 10 countries

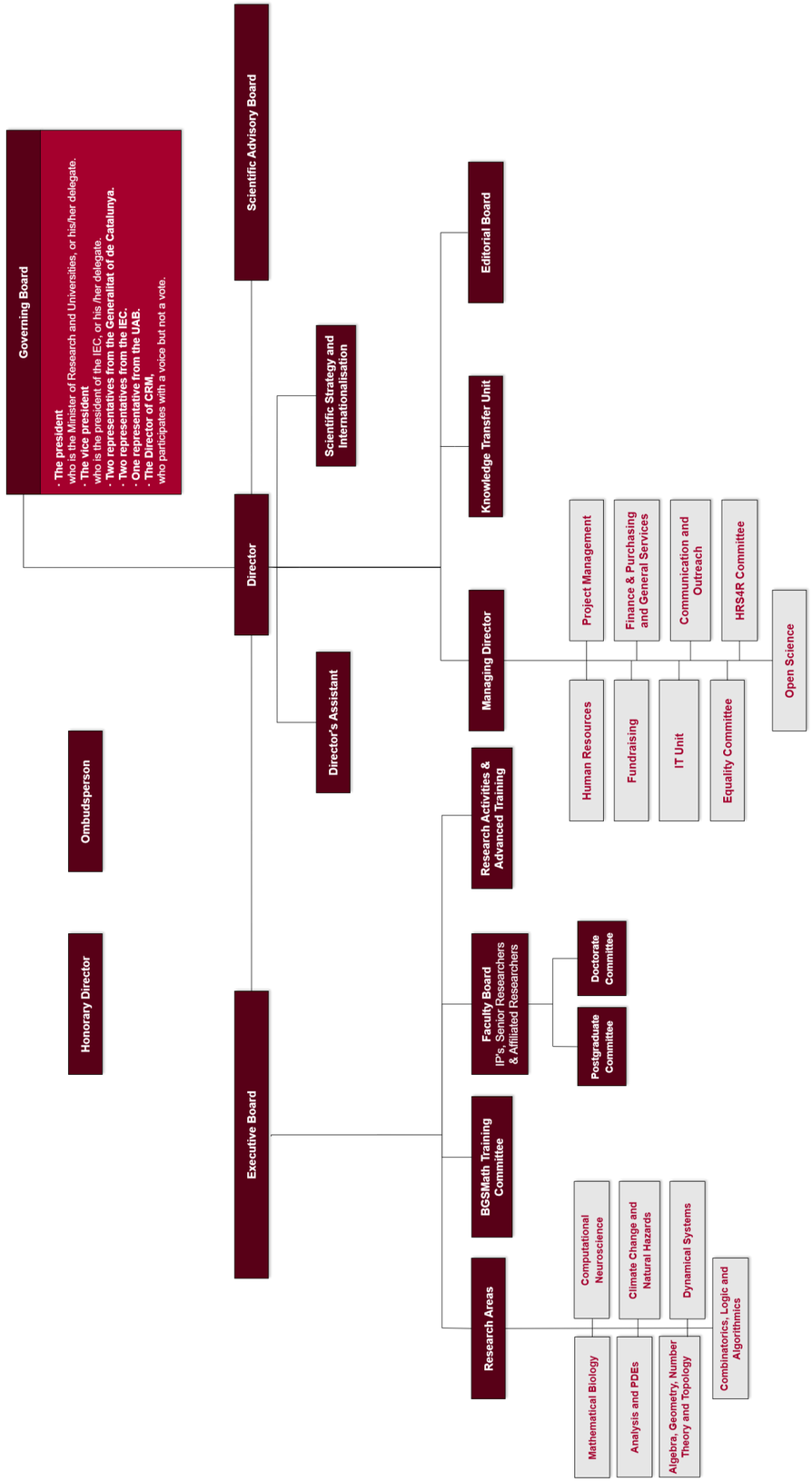
by Institution

Spain: 624
United States: 93
Italy: 88
Germany: 83
France: 61
United Kingdom: 40
Canada: 21
Switzerland: 20
China: 19
Portugal: 14

In 2025, CRM welcomed participants from **66 countries** across six continents.



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 for 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 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 in 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 **Afonso Bandeira**, from ETH Zürich
Professor **Kathryn Hess**, from the École Polytechnique Fédérale de Lausanne
Professor **Victoria Gould**, from University of York
Professor **Boris Gutkin**, from Ecole Normale Superieure
Professor **Ari Laptev**, from Imperial College London – **Chair**
Professor **Philippe Michel**, from EPFL
Professor **Alessandra Micheletti**, from Università degli Studi di Milano
Professor **Mikhail Sodin**, from Tel Aviv University
Professor **Juan Soler**, from the University of Granada
Professor **Susanna Terracini**, from Università di Torino
Professor **Katrin Wendland** from Trinity College Dublin

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:

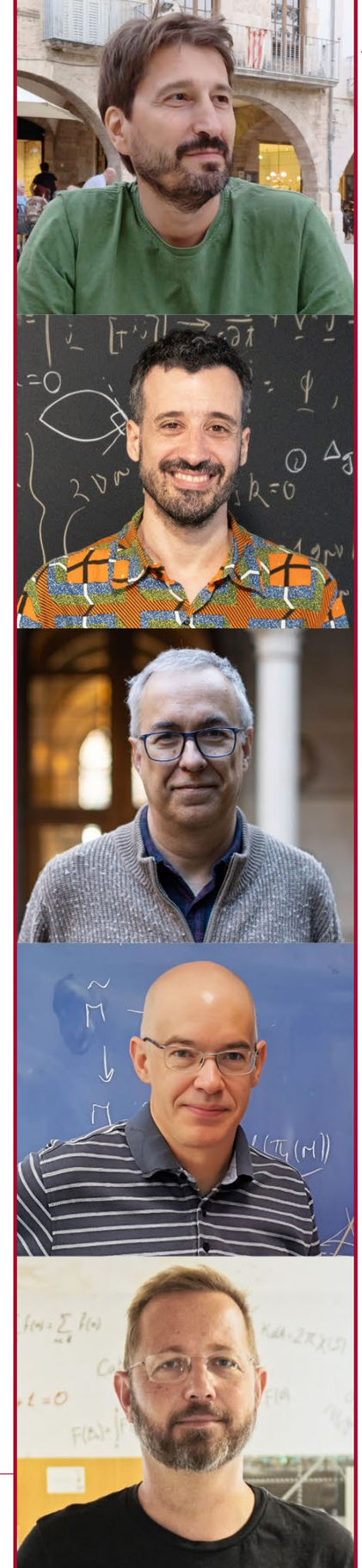
Josep Alvarez (UPC) – Responsible for BGSMath Training Unit

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



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

i2sysbio INSTITUTE FOR INTEGRATIVE SYSTEMS BIOLOGY

upf. Universitat Pompeu Fabra Barcelona

IMAG INSTITUTO DE MATEMÁTICAS Universidad de Granada

Awards

HR EXCELLENCE IN RESEARCH

EXCELENCIA MARÍA DE MAEZTU

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

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 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.

SOMMa

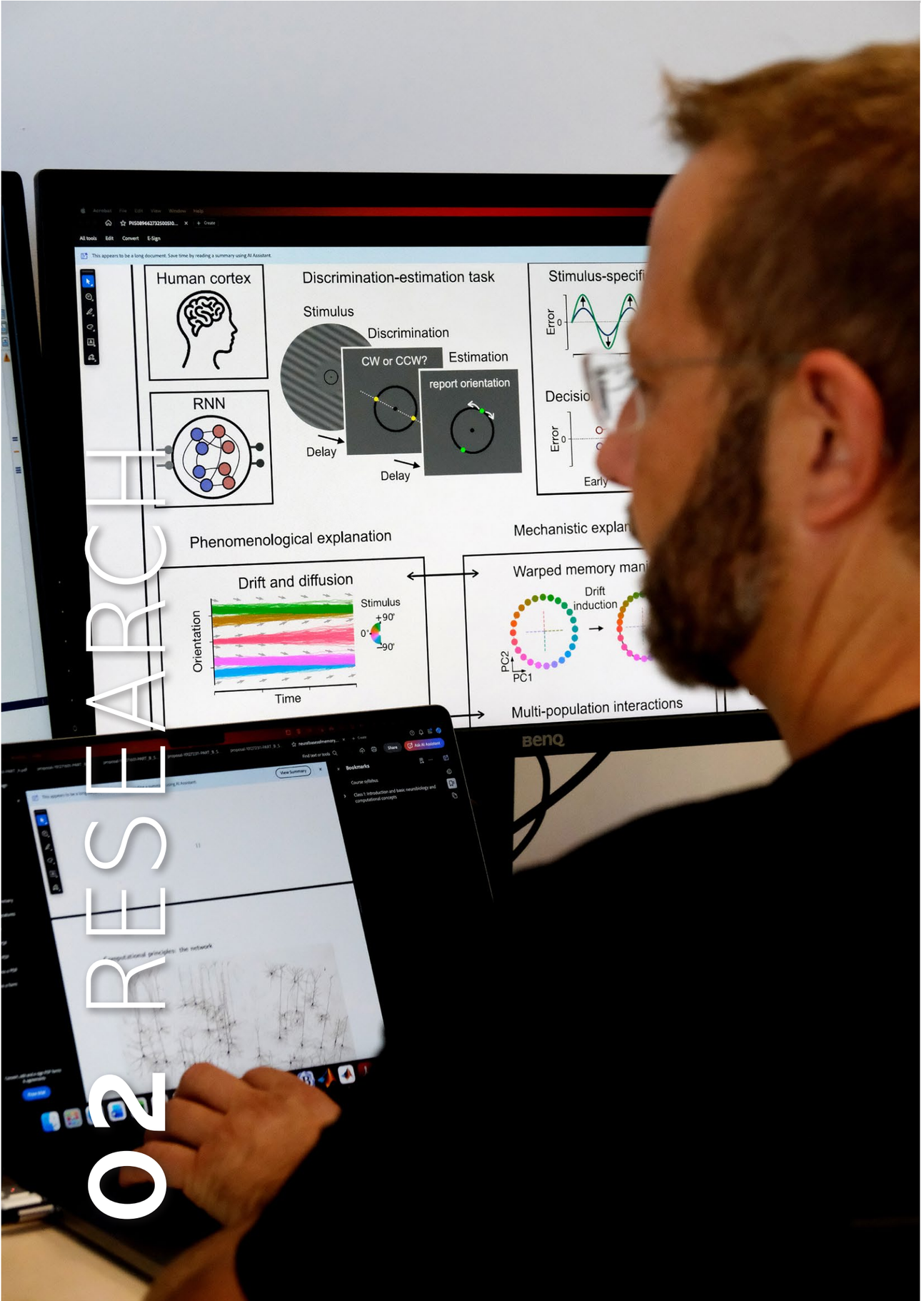
SOMMa's mission is to internationally promote, strengthen and maximise the value of the ground-breaking research produced by the Spanish 'Severo Ochoa' Centres and 'María de Maeztu' Units of Excellence and the scientific, social and economic impact it generates.

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.

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.



GEOMETRY AND TOPOLOGY

AND SOCIETY

FOR THE ENVIRONMENT

MATHEMATICS

NUMBER

THEORY

PARTIAL DIFFERENTIAL EQUATIONS

ALGEBRA AND ALGEBRAIC GEOMETRY

COMBINATORICS AND MATHEMATICS OF COMPUTER SCIENCE

ANALYSIS

COMPUTATIONAL AND MATHEMATICAL

DYNAMICAL SYSTEMS

NEUROSCIENCE

MATHEMATICAL AND COMPUTATIONAL BIOLOGY

ALGEBRA & ALGEBRAIC GEOMETRY

The Algebra and Algebraic Geometry group at CRM boasts a wide range of research interests, reflecting the diversity of its members. Despite this diversity, the group maintains fluid and dynamic interactions through common seminars and frequent discussions on topics at the intersection of their respective fields.

The research on non-commutative algebra revolves around the structure theory of C*-algebras, with classification results in sight. In particular, we study pureness in the sense of Winter and properties of the central sequence algebra, using techniques that are partly based on the structure of the Cuntz semigroup.

On the commutative algebra side, we developed fundamental aspects of computational algebra and the complexity of algorithms. Additionally, we apply combinatorial techniques to study some particular algebras and local cohomology modules. Our research also uses differential operators and methods in positive characteristic to examine invariants of singularities. Furthermore, we explore the arithmetic aspects of varieties through the lens of Arakelov geometry.

The group has a long tradition of addressing classical problems in algebraic geometry, employing both traditional and modern techniques. Our topics of interest include the study of the structure and properties of both moduli spaces of vector bundles and moduli spaces of curves. The study of fibrations over curves and also higher-dimensional base spaces is a cornerstone of our research. Bridgeland-type stability conditions, recently developed for families of algebraic varieties, play a crucial role in this research. Another classical theme for the members of the group is the study of Abelian varieties over the complex numbers but also over number fields.

MEMBERS

Senior Researchers: Josep Alvarez | Jaume Amoros | Ramon Antoine | Florent Balacheff | Guillem Blanco | Carlos d'Andrea | Javier J. Gutierrez | Dolors Herbera | Joachim Kock | Marti Lahoz | Simone Marchesi | Rosa Maria Miro | Joan Carles Naranjo | Francesc Perera | Martin Sombra

PhD Students: Lluis Llacer

PUBLICATIONS

1. Alvarez, R., Herbera, D., & Prihoda, P. (2025). Torsion-free modules over commutative domains of Krull dimension one. Revista Matematica Iberoamericana. https://doi.org/10.4171/rmi/1564

2. Colombo, E., Frediani, P., Naranjo, J. C., & Pirola, G. P. (2025). On the local geometry of the moduli space of (2,2)-threefolds in A9. Revista Matematica Iberoamericana. https://doi.org/10.4171/RMI/1542

3. Antonelli, V., Malaspina, F., Marchesi, S., & Pons-Llopis, J. (2025). 't Hooft bundles on the complete flag threefold and moduli spaces of instantons. Journal de Mathematiques Pures et Appliquees. https://doi.org/10.1016/j.matpur.2025.103763

4. Montaner, J. A., Villa, M. G., Leon-Cardenal, E., & Nunez-Betancourt, L. (2025). Bernstein-Sato polynomial and related invariants for meromorphic functions. Transactions of the American Mathematical Society. https://doi.org/10.1090/tran/9390

5. Ara, P., Goodearl, K., Nielsen, P. P., O'Meara, K. C., Pardo, E., & Perera, F. (2025). Levels of cancellation for monoids and modules. Journal of the Australian Mathematical Society. https://doi.org/10.1017/S144678872510133X

6. Bergner, J. E., Borghi, O., Dey, P., Galvez-Carrillo, I., & Hoekstra-Mendoza, T. (2025). 2-Segal sets from cuts of rooted trees. Topology and Its Applications. https://doi.org/10.1016/j.topol.2025.109447

7. Coltraro, F., Amoros, J., Torras, C., & Alberich-Carramina, M. (2025). A practical aerodynamic model for dynamic textile manipulation in robotics. Mechanism and Machine Theory. https://doi.org/10.1016/j.mechmachtheory.2025.105993

8. Galvez-Carrillo, I., Ronco, M., & Tonks, A. (2025). On Differential Hopf Algebras and B-infinity Algebras. Mediterranean Journal of Mathematics. https://doi.org/10.1007/s00009-025-02863-w

9. Marchesi, S., Palezzato, E., & Torielli, M. (2025). Lefschetz properties and the Jacobian algebra of 3-dimensional hyperplane arrangements. Portugaliae Mathematica. https://doi.org/10.4171/pm/2155

10. D'Andrea, C., & Jeronimo, G. (2025). Sparse Nullstellensatz, Resultants, and Determinants of Complexes. International Mathematics Research Notices. https://doi.org/10.1093/imrn/rnaf174

11. Bravo, A., Encinas, S., & Guillan-Rial, J. (2025). On some properties of the asymptotic Samuel function. Mathematische Nachrichten. https://doi.org/10.1002/mana.12037

12. Bosa, J., Perera, F., Wu, J. C., & Zacharias, J. (2025). The dynamical Cuntz semigroup and ideal-free quotients of Cuntz semigroups. Linear Algebra and Its Applications. https://doi.org/10.1016/j.laa.2025.07.006

PROJECTS

PID2023-147642NB-I00 — Birational Geometry, Group Actions, and Moduli Spaces.
PI: Marti Lahoz / Juan Carlos Naranjo. Funded by: MICINN (2024–2028).

GEOMETRY & TOPOLOGY

In differential geometry we deal with metric, topological and integral geometry questions. In particular we are interested in universal inequalities on closed Riemannian or Finsler manifolds involving metric and topological invariants, in the interaction with geometric group theory, in valuation theory, or in geometric structures on low dimensional manifolds.

In symplectic geometry, we work with symplectic manifolds admitting singularities, including normal forms and quantization. A highlight of the group is the construction of an abstract fluid computer using techniques from contact geometry, symbolic dynamics and Turing completeness. Using topological quantum field theory we aim to abstractly construct a hybrid machine combining the fluid computer with a quantum computer.

In algebraic topology the techniques of homotopy theory and infinity categories have infiltrated other areas, with impact in classification problems in algebraic geometry and representation theory. We also consider the interactions of algebraic topology with algebraic and complex geometry: topology of algebraic varieties and complex and almost manifolds, mixed Hodge theory, formality, and multiplicative structures in homotopical algebra and cohomological operations.

MEMBERS

Senior Researchers: Miguel Angel Barja | Carles Broto | Robert Cardona | Natalia Castellana | Joana Cirici | Immaculada Galvez | Marta Mazzocco | Eva Miranda | Ignasi Mundet | Wolfgang Pitsch | Joan Porti | Gil Solanes

PhD Students: Soren Dyhr | Pablo Nicolas

PUBLICATIONS

13. Cardona, R. (2025). Hydrodynamic and symbolic models of computation with advice. Revista Matematica Iberoamericana. https://doi.org/10.4171/RMI/1506

14. Cardona, R., & Rechtman, A. (2025). Periodic orbits and Birkhoff sections of stable Hamiltonian structures. Journal de l'Ecole Polytechnique. https://doi.org/10.5802/jep.289

15. Balacheff, F., Sarda, T. G. M. D., & Sabourau, S. (2025). Complete 3-manifolds of positive scalar curvature with quadratic decay. Mathematische Annalen. https://doi.org/10.1007/s00208-025-03192-9

16. Cardona, R., Duignan, N., & Perrella, D. (2025). Asymmetry of MHD Equilibria for Generic Adapted Metrics. Archive for Rational Mechanics and Analysis. https://doi.org/10.1007/s00205-024-02075-8

17. Kapovich, M., Leeb, B., & Porti, J. (2025). Morse actions of discrete groups on symmetric spaces: local-to-global principle. Geometry & Topology. https://doi.org/10.2140/gt.2025.29.2343

18. Cardona, R., & Vega, A. (2025). Local construction of knotted screw dislocations in smectic liquid crystals. Proceedings of the Royal Society A. https://doi.org/10.1098/rspa.2025.0257

19. Cardona, R., & Gironella, F. (2025). Nondensity results in high-dimensional stable Hamiltonian topology. Journal of the London Mathematical Society. https://doi.org/10.1112/jlms.70143

20. Cirici, J., Livernet, M., & Whitehouse, S. (2025). Model category structures on truncated multicomplexes for complex geometry. Bulletin of the London Mathematical Society. https://doi.org/10.1112/blms.70239

PROJECTS

PID2023-146936NB-I00 — INTERGAP: Interacciones de Geometria con Algebra y aplicaciones.
PI: **Eva Miranda**.
Funded by: MICINN.

AEI-DFG Bilateral Project AQUACELL: Celestial Mechanics, Hydrodynamics, and Turing Machines.
PI Spanish Team: **Eva Miranda**.
Funded by: AEI-DFG.

PID2023-147585NA-I00 — SymHyCon: Interactions between symplectic topology, hydrodynamics, and conservative flows.
PI: **Robert Cardona**.
Funded by: MICINN (2024–2027).

PID2024-158573NB-I00 — SYGHOC: Synergies between group theory, homotopy theory, and combinatorics.
PI: **Natalia Castellana**.
Funded by: MICINN.

PID2024-157757NB-I00.
PI: **Florent Balacheff**.
Funded by: MICINN.

PID2021-125625NB-I00.
PI: **Gil Solanes**.
Funded by: MICINN.

DEFENDED THESES

Large and iterated finite group actions on aspherical manifolds
Student: Jordi Daura Serrano
Supervisor: **Ignasi Mundet i Riera**. Universitat de Barcelona, July 2025.

Arcs, curves, and the surfaces they live on
Student: David Fisac Camara
Supervisor: **Florent Balacheff** & Hugo Parlier. Universitat Autonoma de Barcelona, January 2025.

A metric approach to the study of manifolds of positive scalar curvature
Student: Teo Gil Moreno de Mora i Sarda
Supervisor: **Florent Balacheff** & Stephane Sabourau. Universitat Autonoma de Barcelona, September 2025.

SCIENTIFIC ACTIVITIES

BCN Face(t)s in Symplectic Geometry.
EPSEB-UPC, Barcelona,
January 28–31, 2025.
Organizer: **Eva Miranda**

Oberwolfach Seminar: Tensor Triangular Geometry and Interactions 2543a.
Mathematisches Forschungsinstitut Oberwolfach, 2025
Natalia Castellana

Barcelona Introduction to Mathematical Research (BIMR) 2025
Natalia Castellana

Intensive Research Program: Equivariant Homotopy Theory in Context.
Isaac Newton Institute for Mathematical Sciences, March 16–29, 2025
Natalia Castellana

Parallel session at the Congreso de Jovenes de la RSME 2025.
Robert Cardona

BGSMath Course: Hyperbolic Geometry with Applications to Dynamics
Robert Cardona

OUTREACH

Eva Miranda:

- Featured in *Wired* (April 2025), *Quanta Magazine* (March 2025), *Cugat Media*, and *Tot Sant Cugat* (April 2025).
- Invited speaker at the *World AI Conference* (WAIC 2025, Shanghai), Mathematics and AI session. *Nachdiplom Lectures* at ETH Zurich.
- Podcast appearances: *Theories of Everything* with Curt Jaimungal (57,000+ views); *Ments Meravelloses*.

Natalia Castellana:

- Talk and workshop EMBOLICA QUE FA FORT!, Dissabte de les Matematiques UAB, March 15, 2025.

NUMBER THEORY

The Number Theory group at the CRM investigates deep arithmetic phenomena through the lens of the Langlands Program, which connects number theory, representation theory, and algebraic geometry. Our research seeks to understand the arithmetic of Galois representations, automorphic forms and abelian varieties.

Part of our work concerns the use of modularity lifting theorems and the modular method to address Diophantine problems, such as those arising in the study of rational points on curves. We also apply p-adic methods to the Birch and Swinnerton-Dyer conjecture, and to the construction and computation of special cycles, points, and cohomology classes on Shimura varieties.

Our work is both theoretical and computational, and we aim to develop new frameworks and techniques that not only advance fundamental understanding, but also inform broader developments in arithmetic geometry. The group's activity is highly collaborative, with strong ties to international research networks in number theory and related fields.

MEMBERS

Senior Researchers: Francesc Bars | Paloma Bengoechea | Luis Dieulefait | Francesc Fite | Xavier Guitart | Marc Masdeu | Victor Rotger

Postdoctoral Researchers: Michele Fornea

PhD Students: Javier Guillan

PUBLICATIONS

21. Badr, E., & Bars, F. (2025). The stratification by automorphism groups of smooth plane sextic curves. Annali di Matematica Pura ed Applicata. https://doi.org/10.1007/s10231-025-01558-z

22. Masdeu, M., & Xarles, X. (2025). Efficient computation of non-archimedean theta functions. Mathematics of Computation. https://doi.org/10.1090/mcom/4066

23. Darmon, H., Lauder, A., & Rotger, V. (2025). Elliptic Stark conjectures and exceptional weight-one forms. Tunisian Journal of Mathematics. https://doi.org/10.2140/tunis.2025.7.611

24. Bars, F., & Dalal, T. (2025). On the automorphism group of quotient modular curves. Journal of Algebra. https://doi.org/10.1016/j.jalgebra.2025.02.037

25. Billerey, N., Chen, I. M., Dieulefait, L., & Freitas, N. (2025). On Darmon's program for the generalized Fermat equation, I. Journal fur die reine und angewandte Mathematik. https://doi.org/10.1515/crelle-2025-0014

26. Bars, F., & Dalal, T. (2025). The modular automorphisms of quotient modular curves. Mathematika. https://doi.org/10.1112/mtk.70065

27. Cortina, F. B., & Dalal, T. (2025). Infinitely many cubic points on X0(N) with N square-free. Ramanujan Journal. https://doi.org/10.1007/s11139-025-01083-w

28. Dieulefait, L. V., & Urroz, J. (2025). Computing phi(N) for an RSA module with a single quantum query. Quantum Information Processing. https://doi.org/10.1007/s11128-025-05008-w

PROJECTS

PID2020-116542GB-I00 — Non-archimedean valuations in geometry and explicit number theory.
PI: **Marc Masdeu**.
Funded by: MICINN.

PID2024-159095NB-I00 — Geometry over monoids and semirings.
PI: **Marc Masdeu**.
Funded by: MICINN.

DEFENDED THESES

Fundamental domains for quaternionic S-arithmetic groups
Student: Eloi Torrents Juste
Supervisor: **Marc Masdeu**. Universitat Autonoma de Barcelona, December 2025.

SCIENTIFIC ACTIVITIES

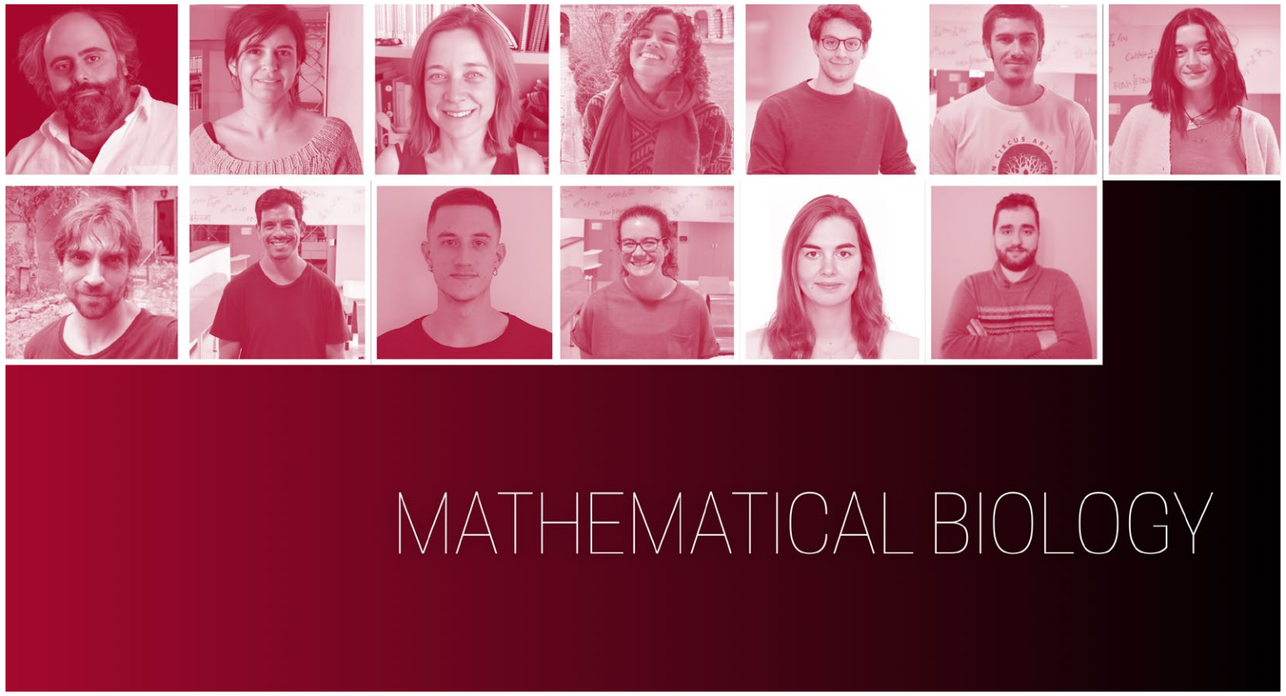
Workshop Geometry over Semirings.
Marc Masdeu

Lean Bootcamp 2025.
Marc Masdeu

Barcelona Introduction to Mathematical Research (BIMR) 2025.
Co-organized **Marc Masdeu**

OUTREACH

Marc Masdeu: Session at Bojos per les Matematiques.



MATHEMATICAL 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 group 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 and optimization.

We tackle issues such as understanding how genetic variation leads to variation in the characteristics of organisms (the genotype-phenotype map), its arising in embryonic development, and 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, study the design of 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 ties with both biologists and medical practitioners.

MEMBERS

Senior Researchers: Tomas Alarcon | Marta Casanellas | Silvia Cuadrado | Gissell Estrada-Rodriguez | Jesus Fernandez | Eric Latorre | Josep Sardanyes

Postdoctoral Researchers: Ielyaas Cloete | Roser Homs | Daria Stepanova

PhD Students: Oriol Llopis | Juan Arellano | Kevin Martinez | Amaia Vielba

PUBLICATIONS

29. Lopez, J., et al. (2025). Mitochondrial priming and response to BH3 mimetics in one-two punch senogenic-senolytic strategies. Cell Death Discovery. https://doi.org/10.1038/s41420-025-02379-y

30. Casanellas, M., & Fernandez-Sanchez, J. (2025). Phylogenetic Invariants: From the General Markov to Equivariant Models. SIAM Journal on Applied Algebra and Geometry. https://doi.org/10.1137/24M1644821

31. Menendez, J. A., et al. (2025). Mitochondrial priming in therapy-induced senescence: implications for CAR-T/NK immunosenolytic therapy. Frontiers in Immunology. https://doi.org/10.3389/fimmu.2025.1695244

32. Turner, E. A., Crespo, F., Sardanyes, J., & Morales, N. (2025). Quasispecies dynamics with time lags and periodic fluctuations in replication. Journal of Mathematical Biology. https://doi.org/10.1007/s00285-025-02239-4

33. Barril, C., Bardina, X., & Cuadrado, S. (2025). Dynamics of Encapsulated Bacteriophage in the Gastrointestinal Tract. Mathematical Methods in the Applied Sciences. https://doi.org/10.1002/mma.70342

34. Garcia, M. C., Moscardo, A. D., & Casanellas, M. (2025). Generating Heterogeneous Data on Gene Trees. Journal of Computational Biology. https://doi.org/10.1089/cmb.2024.0843

35. Cloete, I., & Alarcon, T. (2025). Dynamical analysis of a model of BCL-2-dependent cellular decision making. NPJ Systems Biology and Applications. https://doi.org/10.1038/s41540-025-00615-w

36. Arellano-Tinto, J., Stepanova, D., Byrne, H. M., Maini, P. K., & Alarcon, T. (2025). Multiscale modelling shows how cell-ECM interactions impact ECM fibre alignment and cell detachment. PLOS Computational Biology. https://doi.org/10.1371/journal.pcbi.1012698

37. Vera-Siguenza, E., et al. (2025). A Mathematical Exploration of SDH-b Loss in Chromaffin Cells. Bulletin of Mathematical Biology. https://doi.org/10.1007/s11538-025-01427-z

PROJECTS

PID2024-162434OB-I00 — Mathematical modelling to discover tipping points and warning signals in complex diseases // MATH-TIPDIS.
PI: **Tomas Alarcon** i **Josep Sardanyes**.
Funded by: AEI.

2025 PROD 00283 — AI-guided search of Therapeutic Interfering Genomes as optimized Antivirals - AITIGsA
PI: **Josep Sardanyes**.
Funded by: AGAUR.

DEFENDED THESES

Mathematical modeling of cancer-immune cell dynamics in vitro: the impact of cancer cell metabolism
Student: Stefano Pedarra
Supervisor: **Tomas Alarcon**, **Josep Sardanyes** & Javier Abel Menendez. Universitat Autonoma de Barcelona, October 2025.

An exhaustive topological characterization of the gene regulatory networks capable of stationary pattern transformation via extracellular signaling
Student: Kevin Martinez
Supervisor: Isaac Salazar. Universitat Autonoma de Barcelona, November 2025.

COMPUTATIONAL AND MATHEMATICAL NEUROSCIENCE

The computational neuroscience unit at the CRM was founded in 2012 and is made up of eight 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 centres (www.barccsyn.org). Research in the 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 behaviour. Our approach is generally to combine computational modelling with data analysis.

MEMBERS

Senior Researchers: Toni Guillamon | Gemma Huguet | Alexandre Hyafil | Manuel Molano | Adrian Ponce | Alex Roxin | Diego Vidaurre | Klaus Wimmer

Postdoctoral Researchers: Gloria Cecchini | Maria Da Fonseca | Jens-Bastian Eppler | Demetrio Ferro | Lluis Hernandez | Aikaterni Kalou | Gabriel Mel | Martijn Wokke

PhD Students: Alexandra Antoniadou | Lucia de Arancibia | Pablo Crespo | Tomas D'Amelio | Alexandre Garcia-Duran Castilla | Federico Poncio | Haowen Tang

PUBLICATIONS

38. Devalle, F., Zou, L. C., Cecchini, G., & Roxin, A. (2025). Representational drift as the consequence of ongoing memory storage. Scientific Reports. https://doi.org/10.1038/s41598-025-11102-x

39. Yeldesbay, A., Huguet, G., & Daun, S. (2025). Reconstruction of phase-amplitude dynamics from signals of a network of oscillators. Chaos. https://doi.org/10.1063/5.0251072

40. Muller, S., et al. (2025). Psilocybin-induced modulation of visual salience processing. Neuroscience of Consciousness. https://doi.org/10.1093/nc/niaf060

41. Bergoin, R., Torcini, A., Deco, G., Quoy, M., & Zamora-Lopez, G. (2025). Emergence and maintenance of modularity in neural networks with Hebbian and anti-Hebbian inhibitory STDP. PLOS Computational Biology. https://doi.org/10.1371/journal.pcbi.1012973

42. Sapountzis, P., Antoniadou, A., & Gregoriou, G. G. (2025). Diverse neuronal activity patterns contribute to the control of distraction in the prefrontal and parietal cortex. PLOS Biology. https://doi.org/10.1371/journal.pbio.3003008

43. D'Amelio, T. A., et al. (2025). Emotion recognition systems with electrodermal activity: From affective science to affective computing. Neurocomputing. https://doi.org/10.1016/j.neucom.2025.130831

44. Ponce-Alvarez, A. (2025). Network Mechanisms Underlying the Regional Diversity of Variance and Time Scales of the Brain's Spontaneous Activity Fluctuations. Journal of Neuroscience. https://doi.org/10.1523/JNEUROSCI.1699-24.2024

45. Eppler, J. B., Kaschube, M., & Rumpel, S. (2025). Statistical learning and representational drift: A dynamic substrate for memories. Current Opinion in Neurobiology. https://doi.org/10.1016/j.conb.2025.103107

46. Ahrends, C., et al. (2025). Prediction of Individual Melodic Contour Processing in Sensory Association Cortices From Resting State Functional Connectivity. Human Brain Mapping. https://doi.org/10.1002/hbm.70409

47. Ortiz, A. J., Romero, D., Guillamon, A., & Giraldo, J. (2025). A mathematical formalism to quantify drug-target residence time. Biochemical Pharmacology. https://doi.org/10.1016/j.bcp.2025.117037

48. Oyarzo, P., Cichy, R. M., & Vidaurre, D. (2025). ADA: A decoding algorithm for temporally-variable brain responses. Computational and Structural Biotechnology Journal. https://doi.org/10.1016/j.csbj.2025.10.044

PROJECTS

PID2023-147627OB-I00 — Neural network mechanisms underlying perceptual decision making and working memory.
PI: **Klaus Wimmer**.
Funded by: MICINN.

PID2022-137708NB-I00 — The role of cell types in critical neural activity.
PI: **Adrian Ponce**.
Funded by: MICINN.

PID2021-124702OB-I00 and **PCI2023-145967-2.**
PI: **Alex Roxin**.

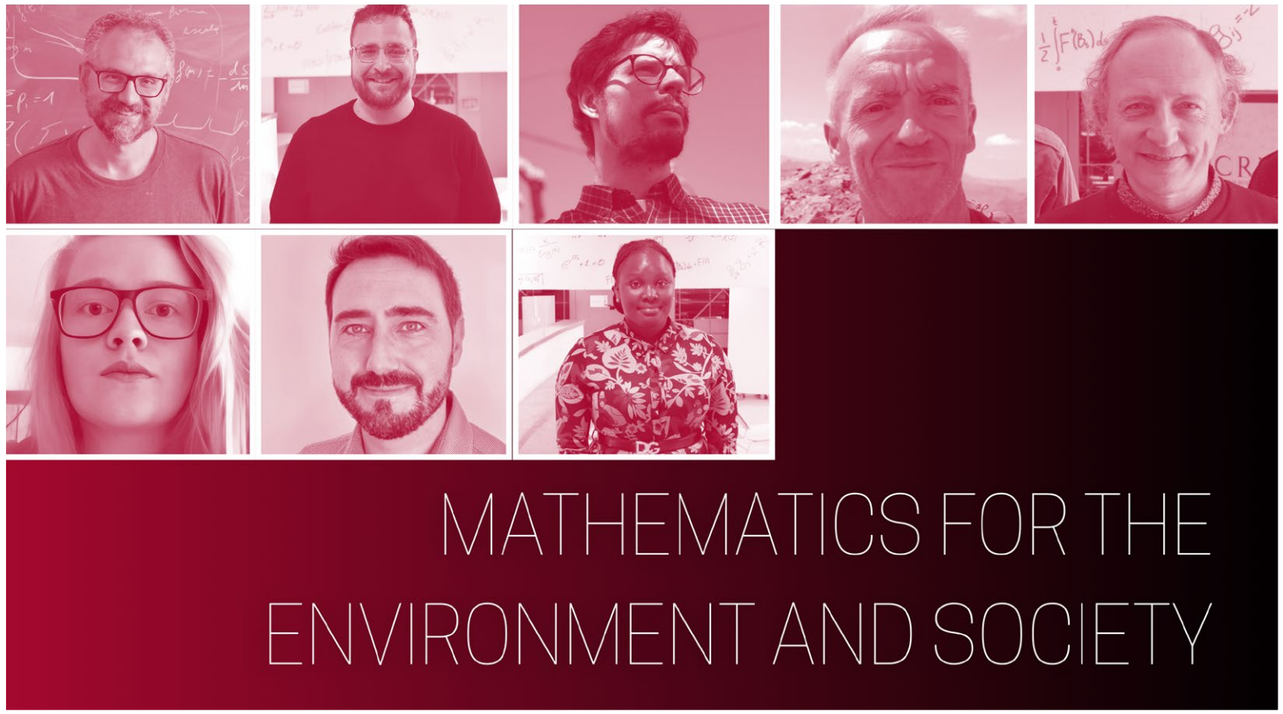
ATRAE Project.
PI: **Diego Vidaurre**.

DEFENDED THESES

Neural Network Dynamics Underlying Flexible Adjustment of Temporal Evidence Weighting in Perceptual Decision-Making
Student: Citlalli Vivar Aburto
Supervisor: **Klaus Wimmer**. Universitat Autonoma de Barcelona, March 2025.

SCIENTIFIC ACTIVITIES

BAMB! 2025 — Barcelona Summer School for Advanced Modeling of Behaviour.
ICMNS 2025 — International Conference on Mathematical Neuroscience, Barcelona.
BARCCSYN Retreat 2026. Organized by Adrian Ponce.



MATHEMATICS FOR THE ENVIRONMENT AND SOCIETY

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 degrees Celsius, can only be achieved through the extraction of greenhouse gases and emission reductions, among others. We focus on topics related to the elimination of pollutants, including the removal of environmental contaminants such as CO2, volatile organic compounds and pharmaceuticals via adsorption techniques, the role of green roofs, and the use of direct absorption solar cells.

MEMBERS

Senior Researchers: Alvaro Corral | Marc Calvo | David Morina | Timothy G. Myers | Pere Puig

Postdoctoral Researchers: Lucy Charlotte Auton | Alvaro Gonzalez | Udayraj Thorat

PhD Students: Rachael Olwande

PUBLICATIONS

49. Myers, T. G., Calvo-Schwarzwalder, M., Font, F., & Valverde, A. (2025). Modelling large mass removal in adsorption columns. International Communications in Heat and Mass Transfer. https://doi.org/10.1016/j.icheatmasstransfer.2025.108652

50. Auton, L. C., Ravuru, S. S., De, S., Myers, T. G., & Valverde, A. (2025). Development and experimental validation of a mathematical model for fluoride-removal filters. Journal of Water Process Engineering. https://doi.org/10.1016/j.jwpe.2025.108914

51. Calvo-Schwarzwalder, M., Myers, T. G., Cabrera-Codony, A., & Valverde, A. (2025). An analytical model for column adsorption with two competing contaminants. International Journal of Heat and Mass Transfer. https://doi.org/10.1016/j.ijheatmasstransfer.2025.127004

52. Auton, L. C., Dalwadi, M. P., & Griffiths, I. M. (2025). A homogenized model for dispersive transport and sorption in a heterogeneous porous medium. SIAM Journal on Applied Mathematics. https://doi.org/10.1137/24M1692393

53. Blasco-Moreno, A., & Puig, P. (2025). A Non-Parametric Estimation Method of the Population Size in Capture-Recapture Experiments With Right Censored Data. Environmetrics. https://doi.org/10.1002/env.70013

54. Baro, J., & Corral, A. (2025). A universal route from avalanches in mean-field models with random fields to stochastic Poisson branching events. Chaos. https://doi.org/10.1063/5.0268639

55. Corral, A. (2025). Universal finite-time scaling in the transcritical, saddle-node, and pitchfork discrete and continuous bifurcations. Chaos. https://doi.org/10.1063/5.0231950

56. Arroyo-Solorzano, M., et al. (2025). Impact of geodetic information, subduction zone segmentation and slow-slip events in probabilistic seismic hazard: a case study for Costa Rica. Geophysical Journal International. https://doi.org/10.1093/gji/ggaf204

57. Jimenez-Gamero, M. D., Puig, P., & Ngatchou-Wandji, J. (2025). Testing for the zero-altered Poisson distribution with positive data. Statistica Neerlandica. https://doi.org/10.1111/stan.70010

PROJECTS

PID2022-137414OB-I00 — Modelizacion Estadistica de Acontecimientos Extremos y Riesgos para la Salud.
PI: **Pere Puig**.
Funded by: MINECO (2024–2026).

PID2023-146332OB-C21 — Mathematical modelling of the capture of environmental contaminants by adsorption.
PI: **Tim Myers**.
Funded by: MICINN.

DEFENDED THESES

Modelizacion de datos con exceso de ceros y de captura-recaptura
Student: Anabel Blasco
Supervisor: **Pere Puig**. Universitat Autonoma de Barcelona, July 2025.

Data-driven modelling in dense and scarce data regimes: applications to climate data and marine plastic pollution
Student: Niclas Rieger
Supervisor: Antonio Turiel, Estrella Olmedo & **Alvaro Corral**. Universitat Autonoma de Barcelona, June 2025.

Statistical Analysis of the Madden-Julian Oscillation
Student: Monica Minjares
Supervisor: Marcelo Barreiro & **Alvaro Corral**. Universitat Autonoma de Barcelona, September 2025.

ANALYSIS

The research of the group of mathematical analysis is focused on different questions in classical analysis, especially in the interaction of complex and harmonic analysis with other areas of mathematics, such as geometric measure theory, PDEs, fluid mechanics, probability theory, and geometric function theory. The group has been organizing a weekly seminar for more than thirty years and is funded regularly with research grants from the Catalan, Spanish, and European administrations.

MEMBERS

Senior Researchers: Jorge Antezana | Carme Cascante | Albert Clop | Egor Kosov | Jordi Marzo | Joan Mateu | Artur Nicolau | Joaquim Ortega | Jordi Pau | Olli Saari | Sergey Tikhonov | Xavier Tolsa

Postdoctoral Researchers: Batyrbek Allamzharov | Cristian Gonzalez-Riquelme | Niyaz Tokmagambetov

PhD Students: Miquel Saucedo Cuesta

PUBLICATIONS

58. Saucedo, M., & Tikhonov, S. (2025). Kahane-Katznelson-de Leeuw theorem and absolute convergence of Fourier series. Journal d'Analyse Mathematique. https://doi.org/10.1007/s11854-025-0424-x

59. Frank, R. L., Mateu, J., Mora, M. G., Rondi, L., Scardia, L., & Verdera, J. (2025). Explicit minimisers for anisotropic Riesz energies. Calculus of Variations and Partial Differential Equations. https://doi.org/10.1007/s00526-025-03185-1

60. Garcia-Ferrero, M. A., & Ortega-Cerda, J. (2025). Stability of the Concentration Inequality on Polynomials. Communications in Mathematical Physics. https://doi.org/10.1007/s00220-025-05292-8

61. Kosov, E., & Tikhonov, S. (2025). Sampling discretization in Orlicz spaces. Journal of Functional Analysis. https://doi.org/10.1016/j.jfa.2025.110971

62. Bekbolat, B., & Tokmagambetov, N. (2025). The heat equation for singular Dunkl-Laplacian operator. Georgian Mathematical Journal. https://doi.org/10.1515/gmj-2025-2019

63. Dominguez, O., Li, Y. Q., Tikhonov, S., Yang, D. C., & Yuan, W. (2025). New approach to affine Moser-Trudinger inequalities via Besov polar projection bodies. Mathematische Annalen. https://doi.org/10.1007/s00208-025-03162-1

64. Kosov, E. D., & Temlyakov, V. N. (2025). Bounds for the sampling discretization error and their applications to the universal sampling discretization. Journal of Complexity. https://doi.org/10.1016/j.jco.2025.101958

65. Tolsa, X. (2025). A Counterexample Regarding a Two-phase Problem for Harmonic Measure in VMO. Potential Analysis. https://doi.org/10.1007/s11118-025-10214-3

66. Kulikov, A., Nicola, F., Ortega-Cerda, J., & Tilli, P. (2025). A monotonicity theorem for subharmonic functions on manifolds. Advances in Mathematics. https://doi.org/10.1016/j.aim.2025.110423

67. Ganzburg, M. I., Saucedo, M., & Tikhonov, S. (2025). Bernstein-Nikolskii Inequalities: Optimality with Respect to the Smoothness Parameter. Journal of Fourier Analysis and Applications. https://doi.org/10.1007/s00041-025-10157-8

68. Oganesyan, K. (2025). Univalence of T-symmetric Suffridge type polynomials of degree 3T+1. Complex Variables and Elliptic Equations. https://doi.org/10.1080/17476933.2025.2553117

69. Saucedo, M., & Tikhonov, S. (2025). Note on Fourier inequalities. Nonlinear Analysis. https://doi.org/10.1016/j.na.2025.113896

70. Gorev, V., & Kosov, E. (2025). Functional analogs of the Shephard, Busemann-Petty and Milman problems. Journal d'Analyse Mathematique. https://doi.org/10.1007/s11854-025-0398-8

71. Guillen-Mola, I., Prats, M., & Tolsa, X. (2025). The dimension of planar elliptic measures arising from Lipschitz matrices in Reifenberg flat domains. Analysis and Mathematical Physics. https://doi.org/10.1007/s13324-025-01067-5

72. Sanchez, D. C., Kumar, V., Ruzhansky, M., & Tokmagambetov, N. (2025). Lp-Lq boundedness of continuous linear operators on smooth manifolds. Annals of Functional Analysis. https://doi.org/10.1007/s43034-025-00437-1

73. Bampouras, K., & Nicolau, A. (2025). Inner functions, Mobius distortion and angular derivatives. Journal d'Analyse Mathematique. https://doi.org/10.1007/s11854-025-0408-x

74. Fraccaroli, M., Saari, O., & Thiele, C. (2025). Uniform bounds for bilinear symbols with linear k-quasiconformally embedded singularity. Analysis & PDE. https://doi.org/10.2140/apde.2025.18.2293

75. Mourgoglou, M., Poggi, B., & Tolsa, X. (2025). Solvability of the Poisson-Dirichlet problem with interior data in Lp'-Carleson spaces and its applications to the Lp-regularity problem. Journal of the European Mathematical Society. https://doi.org/10.4171/jems/1660

76. Cardona, D., Kumar, V., Ruzhansky, M., & Tokmagambetov, N. (2025). Expansion of traces and Dixmier traceability for global pseudo-differential operators on manifolds with boundary. Advances in Operator Theory. https://doi.org/10.1007/s43036-025-00438-w

77. Antezana, J., & Ombrosi, S. (2025). Weighted maximal inequalities on hyperbolic spaces. Advances in Mathematics. https://doi.org/10.1016/j.aim.2025.110641

78. Fleschler, I., Tolsa, X., & Villa, M. (2025). Carleson's epsilon-squared conjecture in higher dimensions. Inventiones Mathematicae. https://doi.org/10.1007/s00222-025-01337-w

79. Bortz, S., Egert, M., & Saari, O. (2025). Carleson conditions for weights: The quantitative small constant case. Nonlinear Analysis. https://doi.org/10.1016/j.na.2025.113802

PROJECTS

PID2021-123405NB-I00 — Varias variables complejas y distribucion optima de puntos.
PI: **Joaquim Ortega**.
Funded by: MICINN.

PID2021-123405NB-I00.
PI: **Artur Nicolau**.
Funded by: MICINN.

DEFENDED THESES

Boundary problems in elliptic PDEs on rough domains
Student: Josep M Gallegos
Supervisor: **Xavier Tolsa**. Universitat Autonoma de Barcelona, July 2025.

On fractional caloric capacities in several function spaces
Student: Joan Hernandez
Supervisor: **Laura Prat** & Joan Mateu. Universitat Autonoma de Barcelona, July 2025.

Geometric properties of harmonic measure
Student: Ignasi Guillen
Supervisor: Marti Prats & **Xavier Tolsa**. Universitat Autonoma de Barcelona, July 2025.

SCIENTIFIC ACTIVITIES

Bilbao-Barcelona Analysis and PDEs Meeting.
BCAM, Bilbao, September 3–5, 2025.
Co-organized by **Albert Mas**.

Analytic and algebraic methods in physics.
Czech Technical University, Prague, August 26–29, 2025.
Co-organized by **Albert Mas**.

BGSMath Course: Convex Integration, Staircase Laminates and Applications
Albert Clop

PARTIAL DIFFERENTIAL EQUATIONS

Partial Differential Equations (PDE) are ubiquitous in essentially all sciences and engineering, and have important interactions with several branches of pure mathematics, including Geometry and Probability.

Our research covers a wide variety of topics and connections to other areas, including: regularity and smoothness of solutions to nonlinear PDE; free boundary problems and minimal surfaces; nonlocal equations arising in probability, physics, or geometry; reaction-diffusion equations, including those modelling population dynamics; isoperimetric problems and other geometric inequalities; and PDEs arising in fluid mechanics, statistical mechanics, and relativistic quantum mechanics.

MEMBERS

Senior Researchers: Xavier Cabre | Gyula Csato | Albert Mas | Xavier Ros-Oton | Tomas Sanz

Postdoctoral Researchers: Alberto Maione

PhD Students: Joaquim Duran

PUBLICATIONS

80. Fernandez-Real, X., Ros-Oton, X., & Weidner, M. (2025). Regularity for the Boltzmann Equation Conditional to Pressure and Moment Bounds. Communications in Mathematical Physics. https://doi.org/10.1007/s00220-025-05356-9

81. Cabre, X., Cinti, E., & Serra, J. (2025). Stable solutions to the fractional Allen-Cahn equation in the nonlocal perimeter regime. American Journal of Mathematics. https://doi.org/10.1353/ajm.2025.a966290

82. Buckmaster, T., Cao-Labora, G., & Gomez-Serrano, J. (2025). Smooth imploding solutions for 3D compressible fluids. Forum of Mathematics Pi. https://doi.org/10.1017/fmp.2024.12

83. Cabre, X., Csato, G., & Mas, A. (2025). Periodic solutions to integro-differential equations: variational formulation, symmetry, and regularity. Communications in Partial Differential Equations. https://doi.org/10.1080/03605302.2024.2441851

84. Csato, G., & Mas, A. (2025). Examples of optimal Holder regularity in semilinear equations involving the fractional Laplacian. Nonlinear Analysis. https://doi.org/10.1016/j.na.2025.113755

85. Lewenstein-Sanpera, J., & Ros-Oton, X. (2025). Lp estimates for the Laplacian via blow-up. Journal of Differential Equations. https://doi.org/10.1016/j.jde.2025.113478

86. Caponi, M., Carbotti, A., & Maione, A. (2025). H-compactness for nonlocal linear operators in fractional divergence form. Calculus of Variations and Partial Differential Equations. https://doi.org/10.1007/s00526-025-03139-7

87. Csato, G., & Mas, A. (2025). Strict rearrangement inequalities: nonexpansivity and periodic Gagliardo seminorms. Transactions of the American Mathematical Society. https://doi.org/10.1090/tran/9510

88. Ros-Oton, X., & Weidner, M. (2025). Improvement of flatness for nonlocal free boundary problems. Journal of the European Mathematical Society. https://doi.org/10.4171/jems/1724

89. Restrepo, D., & Ros-Oton, X. (2025). C-infinity regularity in semilinear free boundary problems. Mathematische Annalen. https://doi.org/10.1007/s00208-025-03135-4

90. Cabre, X., Erneta, I. U., & Felipe-Navarro, J. C. (2025). Null-Lagrangians and calibrations for general nonlocal functionals and an application to the viscosity theory. Journal of Functional Analysis. https://doi.org/10.1016/j.jfa.2025.111086

PROJECTS

PID2024-156429NB-I00 — PDE in Physics and Analysis.
PIs: **X. Ros-Oton** & **A. Clop**.
Funded by: AEI (2025–2028).

ERC-2023-COG 101123223 — Stable solutions and nonstandard diffusions: PDE questions arising in Mathematical Physics (SSNSD).
PI: **Xavier Ros-Oton**.
Funded by: European Research Council (2024–2029).

AEI-DFG Bilateral Project — Transcending boundaries in Analysis through nonlocality.
PI (Spanish team): **X. Ros-Oton**.
Funded by: AEI-DFG (2025–2027).

PID2021-123903NB-I00 — Ecuaciones en Derivadas Parciales: problemas de reaccion-difusion, integro-diferenciales, y de la fisica matematica.
PI: **Albert Mas**.
Funded by: MICINN (2022–2026).

AEI Research Network — Network on nonlocal PDE and applications.
PI: **X. Ros-Oton** (2025–2026).

SCIENTIFIC ACTIVITIES

JISD 2025 — 21st School on Interactions between Dynamical Systems and Partial Differential Equations.
CRM, Bellaterra, June 30 – July 4, 2025.
Organized by **Xavier Cabre** and **M. T. Martinez-Seara**.

PDE in Barcelona.
Universitat de Barcelona, May 2025.
Organized by **X. Ros-Oton** and **T. Sanz-Perela**.

MFO Workshop: Partial Differential Equations.
Oberwolfach, July 2025.
Organized by **X. Ros-Oton**.

Thematic Programme Free Boundary Problems.
Erwin Schrodinger Institute, Vienna, September–December 2025.
Co-organized by **X. Ros-Oton**.

New Frontiers in Homogenization and Fractional Calculus.
Meeting, March 24–25, 2025
Xavier Cabre (Programme Committee).

OUTREACH

Xavier Cabre:
- Interview at Telenotícies de TV3 on four Catalan mathematicians presenting at the 2026 International Congress of Mathematics (July 2025).
- Chairman of CosmoCaixa talk by Fields medalist Pierre-Louis Lions (April 2025).

Xavier Ros-Oton:
- Interview for Diari Ara (March 2025).
- Public lecture for high school Olympiad winners, IEC Barcelona (May 2025).
- Minicourses at Warsaw Summer School on Evolutionary PDEs (July 2025)
- BCAM Spring School (May 2025).

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 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 phase portraits and bifurcation diagrams is also widely used in modelling 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 global dynamics emanates, 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: Inmaculada Baldoma | Andrew Clarke | Jezabel Curbelo | Amadeu Delshams | Kostiantyn Drach | Nuria Fagella | Ernest Fontich | Marcel Guardia | Alejandro Haro | Xavier Jarque | Angel Jorba | Marc Jorba | Jose Tomas Lazaro | Pau Martin | Maria Teresa Martinez-Seara | Josep Masdemont | Merce Olle | Leticia Pardo | Joan Torregrosa | Arturo Vieiro

Postdoctoral Researchers: Gustavo Rodrigues-Ferreira | Frank Trujillo

PhD Students: Didac Gil Rams

PUBLICATIONS

91. Baldoma, I., Guardia, M., & Pelinovsky, D. E. (2025). On a Countable Sequence of Homoclinic Orbits Arising Near a Saddle-Center Point. Communications in Mathematical Physics. https://doi.org/10.1007/s00220-025-05381-8

92. Marin, D., Queiroz, L., & Villadelprat, J. (2025). The period of the limit cycle bifurcating from a persistent polycycle. Publicacions Matematiques. https://doi.org/10.5565/PUBLMAT6922502

93. Gomide, O. M. L., Guardia, M., Seara, T. M., & Zeng, C. C. (2025). On small breathers of nonlinear Klein-Gordon equations via exponentially small homoclinic splitting. Inventiones Mathematicae. https://doi.org/10.1007/s00222-025-01327-y

94. Sanchez-Martin, P., Amoros, J., & Masdemont, J. J. (2025). Capturing the short-term characteristics of a barred galaxy from a single snapshot. Communications in Nonlinear Science and Numerical Simulation. https://doi.org/10.1016/j.cnsns.2025.108923

95. De Maesschalck, P., & Torregrosa, J. (2025). Limit cycles and critical periods with non-hyperbolic slow-fast systems. Journal of Differential Equations. https://doi.org/10.1016/j.jde.2025.113307

96. Garrido, M., Martin, P., & Paradela, J. (2025). Parabolic Saddles and Newhouse Domains in Celestial Mechanics. Communications in Mathematical Physics. https://doi.org/10.1007/s00220-025-05299-1

97. Berk, P., Trujillo, F., & Wu, H. (2025). Ergodic properties of infinite extension of symmetric interval exchange transformations. Journal de l'Ecole Polytechnique. https://doi.org/10.5802/jep.302

98. da Cruz, L. P. C., Rezende, A. C., & Torregrosa, J. (2025). Coexistence of Analytic and Piecewise Analytic Limit Cycles in Planar Piecewise Quadratic Differential Systems. Qualitative Theory of Dynamical Systems. https://doi.org/10.1007/s12346-025-01252-8

99. Buzzi, C., Gasull, A., & Santana, P. (2025). On the cyclicity of hyperbolic polycycles. Journal of Differential Equations. https://doi.org/10.1016/j.jde.2025.02.061

100. Jove, A., & Fagella, N. (2025). Boundary dynamics in unbounded Fatou components. Transactions of the American Mathematical Society. https://doi.org/10.1090/tran/9287

101. Gine, J., & Torregrosa, J. (2025). Limit cycles of homogeneous polynomial Kukles differential systems. Mathematics and Computers in Simulation. https://doi.org/10.1016/j.matcom.2025.04.045

102. Calleja, R. C., Haro, A., & Porras, P. (2025). Constructive approaches to QP-time-dependent KAM theory for Lagrangian tori in Hamiltonian systems. Journal of Differential Equations. https://doi.org/10.1016/j.jde.2025.113681

103. Lamas, J., Guardia, M., & Seara, T. M. (2025). Oscillatory Motions, Parabolic Orbits and Collision Orbits in the Planar Circular Restricted Three-Body Problem. Communications in Mathematical Physics. https://doi.org/10.1007/s00220-025-05283-9

104. Curbelo, J., & Linz, M. (2025). Lagrangian coherent structures to examine mixing in the stratosphere. Atmospheric Chemistry and Physics. https://doi.org/10.5194/acp-25-7941-2025

105. Murillo, A., & Vieiro, A. (2025). Periodic perturbation of a 3D conservative flow with a heteroclinic connection to saddle-foci. Communications in Nonlinear Science and Numerical Simulation. https://doi.org/10.1016/j.cnsns.2025.108620

106. Ferreira, G. R., & Jove, A. (2025). Boundary behaviour of universal covering maps. Advances in Mathematics. https://doi.org/10.1016/j.aim.2025.110232

107. Florido, R., & Fagella, N. (2025). On the Parameter Space of Fibered Hyperbolic Polynomials. Journal of Geometric Analysis. https://doi.org/10.1007/s12220-025-02060-x

108. Curbelo, J. (2025). Lagrangian descriptors in geophysical flows: a survey. SEMA Journal. https://doi.org/10.1007/s40324-025-00382-y

109. Berk, P., Trujillo, F., & Ulcigrai, C. (2025). Ergodicity of explicit logarithmic cocycles over IETs. Mathematische Annalen. https://doi.org/10.1007/s00208-025-03246-y

110. Pardo-Simon, L., & Rempe, L. (2025). Entire functions with Cantor bouquet Julia sets. Journal of the London Mathematical Society. https://doi.org/10.1112/jlms.70142

111. Ferreira, G. R., & van Strien, S. (2025). Holomorphic motions, natural families of entire maps, and multiplier-like objects for wandering domains. Mathematische Annalen. https://doi.org/10.1007/s00208-025-03107-8

112. Forrier, P. P., Gimeno, J., & Jorba, A. (2025). A note on the local behavior of the Taylor method for stiff ODEs. Applied Mathematics and Computation. https://doi.org/10.1016/j.amc.2025.129344

113. Agaoglou, M., & Curbelo, J. (2025). Preface to the special issue Nonlinear processes in Fluid Dynamics. Physica D: Nonlinear Phenomena. https://doi.org/10.1016/j.physd.2025.134966

114. Barbieri, S., & Clarke, A. (2025). Existence and nonexistence of invariant curves of coin billiards. Nonlinearity. https://doi.org/10.1088/1361-6544/ae2374

115. Aguareles, M., Baldoma, I., & Martinez-Seara, T. (2025). A rigorous derivation of the asymptotic wavenumber in spiral wave solutions of the complex Ginzburg-Landau equation. Journal of the European Mathematical Society. https://doi.org/10.4171/jems/1637

116. Berk, P., & Trujillo, F. (2025). On the ergodicity of infinite antisymmetric extensions of symmetric IETs. Journal of the European Mathematical Society. https://doi.org/10.4171/jems/1635

117. Buzzi, C. A., Tonon, D. J., & Torregrosa, J. (2025). Limit cycles for a piecewise polynomial potential perturbation of a symmetric 8-loop Hamiltonian. NoDEA: Nonlinear Differential Equations and Applications. https://doi.org/10.1007/s00030-025-01146-3

118. Braun, F., da Cruz, L. P. C., & Torregrosa, J. (2025). Local and global analysis of the displacement map for some near integrable systems. Physica D: Nonlinear Phenomena. https://doi.org/10.1016/j.physd.2025.134932

119. Alseda, L., Bobok, J., Misiurewicz, M., & Snoha, L. (2025). The Real Teapot. Ergodic Theory and Dynamical Systems. https://doi.org/10.1017/etds.2025.15

120. Llopis-Almela, O., Lazaro, J. T., Elena, S. F., & Sardanyes, J. (2025). Global bifurcation in a virus, defective genomes, satellite RNAs tripartite system. Chaos, Solitons & Fractals. https://doi.org/10.1016/j.chaos.2025.116037

121. Fucho-Rius, M., Maretvadakethope, S., Haro, A., Alarcon, T., Sardanyes, J., & Perez-Carrasco, R. (2025). Local nearby bifurcations lead to synergies in critical slowing down: The case of mushroom bifurcations. Physical Review E. https://doi.org/10.1103/PhysRevE.111.024213

122. Gimeno, J., Jorba, A., Jorba-Cusco, M., & Zou, M. R. (2025). Explicit numerical computation of normal forms for Poincare maps. Communications in Nonlinear Science and Numerical Simulation. https://doi.org/10.1016/j.cnsns.2025.108913

123. da Cruz, L. P. C., Torregrosa, J., Berdugo, M., & Sardanyes, J. (2025). Resource-consumer dynamics in drylands: Modeling the role of plant-plant facilitation-competition shifts with a piecewise system. Physica D: Nonlinear Phenomena. https://doi.org/10.1016/j.physd.2025.134548

124. Baranski, K., Karpinska, B., Marti-Pete, D., Pardo-Simon, L., & Zdunik, A. (2025). On the dimension of the boundaries of attracting basins of entire maps. Journal of the London Mathematical Society. https://doi.org/10.1112/jlms.70349

PROJECTS

PID2024-158570NB-I00 — RACIMCEL: Rigorous and Computational Approach to the study of Invariant Manifolds with applications to Celestial Mechanics.
PI: **M. T. Martinez-Seara**.
Funded by: AEI.

PID2021-122954NB-I00 — IMHNEA: Invariant Manifolds, Hamiltonian Systems and Dynamics in Neuroscience, Epidemiology and Atmosphere.
PI: **M. T. Martinez-Seara**.
Funded by: AEI (2022–2025).

ICREA Academia 2023.
PI: **Marcel Guardia**.

DEFENDED THESES

Flow map parameterization methods for invariant tori in Hamiltonian systems
Student: Alvaro Fernandez-Mora
Supervisor: **Alejandro Haro** & Jose Maria Mondelo.
Universitat de Barcelona, June 2025.

Periodic boundary points for transcendental Fatou components
Student: Anna Jove Campabadal
Supervisor: **Nuria Fagella**.
Universitat de Barcelona, September 2025.

The role of resonances in Arnold diffusion
Student: Roman Moreno Gonzalez
Supervisor: **M. Teresa Martinez-Seara** & **Inmaculada Baldoma**.
Universitat Politecnica de Catalunya, July 2025.

Oscillatory motions, parabolic orbits and collision orbits in the planar circular restricted three-body problem
Student: José Lamas Rodriguez
Supervisor: **M. Teresa Martinez-Seara** & **Marcel Guardia**.
Universitat Politecnica de Catalunya, July 2025.

SCIENTIFIC ACTIVITIES

JISD 2025 — 21st School on Interactions between Dynamical Systems and Partial Differential Equations.
CRM, June 30 – July 4, 2025.

Topics in Complex Dynamics 2025: Connections to Geometry and Analysis.
Universitat de Barcelona, June 2–6, 2025
Leticia Pardo, **Xavier Jarque**, (co-organization).

Conformal Dynamics and Geometry. Bordeaux,
Scientific Committee: **M. T. Martinez-Seara**.

Jornades d'Introducció als Sistemes Dinàmics i les EDP
Organized by **Marcel Guardia**.

COMBINATORICS AND MATHEMATICS OF COMPUTER SCIENCE

The Combinatorics and Mathematics of Computer Science group at CRM covers a broad spectrum of research areas in discrete mathematics, theoretical computer science, and mathematical logic, including structural graph theory, discrete geometry, enumerative and asymptotic combinatorics, probabilistic methods, additive combinatorics, extremal combinatorics, analysis of algorithms, computational complexity, proof theory, and finite model theory. This diverse mix of topics enables fruitful collaboration among group members and highlights the group's interdisciplinary nature.

During tuition periods, the group holds regular weekly seminar meetings where both invited speakers and local researchers present their most recent work. These seminars are intended for mathematicians and graduate students in the area of influence of Barcelona who have an interest in these topics, and aim to promote the exchange of ideas and to keep in touch with ongoing research advances in the field.

MEMBERS

Senior Researchers: Albert Atserias | Simeon Ball | Kolja Knauer | Richard Lang | Marc Noy | Arnau Padrol | Guillem Perarnau | Vincent Pilaud | Juan Jose Rue | Oriol Serra | Lluis Vena

Postdoctoral Researchers: Tassio Naia

PhD Students: Jordi Castellvi

PUBLICATIONS

125. Fernandes, C. G., Naia, T., Santos, G., & Stein, M. (2025). Packing large balanced trees into bipartite graphs. Discrete Mathematics. https://doi.org/10.1016/j.disc.2025.114641

126. Pilaud, V. (2025). Pebble trees. Canadian Journal of Mathematics. https://doi.org/10.4153/S0008414X25000094

127. Perarnau, G., & Serra, O. (2025). The Lonely Runner Conjecture turns 60. Computer Science Review. https://doi.org/10.1016/j.cosrev.2025.100798

128. Pilaud, V., & Poliakova, D. (2025). Hochschild polytopes. Mathematische Annalen. https://doi.org/10.1007/s00208-025-03120-x

129. Atserias, A., & Kolaitis, P. G. (2025). Consistency of Relations over Monoids. Journal of the ACM. https://doi.org/10.1145/3721855

130. Bergeron, N., Cartier, N., Ceballos, C., & Pilaud, V. (2025). Lattices of acyclic pipe dreams. Algebraic Combinatorics. https://doi.org/10.5802/alco.423

131. Castellvi, J., & Stufler, B. (2025). Limits of Chordal Graphs With Bounded Tree-Width. Random Structures & Algorithms. https://doi.org/10.1002/rsa.21275

132. Botler, F., & Naia, T. (2025). Separating the Edges of a Graph by Cycles and by Subdivisions of K4. Journal of Graph Theory. https://doi.org/10.1002/jgt.23248

133. Pilaud, V., & Poullot, G. (2025). Pivot Polytopes of Products of Simplices and Shuffles of Associahedra. Discrete & Computational Geometry. https://doi.org/10.1007/s00454-025-00765-y

134. Bapat, A., & Pilaud, V. (2025). The Wigglyhedra. Mathematische Zeitschrift. https://doi.org/10.1007/s00209-025-03688-9

135. Philippe, E., & Pilaud, V. (2025). Geometric realizations of the s-weak order and its lattice quotients. Journal of the London Mathematical Society. https://doi.org/10.1112/jlms.70268

136. Kathapurkar, A., Morris, P., & Perarnau, G. (2025). A rainbow Dirac theorem for loose Hamilton cycles in hypergraphs. Combinatorics Probability and Computing. https://doi.org/10.1017/S0963548325100266

137. Chapuy, G., & Perarnau, G. (2025). Short Synchronizing Words for Random Automata. ACM Transactions on Algorithms. https://doi.org/10.1145/3736722

138. Davies, J., Hatzel, M., Knauer, K., McCarty, R., & Ueckerdt, T. (2025). Girth in GF(q)-representable matroids. Bulletin of the London Mathematical Society. https://doi.org/10.1112/blms.70159

139. Jimenez, A., Knauer, K., et al. (2025). Boundedness for proper conflict-free and odd colorings. Discrete Mathematics. https://doi.org/10.1016/j.disc.2025.114730

140. Atserias, A. (2025). Proof Complexity and Its Relations to SAT Solving. 42nd International Symposium on Theoretical Aspects of Computer Science (STACS 2025). https://doi.org/10.4230/LIPIcs.STACS.2025.1

PROJECTS

PID2023-147202NB-I00 — COCOA: Contemporary Combinatorics and its Applications.
PI: **Guillem Perarnau**.
Funded by: MICINN.

RED2024-153572-T — Red de Matematica Discreta y Algoritmica.
PI: **Guillem Perarnau**.
Funded by: AEI.

PCI2024-155081-2 — COMPOTE: Combinatorial Polytope Theory.
Co-led with **Arnau Padrol**.
Funded by: AEI-DFG.

PID2022-137283NB-C21 — Geometry and Algebra in Combinatorics: Geometric combinatorics and its connections to algebra.
PI: **Arnau Padrol**.
Funded by: MICINN.

PCI2024-155080-2 — SRC-ExCo: Structure, Randomness and Computational Methods in Extremal Combinatorics.
PI: **Juan Jose Rue**.
Funded by: AEI.

PID2022-137283NB-C22 — ACoGe: Algebraic Combinatorics and its Connections to Geometry.
PI: **Kolja Knauer**.
Funded by: MICINN.

DEFENDED THESES

Quantum analogs of classical codes
Student: Ricard Vila Alguer
Supervisor: **Simeon Ball**.
Universitat Politecnica de Catalunya, March 2025.

SCIENTIFIC ACTIVITIES

MDM Focused Research Programme on Combinatorial Geometries and Geometric Combinatorics.
CRM Barcelona, 2025.
Organized by **Arnau Padrol, Kolja Knauer** and **Vincent Pilaud**.

Barcelona Discrete Mathematics Meeting (BDMM) 2025.
CRM Barcelona.

CIRM Conference: Combinatorics and Discrete Probability.
Luminy, France, November 2025
Guillem Perarnau.

CIRM Conference: Beyond permutahedra and associahedra.
Marseille, 2025
Vincent Pilaud.

HIGHLIGHTED PUBLICATIONS

CRM Annual Report 2025 — corrected mathematical notation

The Centre de Recerca Matemàtica (CRM) remains at the forefront of mathematical research, with recent contributions spanning PDEs, dynamical systems, mathematical biology, combinatorics, analysis, and neuroscience. From breakthroughs in nonlocal operators to advances in computational models of memory storage, these studies highlight the depth and impact of CRM's work across disciplines. Below is a selection of publications by CRM researchers from 2025.

On small breathers of nonlinear Klein-Gordon equations via exponentially small homoclinic splitting

Authors: Gomide, O. M. L., Guardia, M., Seara, T. M., & Zeng, C. C.

Abstract: Breathers are nontrivial time-periodic and spatially localized solutions of nonlinear dispersive partial differential equations (PDEs). Families of breathers have been found for certain integrable PDEs but are believed to be rare in non-integrable ones such as nonlinear Klein-Gordon equations. In this paper we show that small amplitude breathers of any temporal frequency do not exist for semilinear Klein-Gordon equations with generic analytic odd nonlinearities. A breather with small amplitude exists only when its temporal frequency is close to being resonant with the linear Klein-Gordon dispersion relation. Our main result is that, for such frequencies, we rigorously identify the leading order term in the exponentially small (with respect to the small amplitude) obstruction to the existence of small breathers in terms of the so-called Stokes constant, which depends on the nonlinearity analytically, but is independent of the frequency. This gives a rigorous justification of a formal asymptotic argument by Kruskal and Segur (Phys. Rev. Lett. 58(8):747, 1987) in the analysis of small breathers.

Citation: Gomide, O. M. L., Guardia, M., Seara, T. M., & Zeng, C. C. (2025). *Inventiones Mathematicae*. https://doi.org/10.1007/s00222-025-01327-y

Representational drift as the consequence of ongoing memory storage

Authors: Devalle, F., Zou, L. C., Cecchini, G., & Roxin, A.

Abstract: Memory systems with biologically constrained synapses have been the topic of intense theoretical study for over thirty years. Perhaps the most fundamental and far-reaching finding from this work is that the storage of new memories implies the partial erasure of already-stored ones. This overwriting leads to a decorrelation of sensory-driven activity patterns over time, even if the input patterns remain similar. Representational drift (RD) should therefore be an expected and inevitable consequence of ongoing memory storage. We tested this hypothesis by fitting a network model to data from long-term chronic calcium imaging experiments in mouse hippocampus. Synaptic turnover in the model inputs, consistent with the ongoing encoding of new activity patterns, accounted for the observed statistics of RD. This mechanism also provides a parsimonious explanation for the diverse effects of experience on drift found in experiment. Our results suggest that RD should be observed wherever neuronal circuits are involved in a process of ongoing learning or memory storage.

Citation: Devalle, F., Zou, L. C., Cecchini, G., & Roxin, A. (2025). *Scientific Reports*. https://doi.org/10.1038/s41598-025-11102-x

't Hooft bundles on the complete flag threefold and moduli spaces of instantons

Authors: Antonelli, V., Malaspina, F., Marchesi, S., & Pons-Llopis, J.

Abstract: In this work we study the moduli spaces of instanton bundles on the flag twistor space $F := F(0, 1, 2)$. We stratify them in terms of the minimal twist supporting global sections and we introduce the notion of (special) 't Hooft bundle on F. In particular we prove that there exist μ-stable 't Hooft bundles for each admissible charge k. We completely describe the geometric structure of the moduli space of (special) 't Hooft bundles for arbitrary charge k. Along the way to reach these goals, we describe the possible structures of multiple curves supported on some rational curves in F as well as the family of del Pezzo surfaces realized as hyperplane sections of F. Finally we investigate the splitting behavior of 't Hooft bundles when restricted to conics.

Citation: Antonelli, V., Malaspina, F., Marchesi, S., & Pons-Llopis, J. (2025). *Journal de Mathematiques Pures et Appliquees*. https://doi.org/10.1016/j.matpur.2025.103763

Complete 3-manifolds of positive scalar curvature with quadratic decay

Authors: Balacheff, F., Sardá, T. G. M. D., & Sabourau, S.

Abstract: We prove that if an orientable 3-manifold M admits a complete Riemannian metric whose scalar curvature is positive and has a subquadratic decay at infinity, then it decomposes as a (possibly infinite) connected sum of spherical manifolds and $S^2 \times S^1$ summands. This generalises a theorem of Gromov and Wang by using a different, more topological, approach. As a result, the manifold M carries a complete Riemannian metric of uniformly positive scalar curvature, which partially answers a conjecture of Gromov. More generally, the topological decomposition holds without any scalar curvature assumption under a weaker condition on the filling discs of closed curves in the universal cover based on the notion of fill radius. Moreover, the decay rate of the scalar curvature is optimal in this decomposition theorem. Indeed, the manifold $\mathbb{R}^2 \times S^1$ supports a complete metric of positive scalar curvature with exactly quadratic decay, but does not admit a decomposition as a connected sum.

Citation: Balacheff, F., Sardá, T. G. M. D., & Sabourau, S. (2025). *Mathematische Annalen*. https://doi.org/10.1007/s00208-025-03192-9

Stable solutions to the fractional Allen-Cahn equation in the nonlocal perimeter regime

Authors: Cabré, X., Cinti, E., & Serra, J.

Abstract: We study stable solutions to the fractional Allen-Cahn equation $(-\Delta)^{s/2}u = u - u^3$, $|u| < 1$ in $\mathbb{R}^n$. For every $s \in (0, 1)$ and dimension $n \geq 2$, we establish sharp energy estimates, density estimates, and the convergence of blow-downs to stable nonlocal s-minimal cones. As a consequence, we obtain a new classification result: if for some pair (n, s), with $n \geq 3$, hyperplanes are the only stable nonlocal s-minimal cones in $\mathbb{R}^n \setminus \{0\}$, then every stable solution to the fractional Allen-Cahn equation in $\mathbb{R}^n$ is 1D, namely, its level sets are parallel hyperplanes. Combining this result with the classification of stable s-minimal cones in $\mathbb{R}^3 \setminus \{0\}$ for $s = 1$ obtained by the authors in a recent paper, we give positive answers to the "stability conjecture" in $\mathbb{R}^3$ and to the "De Giorgi conjecture" in $\mathbb{R}^4$ for the fractional Allen-Cahn equation when the order $s \in (0, 1)$ of the operator is sufficiently close to 1.

Citation: Cabré, X., Cinti, E., & Serra, J. (2025). *American Journal of Mathematics*. https://doi.org/10.1353/ajm.2025.a966

Hochschild polytopes

Authors: Pilaud, V., & Poliakova, D.

Abstract: The (m, n)-multiplihedron is a polytope whose faces correspond to m-painted n-trees, and whose oriented skeleton is the Hasse diagram of the rotation lattice on binary m-painted n-trees. Deleting certain inequalities from the facet description of the (m, n)-multiplihedron, we construct the (m, n)-Hochschild polytope whose faces correspond to m-lighted n-shades, and whose oriented skeleton is the Hasse diagram of the rotation lattice on unary m-lighted n-shades. Moreover, there is a natural shadow map from m-painted n-trees to m-lighted n-shades, which turns out to define a meet semilattice morphism of rotation lattices. In particular, when $m = 1$, our Hochschild polytope is a deformed permutahedron whose oriented skeleton is the Hasse diagram of the Hochschild lattice.

Citation: Pilaud, V., & Poliakova, D. (2025). *Mathematische Annalen*. https://doi.org/10.1007/s00208-025-03120-x

Consistency of Relations over Monoids

Authors: Atserias, A., & Kolaitis, P. G.

Abstract: The interplay between local consistency and global consistency has been the object of study in several different areas, including probability theory, relational databases, and quantum information. For relational databases, Beeri, Fagin, Maier, and Yannakakis showed that a database schema is acyclic if and only if it has the local-to-global consistency property for relations, which means that every collection of pairwise consistent relations over the schema is globally consistent. More recently, the same result has been shown under bag semantics. In this article, we carry out a systematic study of local versus global consistency for relations over positive commutative monoids, which is a common generalization of ordinary relations and bags. We characterize the positive commutative monoids for which acyclicity is both necessary and sufficient for the local-to-global consistency property to hold. This characterization involves a combinatorial property of monoids, which we call the transportation property.

Citation: Atserias, A., & Kolaitis, P. G. (2025). *Journal of the ACM*. https://doi.org/10.1145/3721855

On Darmon's program for the generalized Fermat equation, I

Authors: Billerey, N., Chen, I. M., Dieulefait, L., & Freitas, N.

Abstract: In 2000, Darmon described a program to study the generalized Fermat equation using modularity of abelian varieties of GL(2)-type over totally real fields. The original approach was based on hard open conjectures, which have made it difficult to apply in practice. In this paper, building on the progress surrounding the modular method from the last two decades, we analyze and expand the current limits of this program by developing all the necessary ingredients to use Frey abelian varieties for new Diophantine applications. As an application, for all integers $n \geq 2$, we give a resolution of the generalized Fermat equation $x^{11} + y^{11} = z^n$ for solutions (a, b, c) such that $a + b$ satisfies certain 2- or 11-adic conditions. We are also able to reduce the problem of solving $x^5 + y^5 = z^p$ to a weaker version of Darmon's big image conjecture, thus completing a line of ideas suggested in his original program.

Citation: Billerey, N., Chen, I. M., Dieulefait, L., & Freitas, N. (2025). *Journal für die reine und angewandte Mathematik*. https://doi.org/10.1515/crelle-2025-0014

A rigorous derivation of the asymptotic wavenumber in spiral wave solutions of the complex Ginzburg-Landau equation

Authors: Aguareles, M., Baldomà, I., & Martinez-Seara, T.

Abstract: In this work n-armed Archimedean spiral wave solutions of the complex Ginzburg-Landau equation are considered. These solutions are shown to depend on two characteristic parameters, the so-called twist parameter and the asymptotic wavenumber. The existence and uniqueness of the value of the asymptotic wavenumber, depending on the twist parameter, for which n-armed Archimedean spiral wave solutions exist is a classical result, obtained back in the 80s by Kopell and Howard. In this work we deal with a different problem, that is, the asymptotic expression of the asymptotic wavenumber for small values of the twist parameter. Since the eighties, different heuristic perturbation techniques, like formal asymptotic expansions, have conjectured an asymptotic expression which is exponentially small with respect to the twist parameter. However, the validity of this expression has remained open until now, despite the fact that it has been widely used for more than 40 years. In this work, using a functional analysis approach, we finally prove the validity of the asymptotic formula, providing a rigorous bound for its relative error.

Citation: Aguareles, M., Baldomà, I., & Martinez-Seara, T. (2025). *Journal of the European Mathematical Society*. https://doi.org/10.4171/jems/1637

On the ergodicity of infinite antisymmetric extensions of symmetric IETs

Authors: Berk, P., & Trujillo, F.

Abstract: We consider skew product extensions over symmetric interval exchange transformations on the unit interval $[0, 1)$ with respect to the cocycle $f = \chi_{(0,1/2)} - \chi_{(1/2,1)}$. We prove that for almost every interval exchange transformation T with symmetric combinatorial data, the skew product

$$T_f : [0, 1) \times \mathbb{Z} \to [0, 1) \times \mathbb{Z}$$

given by $T_f(x, r) = (T(x), r + f(x))$ is ergodic with respect to the product of the Lebesgue and counting measures.

Citation: Berk, P., & Trujillo, F. (2025). *Journal of the European Mathematical Society*. https://doi.org/10.4171/jems/1635

Improvement of flatness for nonlocal free boundary problems

Authors: Ros-Oton, X., & Weidner, M.

Abstract: In this article, we study for the first time the regularity of the free boundary in the one-phase free boundary problem driven by a general nonlocal operator. Our main results establish that the free boundary is $C^{1,\alpha}$ near regular points, and that the set of regular free boundary points is open and dense. Moreover, in 2D we classify all blow-up limits and prove that the free boundary is $C^{1,\alpha}$ everywhere. The main technical tool of our proof is an improvement of flatness scheme, which we establish in the general framework of viscosity solutions, and which is of independent interest. All of these results were only known for the fractional Laplacian, and are completely new for general nonlocal operators. In contrast to previous works on the fractional Laplacian, our method of proof is purely nonlocal in nature.

Citation: Ros-Oton, X., & Weidner, M. (2025). *Journal of the European Mathematical Society*. https://doi.org/10.4171/jems/

Solvability of the Poisson-Dirichlet problem with interior data in $L^{p'}$-Carleson spaces and its applications to the L^p-regularity problem

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

Abstract: We prove that the $L^{p'}$-solvability of the homogeneous Dirichlet problem for an elliptic operator $L = -\operatorname{div}(A\nabla)$ with real and merely bounded coefficients is equivalent to the $L^{p'}$-solvability of the Poisson-Dirichlet problem $Lw = H - \operatorname{div} F$, which is defined in terms of an $L^{p'}$-estimate on the non-tangential maximal function, assuming that $\operatorname{dist}(\cdot, \partial\Omega)\, H$ and F lie in certain $L^{p'}$-Carleson-type spaces, and that the domain $\Omega \subset \mathbb{R}^{n+1}$, $n \geq 2$, satisfies the corkscrew condition and has n-Ahlfors regular boundary. This result for Dahlberg-Kenig-Pipher operators is new even if Ω is the unit ball, despite the fact that the $L^{p'}$-solvability of the Dirichlet problem for these operators in Lipschitz domains has been known since 2001.

Citation: Mourgoglou, M., Poggi, B., & Tolsa, X. (2025). *Journal of the European Mathematical Society*. https://doi.org/10.4171/jems/1660

Carleson's ε^2 conjecture in higher dimensions

Authors: Fleschler, I., Tolsa, X., & Villa, M.

Abstract: In this paper we prove a higher dimensional analogue of Carleson's ε^2 conjecture. Given two arbitrary disjoint Borel sets $\Omega^+, \Omega^- \subset \mathbb{R}^{n+1}$, and $x \in \mathbb{R}^{n+1}$, $r > 0$, we denote

$$\varepsilon(x, r) := \frac{1}{r^n} \inf_{H^+} \mathcal{H}^n\Big(\big((\partial B(x, r) \cap H^+) \setminus \Omega^+\big) \cup \big((\partial B(x, r) \cap H^-) \setminus \Omega^-\big)\Big),$$

where the infimum is taken over all open affine half-spaces H^+ such that $x \in \partial H^+$, and we define $H^- = \mathbb{R}^{n+1} \setminus H^+$. Our first main result asserts that the set of points $x \in \mathbb{R}^{n+1}$ where the integral

$$\int_0^1 \varepsilon(x, r)^2 \, \frac{dr}{r}$$

is finite has Hausdorff dimension at most n.

Citation: Fleschler, I., Tolsa, X., & Villa, M. (2025). *Inventiones Mathematicae*. https://doi.org/10.1007/s00222-025-01337-w

Multiscale modelling shows how cell-ECM interactions impact ECM fibre alignment and cell detachment

Authors: Arellano-Tinto, J., Stepanova, D., Byrne, H. M., Maini, P. K., & Alarcon, T.

Abstract: The extracellular matrix (ECM) is a dynamic network structure that surrounds, supports, and influences cell behaviour. It facilitates cell communication and plays an important role in cell functions such as growth and migration. One way that cells interact with the ECM is via focal adhesions, which enable them to sense and respond to matrix mechanical properties and exert traction forces that deform it. To gain a better understanding of these mechanical interactions, we have developed a multiscale agent-based model based on a mechanical description of forces that simultaneously integrates the mechanosensitive regulation of focal adhesions, cytoskeleton dynamics, and ECM deformation. We use our model to quantify cell-cell communication mediated by ECM deformation and to show how this process depends on the mechanical properties of cells, the ECM fibres and the topology of the ECM network.

Citation: Arellano-Tinto, J., Stepanova, D., Byrne, H. M., Maini, P. K., & Alarcon, T. (2025). *PLOS Computational Biology*. https://doi.org/10.1371/journal.pcbi.1012698

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 external partners to address challenges with societal impact through the development of tailored mathematical solutions, while also managing the protection and valorisation of the centre's research results. In this way, it contributes to bringing the CRM's research beyond academia and towards concrete applications in areas where mathematical tools can inform decisions, improve processes and respond to socially relevant needs. These solutions are designed to be clear, accurate and user-friendly, benefiting from the close interaction 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. In November 2025, CRM Director Carme Cascante and KTU Head David Romero attended the 100xCiencia meeting held in Valencia (November 13-14), an annual gathering of SOMMa alliance members focused on science communication and knowledge transfer initiatives. 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 Transfer 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 2025

Daniel Cuadrillero Moles (Research Technician), **Lucia Escudero Sartages** (Impact Officer), **Marc Homs Dones** (Scientific Software Developer), **Manel Mas Martín** (Research Technician), and **David Romero Sànchez** (Head of the KTU).

THE PROJECTS

Throughout 2025, the KTU 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 work led to partnerships with research centres such as ICFO, ICM, and ALBA Synchrotron, among others. The following selection of projects reflects the scope and reach of the KTU's work across sectors.

BISTECH: The KTU is developing and refining a mathematical model for cooking a wide range of foods using a new device. The unit is also creating an interface to provide a more user-friendly experience.

DYSEDAS (Data Shrinking Method Enabled by Dynamical Systems for Resources Saving): This project aims to develop a lossless data compression method that increases compression rates beyond current state-of-the-art methods. DYSEDAS 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 cybersecurity project involved developing 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.

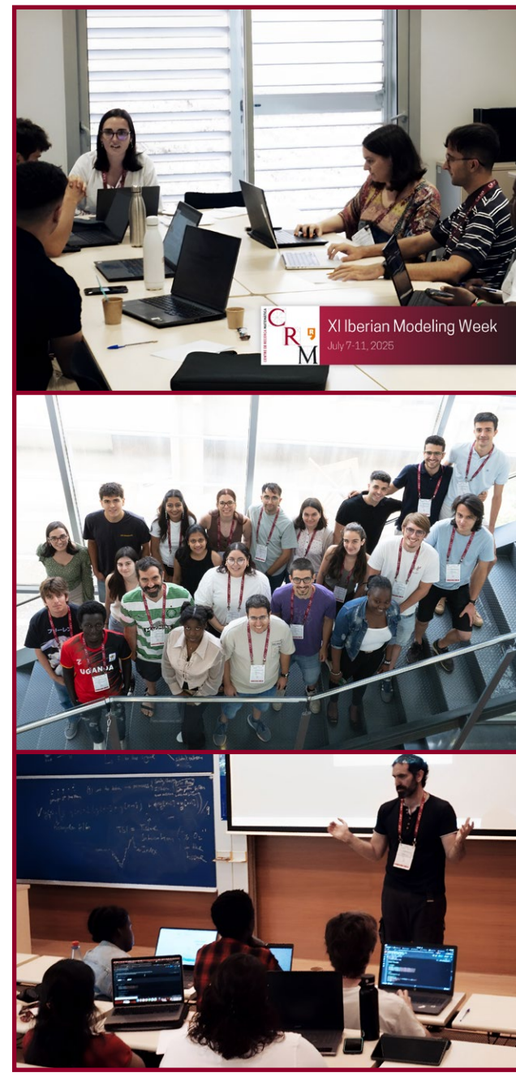
TIPSAVIR (AI-TIGsa: AI-guided search of Therapeutic Interfering Genomes as optimized Antivirals): The KTU simulates virus infection on tissue at the level of RNA replication, enabling in silico study of different aspects of virus evolution with low computation time. The project aims to identify the correct RNA sequence (generated by replication of the wild-type virus) that can stop the infection.

eBRT2030: Climate change and air pollution are pressing global concerns, and public transport plays a key role in promoting sustainable urban mobility. eBRT2030, a Horizon Europe project in which the KTU is a partner, 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. In 2025, KTU representatives participated in the General Assembly held in Istanbul and presented project results at conferences in the United States.

ENHANCE EUROPE: This project 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 such as shopping centers, transport terminals, or public services. The system lowers road surface temperatures, mitigating the urban heat island effect while aligning with urban planning regulations and creating more liveable urban environments. The project's mathematical models, developed within the KTU, support and guide the real-world experiments carried out during the project, ensuring that the solutions tested in the field are reliable, efficient, and scalable. The interdisciplinary nature of the project brings together expertise from mathematics, engineering, urban planning, and environmental sciences. ENHANCE EUROPE is funded by the Clean Energy Transition Partnership. In 2025, the KTU participated in the project kick-off meeting held in Padova.

SCIENTIFIC MEETINGS

Throughout 2025, the KTU organized two major international events that brought together students, researchers, and industry partners to work on applied mathematical problems.



XI Iberian Modeling Week (July 7-11, 2025)

The CRM hosted the eleventh edition of the Iberian Modeling Week, organized in collaboration with math-in (Spain) and Pt-maths-in (Portugal). Nearly 30 students from across Europe participated, including students from Barcelona, Lisbon, Hamburg, and L'Aquila. Participants came from diverse academic backgrounds, including mathematics, physics, chemistry, artificial intelligence, biomedical engineering, and aerospace engineering.

The week centered on four practical problems: optimal bus allocation throughout a city's daily cycle, blood flow modeling using the Windkessel model with real spectroscopy data, climate shelter placement in Barcelona for vulnerable populations during extreme heat events, and energy harvesting versus flow efficiency in asphalt solar collectors. KTU members Lucía Escudero, Marc Homs-Dones, Manel Mas, and David Romero served as mentors for the four working groups.

European Study Group with Industry (ESGI 2025, July 14-18, 2025)

Immediately following the Iberian Modeling Week, the CRM co-organized ESGI 2025 with Math-in and Pt-maths-in. This event brought together academic researchers and industry professionals to solve real-world problems through applied

mathematics. Three companies presented challenges: Sener Mobility proposed developing an Advanced Driver Assistance System for overtaking maneuvers, Cetaqua presented a water source optimization problem balancing costs and quality across multiple sources, and EDP addressed volumetric risk in renewable energy production.

Participants came from Portugal, Spain, Finland, France, Georgia, Norway, and Italy. The scientific committee included Emilio Carrizosa (Universidad de Sevilla, Math-in), Ricardo Enguiça (Instituto Superior de Engenharia de Lisboa, Pt-maths-in), Ana Moura (Polytechnic of Porto, Pt-maths-in), and David Romero (CRM). The KTU coordinated the event.

The back-to-back organization of these two events created continuity and networking opportunities, with students from the Modeling Week able to observe professional mathematical problem-solving at ESGI.

KNOWLEDGE TRANSFER & OUTREACH

The KTU participated in several outreach initiatives during 2025, connecting mathematics research with young people and the broader public.

European Researchers' Night (September 23-24, 2025)

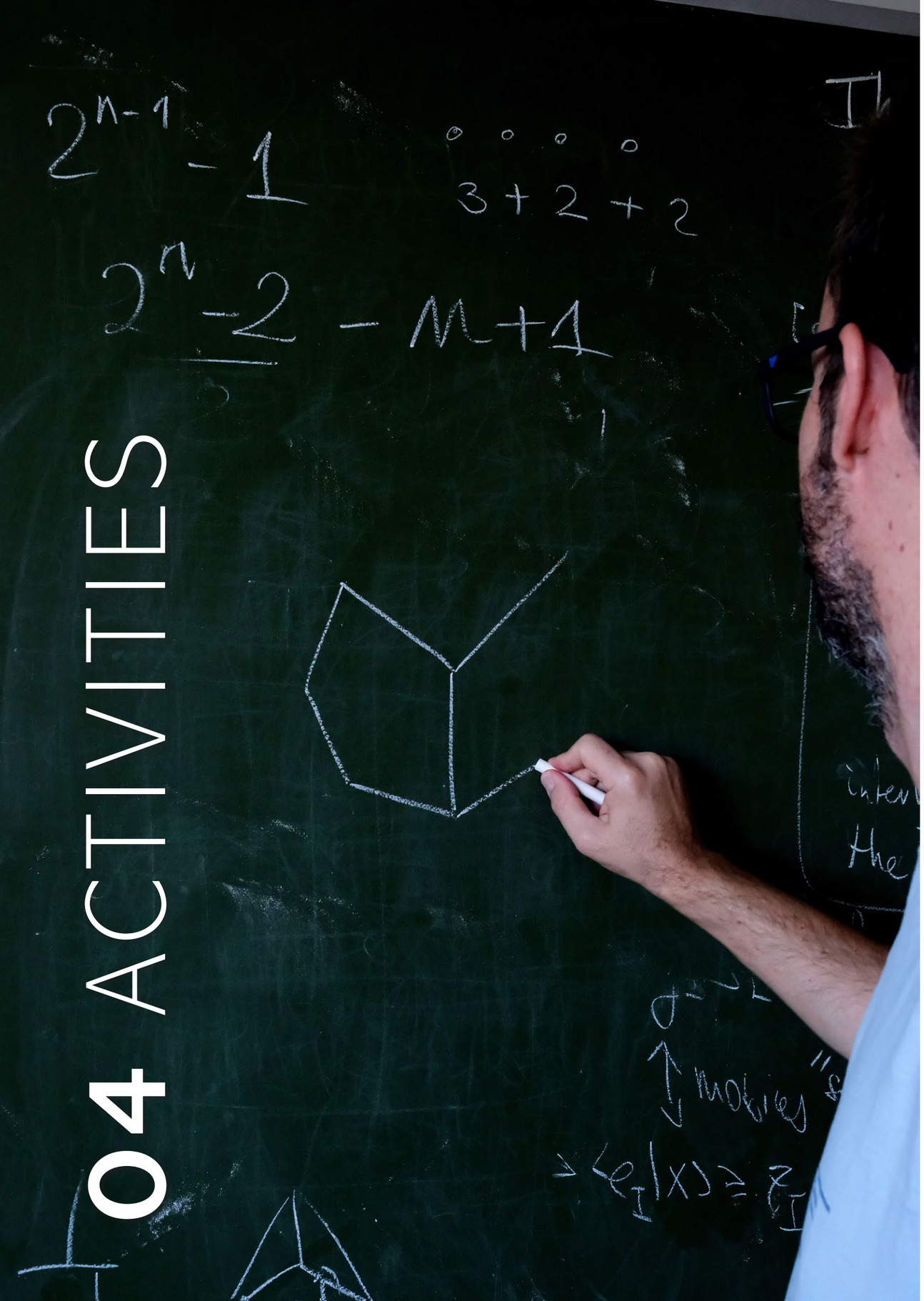
Three CRM researchers participated in the European Researchers' Night at different locations across Catalonia. Leticia Pardo (UB-CRM) presented on fractals at Casa Golferichs in Barcelona on September 23. Marc Calvo (UPC-CRM) gave a talk titled "Mathematics in the Real World" at Auditori Barradas in L'Hospitalet on September 23, including examples such as a South African football team that used mathematics to gain competitive advantage. David Romero (CRM) presented the ENHANCE EUROPE project on harvesting heat from asphalt for renewable energy at Casino de Vic on September 24.

ExpoRecerca 2025 (March 6-8, 2025)

The CRM participated as a sponsor at ExpoRecerca Jove 2025, held at La Salle-URL Campus in Barcelona. Organized by MAGMA (Associació per a Promoure la Recerca Jove), the event provides secondary and high school students the opportunity to present scientific research projects. The CRM awarded two prizes: one to Kira Garcia Aguilera (Institut Ramon Turró i Darder, Malgrat de Mar) for her work on the evolution of equation-solving methods throughout mathematical history, and another to Marc Jordán de la Cruz (Escola Virolai, Barcelona) for developing an AI model that detects Alzheimer's disease patterns in MRI images with 96% accuracy. The jury included David Romero (KTU director), Alberto Maione and Frank Trujillo (postdoctoral researchers), Dídac Gil and Kevin Martínez (predoctoral researchers), and Pau Varela and Natalia Vallina (communications team).

Joves i Ciència Program (July 2025)

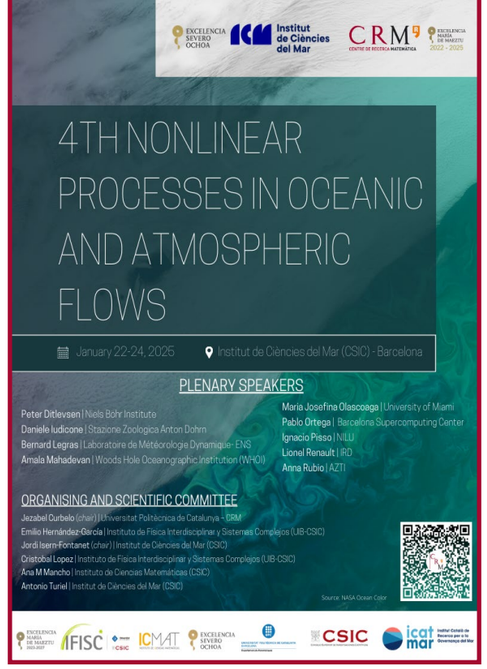
For the second consecutive year, the KTU hosted students from the Fundació Catalunya La Pedrera's Joves i Ciència program, a three-year initiative for students with science and technology potential that begins in 4th year of ESO. Three students participated: Roger Carrillo (1st batxillerat), Clara Castelló (1st batxillerat), and Maria Borrell (2nd batxillerat). Roger worked on heat capture in asphalt for energy generation and participated in the Iberian Modeling Week. Clara and Maria worked on biomedical modeling of venous occlusion and blood flow, and attended final presentations at ESGI 2025.



04 ACTIVITIES

4TH NONLINEAR PROCESSES IN OCEANIC AND ATMOSPHERIC FLOWS

January 22-25, 2025



DESCRIPTION

NLOA 2025 intended to create cross-disciplinary interaction among mathematicians, physicists, oceanographers and atmospheric scientists in a wide sense. It focused on nonlinear dynamics of atmospheric and oceanic phenomena and aimed to create an international forum where international researchers explored timely open problems in ocean and atmosphere sciences, and also investigated the power and impact of mathematics in these areas.

ORGANISING AND SCIENTIFIC COMMITTEE

Jezabel Curbelo (chair) | Universitat Politècnica de Catalunya – CRM
Emilio Hernández-García | Instituto de Física Interdisciplinar y Sistemas Complejos (UIB-CSIC)
Jordi Isern-Fontanet (chair) | Institut de Ciències del Mar (CSIC)
Cristobal Lopez | Instituto de Física Interdisciplinar y Sistemas Complejos (UIB-CSIC)
Ana M Mancho | Instituto de Ciencias Matemáticas (CSIC)
Antonio Turiel | Institut de Ciències del Mar (CSIC)

PLENARY SPEAKERS

Peter Ditlevsen | Niels Bohr Institute
Daniele Iudicone | Stazione Zoologica Anton Dohrn
Bernard Legras | Laboratoire de Météorologie Dynamique- ENS
Amala Mahadevan | Woods Hole Oceanographic Institution
Maria Josefina Olascoaga | University of Miami
Pablo Ortega | Barcelona Supercomputing Center
Ignacio Pisso | NILU
Lionel Renault | IRD
Anna Rubio | AZTI

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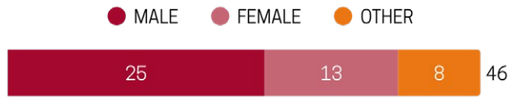

GEOGRAPHIC DISTRIBUTION

BARCELONA DISCRETE MATHEMATICS MEETING 2025 (BDMM)

January 30, 2025

DESCRIPTION

The Barcelona Discrete Mathematics Meeting (BDMM) is a new initiative organized by members of seven research groups in Barcelona working in different areas of Discrete Mathematics. The aim is to bring together these different groups in the area and host a day of talks with both internal and external speakers to learn more about each others research interests and foster future collaboration between the groups.

ORGANISING COMMITTEE

Dipak Bhunia | Universitat Autònoma de Barcelona
Ilario Bonacina | Universitat Politècnica de Catalunya
Fabian Klute | Universitat Politècnica de Catalunya
Enric Monsó | Universitat Politècnica de Catalunya
Patrick Morris | Universitat Politècnica de Catalunya
Vincent Pilaud | Universitat de Barcelona - CRM
Rui Zhang | Universitat Pompeu Fabra

SPEAKERS

Maria José Jiménez | Universitat Politècnica de Catalunya
Amanda Montejano | National Autonomous University of Mexico
Moritz Müller | Passau University
Eulàlia Nualart | Universitat Pompeu Fabra
Francisco Santos | Universidad de Cantabria
Torsten Ueckerdt | Karlsruhe Institute of Technology
Mercè Villanueva | Universitat Autònoma de Barcelona

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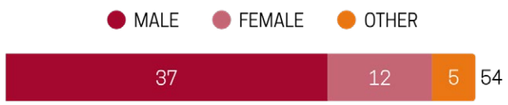

GEOGRAPHIC DISTRIBUTION

WORKSHOP ON DISCRETE DYNAMICAL SYSTEMS

February 03 - 06, 2025

DESCRIPTION

The workshop provided a valuable opportunity to explore and discuss the latest advances in discrete dynamical systems from various perspectives, including difference equations, topological dynamics, combinatorial dynamics, integrability theory and population dynamics.

It was the second edition of the WDE2005, an event held 20 years ago in Cardona (https://www.gsd.uab.cat/wde2005/), where all the above topics were presented in a good atmosphere of informal discussion and interchange of ideas. We wanted to maintain that spirit in this second edition.

The main objectives of this event were to foster an open collaborative environment that encouraged the exchange of ideas and critical discussion, to strengthen relationships between research groups both nationally and internationally, and to establish new synergies. Additionally, the workshop aimed to serve as a platform to drive active research lines forward, particularly by engaging younger researchers who were essential to ensuring the continuity and evolution of this field.

Thus, this workshop was a space for reflection and collaboration, aiming to advance the state of the art in discrete dynamical systems and to reinforce connections within the Spanish and the international scientific community.

ORGANISING AND SCIENTIFIC COMMITTEE

Armengol Gasull | Universitat Autònoma de Barcelona
Víctor Mañosa | Universitat Politècnica de Catalunya
David Rojas | Universitat Autònoma de Barcelona
Joan Torregrosa | Universitat Autònoma de Barcelona – CRM

SPEAKERS

Jaume Alonso | Institute of Mathematics of the Technische Universität Berlin
Lluís Alsedà | Universitat Autònoma de Barcelona
Alberto Cabada | Universidade de Santiago de Compostela

Jordi Canela | Universitat Jaume I
José Cánovas | Universidad Politécnica de Cartagena
Laura Gardini | Università di Urbino
Marc Jorba-Cuscó | Universitat Politècnica de Catalunya - CRM
David Juher | Universitat de Girona
Antonio Linero | Universidad de Murcia
Jaume Llibre | Universitat Autònoma de Barcelona
Jérome Lôs | Aix-Marseille Université
Davide Radi | Università Cattolica del Sacro Cuore
David Rojas | Universitat Autònoma de Barcelona
Alfonso Ruiz | Universidad de Oviedo
Joan Segura | EADA Business School
Joan Carles Tatjer | Universitat de Barcelona
Joan Torregrosa | Universitat Autònoma de Barcelona - CRM

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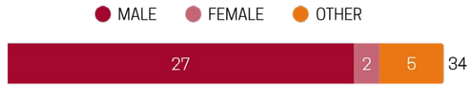


GEOGRAPHIC DISTRIBUTION

NEW FRONTIERS IN HOMOGENIZATION AND FRACTIONAL CALCULUS

March 24 - 25, 2025

DESCRIPTION

This event was organized to celebrate the 50th anniversary of the mathematical technique known as Γ -convergence, introduced by Ennio De Giorgi and Tullio Franzoni in 1975.

Originally developed for applied purposes, this technique remained a fundamental tool in the study of various scientific applications, such as homogenization, phase transitions, and the asymptotic analysis of partial differential equations. At the same time, there had been a growing interest within the scientific community in the study of nonlocal problems, which were primarily recognized for their probabilistic significance. In addition to representing a particularly challenging area of mathematics, these problems had become increasingly relevant in material science applications.

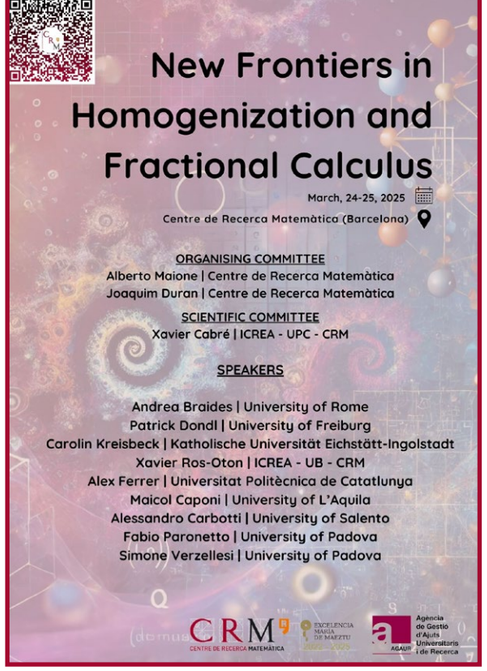
The speakers were experts in these fields, and in addition to their contribution, the organizers explored the possibility of publishing the conference proceedings. The goal was to provide speakers and interested participants, experts in these areas, the opportunity to report on the state of the art in these fascinating research topics.

ORGANISING COMMITTEE

Alberto Maione | CRM
Joaquim Duran | CRM

SCIENTIFIC COMMITTEE

Xavier Cabré | ICREA - UPC - CRM



SPEAKERS

Andrea Braides | University of Rome
Maicol Caponi | University of L'Aquila
Alessandro Carbotti | University of Salento
Patrick Dondl | University of Freiburg
Alex Ferrer | Universitat Politècnica de Catalunya
Carolin Kreisbeck | Katholische Universität Eichstätt-Ingolstadt
Fabio Paronetto | University of Padova
Xavier Ros-Oton | ICREA - Universitat de Barcelona - CRM
Simone Verzellesi | University of Padova

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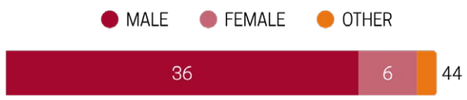

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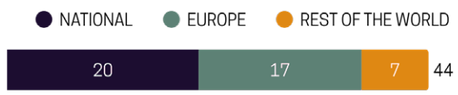


CRM COLLOQUIUM - CHAIR OF EXCELLENCE

HIGHER STRUCTURES IN SYMPLECTIC GEOMETRY

April 09, 2025

DESCRIPTION

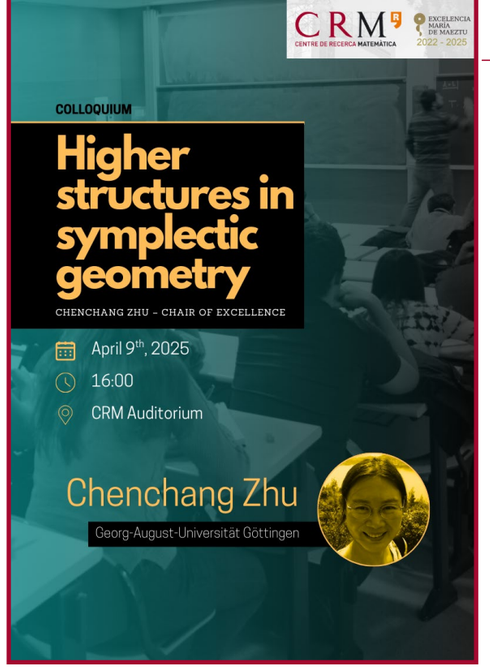
The Centre de Recerca Matemàtica was pleased to invite attendees to the Inaugural Colloquium of the CRM–María de Maeztu Chair of Excellence 2025, featuring Professor Chenchang Zhu (University of Göttingen). This event marked the beginning of her stay at CRM as Chair of Excellence, a distinction awarded to internationally renowned researchers whose work aligns with the centre's strategic research areas. Professor Zhu's contributions in higher category theory, differential geometry, and mathematical physics opened new perspectives at the crossroads of geometry and quantum theory. The CRM community gathered to celebrate the launch of this prestigious appointment.

Almost four hundred years ago, at the other end of the Mediterranean, Galileo observed that the fastest descent curve for a small ball is not a straight line. However, in order to solve this problem rigorously, he anticipated that a "higher" form of mathematics would be required. Six decades later, J. Bernoulli posed this challenge to the mathematical world, prompting Newton's overnight solution. The higher mathematics that emerged to address such problems—and ultimately to shape all of classical mechanics—was calculus.

This journey through mechanics and geometry continued with Lagrange's formulation of mechanics, Noether's theorem on symmetries and conservation laws, and the development of modern symplectic geometry. Within this setting, Alan Weinstein's insight—"everything is Lagrangian"—profoundly influenced the understanding of phase space, reduction, and quantization. Yet, just as Galileo's challenge required more advanced mathematics, contemporary questions in symplectic reduction and singularities now call for an even more powerful framework.

In this talk, Professor Zhu introduced higher and derived structures in differential geometry, inspired by Grothendieck's derived algebraic geometry, which provide a natural language to resolve singularities and allow for shifted symplectic structures. She suggested that the physical origin of these higher structures lies in the 3+1-dimensional nature of our universe. Higher and derived geometry, in this view, may serve as a mathematical language capable of describing topological quantum field theories (TQFTs) and sigma models with greater conceptual clarity.

To illustrate this approach, she presented key ideas in higher and derived differential geometry and discussed their application to Marsden–Weinstein symplectic reduction, showing how this modern perspective refines classical techniques and opens new directions in symplectic geometry and mathematical physics. The talk was based on joint work with Cueca, Dorsch, and Sjamaar.



SPEAKER

Chenchang Zhu | Georg-August Universität Göttingen

INTENSIVE RESEARCH PROGRAMME

MODERN TRENDS IN FOURIER ANALYSIS

May 05 - June 25, 2025

DESCRIPTION

This program focused on recent developments in Harmonic Analysis, Geometric Measure Theory, and Constructive Approximation, with an emphasis on Fourier uncertainty principles, restriction estimates in Fourier analysis, and analysis in discrete geometry. The aim was to create an ideal atmosphere for significant progress in these areas. To achieve this, leading scientists with expertise in Fourier analysis brought together their diverse backgrounds, interacted, and collaborated to stimulate the development of research. In addition to the Conference and Advanced Courses described below, there were regular activities such as weekly seminars and group research sessions. Seminars were conducted during the programme.

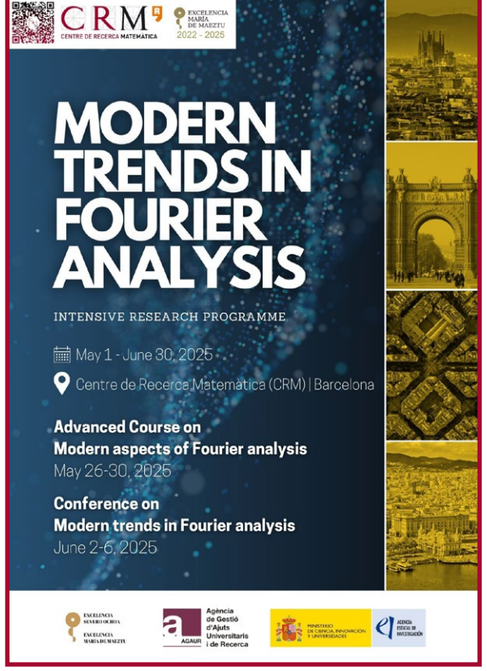
The plan was to offer three five-hour advanced courses. The timetable included courses from Monday to Friday morning; short communications by the participants on Monday, Tuesday, and Thursday afternoon; a cultural outing and dinner on Wednesday afternoon; and the closing of the school at noon on Friday.

ORGANISING AND SCIENTIFIC COMMITTEE

Dmitriy Bilyk | University of Minnesota
Emanuel Carneiro | The Abdus Salam International Centre for Theoretical Physics
Diogo Oliveira e Silva | Instituto Superior Técnico
Betsy Stovall | University of Wisconsin–Madison
Sergey Tikhonov | ICREA - CRM

LOCAL ORGANIZERS

Carlo Bellavita | Universitat de Barcelona
Óscar Domínguez | CUNEF
Egor Kosov | CRM
Olli Saari | Universitat Politècnica de Catalunya - CRM
Sergey Tikhonov | ICREA - CRM



ADVANCED COURSE

May 26 - 30, 2025

ORGANISING AND SCIENTIFIC COMMITTEE

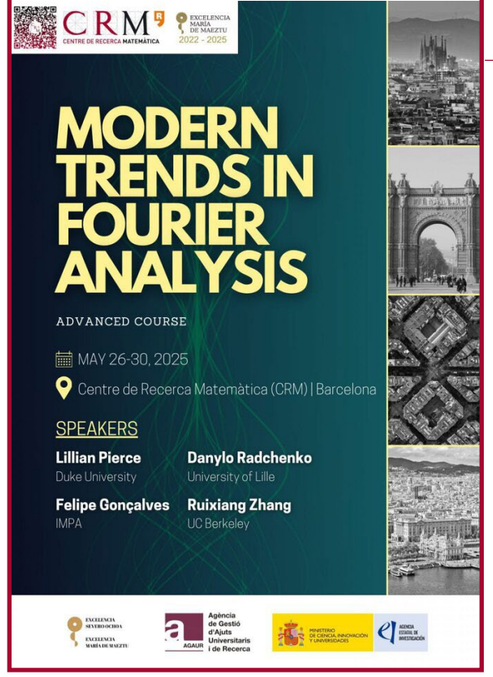
Dmitriy Bilyk | University of Minnesota
Emanuel Carneiro | The Abdus Salam International Centre for Theoretical Physics
Diogo Oliveira e Silva | Instituto Superior Técnico
Betsy Stovall | University of Wisconsin–Madison
Sergey Tikhonov | ICREA - CRM

LOCAL ORGANIZERS

Carlo Bellavita | Universitat de Barcelona
Óscar Domínguez | CUNEF
Egor Kosov | CRM
Sergey Tikhonov | ICREA - CRM

INVITED SPEAKERS

Felipe Gonçalves | IMPA
Lillian Pierce | Duke University
Danylo Radchenko | Lille University
Ruixiang Zhang | University of California



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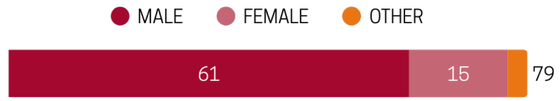

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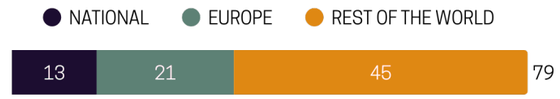


CONFERENCE

June 02 - 06, 2025

ORGANISING AND SCIENTIFIC COMMITTEE

Dmitriy Bilyk | University of Minnesota
Emanuel Carneiro | The Abdus Salam International Centre for Theoretical Physics
Diogo Oliveira e Silva | Instituto Superior Técnico
Betsy Stovall | University of Wisconsin–Madison
Sergey Tikhonov | ICREA - CRM

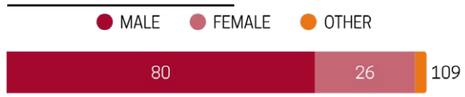
LOCAL ORGANIZERS

Carlo Bellavita | Universitat de Barcelona
Óscar Domínguez | CUNEF
Egor Kosov | CRM
Sergey Tikhonov | ICREA - CRM

INVITED SPEAKERS

Mateus Costa de Sousa | BCAM
Alex Iosevich | University of Rochester
Alexei Kulikov | Tel Aviv University
Nir Lev | Bar-Ilan University
José Ramon Madrid Padilla | Virginia Tech
Eugenia Malinnikova | Stanford University
Svitlana Mayboroda | ETH Zürich
Giuseppe Negro | IST Lisboa
Shahaf Nitzan | Georgia Institute of Technology
Yumeng Ou | University of Pennsylvania
Jill Pipher | Brown University
Danylo Radchenko | Lille University
João Pedro Ramos | EPFL - King's College London
Kristian Seip | NTNU
Krystal Taylor | Ohio State University
Hong Wang | Courant Institute of mathematical Sciences (NYU Courant)

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

BARCCSYN 2025

BARCELONA COMPUTATIONAL, COGNITIVE AND SYSTEMS NEUROSCIENCE

May 22 - 23, 2025

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 13th annual Barccsyn conference. The conference will be held on May 22 and 23, 2025, 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 three renowned researchers from abroad.

BARCCSYN 2025 is the third edition organised by the section Neurociència computacional i de sistemes that belongs to the Societat Catalana de Biologia and Societat Catalana de Matemàtiques.

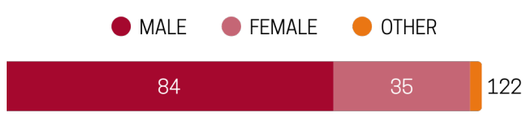
ORGANISING COMMITTEE

Alexandre Garcia-Duran | CRM
Angela Marti-Marca | Universitat Pompeu Fabra
Laura Modol | Hospital del Mar Research Institute
Manuel Molano-Mazón | Universitat Politècnica de Catalunya – CRM
Adam Ranson | Universitat Autònoma de Barcelona

SPEAKERS

Matteo Carandini | University College London
Megan Carey | Champalimaud Foundation
Chris Summerfield | Oxford University / Universitat Pompeu Fabra

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

TOPICS IN COMPLEX DYNAMICS 2025:
CONNECTIONS TO GEOMETRY AND ANALYSIS

June 02 - 06, 2025

DESCRIPTION

The main goal of the school was to explore the numerous connections between complex dynamics and the areas of geometry and analysis. The school consisted of mini-courses and talks by invited senior researchers, as well as short talks by the young participants. The mini-courses were intended for graduate students or recent PhDs. The afternoons were reserved for student talks, where they could present their work, either completed or in progress.

SCIENTIFIC COMMITTEE

Walter Bergweiler | Christian-Albrechts-Universität zu Kiel
Núria Fagella | Universitat de Barcelona
Jasmin Raissy | Université de Bordeaux
Dierk Schleicher | Aix Marseille Université

ORGANISING COMMITTEE

Jordi Canela | Universidad Jaume I
Kostiantyn Drach | Universitat de Barcelona – CRM
Núria Fagella | Universitat de Barcelona – CRM
Xavier Jarque | Universitat de Barcelona – CRM
Leticia Pardo-Simon | Universitat de Barcelona – CRM
Gustavo Rodrigues Ferreira | CRM

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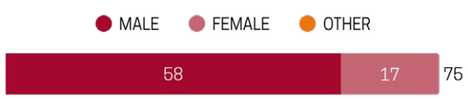


LECTURERS

Luna Lomonaco | IMPA
Lasse Rempe | University of Manchester
Mitsuhiro Shishikura | Kyoto University

JORNADA DE CIÈNCIA OBERTA

June 11, 2025

DESCRIPTION

The term “Open Science” is gaining traction in the research field, but it is sometimes limited to promoting the openness of obtained results. However, “Open Science” encompasses other aspects such as transparency and accessibility throughout the scientific process, from data generation to the publication of results. In this session, the ways in which the principles of open science can be applied across all stages of research were explored, as well as how any researcher can get involved from the beginning of their career.

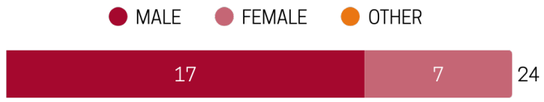
SPEAKER

Ignasi Labastida | Universitat de Barcelona

ROUNDTABLE MEMBERS

Enrico Valdinoci | University of Western Australia
Francesc Perera | Universitat Autònoma de Barcelona – CRM

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

GRADUATE SUMMER SCHOOL

HYPATIA 2025

June 16 - 19, 2025

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

Henri Darmon | McGill University
Victor Rotger | Universitat Politècnica de Catalunya – CRM
Özlem Imamoğlu | ETH Zurich
Paloma Bengoechea | Universitat de Barcelona – CRM
Luis Dieulefait | Universitat de Barcelona - CRM

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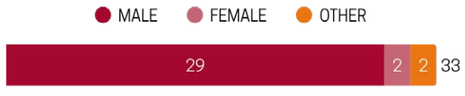

GEOGRAPHIC DISTRIBUTION

ICMNS 2025

INTERNATIONAL CONFERENCE ON MATHEMATICAL NEUROSCIENCE

June 17 - 20, 2025

DESCRIPTION

The International Conference on Mathematical Neuroscience (ICMNS) is an inter-disciplinary conference series, bringing together theoretical/computational neuroscientists and mathematicians. The conferences are aimed at scientists interested in using or developing mathematical techniques for neuroscience problems. ICMNS 2025 will be the tenth annual conference. ICMNS 2024 was held in Dublin, whereas previous editions were held in Copenhagen, Juan les Pins and Boulder, Colorado.

KEYNOTE SPEAKERS

Elad Schneidman | Weizmann Institute of Science
Tatyana Sharpee | Salk Institute
Tatjana Tchumatchenko | Universität Bonn

INVITED SPEAKERS

Rafal Bogacz | Oxford University
Áine Byrne | University College Dublin
Alexis Dubreuil | University of Bordeaux, CNRS
Soledad Gonzalo Cogno | Kavli Institute, NTNU
Stephanie Jones | Brown University
Anna Levina | University of Tübingen
Sukbin Lim | NYU Shanghai
Jonathan Touboul | Brandeis University

ORGANISING COMMITTEE

Toni Guillamon | Universitat Politècnica de Catalunya – CRM
Gemma Huguet | Universitat Politècnica de Catalunya – CRM
Ernest Montbrió | University Pompeu Fabra
Alex Roxin | CRM

SCIENTIFIC COMMITTEE

Victoria Booth | University of Michigan
Alla Borisyuk | University of Utah
Carina Curto | University of Brown
Rodica Curtu | University of Iowa
Silvia Daun | University of Cologne
Boris Gutkin | Ecole Normale Supérieure
Vivien Kirk | University of Auckland
Elif Koksal | INRIA
Songting Li | Shanghai Jiao Tong University
André Longtin | University of Ottowa
Gianluigi Mongillo | CNRS
Simona Olmi | Istituto dei Sistemi Complessi, CNR
Horacio Rotstein | NJIT
Tilo Schwalger | TU, Berlin
Susanne Schreiber | HU-Berlin
Kyle Wedgwood | University of Exeter
Cati Vich | Universitat de les Illes Balears

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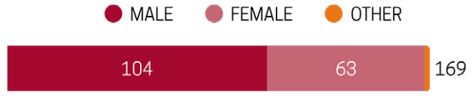

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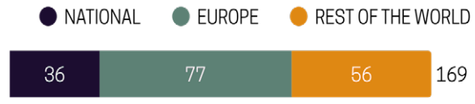


HARMONIC ANALYSIS AND PDES SUMMER SCHOOL

June 25 - 27, 2025

DESCRIPTION

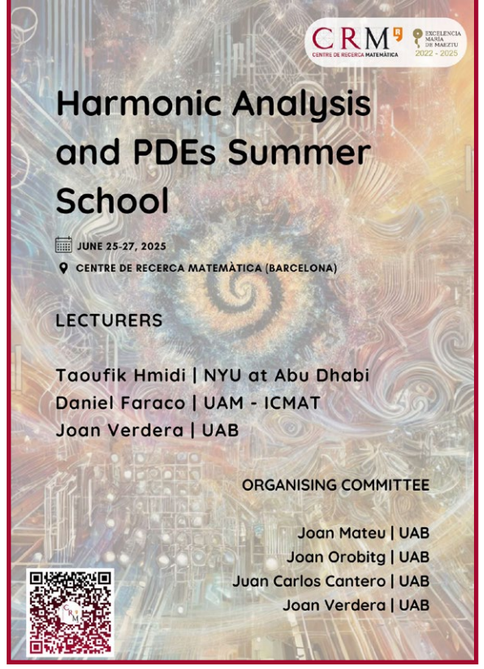
This summer school aimed to study problems related to questions of singular integrals in a wide sense, fluid mechanics and other active scalar equations, as well as problems of anisotropic interaction energy minimizers. These energy minimizer questions came from materials science and biological populations.

ORGANISING COMMITTEE

Joan Mateu Bennassar | Universitat Autònoma de Barcelona - CRM
Juan Carlos Cantero Guardeño | Universitat Autònoma de Barcelona
Joan Orobitg Huguet | Universitat Autònoma de Barcelona
Joan Verdera | Universitat Autònoma de Barcelona

LECTURERS

Taoufik Hmidi | New York University at Abu Dhabi
Daniel Faraco | Universidad Autónoma de Madrid – ICMAT
Joan Verdera | Universitat Autònoma de Barcelona



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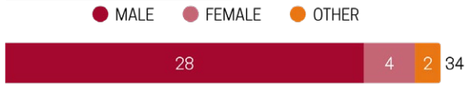


GEOGRAPHIC DISTRIBUTION

JISD 2025

21ST SCHOOL ON INTERACTIONS BETWEEN DYNAMICAL SYSTEMS AND PARTIAL DIFFERENTIAL EQUATIONS

June 30 - July 04, 2025

DESCRIPTION

The School on Interactions between Dynamical Systems and Partial Differential Equations (JISD) is an international summer school that has taken place at the School of Mathematics and Statistics of the Universitat Politècnica de Catalunya (UPC) since 2002. The last five editions have been held at the Centre de Recerca Matemàtica (CRM).

The JISD is an annual meeting between experts and young researchers in Dynamical Systems and Partial Differential Equations (PDEs). It is designed to encourage and enhance the exchange of knowledge and methods, with the goal of advancing the study of cutting-edge problems in the aforesaid fields of mathematics and with the aim of fostering interaction among the participants. The symposium is aimed at local researchers, as well as scientists from the rest of Spain and foreign countries. It is organized into four advanced courses of about 7 hours and complemented by a poster session by young researchers. Throughout the latest editions, the attendance numbers have ranged between 60 and 100 participants, mostly internationals.

A primary objective of the JISD is to attract talented young researchers who can present a poster to put them in a position to benefit from exposure to world-leading experts and help them establish working relationships that could prove critical for their short- and long-term success. An especially strong effort has been devoted in past years to encourage the participation of undergraduates, PhDs and postdocs from developing countries and, more generally, young researchers who may encounter difficulties in accessing adequate financial support.

LECTURERS

Dmitry Dolgopyat | University of Maryland
Serena Dipierro | University of Western Australia
Luciano Mari | Università degli Studi di Milano Statale
Sylvain Crovisier | Université Paris-Saclay

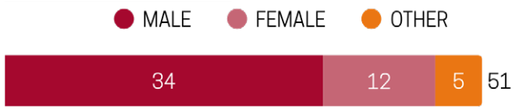
ORGANISING COMMITTEE

Xavier Cabré | ICREA – Universitat Politècnica de Catalunya – CRM
Amadeu Delshams | Universitat Politècnica de Catalunya – CRM
Mar Giralt | IMCCE at Observatoire de Paris
Marcel Guàrdia | Universitat de Barcelona – CRM
Tomás Sanz | 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

GENDER BALANCE



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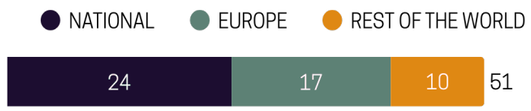


BIMR 2025
BARCELONA INTRODUCTION TO MATHEMATICAL RESEARCH

June 30 - July 25, 2025

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) into the first steps in mathematical research in different disciplines.

The students will participate in the following activities:

1) 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.

2) Attendance to the Minicourses on Introduction to Research that will take place during the weeks of June 30-July 4 and July 7-11.

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

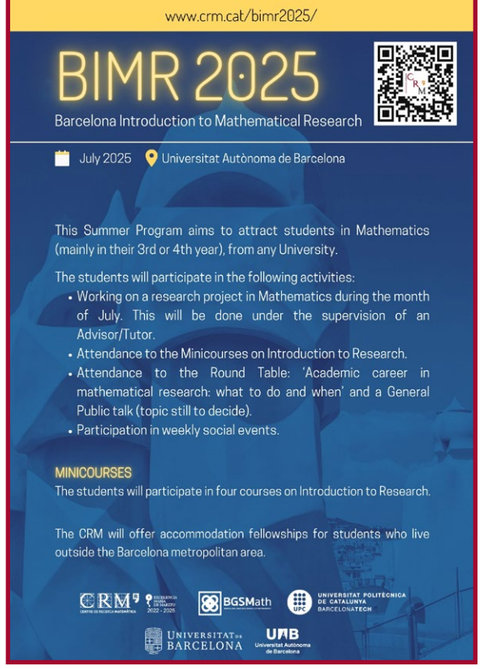
4) Participation in weekly social events (coffee breaks during the minicourses, and one social pizza evening for each of the four weeks of the program).

ORGANISING COMMITTEE

Natàlia Castellana | Universitat Autònoma de Barcelona - CRM
Marc Masdéu | Universitat Autònoma de Barcelona - CRM
Xavier Ros-Oton | ICREA - Universitat de Barcelona - CRM
Olli Saari | Universitat Politècnica de Catalunya - CRM

LECTURERS

Enric Ventura | Universitat Politècnica de Catalunya
Jordi Delgado | Universitat Politècnica de Catalunya
Guillem Perearnau | Universitat Politècnica de Catalunya - CRM
Laura Prat | Universitat Autònoma de Barcelona
Tomás Alarcón | ICREA - CRM



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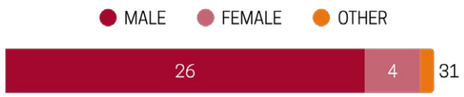


GEOGRAPHIC DISTRIBUTION

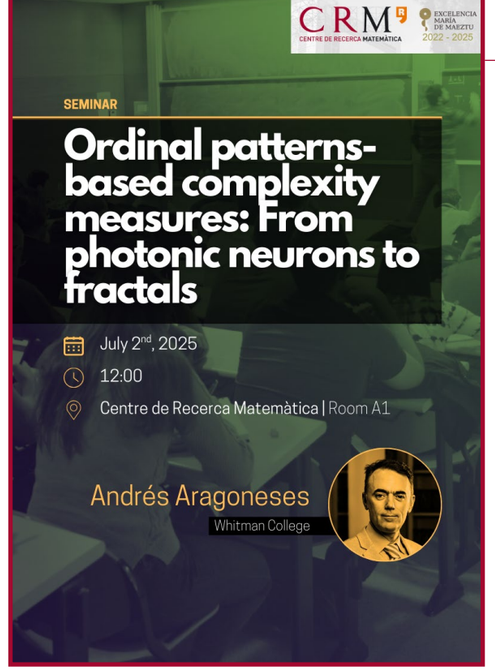
SEMINAR

ORDINAL PATTERNS-BASED COMPLEXITY MEASURES: FROM PHOTONIC NEURONS TO FRACTALS

July 02, 2025

DESCRIPTION

In complex dynamical systems, noise, feedback, external forcing, and time delay shape the behavior that can range from regularity to high-dimensional chaos. Unveiling signatures of determinism in the time series of a variable can be challenging. Based on ordinal patterns techniques that aim at extracting temporal correlations in complex dynamics I will describe new complexity quantifiers that allow us to distinguish and characterize families of chaos. These techniques also correlate the dynamic behavior with dynamical and temporal approximate symmetries. I will show examples ranging from experiments with photonic neurons to mathematical iterative models.



SPEAKER

Andrés Aragoneses | Whitman College

XI IBERIAN MODELING WEEK

July 07 - 11, 2025

DESCRIPTION

The IMW is a joint initiative of pt-maths-in (Portugal) and math-in (Spain), designed to introduce undergraduate and master's students to industrial mathematics through hands-on problem-solving. Each year, students from both countries work in teams on real-world challenges proposed by companies, under the supervision of academic and industry mentors.

IMW aims to:

• Train students in applied mathematical modeling, encouraging innovative problem-solving.

• Foster collaboration between young mathematicians, preparing them for industry or

research careers.

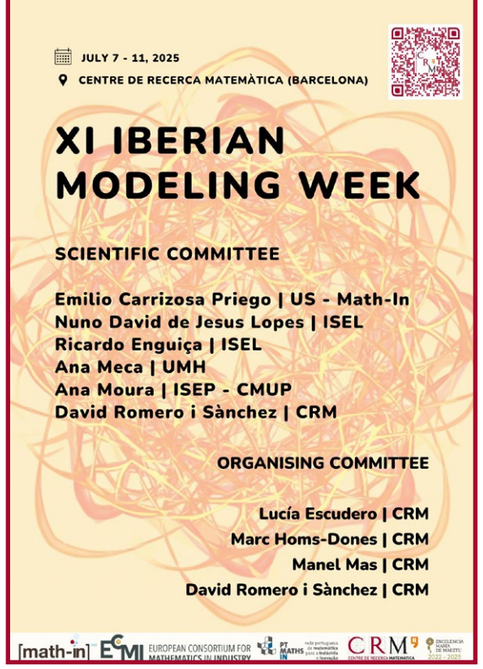
• Strengthen ties between Portugal, Spain, and industry through cross-border cooperation.

By working in an international environment and tackling real challenges, students develop key skills in mathematical modeling, teamwork, and communication while contributing to practical industry solutions. Moreover, by hosting both IMW and ESGI back-to-back, CRM would maximize the interaction between students, researchers, and industry professionals, reinforcing the role of mathematics in solving industrial challenges and driving innovation.

The IMW featured four to five problems, each assigned to a team of five to six students. Each team worked under the guidance of a senior researcher, applying mathematical modeling techniques to tackle real-world challenges. The problems, which were tentative at that stage, were expected to come from fields such as mobility, optimization, and pharmaceuticals. This structure aimed to provide students with hands-on experience in industrial mathematics while fostering teamwork and collaboration

ORGANISING COMMITTEE

Lucía Escudero | CRM
Marc Homs-Dones | CRM
Manel Mas | CRM
David Romero i Sànchez | CRM



SCIENTIFIC COMMITTEE

Emilio Carrizosa Priego | Universidad de Sevilla – Math-in
Nuno David de Jesus Lopes | Instituto Superior de Engenharia de Lisboa
Ricardo Enguiça | Instituto Superior de Engenharia de Lisboa – Pt-maths-in
Ana Meca | Universidad Miguel Hernández
Ana Moura | School of Engineering, Polytechnic of Porto – Centre of Mathematics of University of Porto – Pt-maths-in
David Romero i Sànchez | CRM

GEOGRAPHIC DISTRIBUTION

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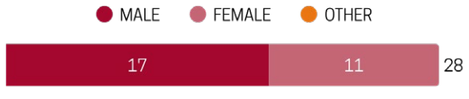

A SUMMER TAPAS INVITATION TO HIGHER STRUCTURES IN SYMPLECTIC AND POISSON GEOMETRY I

July 07, 2025

DESCRIPTION

A one-day thematic gathering at the crossroads of Symplectic and Poisson Geometry, with a taste of Higher Structures — both mathematical and culinary. This informal minicourse features inspiring talks, in-depth sessions, and open discussions over tapas at SYMCREA.

Higher Structures in Symplectic and Poisson Geometry arise naturally when one seeks to understand complex interactions between geometry, algebra, and physics beyond classical frameworks. They encompass categorified notions such as Lie ∞-algebroids, higher groupoids, and derived stacks, which extend the foundational ideas of symplectic and Poisson structures to incorporate layers of homotopical or homological information. These structures are not only powerful tools for encoding deformation theory and quantisation but also offer a unifying language bridging differential geometry, topological field theory, and mathematical physics. In the context of this minicourse, we explore how physical intuition and categorical sophistication jointly illuminate the rich landscape of symmetries and constraints governing geometric systems.

ORGANISING COMMITTEE

SYMCREA hub and ICMAT Hitchin-Ngo Lab

SPEAKERS

Alejandro Cabrera | UFRJ
Miquel Cueca | KU Leuven
Mario Garcia-Fernandez | ICMAT
Chenchang Zhu | University of Göttingen

EUROPEAN STUDY GROUP WITH INDUSTRY (ESGI)

July 14 - 18, 2025

DESCRIPTION

The ESGI is an established initiative that connects mathematicians with industry professionals to solve complex real-world problems using advanced mathematical techniques. Originating in 1968 at the University of Oxford, ESGI has grown into a Europe-wide network that supports industrial innovation through mathematics.

Each ESGI is an intensive, week-long workshop, where teams of mathematicians—ranging from graduate students to senior researchers—collaborate on industry-proposed problems.

These challenges span various sectors, including engineering, finance, healthcare, logistics, and energy.

ESGI offers:

• Practical solutions for companies, leveraging cutting-edge mathematical expertise.

• Opportunities for researchers and students to apply their skills in an industry setting.

• Long-term collaborations, often leading to further research, publications, and real-world applications.

This edition of ESGI is a coorganization between math-in and PT-Math-in.

The ESGI featured four to five problems, each assigned to a group of five to six researchers. Each group worked under the joint guidance of industry representatives and academic researchers, applying mathematical techniques to address real-world challenges. The problems, which were tentative at that stage, were expected to come from fields such as mobility, optimization, and pharmaceuticals. This structure aimed to promote collaboration between academia and industry while developing practical solutions through applied mathematics.

ORGANISING COMMITTEE

Lucía Escudero | CRM
Marc Homs-Dones | CRM
Manel Mas | CRM
David Romero i Sànchez | CRM

SCIENTIFIC COMMITTEE

Emilio Carrizosa Priego | Universidad de Sevilla – Math-in
Ricardo Enguiça | Instituto Superior de Engenharia de Lisboa – Pt-maths-in
Ana Moura | School of Engineering, Polytechnic of Porto – Centre of Mathematics of University of Porto – Pt-maths-in
David Romero i Sànchez | CRM

GENDER BALANCE

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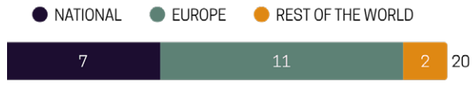


BAMB! 2025

BARCELONA SUMMER SCHOOL FOR ADVANCED MODELING OF BEHAVIOUR

July 15 - 24, 2025

DESCRIPTION

The course aimed to train PhD students and early-career researchers in advanced model-based analysis of behavior. This was done through a combination of introductory lectures, hands-on tutorials, and group projects designed to make the methods directly applicable to participants' own research. Lectures opened each day and provided conceptual background and state-of-the-art overviews, focusing on understanding the principles behind the techniques rather than detailed mathematical derivations.

A significant part of the program was devoted to tutorials, where trainees worked with real behavioral datasets under the guidance of experienced teaching assistants. Participants also collaborated in small groups on projects using open-access datasets, applying the techniques presented in the course and receiving support from faculty and TAs.

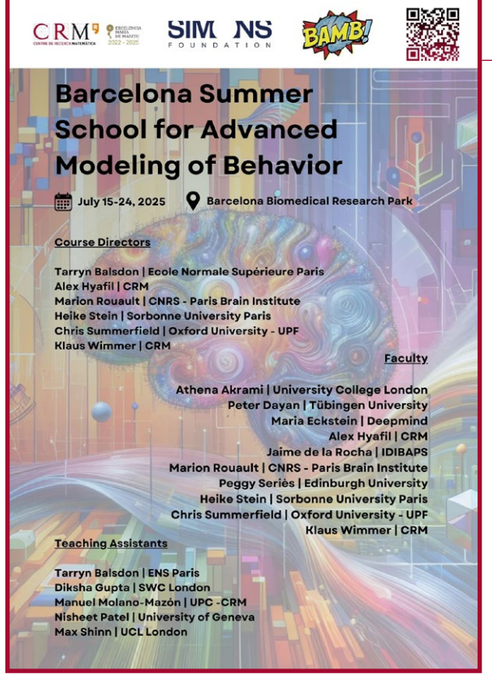
The course additionally featured two keynote talks showcasing successful applications of cutting-edge behavioral modeling in neuroscience. One-to-one meetings between trainees and faculty offered further opportunities to discuss research interests and career development.

ORGANISING COMMITTEE

Tarryn Balsdon | Ecole Normale Supérieure Paris
Alex Hyafil | CRM
Marion Rouault | CNRS - Paris Brain Institute
Heike Stein | Sorbonne University Paris
Chris Summerfield | Oxford University / Universitat Pompeu Fabra
Klaus Wimmer | CRM

LECTURERS

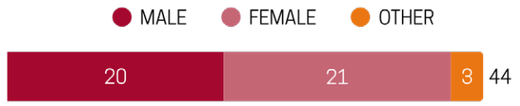
Athena Akrami | University College London
Peter Dayan | Tübingen University
Jaime de la Rocha | IDIBAPS
Alex Hyafil | CRM
Marion Rouault | CNRS - Paris Brain Institute
Peggy Seriès | Edinburgh University
Heike Stein | Sorbonne University Paris
Chris Summerfield | Oxford University - UPF
Klaus Wimmer | CRM



TEACHING ASSISTANTS

Tarryn Balsdon | ENS Paris
Diksha Gupta | SWC London
Manuel Molano-Mazón | Universitat Politècnica de Catalunya - CRM
Nisheet Patel | University of Geneva
Max Shinn | UCL London

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

5TH BARCELONA SUMMER SCHOOL OF STOCHASTIC ANALYSIS AND QUANTITATIVE FINANCE

July 21 - 25, 2025

DESCRIPTION

The goal of the summer school was to offer advanced courses on topics of interest to the research group, taught by professors of recognized prestige and aimed at doctoral students, postdoctoral fellows, and researchers. The activity was valuable for the research group because it allowed them to stay in contact with the most current research, provide training to their PhD students and young researchers, and strengthen their international presence. In addition, it contributed to the international projection of research in Stochastic Analysis and Mathematics in Catalonia. On the other hand, we aimed to recover and resume the series of summer schools organized at CRM between 2012 and 2018, which had been interrupted due to the pandemic.

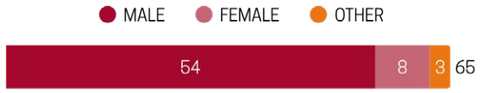
ORGANISING AND SCIENTIFIC COMMITTEE

Elisa Alòs | Universitat Pompeu Fabra
José Manuel Corcuera | Universitat de Barcelona
Carlos Escudero | UNED
Luis Ortiz | Universitat de Barcelona
Rafael de Santiago | IESE
Wim Schoutens | KU Leuven
Josep Vives | Universitat de Barcelona

LECTURERS

Masaaki Fukasawa | Osaka University
Christian Bayer | Technical University Berlin
Fred E. Benth | Oslo University

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

SUMMER SCHOOL ON COMPLEX SYSTEMS SOCIETY (CS3)

September 29 - October 03, 2025

DESCRIPTION

The Science of Complex Systems is providing radical new ways of understanding the physical, biological, ecological, and social universe.

The Complex Systems Society Spain (CS3) is a recently created organization that encompasses the Spanish Chapter of the Complex Systems Society.

CS3 is an organization dedicated to coordinating and promoting research in complex systems in Spain. Its mission is to connect the broad and active research community in this field, broaden the range of research topics, and provide greater visibility nationally and internationally.

A number of activities have been developed already, in particular three annual meetings.

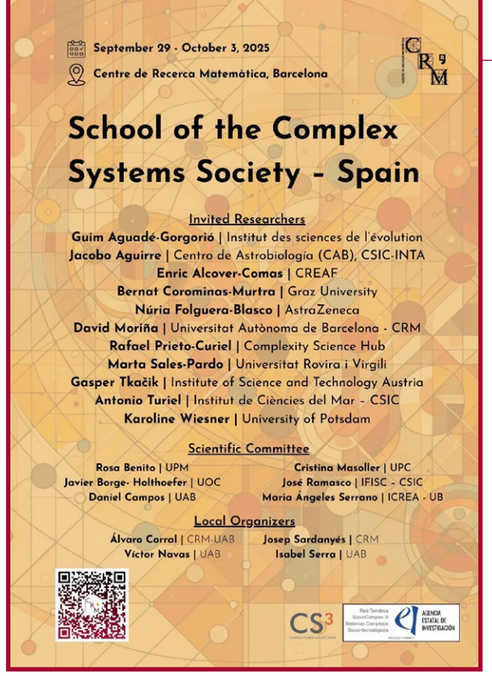
The school here is the 1st edition of a future series of biennial schools.

ORGANISING COMMITTEE

Álvaro Corral | CRM – Universitat Autònoma de Barcelona
Víctor Navas | Universitat Autònoma de Barcelona
Josep Sardanyés | CRM
Isabel Serra | Universitat Autònoma de Barcelona

SCIENTIFIC COMMITTEE

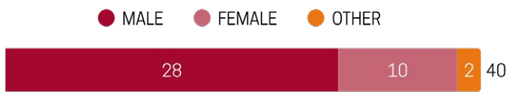
Rosa Benito | Universidad Politécnica de Madrid
Javier Borge- Holthoefer | Universitat Oberta de Catalunya
Daniel Campos | Universitat Autònoma de Barcelona
Cristina Masoller | Universitat Politècnica de Catalunya
José Ramasco | IFISC – CSIC
Maria Ángeles Serrano | ICREA – Universitat de Barcelona



SPEAKERS

Guim Aguadé-Gorgorió | Institut des sciences de l'évolution de Montpellier
Jacobo Aguirre | Centro de Astrobiología - CSIC-INTA
Enric Alcover-Comas | CREAF
Bernat Corominas-Murtra | Graz University
Núria Folguera-Blasco | AstraZeneca
David Moriña | Universitat Autònoma de Barcelona – CRM
Marta Sales-Pardo | Universitat Rovira i Virgili
Rafael Prieto-Curiel | Complexity Science Hub
Gasper Tkačik | Institute of Science and Technology Austria (ISTA)
Antonio Turiel | Institut de Ciències del Mar – CSIC
Karoline Wiesner | University of Potsdam

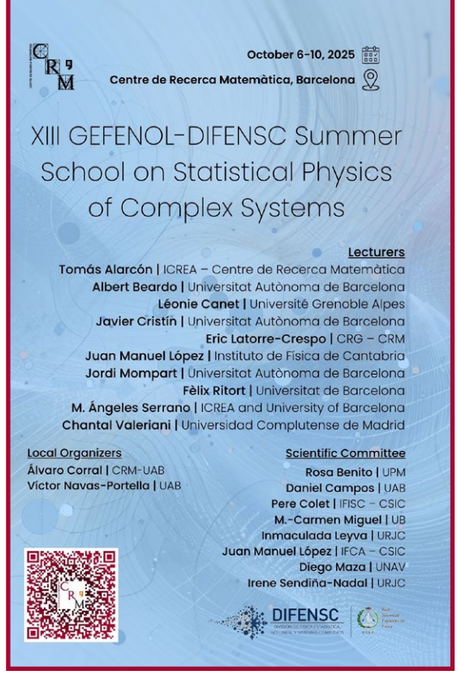
GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

XIII GEFENOL-DIFENSC SUMMER SCHOOL ON STATISTICAL PHYSICS OF COMPLEX SYSTEMS

October 06 - 10, 2025



DESCRIPTION

Statistical physics allows for the understanding of macroscopic collective phenomena in physical systems. But the tools and concepts developed by statistical physics are of key importance in the understanding of complex systems, which are also characterized by emergent and collective phenomena arising from many interacting parts

While the basic body of knowledge of statistical physics is well described in textbooks, the applications to open problems in complex systems are beyond the scope of those textbooks. Aiming at bridging this gap, the GEFENOL (now DIFENSC) promoted in 2011 its Summer School on Statistical Physics of Complex Systems.

GEFENOL was the Topical Group on Statistical and Nonlinear Physics of the Royal Spanish Physical Society (RSEF), which has recently transformed into the Division on Statistical and Nonlinear Physics and Complex Systems (DIFENSC) of the RSEF.

The school is open to predoctoral and postdoctoral researchers, as well as to any academic interested in new research topics. It consists of four main courses, complemented by hands-on sessions, seminars, presentations by the attendants, and social activities, following the spirit and format of precedent successful editions (Palma de Mallorca, Benasque, Barcelona, Pamplona, Santander, and Madrid; 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2022, 2023, 2024).

ORGANISING COMMITTEE

Álvaro Corral | CRM – Universitat Autònoma de Barcelona
Víctor Navas-Portella | Universitat Autònoma de Barcelona

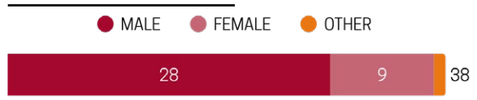
SPEAKERS

Tomás Alarcón | ICREA – CRM
Albert Beardo | Universitat Autònoma de Barcelona
Léonie Canet | Université Grenoble Alpes
Javier Cristín | Universitat Autònoma de Barcelona
Eric Latorre-Crespo | CRG – CRM
Juan Manuel López | Instituto de Física de Cantabria
Jordi Mompart | Universitat Autònoma de Barcelona
Isabel Pastor | Universitat de Barcelona
Fèlix Ritort | Universitat de Barcelona
M. Ángeles Serrano | ICREA and University of Barcelona
Chantal Valeriani | Universidad Complutense de Madrid

SCIENTIFIC COMMITTEE

Rosa Benito | Universidad Politécnica de Madrid
Daniel Campos | Universitat Autònoma de Barcelona
Pere Colet | IFISC – CSIC
M.-Carmen Miguel | Universitat de Barcelona
Inmaculada Leyva | Universidad Rey Juan Carlos
Juan Manuel López | IFCA – CSIC
Diego Maza | Universidad de Navarra
Irene Sendiña-Nadal | Universidad Rey Juan Carlos

GENDER BALANCE

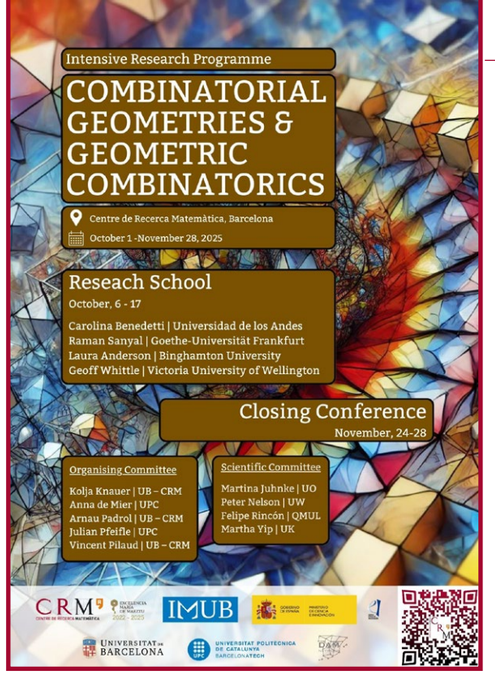


GEOGRAPHIC DISTRIBUTION

INTENSIVE RESEARCH PROGRAMME - MdM

COMBINATORIAL GEOMETRIES & GEOMETRIC COMBINATORICS

October 01 - November 28, 2025



DESCRIPTION

The MdM Focused Research Programme on Combinatorial Geometries and Geometric Combinatorics, held from October to November 2025, brought together an intensive sequence of scientific activities. It began with preliminary lectures on polytopes and oriented matroids (Oct 1–3), followed by a two-week research school featuring advanced courses on polytopes, matroids, and related structures (Oct 6–17). Throughout the period from Oct 20 to Nov 21, participants developed research projects, attended two parallel seminars, and interacted with several international research visitors. The programme concluded with a one-week conference (Nov 24–28) that showcased invited and contributed talks, during which participants also presented the progress achieved on their collaborative research projects.

ORGANISING COMMITTEE

Kolja Knauer | Universitat de Barcelona – CRM
Anna de Mier | Universitat Politècnica de Catalunya
Arnau Padrol | Universitat de Barcelona – CRM
Julian Pfeifle | Universitat Politècnica de Catalunya
Vincent Pilaud | Universitat de Barcelona – CRM

SCIENTIFIC COMMITTEE

Martina Juhnke | Universität Osnabrück
Peter Nelson | University of Waterloo
Felipe Rincón | Queen Mary University of London
Martha Yip | University of Kentucky

RESEARCH VISITORS

Laura Anderson | Binghamton University
Federico Ardila | San Francisco State University
Asilata Bapat | The Australian National University
Spencer Backman | University of Vermont
Carolina Benedetti | Universidad de los Andes, Bogotá, Colombia
Kristóf Bérczi | Eötvös Loránd University
Marie Brandenburg | Universität Bochum
Federico Castillo | Pontificia Universidad Catolica
César Ceballos | Technische Universität Graz
Jérémie Chalopin | CNRS & Université Aix-Marseille
Victor Chepoi | Aix-Marseille Université
Giulia Codenotti | Freie Universitat Berlin
Péter Csikvari | Alfréd Rényi Institute of Mathematics
Anton Dochtermann | Texas State University
Galen Dorpalen-Barry | Texas A&M University
Luis Ferroni | Università di Pisa
Alex Fink | Queen Mary University of London
Relinde Jurrius | Netherland Defence Academy
Georg Loho | Freie Universität Berlin & Universiteit Twente
Chiara Meroni | ETH Zürich
Eran Nevo | Universidad de Valladolid & Hebrew University
Daria Polyakova | Hamburg Universität
Francisco Santos | Universidad de Cantabria
Raman Sanyal | Goethe-Universität Frankfurt
Ben Smith | University of Lancaster
Eleni Tzanaki | University of Crete
Geoff Whittle | Victoria University of Wellington

POLYTOPE WEEK
October 06 - 10, 2025

LECTURERS

Carolina Benedetti | Universidad de los Andes
Raman Sanyal | Goethe-Universität Frankfurt

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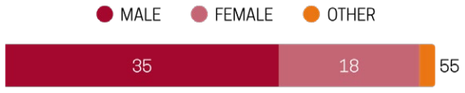

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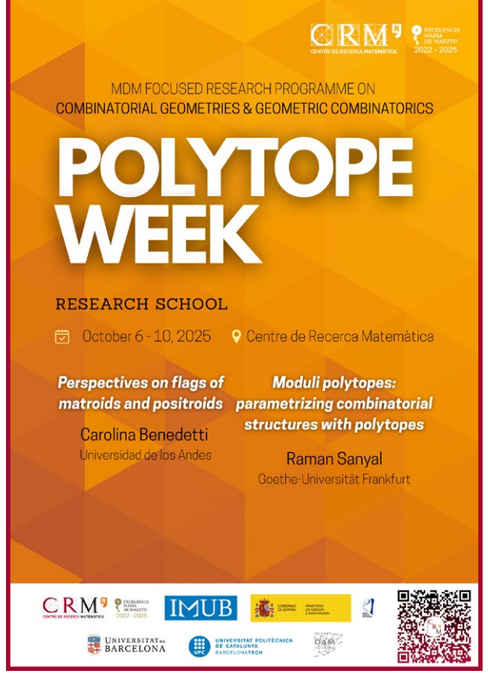
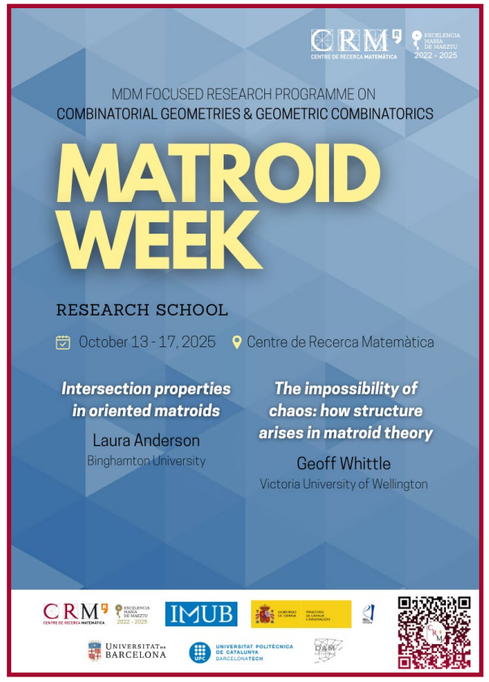


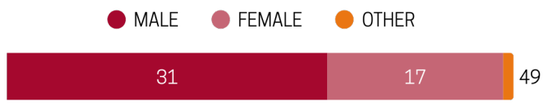


MATROID WEEK
October 13 - 17, 2025

LECTURERS

Laura Anderson | Binghamton University
Geoff Whittle | Victoria University of Wellington

GENDER BALANCE



GEOGRAPHIC DISTRIBUTION

CLOSING CONFERENCE ON COMBINATORIAL GEOMETRIES AND GEOMETRIC COMBINATORICS

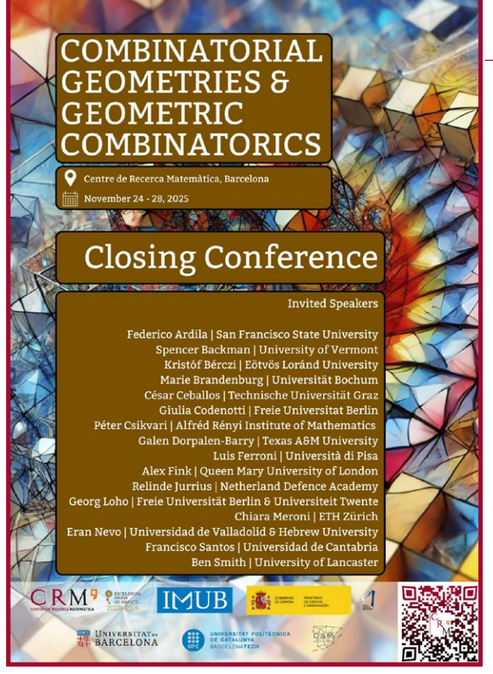
November 24 - 28, 2025

DESCRIPTION

The program concluded with a conference featuring invited talks and contributed presentations by participants.

INVITED SPEAKERS

Federico Ardila | San Francisco State University
Spencer Backman | University of Vermont
Kristóf Bérczi | Eötvös Loránd University
Marie Brandenburg | Universität Bochum
César Ceballos | Technische Universität Graz
Giulia Codenotti | Freie Universitat Berlin
Péter Csikvari | Alfréd Rényi Institute of Mathematics
Galen Dorpalen-Barry | Texas A&M University
Luis Ferroni | Università di Pisa
Alex Fink | Queen Mary University of London
Relinde Jurrius | Netherland Defence Academy
Georg Loho | Freie Universität Berlin & Universiteit Twente
Chiara Meroni | ETH Zürich
Eran Nevo | Universidad de Valladolid & Hebrew University
Francisco Santos | Universidad de Cantabria
Ben Smith | University of Lancaster



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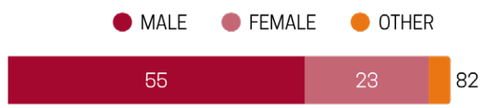

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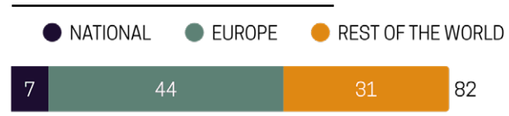


SEMINAR

VAN EST THEORY FOR HIGHER LIE GROUPOIDS BY FLORIAN DORSCH

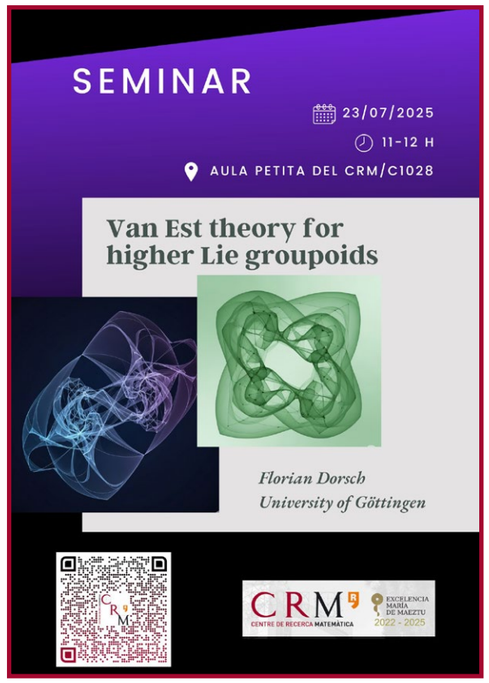
July 23, 2025

DESCRIPTION

In this talk, a generalization of the Van Est morphism to the setting of higher Lie groupoids was presented. After a brief introduction to Ševera differentiation, several key properties of the generalized Van Est morphism were discussed, its recovery of classical Van Est constructions was highlighted, and its application to the differentiation of simplicial Lie groups was demonstrated.

SPEAKER

Florian Dorsch | University of Göttingen



RESEARCH DAY

NONLINEAR DYNAMICS AND FLUIDS

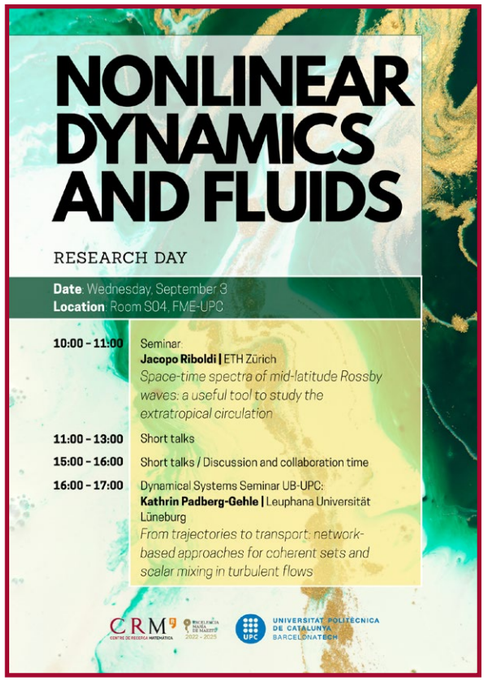
September 03, 2025

ORGANISING COMMITTEE

Jezabel Curbelo | Universitat Politècnica de Catalunya - CRM

SPEAKERS

Jacopo Riboldi | ETH Zürich
Kathrin Padberg-Gehle | Leuphana Universität Lüneburg



BILBAO-BARCELONA ANALYSIS AND PDE MEETING

September 03 - 05, 2025

DESCRIPTION

This 3-day meeting aimed to develop meaningful interactions between the communities of researchers in Analysis and Partial Differential Equations mainly based in Barcelona and Bilbao (CRM, Universitat Autònoma de Barcelona, Universitat de Barcelona, Universitat Politècnica de Catalunya, BCAM, and Universidad del País Vasco/ Euskal Herriko Unibertsitatea), together with close collaborators from other institutions. The scientific content was organized around the themes of Analysis and PDEs.

SPEAKERS

Carlota Cuesta | Universidad del País Vasco - Euskal Herriko Unibertsitatea
Ujjal Das | BCAM
Gissell Estrada | Universitat Politècnica de Catalunya - CRM
Luca Fanelli | Universidad del País Vasco - Euskal Herriko Unibertsitatea
Josep M. Gallegos | Universitat Autònoma de Barcelona
Marcel Guardia | Universitat de Barcelona - CRM
Mihalis Mourgoglou | Universidad del País Vasco - Euskal Herriko Unibertsitatea
Quim Ortega-Cerdá | Universitat de Barcelona - CRM
Marta Pellicer | Universitat de Girona
Carlos Pérez | Universidad del País Vasco - Euskal Herriko Unibertsitatea
Laura Prat | Universitat Autònoma de Barcelona
Xavier Ros-Oton | ICREA - Universitat de Barcelona - CRM
Arnab Roy | BCAM
Olli Saari | Universitat Politècnica de Catalunya
Joaquim Serra | ETH Zürich
Mateus Sousa | BCAM
Xavier Tolsa | ICREA - Universitat Autònoma de Barcelona - CRM
Ying Wang | BCAM

ORGANISING COMMITTEE

Naiara Arrizabalaga | Universidad del País Vasco - Euskal Herriko Unibertsitatea
Albert Mas | Universitat Politècnica de Catalunya
Carme Cascante | Universitat de Barcelona - CRM
Luz Roncal | BCAM
Luis Vega | Universidad del País Vasco - Euskal Herriko Unibertsitatea

MDM CLOSING CONFERENCE

November 19, 2025

DESCRIPTION

In 2021, the Centre de Recerca Matemàtica (CRM) was awarded the distinction of “Unit of Excellence Maria de Maeztu” by the Spanish Research Agency (AEI). This recognition, one of the most prestigious in the Spanish research system, acknowledged the CRM’s international impact and scientific quality. It was the second time the centre received such recognition, following the award granted to BGSMath (2015), also coordinated by the CRM.

Supported by a four-year grant of two million euros, the Maria de Maeztu programme at CRM (2022–2025) has fostered interdisciplinary research, promoted international collaboration, and strengthened the centre’s role in addressing key societal challenges. The strategic plan has also placed a strong emphasis on equity and the integration of mathematical knowledge across domains.

The CRM thanks all individuals and institutions who have contributed to the success of the Maria de Maeztu programme.

SPEAKERS

Joana Cirici | Universitat de Barcelona - CRM
Ma. Ángeles García-Ferrero | Instituto de Ciencias Matemáticas
David Moriña | Universitat Autònoma de Barcelona - CRM
Tassio Naia | CRM
Diego Vidaurre | CRM

BARCCSYN SEMINAR CYCLE

DESCRIPTION

The Barccsyn Seminar Cycle, funded by the SGR "Network Dynamics", aims to invite researchers from abroad in computational and systems neuroscience to Barcelona. We are excited to hear about their own work, as well as to have them get to know the growing Barccsyn community. In this vein we encourage our invited speakers to spend enough time in Barcelona to visit several labs, ideally one day and a half.

ORGANISING COMMITTEE

Albert Compte | IDIBAPS
Ignasi Cos | UB
Alex Hyafil | CRM
Ernest Montbrió | UPF
Jaime de la Rocha | IDIBAPS
Alex Roxin | CRM
Klaus Wimmer | CRM

SPEAKERS

N Alex Cayco Gajic | École Normale Supérieure
Peter Murphy | Maynooth University
Jeffrey Erlich | Sainsbury Wellcome Centre - University College London
Chunyu Ann Duan | Sainsbury Wellcome Centre - University College London

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.

ORGANISING COMMITTEE

Lucía Arancibia | CRM
Juan Arellano | CRM
Dídac Gil | CRM
Roser Homs | CRM
Marc Homs | CRM

SPEAKERS

Álvaro González | CRM
Tássio Naia | CRM
Dídac Gil | CRM
Anna Jové Campabadal | UB
Miquel Saucedo | CRM
Gissell Estrada Rodríguez | UPC - CRM
Zaira Pindado Tost | BSC
Marc Homs | CRM
Beatriz Pascual Escudero | Universidad Politécnica de Madrid
Roser Homs | CRM
Leire Unamuno | CRM
Alexandre Garcia-Duran | CRM
Søren Dyhr | CRM

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.

ORGANISING COMMITTEE

Caterina Barezzi | IDIBAPS
Tomás Berjaga | Universitat Pompeu Fabra
Alexandre García-Duran | CRM

SPEAKERS

Marta Picco | Fundació Insitut Hospital del Mar d'Investigacions Mèdiques
Emanuela Iannella | Hospital del Mar Research institute
Jens-Bastian Eppler | CRM
Demetrio Ferro | Universitat Pompeu Fabra

CIMPA

DESCRIPTION

The collaboration between CIMPA and the CRM focuses on supporting mathematical development in low- and middle-income countries through a combined training and research model. Each year, the CRM hosts visitors from CIMPA partner countries who spend a short research stay working closely with a local researcher. During this period, they also deliver a one-week online course that is open to the international community, helping to share advanced mathematical knowledge while strengthening global networks of collaboration.

SPEAKERS

Hero Saremi | Islamic Azad University
Alexandre Fotue Tabue | The University of Bertoua

05 CRM-BGSMath

CRM-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:

- Universitat de Barcelona (UB)
- Universitat Autònoma de Barcelona (UAB)
- Universitat Pompeu Fabra (UPF)
- Universitat Politècnica de Catalunya (UPC)
- Centre de Recerca Matemàtica (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

UPC Universitat Politècnica de Catalunya BarcelonaTech

CRM Centre de Recerca Matemàtica

GRADUATE COURSE

CONVEX INTEGRATION, STAIRCASE LAMINATES, AND APPLICATIONS

March 17-20, 2025

DESCRIPTION

The method of convex integration, originated in the celebrated construction of isometric immersions by Nash in the 60s, has become an indispensable tool to understand irregular solutions in partial differential equations, leading to celebrated results as the solution of Onsager conjecture in the context of turbulent hydrodynamics. In the course I will explain a variant of the method, based on the so called Staircase Laminates and its relation with Singular Integral Operators, quasiconformal maps, elliptic equations and electromagnetism.

LECTURER

Daniel Faraco | ICMAT

GRADUATE COURSE

HYPERBOLIC GEOMETRY WITH APPLICATIONS TO DYNAMICS

April 01 - May 12, 2025

DESCRIPTION

Hyperbolic geometry deals with manifolds with conformal metrics of constant curvature -1. Despite this apparently narrow focus, it has found widespread applications in dynamical systems – mostly in the study of holomorphic dynamics, but also in relation to geodesic flows and its properties.

In this course, we will focus on the hyperbolic geometry of Riemann surfaces. We will introduce the hyperbolic metric of the unit disc and general hyperbolic surfaces, with an emphasis on the role of complex analysis and Möbius transformations. We will discuss the main structural properties for hyperbolic surfaces and their relations to Fuchsian groups and to holomorphic maps. Finally, we will see how to apply the principles of hyperbolic geometry to holomorphic dynamics and the study of geodesic flows.

This course is geared towards postgraduate students and early career researchers in mathematics with an interest in geometry, dynamics, or both.

ORGANIZERS AND LECTURERS

Gustavo Rodrigues Ferreira | CRM
Robert Cardona | UB – CRM

GRADUATE COURSE

COMMUNICATION COMPLEXITY, CIRCUIT COMPLEXITY, AND COMMON CAUSES (C^2 x C^2 x C^2)

November 3-14, 2025

DESCRIPTION

The P vs. NP problem has been called “a gift to mathematics from computer science” by Fields Medalist Steve Smale in 2000. Also in 2000, the problem was included as one of the seven Millennium Prize Problems of the Clay Mathematics Institute. Besides the intrinsic elegance of its mathematical formulation, the significance of the P vs. NP problem lies in its profound philosophical implications, regardless of how it is resolved. It is expected that the study of the P vs. NP problem will continue to inspire novel technological advances of unpredictable potential impact in industry, the sciences, and the prospects of AI, beyond the impressive array of accomplishments already achieved.

Over the years since the problem was formulated by Steve Cook in 1971, several approaches have been proposed to attack the P vs. NP problem. The goal of this course is to present the foundations, as well as some of the recent advances, of a combinatorial approach to the P vs. NP problem that was proposed in the 1980s. The underlying idea of the approach is to adopt an abstract view of computation as entailing a limited form of communication between two parties that, on one hand, have limited access to the data, but on the other, enjoy all-powerful computing capabilities in compensation. This tradeoff between communication and computation has the effect of turning the questions of computation into purely combinatorial problems that do not depend on computational models and are thus more amenable to the classic tools of mathematics.

In the first part of the course, we will present the linear algebraic method to prove lower bounds on the communication complexity of explicit functions, and then discuss the celebrated Log-Rank Conjecture of Lovász and Saks. We will also prove Razborov’s linear lower bound on the randomized communication complexity of the set disjointness problem using the modern tools of information theory. In the second part of the course, we will introduce Karchmer-Wigderson games, which characterize Boolean circuit complexity in terms of communication. The methodology of KW games will be used to prove linear lower bounds on the depth of monotone Boolean circuits that compute maximum matchings on graphs, and exponential lower bounds on the size of monotone Boolean circuits that compute maximum cliques or optimal colorings.

LECTURERS

Albert Atserias | UPC - CRM
Anup Rao | University of Washington

GRADUATE COURSE

CONCENTRATION INEQUALITIES FOR HOLOMORPHIC FUNCTIONS

October 27- November 05, 2025

DESCRIPTION

Functional inequalities play a crucial role in several mathematical fields, including partial differential equations, calculus of variations and mathematical physics. Let us illustrate the topic with the following rough question:

Given some notion of concentration on a function space, under what conditions is such concentration optimal?

This question may immediately bring to mind uncertainty principles, considered in harmonic (Fourier) analysis, quantum mechanics or signal processing.

If the concentration is given in terms of the Wehrl entropy, the question on its optimality goes back to the late 1970s. Lieb proved that the Wehrl entropy of quantum Glauber states is minimum when it is a coherent state. However, the uniqueness of these minimizers, which in turn answered positively the original Wehrl's conjecture in 1979, has been proved two years ago. Even more recently, the stability or quantitative counterpart of the optimality has been addressed.

Analogous questions can be formulated in other settings, like for Bloch states and the corresponding space of one-dimensional complex polynomials of bounded degree. Moreover, a local version of the entropy has also been considered, that is, the concentration is measured in terms of the localization in a subset. This in particular coincides with the energy concentration for the short-time.

Fourier transform (STFT) or the wavelet transform, in the suitable function spaces. The course would introduce all the aforementioned results on concentration inequalities, covering both the cases in different spaces of holomorphic functions (Fock, Bergman and polynomials) and the two notions of concentration in terms of the localization in a subset and of the (generalized) Wehrl entropy.

LECTURER

María Ángeles García | ICMAT

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 (view)

During 2025, the CRM's outreach blog, ***El Gegant del π***, solidified its role as a leading platform for mathematical storytelling, successfully reaching beyond academia to engage a diverse public. Designed to make complex theories accessible, it offers a window into how mathematics permeates our daily lives. Contributions from CRM researchers ensure that the content is both rigorous and engaging, fostering a passion for the discipline and highlighting its relevance in the world around us.

This year's activity was characterized by a rich thematic variety that linked mathematics with the collective imagination. Featured articles ranged from the "psychohistory" of Isaac Asimov and the stochastic processes behind The Matrix to Hilbert's Infinite Hotel paradox and the historical evolution of the concept of zero. The blog also explored technical curiosities, such as the precision error of π in the Doom video game code, and highlighted resilience in research through the story of George Dantzig. Complemented by literature reviews and an analysis of geometry in Guillermo del Toro's films, the platform made abstract concepts—like higher-dimensional polytopes and Markov chains—both accessible and compelling.

A significant milestone this year was the launch of the "Diari de doctorat" (PhD Diary) series, designed to humanize the research process and provide a voice to the CRM predoctoral community. Through intimate chronicles, such as "From Barcelona to Tokyo" and "The Invisible Proof," researchers Javier Guillán Rial and Dídac Gil pulled back the curtain on the daily life of mathematicians in training during their international stays in Japan and Poland. These stories go beyond equations to explore linguistic barriers, global collaboration, and the resilience needed to face "impossible" problems, offering an authentic perspective on building a scientific career in the 21st century.

Another creative addition was the "Days" series, a collection of literary and observational chronicles that uncover mathematics in the mundane. Through entries like Circle Day, Triangle Day, Parallel Day, and Spiral Day, the series explores how geometric patterns define our sensory experience. This project highlights the beauty of "applied" observation, inviting readers to recognize mathematical harmony in nature and everyday objects.

Finally, 2025 saw the launch of an innovative Mathematical Fiction Saga. This series of interconnected stories follows three friends—Sara, Melissa, and David—as they navigate a transformed Barcelona and mysterious geometric realms triggered by mathematical formulas. The "To be continued..." format has turned the blog into an interactive experience where solving a mathematical proof is the only key to advancing the plot. Collectively, these initiatives have established El Gegant del π as a multifaceted hub for mathematical culture.

28 POSTS
2.049 VIEWS

3 de Juliol de 2025

El Gran Hotel Hilbert: benvinguts a l'infinit, on mai no hi ha cap habitació lliure... però sempre hi ha lloc

Posem que ets matemàtic (ja que estàs llegint un blog de matemàtiques, no calen gaires suposicions). Però un dia, fart de teoremes que es desfan quan t'hi acostes i de guixos trencats abans d'hora, decideixes fer un gir. Potser buscar una vida més tranquil·la, més tangible. Potser... la recepció d'un hotel. No hi ha integrals, ... Continua la lectura de

26 de Juny de 2025

El Laberint Matemàtic de les Espirals-Mirall

Fourth in a saga of mathematical stories — Tens raó, Melissa. No serveix de gaire observar i trobar l'espiral "a ull", ja que qui sigui qui dirigeix aquest espai geomètric sense igual vol les fórmules. Ens ho ha escrit explícitament. — Soc jo, Sara, o t'encanta ironitzar amb això d'"espai geomètric sense igual"? És així ... Continua la lectura de

17 de Juny de 2025

L'equació diferencial que transforma l'espai: viatge a nous mons geomètrics

Third in a saga of mathematical stories — Molt bé, nois! La solució és senzilla — diu la Sara mentre gira la llibreta i els la mostra— L'equació, en el nostre cas, podem suposar que és la d'una ona unidimensional, perquè és com si ens estiguéssim movent sobre una corda en un vaivé. — Sí, ... Continua la lectura de

6 de Maig de 2025

El zero: la idea més perillosa de la història

Imagineu-vos un món sense el número zero. Sense manera d'indicar l'absència, sense la possibilitat de calcular el canvi, sense ordinadors, ni ciència moderna, ni economia tal com la coneixem. Un món sense zero seria com una novel·la sense espais en blanc: incomprensible, caòtic i limitat. Tanmateix, durant segles, la humanitat va viure exactament així. Sense ... Continua la lectura de

MENTS MERAVELLOSES PODCAST (view)

Ments Meravelloses is the Centre de Recerca Matemàtica's mathematics outreach podcast, created to highlight the human stories and scientific contributions of individuals who have shaped the development of mathematics. The project aims to break stereotypes, promote accessible communication of mathematical ideas, and inspire young audiences by showing the diversity and richness of mathematical lives.

Each episode features a central historical or contemporary figure and includes conversations with CRM researchers or invited experts, who provide context and explain the relevance of the featured person's work to modern mathematics.

In 2025, two episodes were released: one focusing on Katherine Johnson, the NASA mathematician whose calculations were critical to early American space missions, featuring CRM researcher Roser Homs; and one dedicated to Srinivasa Ramanujan, the self-taught Indian mathematician whose contributions to number theory continue to influence contemporary research, featuring mathematician Kevin Martinez.

The podcast is available in video format on YouTube and in audio format on Spotify, iVoox, and Apple Podcasts.

4.846 VIEWS
760 LISTENS

INTERNATIONAL DAY OF WOMEN IN MATHEMATICS

To mark the International Day of Women in Mathematics, CRM produced a video featuring interviews with six researchers working at the centre. The video explores their research areas, career trajectories, and perspectives on working in mathematics.

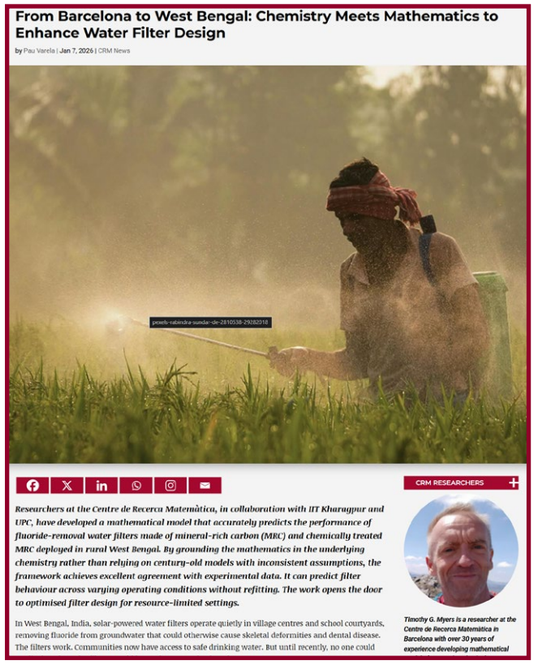
The interviews include: Gloria Cecchini, postdoctoral researcher in CRM's neuroscience group, Gissell Estrada, lecturer at the Universitat Politècnica de Catalunya and CRM researcher, Marta Casanellas, full professor at the Universitat Politècnica de Catalunya and CRM researcher, Núria Fagella, full professor at the Universitat de Barcelona and CRM researcher, Joana Cirici, associate professor at the Universitat de Barcelona's Faculty of Mathematics and Computer Science, and Marta Mazzocco, ICREA research professor at the Universitat Politècnica de Catalunya and CRM researcher.

SCIENTIFIC CHRONICLES: DOCUMENTING RESEARCH ACTIVITIES

In 2025, the CRM introduced a new editorial approach to documenting its scientific life: Event Chronicles. Moving beyond standard news announcements, these web entries provide a narrative and qualitative look at the centre's activities. Throughout the year, more than twenty chronicles were published, capturing the essence of key gatherings such as the ICMNS 2025, BARCCSYN, the ESGI industrial meeting, and various specialized summer schools like BAMB! or GEFENOL. These reports serve as a permanent record of the scientific debate, collaborative atmosphere, and the CRM's role as a vibrant hub for international research.

RESEARCH HIGHLIGHTS: BRINGING PAPERS TO THE PUBLIC

In 2025, the CRM intensified its efforts to communicate the scientific output of its researchers through news articles that translate specialized papers into outreach pieces, showcasing the center's excellence in diverse fields. The key highlights of this year covered advancements in the brain's agility in mid-action decision adjustments, the stratification of equivariant homotopy through Quillen's theory, improved filtration models for competing contaminants, the orbital dynamics of Mercury and Venus, and computer-assisted proofs of celestial stability in the Sun–Jupiter–Saturn system. Additionally, the series featured studies on the role of DNA folding in cell fate, metabolic mysteries in oncology, the discovery of Wigglyhedra as new geometric structures, representational drift in statistical learning, bifurcation proximity in genetic systems, and new horizons for nonlocal H- and Γ-convergence. This initiative ensures that the CRM's high-impact research reaches a broader audience, emphasizing its real-world applications and theoretical significance.


From Barcelona to West Bengal: Chemistry Meets Mathematics to Enhance Water Filter Design

by Pau Varela | Jan 7, 2026 | CRM News

CRM RESEARCHERS

Researchers at the Centre de Recerca Matemàtica, in collaboration with IIT Kharagpur and UPC, have developed a mathematical model that accurately predicts the performance of fluoride-removal water filters made of mineral-rich carbon (MRC) and chemically treated MRC deployed in rural West Bengal. By grounding the mathematics in the underlying chemistry rather than relying on century-old models with inconsistent assumptions, the framework achieves excellent agreement with experimental data. It can predict filter behaviour across varying operating conditions without refitting. The work opens the door to optimised filter design for resource-limited settings.

In West Bengal, India, solar-powered water filters operate quietly in village centres and school courtyards, removing fluoride from groundwater that could otherwise cause skeletal deformities and dental disease. The filters work. Communities now have access to safe drinking water. But until recently, no one could

Timothy G. Myers is a researcher at the Centre de Recerca Matemàtica in Barcelona with over 30 years of experience developing mathematical

THREE STUDENTS FROM THE 'JOVES I CIÈNCIA' PROGRAM COMPLETE INTERNSHIPS AT THE KNOWLEDGE TRANSFER UNIT

For the second consecutive year, the CRM's Knowledge Transfer Unit has hosted three students from the Fundació Catalunya La Pedrera's 'Joves i Ciència' program. Roger, Clara, and Maria, all high school students, worked on real-world projects, discovering firsthand the role of mathematics in fields such as energy and health.

SETMANA DE LA CIÈNCIA 2025

The CRM participated in the 30th edition of Science Week with a guided tour that combined the biographies of female mathematicians with artworks from the centre, connecting science, history, and artistic creation.

NIT DE LA RECERCA 2025

The CRM participated in the 2025 European Researchers' Night with a series of outreach talks across Barcelona, L'Hospitalet, and Vic, showcasing the versatility and real-world impact of mathematics. Researchers Leticia Pardo, Marc Calvo, and David Romero engaged the public by exploring topics ranging from the hidden beauty and complexity of fractals in nature to the surprising role of fluid dynamics in sports strategies—illustrated by a South African football team's success. Additionally, the event highlighted the Enhance Europe project, which utilizes mathematical modeling to harvest thermal energy from asphalt for more sustainable cities. By bridging the gap between abstract theory and everyday applications, the CRM reaffirmed its commitment to making high-quality research accessible and inspiring for the general public.

FESTA DE LA CIÈNCIA 2025

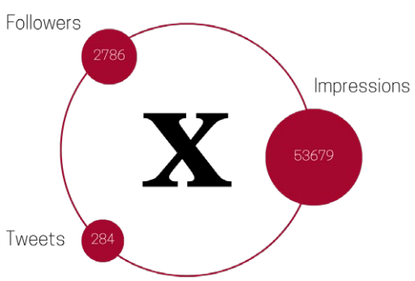
The Centre de Recerca Matemàtica (CRM) participated in the 18th edition of the Barcelona Science Festival, an event that drew nearly 18,000 visitors. In collaboration with IDIBAPS, the CRM presented the interactive workshop "Neural Code," led by researchers from the Computational Neuroscience Group.

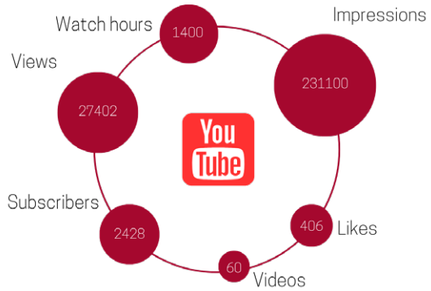
The activity allowed participants to explore the connection between the brain and movement through a human-to-human interface, demonstrating how electrical muscle signals can be recorded and used to trigger movement in another person. Beyond the live demonstrations, the workshop introduced key concepts in working memory and the neural codes governing thought and action. By showcasing how mathematical models, psychophysical experiments, and machine learning help decode brain activity, the CRM highlighted the essential role of mathematics in understanding cognitive processes and its capacity to engage with the general public.

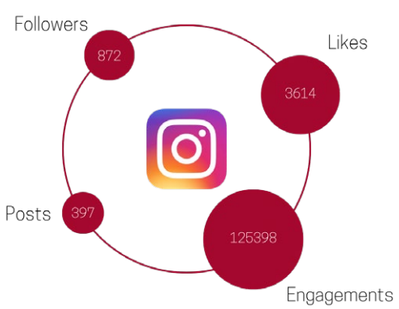
VISIBLE FIGURES: EXPANDING THE EXHIBITION ON WOMEN IN MATHEMATICS

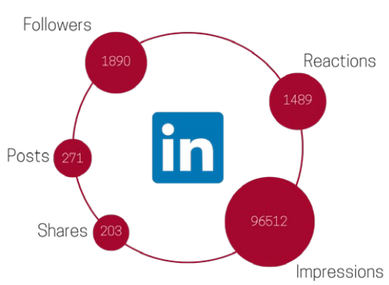
The CRM expanded its “Figures Visibles” exhibition, increasing the collection to thirteen displays that honor the legacies of prominent female mathematicians. The latest update incorporates four key figures from the Spanish and Catalan scientific landscape: Carmen Martínez Sancho, Montserrat Capdevila, Maria Assumpció Català, and María Wonenburger. By showcasing these biographies alongside international icons like Ada Lovelace and Maryam Mirzakhani, the exhibition utilizes the high influx of visiting researchers—nearly 2,000 annually—to challenge the historical silence surrounding women’s contributions. This initiative not only celebrates scientific excellence but also provides diverse role models for future generations of mathematicians.

SOCIAL MEDIA









MATHEMATICS IN CONVERSATION

In 2025, CRM launched a new interview series on YouTube featuring visiting researchers, invited speakers, and organizers of activities at the centre. The series provides a platform for researchers to discuss their work, share insights into their research areas, and explain the scientific programs and events they develop at CRM. The interviews are publicly available on CRM’s YouTube channel.

12 VIDEOS
20.164 VIEWS

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.

PEOPLE

SENIOR RESEARCHERS

Alarcón, Tomás	CRM-ICREA	Mathematical Biology
Álvarez, Josep	UPC-CRM	Algebra and Algebraic Geometry
Amorós, Jaume	UPC-CRM	Algebra and Algebraic Geometry
Antezana, Jorge	UB-CRM	Analysis
Antoine, Ramon	UAB-CRM	Algebra and Algebraic Geometry
Atserias, Albert	UPC-CRM	Combinatorics and Mathematics of Computer Science
Balacheff, Florent	UAB-CRM	Algebra and Algebraic Geometry
Baldomá, Inmaculada	UPC-CRM	Dynamical Systems
Ball, Simeon	UPC-CRM	Combinatorics and Mathematics of Computer Science
Barja, Miguel Angel	UPC-CRM	Geometry and Topology
Bars, Francesc	UAB-CRM	Number Theory
Bengoechea, Paloma	UB-CRM	Number Theory
Blanco, Guillem	UPC-CRM	Algebra and Algebraic Geometry
Broto, Carles	UAB-CRM	Geometry and Topology
Cabré, Xavier	UPC-ICREA-CRM	Partial Differential Equations
Calvo, Marc	UPC-CRM	Mathematics for the Environment and Society
Cardona, Robert	UB-CRM	Geometry and Topology
Casanellas, Marta	UPC-CRM	Mathematical Biology
Cascante, Carme	UB-CRM	Analysis
Castellana, Natàlia	UAB-CRM	Geometry and Topology
Cirici, Joana	UB-CRM	Geometry and Topology
Clarke, Andrew	UPC-CRM	Dynamical Systems
Clop, Albert	UB-CRM	Analysis
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Csato, Gyula	UB-CRM	Partial Differential Equations
Cuadrado, Silvia	UAB-CRM	Mathematical Biology
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Masdeu, Marc	UAB-CRM	Number Theory
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Miranda, Eva	UPC-CRM	Geometry and Topology
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Myers, Timothy G.	CRM	Mathematics for the Environment and Society

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Olle, Mercè	UPC-CRM	Dynamical Systems
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Padrol, Arnau	UB-CRM	Combinatorics and Mathematics of Computer Science
Pardo, Leticia	UB-CRM	Dynamical Systems
Pau, Jordi	UB-CRM	Analysis
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Perera, Francesc	UAB-CRM	Algebra and Algebraic Geometry
Pilaud, Vincent	UB-CRM	Combinatorics and Mathematics of Computer Science
Pitsch, Wolfgang	UAB-CRM	Geometry and Topology
Ponce, Adrián	UPC-CRM	Computational and Mathematical Neuroscience
Porti, Joan	UAB-CRM	Geometry and Topology
Puig, Pere	UAB-CRM	Mathematics for the Environment and Society
Ros-Oton, Xavier	UB-ICREA-CRM	Partial Differential Equations
Rotger, Víctor	UPC-CRM	Number Theory
Roxin, Alex	CRM	Computational and Mathematical Neuroscience
Rué, Juan José	UPC-CRM	Combinatorics and Mathematics of Computer Science
Saari, Olli	UPC-CRM	Analysis
Sanz, Tomás	UB-CRM	Partial Differential Equations
Sardanyés, Josep	CRM	Mathematical Biology
Serra, Oriol	UPC-CRM	Combinatorics and Mathematics of Computer Science
Solanes, Gil	UAB-CRM	Geometry and Topology
Sombra, Martín	UB-ICREA-CRM	Algebra and Algebraic Geometry
Tikhonov, Sergey	CRM-ICREA	Analysis
Tolsa, Xavier	UAB-ICREA-CRM	Analysis
Torregrosa, Joan	UAB-CRM	Dynamical Systems
Vena, Lluís	UPC-CRM	Combinatorics and Mathematics of Computer Science
Vieiro, Arturo	UB-CRM	Dynamical Systems
Vidaurre, Diego	CRM	Computational and Mathematical Neuroscience
Wimmer, Klaus	CRM	Computational and Mathematical Neuroscience

POSTDOCTORAL RESEARCHERS

Auton, Lucy Charlotte	Mathematics for the Environment and Society
Cecchini, Gloria	Computational and Mathematical Neuroscience
Cloete, Ielyaas	Mathematical Biology
Da Fonseca, Maria	Computational and Mathematical Neuroscience
Eppler, Jens Bastian	Computational and Mathematical Neuroscience
Ferro, Demetrio	Computational and Mathematical Neuroscience
Fornea, Michele	Number Theory
González, Alvaro	Mathematics for the Environment and Society
González, Cristian	Analysis
Hernández, Lluís	Computational and Mathematical Neuroscience
Homs, Roser	Mathematical and Computational Biology
Kalou, Aikaterni	Computational and Mathematical Neuroscience
Kosov, Egor	Analysis
Maione, Alberto	Partial Differential Equations
Mel, Gabriel	Computational and Mathematical Neuroscience
Naia, Tássio	Combinatorics and Mathematics of Computer Science
Rodrigues, Gustavo	Dynamical Systems
Stepanova, Daria	Mathematical Biology
Thorat, Udayraj	Mathematics for the Environment and Society
Tokmagambetov, Niyaz	Analysis
Trujillo, Frank	Dynamical Systems
Wokke, Martijn	Computational and Mathematical Neuroscience

PREDOCTORAL RESEARCHERS

Allamzharov, Batyrbek	Analysis
Antoniadou, Alexandra	Computational and Mathematical Neuroscience
Arellano, Juan	Mathematical Biology
Castellvi, Jordi	Combinatorics and Mathematics of Computer Science
Crespo, Pablo	Computational and Mathematical Neuroscience
D'Amelio, Tomás	Computational and Mathematical Neuroscience
De Arancibia, Lucia	Computational and Mathematical Neuroscience
Duran, Joaquim	Partial Differential Equations
Dyhr, Søren István Adorján	Geometry and Topology
Garcia-Duran, Alexandre	Computational and Mathematical Neuroscience
Gil, Didac	Dynamical Systems
Guillan, Javier	Number Theory
Llacer, Lluis	Algebra and Algebraic Geometry
Llopis, Oriol	Mathematical Biology
Martinez, Kevin	Mathematical Biology
Nicolas, Pablo	Geometry and Topology
Olwande, Rachael Atieno	Mathematics for the Environment and Society
Poncio, Federico Tomás	Computational and Mathematical Neuroscience

Saucedo, Miquel	Analysis
Tang, Haowen	Computational and Mathematical Neuroscience
Vielba, Amaia	Mathematical Biology

RESEARCH ASSISTANTS

Tang, Haowen	Computational and Mathematical Neuroscience
Unamuno, Leire	Mathematics for the Environment and Society
Velasco, Núria	Mathematics for the Environment and Society
Wilson, Anna	Computational and Mathematical Neuroscience

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Alonso, Iolanda	Other Institution	Human Resources
Bressgott, Jannis	Universität Wien	Computational and Mathematical Neuroscience
Cangialosi, Francesca	The University of Glasgow	Geometry and Topology
Casamitjana, Joan	Universitat Pompeu Fabra	Mathematical Biology
Fucho, Mariona	Universitat Politècnica de Catalunya	Mathematical Biology
González, Tatiana	Other Institution	Accounting
Martin, Oskar James	Universitat Pompeu Fabra	Computational and Mathematical Neuroscience
Orus, Guerau	Universitat Autònoma de Barcelona	IT
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Velasco, Núria	Universitat Autònoma de Barcelona	Mathematics for the Environment and Society

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Homs, Marc	Research Technician
Mas, Manel	Research Technician
Romero, David	Head of KTU

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Cañamero, Ivan	IT
Cuni Dols, Jordi	Human Resources
Dos Santos, Sara	Scientific Activities
Garcia de la Fuente, Jose Manuel	Projects
Gutiérrez, Ariadna	Data Management
Hernández Martín, Núria	Scientific Activities
Martinez Barrera, Gemma	Management
Martinez Redecillas, Sara	Administration
Mullor Tenas, Jordi	IT
Ramirez Garcia, Vanessa	Scientific Activities
Renter, Anna	Human Resources
Roca Guillen, Consol	Director's Office
Ros, Claudia	Projects
Sánchez, Vanessa	Human Resources
Valero Navazo, Mari Paz	Administration Assistant
Vallina, Natalia	Communication and Outreach
Varela Rodriguez, Pau	Communication and Outreach

AURA FOUNDATION

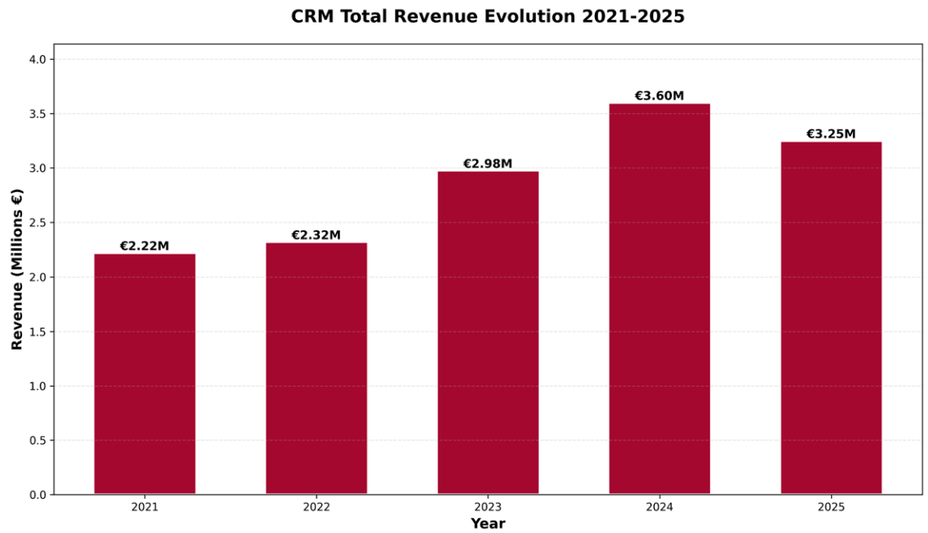
Aura Foundation, created in October 1989, is a non-profit organization initially formed as an association and that since 2004 has operated as a private foundation. It pioneered the «Supported Employment» program in Spain by implementing and developing its methodology. Aura aims to improve the quality 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.

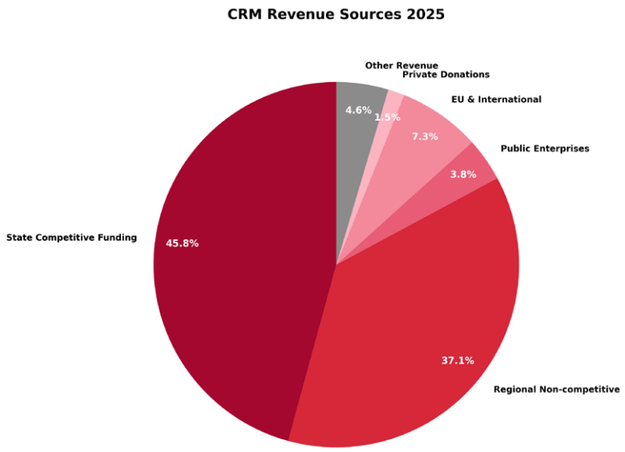
FINANCIAL SUMMARY 2025

In 2025, the Centre de Recerca Matemàtica recorded total revenues of **€3.25 million** and total expenses of **€3.25 million**, maintaining a balanced budget. This represents a decrease of approximately 10% compared to 2024 revenues.

Over the five-year period from 2021 to 2025, CRM revenues showed the following evolution: €2.22 million (2021), €2.32 million (2022), €2.98 million (2023), €3.60 million (2024), and €3.25 million (2025). This represents a cumulative increase of 46% from 2021 to 2025, and 62% growth from 2021 to the 2024 peak.



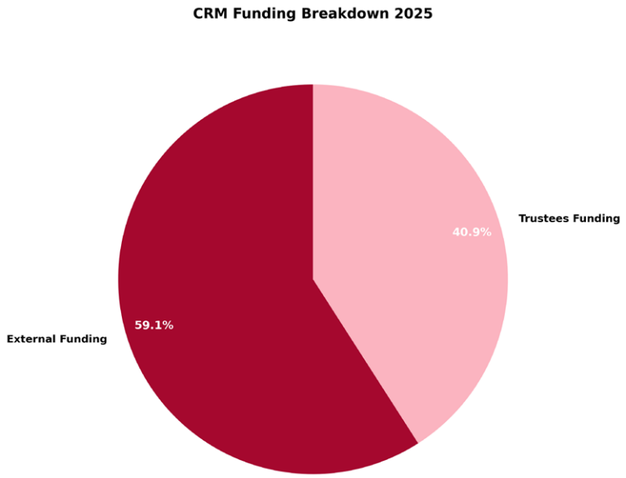
REVENUE SOURCES



CRM's 2025 revenue of €3.25 million was distributed across multiple funding sources:

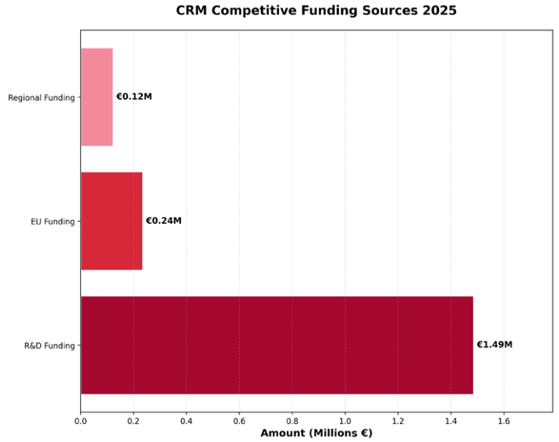
- State competitive funding constituted the largest revenue stream at €1.49 million (45.7% of total revenue). This funding comes through peer-reviewed R&D grant applications submitted to Spanish national research agencies.
- Regional non-competitive funding contributed €1.21 million (37.1% of total revenue). This funding derives from institutional agreements with the Generalitat de Catalunya and partner universities, providing baseline operational support.
- EU and international funding sources provided €236,188 (7.3% of total revenue). This includes funding from European research programs and international collaborative projects.
- Additional revenue sources included: other income €149,328 (4.6%), public enterprises €124,382 (3.8%), and private donations €47,334 (1.5%).

EXTERNAL AND INSTITUTIONAL FUNDING



CRM's 2025 funding can be categorized into two primary streams: external funding and trustee funding.

- External funding totalled €1.92 million, representing 59.1% of total revenue. This category includes competitive grants, EU programs, and private contributions.
- Trustee funding amounted to €1.33 million, representing 40.9% of total revenue.



The Centre de Recerca Matemàtica operates under financial oversight from its governing bodies and complies with reporting requirements established by the Generalitat de Catalunya, funding agencies, and research councils. The centre undergoes regular financial audits to ensure resources are allocated in accordance with its scientific mission.

The 2025 budget showed revenue and expenditure in balance at €3.25 million, with no deficit or surplus recorded for the fiscal year.

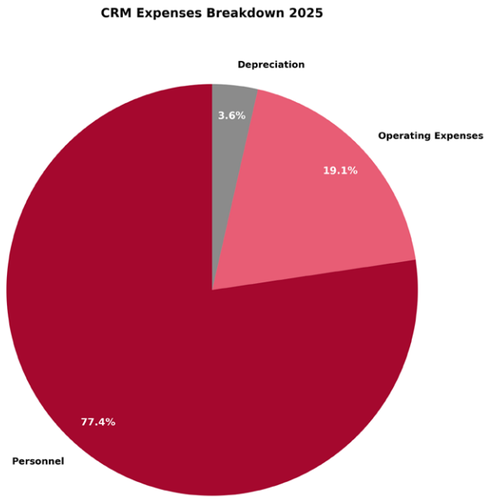
EXPENDITURE ALLOCATION

CRM's 2025 expenses of €3.25 million were allocated across the following categories:

Personnel costs accounted for €2.51 million (77.4% of total expenses). This category covers salaries and stipends for postdoctoral researchers, PhD students, visiting scholars, administrative staff, and research technicians.

Operating expenses totalled €619,985 (19.1% of total expenses). This category includes research activities, conferences, workshops, scientific publications, IT infrastructure, facilities management, and support services for international visitors.

Depreciation of intangible assets represented €115,988 (3.6% of total expenses). This includes software, digital infrastructure, and intellectual property assets.



COMPETITIVE FUNDING

CRM's competitive funding portfolio in 2025 totalled €1.85 million, distributed as follows:

- R&D funding: €1.49 million, supporting fundamental research projects in pure and applied mathematics.
- EU and international funding: €236,188, primarily from European research programs and collaborative projects.
- Regional competitive funding: €124,382, from Catalan research initiatives and competitive regional calls.

Àngel Jorba i Monté, professor of mathematics at the University of Barcelona, died in 2025 at the age of 61. He had received his PhD from UB in 1991 under Carles Simó, and had been a full professor since 1997.

His research focused on celestial mechanics and astrodynamics, with particular attention to quasi-periodic motions in dynamical systems and the development of numerical tools for applying dynamical systems theory to real-world problems. His work had implications for the design of future space missions. In October 2023, UB's Faculty of Mathematics and Computer Science noted that he was among the world's top 2% of most-cited scientists. He had supervised 14 doctoral theses. Shortly before his death, he was awarded an ICREA Acadèmia 2024 grant to continue his research. As a teacher, his areas were differential equations, numerical methods, and scientific programming. Jorba was also an affiliated researcher at the Centre de Recerca Matemàtica.

We remember him as a rigorous and generous colleague, and we are grateful for the years of shared work.

CENTRE DE RECERCA MATEMÀTICA

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