

CENTRE DE RECERCA MATEMÀTICA
MEMÒRIA D'ACTIVITATS 2008
REPORT OF ACTIVITIES 2008



CENTRE DE RECERCA MATEMÀTICA

Centre de Recerca Matemàtica
Apartat 50
08193 Bellaterra

Tel: +34 93 5811081
Fax: +34 93 5812202

crm@crm.cat
www.crm.cat

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Presentació

Aquesta memòria recull el que ha anat passant al CRM durant l'any 2008. El més important és que aquest ha estat el primer any del nou contracte programa signat pel CRM amb la Generalitat de Catalunya a través del Departament d'Innovació, Universitats i Empresa. Aquest contracte programa dibuixa les línies principals de l'activitat del CRM en totes les àrees durant el període 2008-2013 i ha servit autènticament de guia d'actuació per a 2008.

La política científica i l'activitat del CRM s'estructuren en dos eixos diferents. El primer i més important és l'eix històric: el CRM ofereix uns serveis mitjançant l'activitat científica que s'hi fa en suport dels grups de recerca en sentit ampli, a nivell internacional. Els instruments són ben coneguts: programes de recerca, cursos avançats, congressos, *workshops* i jornades temàtiques. Aquestes activitats han estat ben nombroses durant l'any 2008, tal com queda reflectit a les pàgines que venen a continuació. Des del punt de vista pressupostari, el projecte *Ingenio Mathematica*, del qual el CRM és un node, hi ha tingut un paper molt destacat. Dins d'aquest eix tradicional, també cal esmentar la convocatòria oberta d'estades de recerca, que inclou estades en col·laboració, a través de les quals es poden invitar visitants al CRM per tal que donin fruit les col·laboracions amb matemàtics locals.

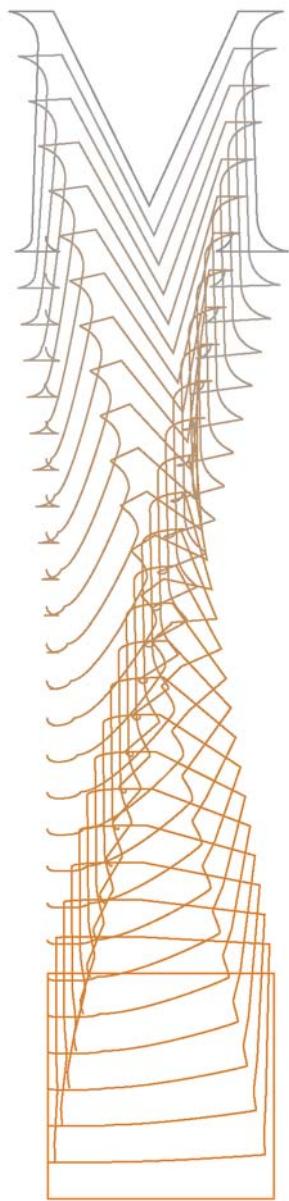
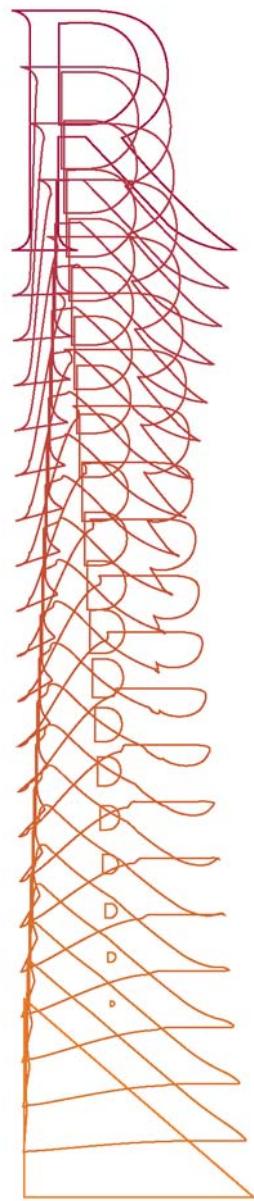
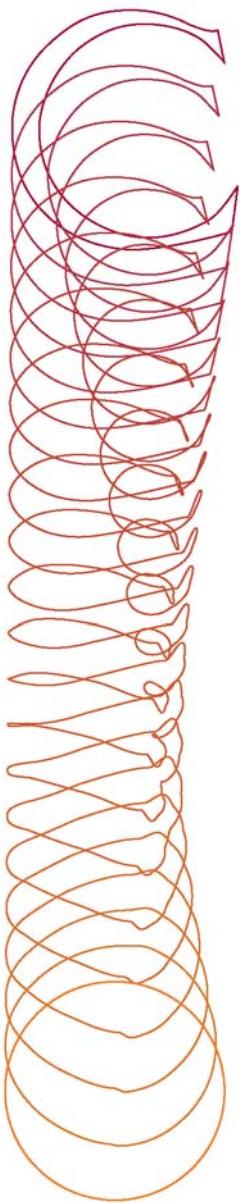
El segon eix, que és nou, és l'eix estratègic. El CRM pretén jugar un paper més actiu en la promoció de línies noves de recerca deficitàries a Catalunya, tal com es defineix en el Programa IAE d'incentivació d'àrees estratègiques, i en la creació de grups nous mitjançant la contractació d'investigadors propis. A un ritme modest, el CRM està començant a construir una plantilla d'investigadors, dins la qual els becaris postdoctorals són una peça essencial. A la convocatòria de beques postdoctorals de la tardor de 2008 al CRM es varen presentar 61 sol·licitants, una xifra que evidencia l'interès d'aquest programa.

L'any 2008 també hi ha hagut una novetat referent a les publicacions: el CRM ha encetat una nova sèrie d'exemplars titulada *Documents*, que s'uneix a les sèries ja existents: *Advanced Courses in Mathematics CRM Barcelona*, *Quaderns* i *Preprints*.

El CRM està creixent, tant quantitativament com qualitativa. Aquest creixement estarà recolzat per una ampliació dels locals: la Generalitat de Catalunya ha aprovat el 2008 un pressupost de construcció de 900 m² addicionals d'espais. D'altra banda, l'equip administratiu del Centre també ha crescut el 2008 amb dues noves persones a la secretaria i amb la contractació d'un gerent.

Joaquim Bruna
Director





Presentation

This report offers an overview of what has been going on at the CRM during 2008. The most important feature is that 2008 was the first year of the six-year contract programme that the CRM has signed with the Generalitat de Catalunya (the Catalan Government) through its Department of Innovation, Universities and Enterprise. This contract programme draws the main guidelines of CRM activity in all areas and has served as a roadmap for 2008.

There are two different axes in the scientific policy and activity of the CRM. The first and most important is the historic one, namely the CRM acting as a service centre through the scientific activity that is carried out in support of research groups in a wide sense, at an international level. The instruments are well known: research programmes, advanced courses, conferences, workshops, and thematic days. The activity along these lines was quite intense in 2008, as the reader may see in the following pages. From the budgetary point of view, an important role in this axis of activity has been played by the Ingenio Mathematica project, of which the CRM is a node. In this traditional axis we should also mention the open call for research stays, including research in pairs, through which a number of visitors come to the CRM in order to push forward research collaborations with local mathematicians.

The second axis is the strategic axis, a newer one, in which the CRM aims at playing a more active role in the promotion of new research lines that are deficitary in Catalonia, as defined in the Strategic Areas Incentive Programme and in the creation of new groups through the appointment of researchers. At a modest pace, the CRM is building its own research staff, of which postdoctoral fellows constitute an essential piece. The CRM postdoctoral call in the Fall of 2008 had 61 applicants, a figure that shows the success of this programme.

Regarding publications, something new in 2008 was the launch of a new series called Documents, which, together with the Advanced Courses series and the Quaderns and Preprints, constitutes the family of CRM publications.

All in all, the CRM is growing, both quantitatively and qualitatively. This increase will rely on a forthcoming enlargement of the CRM premises, since the Government of Catalonia also approved a budget in 2008 to build an additional space of 900 m². The CRM administration staff has increased too, with two new appointments and the recruitment of a general manager in 2008.

Joaquim Bruna
Director



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1.1. Missió i objectius

L'objectiu definit als estatuts del CRM és la recerca i la formació avançada en l'àmbit de les matemàtiques, mitjançant la col·laboració i les sinergies amb les universitats i les institucions de recerca de Catalunya, amb l'objectiu de mantenir-se com un referent científic internacional en aquest àmbit.

El CRM és un centre amb implantació interuniversitària en el sentit que de la seva activitat se'n beneficia el conjunt de la recerca en matemàtiques del país. La política científica del CRM per a l'assoliment de la seva missió té dos eixos d'actuació:

- Donar suport als grups d'investigació, organitzant tipus d'activitats que depassen la capacitat dels mateixos, amb projecció internacional i acollint visitants amb qui treballen conjuntament.
- Des d'un punt de vista més proactiu, dissenyar i executar polítiques estratègiques que incideixin en debilitats de la recerca matemàtica a Catalunya entesa globalment, com són el Programa IAE d'incentivació d'àrees estratègiques i el pla de creació d'un cos propi i estable d'investigadors d'excel·lència.

1.1. Mission and Objectives

As stated in its statutes, the CRM's aim is to foster research and advanced training in mathematics, by collaborating with the universities and research institutions in Catalonia, in order to continue to be an international reference center.

The CRM is transversal in the sense that its activities benefit the whole community of mathematical researchers in our country. The scientific policy of the CRM towards fulfilling its mission is structured around two main axes:

- To give support to research groups by organising activities of a size or nature that goes beyond the capabilities of the teams, achieving broad visibility and hosting visitors for joint work.
- To design and execute strategies aimed at repairing weaknesses of the mathematical research activity in Catalonia as a whole, such as the Strategic Areas Incentive Programme and the creation of a permanent staff of high-level CRM researchers.

1.2. Estructura jurídica

El CRM va ser creat l'any 1984 per l'Institut d'Estudis Catalans (IEC) com a centre de recerca propi. El mateix any, l'IEC signà un conveni de col·laboració amb la Universitat Autònoma de Barcelona (UAB), en virtut del qual el Centre quedà ubicat físicament en uns espais d'aquesta universitat. L'any 1993 s'adequaren uns espais propis per al CRM a la Facultat de Ciències de la UAB amb finançament de la CIRIT. Per aquest motiu, es reformulà el conveni entre l'IEC i la UAB i se sol·licità l'adscripció del CRM a la UAB com a institut universitari.

L'accord del Govern de la Generalitat de 9 de juliol de 2002 (DOGC núm. 3693, de 6 d'agost) aprova la constitució del Consorci Centre de Recerca Matemàtica, integrat per la Generalitat de Catalunya i l'IEC. El Consorci és una entitat pública amb personalitat jurídica pròpia.

El CRM està regit pel Consell de Direcció i pel director, i compta amb un Consell Científic Assessor.

1.2. Legal Status

The CRM was founded in 1984 by the Institut d'Estudis Catalans (IEC), the Catalan Academy. In the same year, an agreement was signed with the Universitat Autònoma de Barcelona (UAB, Autonomous University of Barcelona), by virtue of which the CRM became established in the UAB Campus. In 1993 the CRM inaugurated its own premises at the UAB's Science Faculty, thanks to financial support from CIRIT. On that occasion, the CRM became associated with the UAB as one of its research institutes.

The Government of Catalonia approved on July 9, 2002 (DOGC no. 3693, August 6, 2002) the creation of the CRM Consortium, formed by the Government and the IEC. The CRM Consortium is a public body with its own legal status.

The CRM is conducted by its Governing Board and the Director, and has a Scientific Advisory Board.

1.3. Consell de Direcció

El Consell de Direcció, òrgan superior de decisió i d'administració del CRM, està format per:

- El president, que és la comissionada per a Universitats i Recerca, per delegació del conseller d'Innovació, Universitats i Empresa.
- El vicepresident, que és el president de l'IEC.
- Tres vocals en representació de la Generalitat de Catalunya.
- Tres vocals en representació de l'IEC.
- El director del CRM, que hi participa amb veu però sense vot.

Durant l'any 2008, la Generalitat de Catalunya hi va estar representada pel director general de

1.3. Governing Board

The Governing Board is the steering body of the CRM. Its members are the following:

- The Commissioner for Universities and Research, acting as Chair by delegation of the Minister of Innovation, Universities and Enterprise of the Catalan Government.*
- The IEC President, acting as Vice Chair.*
- Three representatives of the Catalan Government.*
- Three representatives of the IEC.*
- The CRM Director, without vote.*

In 2008, the three representatives of the Catalan Government were Ramon Moreno (General

Recerca, Ramon Moreno, la subdirectora general de Recerca, Iolanda Font, i el director de la CIRIT, Joan Roca. L'IEC hi va estar representat pel seu vicepresident, Salvador Alegret, el secretari científic, Ricard Guerrero, i per Joan Girbau.

El Consell de Direcció es va reunir el 10 de març de 2008.

Director of Research), Iolanda Font (Vice Director of Research), and Joan Roca (Director of CIRIT). The IEC was represented by Salvador Alegret (Vice President), Ricard Guerrero (Scientific Secretary), and by Joan Girbau.

The annual meeting of the Governing Board was held on March 10, 2008.



1.4. Equip de Direcció

El director del CRM és nomenat pel Consell de Direcció, a proposta del president, per a un període de quatre anys. El director actual és Joaquim Bruna, que va ser nomenat per al període de 2007 a 2011.

A proposta del director, el Consell de Direcció va nomenar el 2007 un equip format per Carles Casacuberta, Marta Sanz-Solé i Joan Solà-Morales. Aquest equip assessorà i ajuda el director en les tasques de gestió del Centre.

Manuel Castellet, que va ser director del CRM des de la seva creació el 1984, va ser nomenat director honorari pel Consell de Direcció el 2007.

1.4. Team of Directors

The Governing Board elects a Director, proposed by the Chair, to serve for a period of four years. The current Director is Joaquim Bruna, who was elected for the period 2007-2011.

On the Director's proposal, in 2007 the Governing Board also nominated a team consisting of Carles Casacuberta, Marta Sanz-Solé and Joan Solà-Morales, whose goal is to advise and assist the Director in the management of the Centre.

Manuel Castellet, who had been CRM Director since the creation of the Centre in 1984, was appointed Honorary Director by the Governing Board at its 2007 meeting.



1.5. Consell Científic Assessor

El Consell Científic Assessor està integrat per personalitats de prestigi científic en l'àmbit d'actuació del Centre, nomenats pel Consell de Direcció a proposta del director, el qual n'ostenta la presidència. La llista de membres del Consell Científic Assessor s'especifica a continuació.

El Consell Científic Assesor es va reunir el 13 de juny de 2008 amb els punts següents a l'ordre del dia: memòria anual de 2007; activitats del curs acadèmic 2007-2008; activitats previstes per a 2008-2009; evaluació de les propostes per a 2009-2010; places de personal investigador propi del Centre; investigadors visitants; col·laboracions bilaterals; perspectives del Centre a curt i llarg termini.

1.5. Scientific Advisory Board

The CRM's Scientific Advisory Board is formed by outstanding mathematicians, nominated by the Governing Board on the Director's proposal, and chaired by the Director. The current list of members of the Scientific Advisory Board is given below.

The Scientific Advisory Board met on June 13, 2008, with the following agenda: 2007 report of activities; programme of activities for 2007-2008; expected activities in 2008-2009; evaluation of proposals for 2009-2010; new research positions; visitors; bilateral agreements; mid-term and long-term perspectives of the Centre.

Jaume Aguadé, Universitat Autònoma de Barcelona

Alfredo Bermúdez de Castro, Universidade de Santiago de Compostela

Michel Boileau, Université de Toulouse

Aline Bonami, Université d'Orléans

Bodil Branner, Danmarks Tekniske Universitet, Lyngby

Luis Caffarelli, University of Texas at Austin

Eduard Casas-Alvero, Universitat de Barcelona

José L. Fernández, Universidad Autónoma de Madrid and AFI

Gerhard Frey, Institut für Experimentelle Mathematik, Essen

Oscar García Prada, Consejo Superior de Investigaciones Científicas, Madrid

Antonio Huerta, Universitat Politècnica de Catalunya, Barcelona

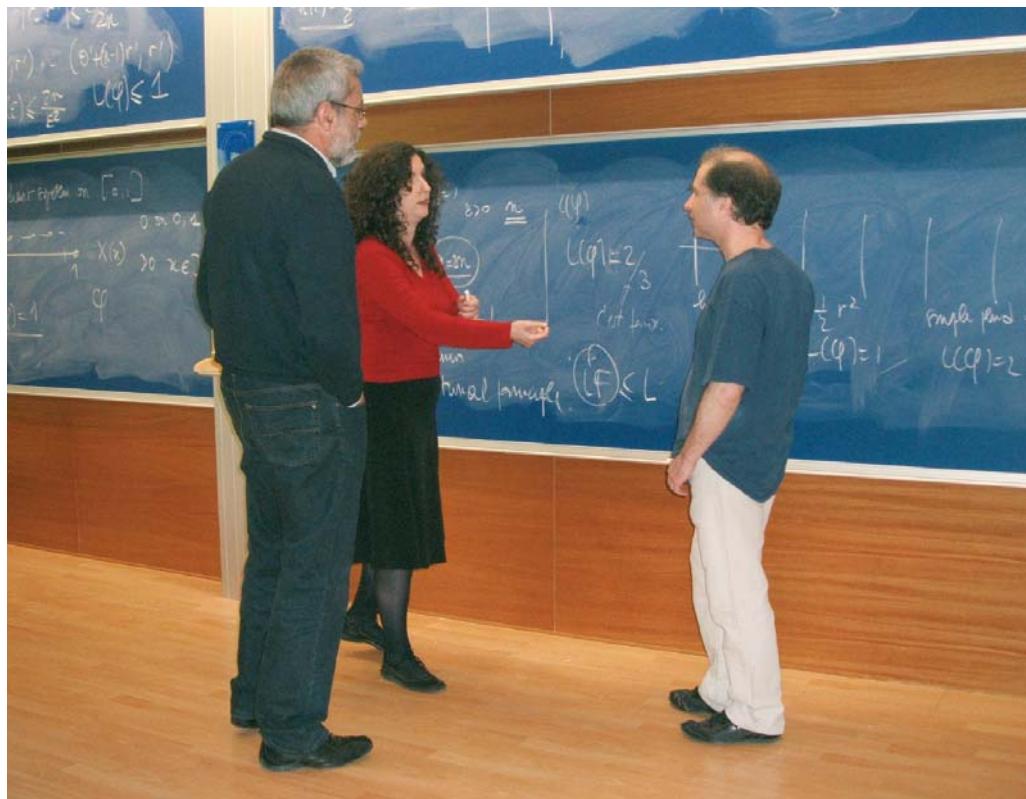
Andreu Mas-Colell, Universitat Pompeu Fabra, Barcelona

Dominique Picard, Université Paris VII

Kristian Seip, Norges Teknisk-Naturvitenskapelige Universitet, Trondheim

Maria Eulalia Vares, Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro

Dominic Welsh, University of Oxford



1.6. Personal investigador

El CRM, des de la seva fundació i fins a 2007, no havia tingut personal investigador propi estable, sinó que el seu personal investigador estava format pels visitants (locals o forans) i per becaris postdoctorals. El pla estratègic del CRM per al període 2008-2013 preveu la formació d'una plantilla pròpia d'investigadors contractats. La primera incorporació amb aquest perfil es va produir l'any 2007.

Una gran part de l'activitat del CRM es recolza científicament en el personal investigador de les universitats catalanes. Tot i això, el CRM no basa aquesta col·laboració en la figura del professorat adscrit. El CRM, per tant, tampoc no té personal adscrit universitari.

El nombre d'investigadors que de mitjana es troben al CRM és actualment de 30 persones en cada moment.

1.6. Research Staff

Until 2007, the only CRM researchers were visitors (local or foreign) and postdoctoral fellows. The CRM's strategic plan for 2008-2013 includes the appointment of research staff through long-term contracts. The first contract was signed in 2007.

A large amount of CRM activities rely on initiatives from research teams of Catalan universities. This collaboration is however not based on any changes of affiliation, and therefore the CRM does not have adscribed personnel from the universities in its staff.

The average number of researchers currently hosted by the CRM is 30 people simultaneously.

1.6.1. Investigadors estables

1.6.1. Long-term Researchers

Álvaro Corral (CRM-I3)

Since December 2007

Research topic: Analysis and modeling of complex systems

Report:

We study the behavior of the so-called complex systems, which are systems built by many units under interaction, and are widespread across the natural and the social sciences. We focus on the outcomes of two complex systems: On the one hand, the Earth, at the tectonic, oceanic, atmospheric, and ecological level, investigating diverse natural hazards and related meteorological phenomena, such as earthquakes, hurricanes, rainfall, or forest fires. On the other hand, we are interested in the properties of one of the main products of the human brain: language, as reflected in texts or speech.

Our approach starts at the phenomenological level, with the detailed analysis of observational data or representative text corpora. The goal is to find statistical patterns that could be formulated as new probabilistic laws. The probabilistic description can shed light on the limits of predictability in these systems. In the cases considered so far, it has been found that the probability distributions measuring diverse properties of the phenomena usually verify scaling laws, signaling the existence of scale invariance. In this way, for natural hazards, the very frequent small events can be a model for the occurrence of the scarce large ones. Regarding text analysis, the patterns of word repetitions could help in the automatic detection of keywords. The second step is the introduction of simple models that are able to reproduce the properties of the systems.

Activities in 2008: Member of the scientific committee of the international conference Modelling Geophysical Systems by Statistical Mechanics Methods, held in Erice, Italy, April 2008; two invited talks and one contributed talk in international conferences.

Sebastian del Baño Rollin (CRM)

Since July 2008

Research topic: Financial mathematics

Report:

A number of lines of enquiry are being pursued, basically centered around stochastic volatility models and the Monte Carlo method. Stochastic volatility models are one of the fundamental tools used by investment banks in the assessment of their market risk. We have made a number of contributions in this field, especially in the context of the Heston model. By applying the Cauchy residue formula to the characteristic function of log-spot we have shown in Spot inversion in the Heston model (CRM Preprint 837) that the Heston model is stable under spot inversion in a simple manner described by an unexpected change of model parameters. Following a suggestion by Vladimir Piterbarg (Barclays) we have recently extended this result to arbitrary stochastic volatility models where we can establish a criterion for the consistency of the model under spot inversions. For example, we show that the popular Hull–White model is not stable under inversions and therefore should be used with great care.

In A new look at the Heston characteristic function (CRM Preprint 846), together with Frederic Utzet (UAB) and Albert Ferreiro (UAB-CRM), we have studied the poles of the characteristic function for log-spot in the Heston model. This is of great importance in

pricing derivatives sensitive to the wings in the smile (such as autoquanto FX options, LIBOR in arrears deals and FX performance notes). Additionally we establish a Weierstrass product type decomposition for the characteristic function which has practical implications for the simulation of the Heston model to be explored. Together with Joan Andreu Lázaro Camí (CRM) in Higher dimensional antithetics (CRM Preprint to appear) we have devised a new technique for speeding up the calculation of financial derivatives using Monte Carlo simulations. The Monte Carlo method is de facto the only pricing method in the presence of a large number of assets, for example in typical mountain range equity exotics, since in this case PDE techniques become numerically unstable. We introduce the concept of higher dimensional antithetic as the orthogonal matrix that minimises a certain correlation function defined on the compact Lie group $O(N)$. This matrix is used to facilitate the acceleration of Monte Carlo calculations. Preliminary numerical experiments indicate this to be a very promising line of enquiry with very realistic applications in the banking industry. These results will be presented at the Third Conference on Numerical Methods in Finance to be held in Paris in April 2009.

In addition to these scientific contributions, we have also worked towards the stimulation of the field of quantitative finance in Barcelona. We have done so by organising the Barcelona Financial Engineering Seminar jointly with Barcelona Stock Exchange, and by starting a very well-received summer school: the Barcelona Financial Engineering Summer School.

Sergey Tikhonov (CRM-ICREA)

Since October 2008

Research topics: Harmonic analysis and approximation theory

Report:

In 2008, the research lines of Sergey Tikhonov addressed several topics in harmonic analysis and approximation theory. The following topics were considered: Fourier transforms/series: weighted integrability criteria, convergence criteria; weighted polynomial approximation; sharp inequalities for moduli of smoothness and K-functionals; spaces of measurable functions, embedding theorems, integral operators.

The author published 10 articles in 2008. Bibliographic references are given in the publications section below (see 3.1).

Activities in 2008: Seminar Sophus Lie, Technische Universität Darmstadt, Germany; Auburn Miniconference on Harmonic Analysis and Related Areas, Auburn, USA (invited talk); Analysis Seminar, Georgia Institute of Technology, USA.

1.6.2. Investigadors postdoctorals

El CRM acull investigadors postdoctorals amb fonts de finançament diverses: beques Marie Curie de la Comissió Europea, programa d'ajudes de recerca per a estades de doctors joves del Ministeri de Ciència i Innovació (MICINN), beques Beatriu de Pinós de la Generalitat de Catalunya, beques de l'EPDI (vegeu 1.15) i beques pròpies del CRM.

Normalment aquestes beques tenen una durada d'entre un i dos anys. El llistat d'investigadors postdoctorals que varen treballar al CRM durant l'any 2008 es detalla a continuació.

Mathieu Anel (CRM)
September 2007 to August 2008

Pierre Berger (EPDI)
Since September 2008

Jérôme Dubois (Marie Curie)
September 2006 to August 2008

L. Houssain El Fadil (MICINN)
Since November 2007

Mostafa El Kalmoun (MICINN)
December 2007 to August 2008

Nicola Gambino (CRM)
September 2007 to August 2008

Javier Gutiérrez (Beatriu de Pinós)
Since September 2007

Gemma Huguet (CRM)
Since September 2008

1.6.2. Post-doctoral Researchers

The CRM receives post-doctoral fellows from several financing sources: Marie Curie Fellowships of the European Commission, research grants for young doctors of the Spanish Ministry of Science and Innovation (MICINN), Beatriu de Pinós Fellowships of the Catalan Government, EPDI Fellowships (see 1.15), and CRM's own post-doctoral grants.

Typically these grants have a duration of between one and two years. The list of post-doctoral researchers working at the CRM in 2008 is the following.

Carlo Marinelli (MICINN)
May 2007 to April 2008

Francesco Matucci (CRM)
Since September 2008

Anne Pichereau (EPDI)
October 2007 to September 2008

Radu Saghin (MICINN)
Since September 2007

Graham Smith (CRM)
Since October 2008

Asli Yaman (Marie Curie)
August 2005 to November 2008

Marco Zambon (MICINN)
January to August 2008

1.6.3. Investigadors predoctorals

L'any 2003, el CRM va iniciar una nova política d'estímul a la recerca matemàtica relacionada amb les àrees prioritàries del 6è programa marc de la Unió Europea. Per tal d'impulsar aquesta línia d'actuació, el CRM va atorgar tres beques l'any 2006, destinades a la realització de tesis doctorals a les universitats catalanes. Des de 2007, el CRM dóna suport a aquesta iniciativa a través del Programa d'incentivació d'àrees estratègiques (vegeu 1.13).

El llistat de becaris predoctorals del CRM durant l'any 2008 s'especifica a continuació.

Albert Ferreiro (CRM-UAB)

Since June 2007

Topic: Mathematical Finance

Advisor: Frederic Utzet, Universitat Autònoma de Barcelona

Pedro Ernesto García Rodríguez (CRM-UPF)

Since February 2007

Topic: Mathematical Neuroscience

Advisor: Gustavo Deco, Universitat Pompeu Fabra

Somayeh Heidarvand (CRM-UPC)

Since September 2007

Topic: Digital Content Security

Advisor: Jorge Luis Villar, Universitat Politècnica de Catalunya

Jinggan Tan (CRM-UPC)

September 2006 to March 2008

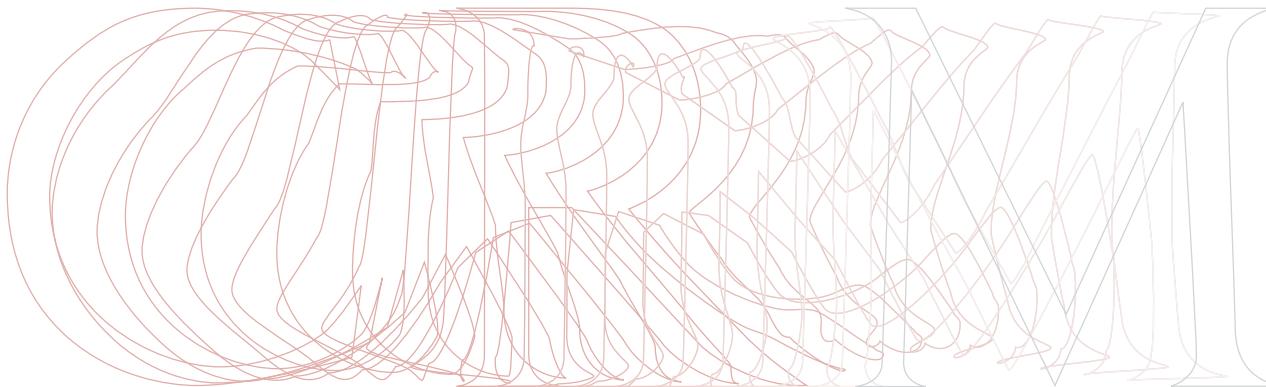
Topic: Partial Differential Equations

Advisor: Xavier Cabré, Universitat Politècnica de Catalunya

1.6.3. Doctoral Researchers

In 2003, the CRM initiated a new policy to stimulate mathematical research linked to the priority thematic areas of the Sixth Framework Programme of the European Union. In order to promote impetus for this line of action, the CRM awarded three scholarships in 2006, for doctoral theses at a university in Catalonia. Support to this initiative is provided since 2007 by the CRM's Strategic Areas Incentive Programme (see 1.13).

The list of CRM doctoral researchers in 2008 is the following:



1.7. Administració

1.7.1. Gerent

El desembre de 2008 es va incorporar al CRM el Sr. Oriol Fernández com a nou gerent (ofernandez@crm.cat, telèfon 93 581 8424).

1.7.2. Equip de secretaria

Les persones esmentades a continuació varen formar l'equip de secretaria del CRM l'any 2008. La Sra. Lara González es va incorporar el mes de juny i la Sra. Maria Àngels Huertos el mes de novembre. A més, el CRM va rebre suport administratiu de les persones següents durant l'any 2008: Borja de Balle (de gener a març), Edgar Ferrer (de març a juny), Raquel Hernández (des de gener), Kamaya Lindquist (d'abril a juny) i Pere Menal (de gener a abril).

1.7. Administration

1.7.1. Manager

Mr. Oriol Fernández was hired as a new manager of the CRM in December 2008 (ofernandez@crm.cat, phone 93 581 8424).

1.7.2. Secretarial Team

The CRM secretaries are listed below. Ms. Lara González joined the team in June 2008 and Ms. Maria Àngels Huertos joined in November. In addition, the CRM was administratively assisted in 2008 by Borja de Balle (January to March), Edgar Ferrer (March to June), Raquel Hernández (since January), Kamaya Lindquist (April to June), and Pere Menal (January to April).



Ana García-Donas

agarcia@crm.cat

Phone: 93 581 2953

Lara González

lgonzalez@crm.cat

Phone: 93 581 8423

Núria Hernández

nhernandez@crm.cat

Phone: 93 581 8192

Maria Àngels Huertos

mahuertos@crm.cat

Phone: 93 581 1081

Neus Portet

nportet@crm.cat

Phone: 93 581 4086

Consol Roca

croca@crm.cat

Phone: 93 581 1081

Mari Paz Valero

mpvalero@crm.cat

Phone: 93 581 1081

1.8. Equipament

Els espais que actualment ocupa el CRM estan situats en una ala de l'edifici de la Facultat de Ciències de la UAB, amb una superfície total de 1.225 m², que permeten la ubicació de la secretaria, la direcció, un màxim de 30 investigadors i dues aules amb capacitat per a 30 i 100 persones.

Per a l'allotjament dels investigadors visitants, el CRM té llogats en règim permanent una dotzena d'apartaments a la Vila Universitària de Bellaterra, a Sant Cugat i a Barcelona ciutat. Per a l'organització d'activitats puntuals com congressos i cursos avançats, el CRM lloga estudis a la Vila Universitària.

Durant l'any 2008, l'equipament informàtic del CRM constava d'una xarxa LAN Ethernet de 1.000/100 Mbps. A la xarxa hi ha connectades 47 estacions de treball, dues estacions Linux i cinc impressores. Totes les estacions formen part d'un domini Windows controlat des d'un servidor central (HP Netserver LC 10) que fa, a més, tasques de servidor de correu electrònic i DNS del domini propi del CRM (crm.cat). Un

1.8. Equipment

The CRM has facilities in the UAB Faculty of Sciences with a total floor space of 1.225 m², including secretarial offices, the Directors's desk, up to 30 researcher places, an auditorium with capacity for 100 people, and a lecture room for 30 people.

The CRM also has a few rented furnished apartments for the use of its visitors in Sant Cugat del Vallès (a town connected by train to the UAB campus and to Barcelona), in Barcelona, and in the Vila Universitària of the UAB campus. During activities such as conferences or advanced courses, the CRM rents additional apartments at the Vila Universitària.

In 2008, the CRM computer equipment was based on a LAN Ethernet net of 1.000/100 Mbps. There were 47 working stations connected to the net, together with two Linux stations and five printers. All workstations are part of a Windows Domain supplied by a central server (HP Netserver LC 10) that at the same time works as a mail server and DNS server of the CRM's own domain (crm.cat). A second server is



segon servidor serveix de còpia de seguretat i com a servidor SQL (aplicació de base de dades per a l'administració del CRM). Aquesta xarxa LAN és connectada a Internet a través de la xarxa de la UAB mitjançant un enllaç de 1.000 Mbps, amb un NetScreen 5 que actua com a encaminador, tallafocs i VPN. El centre disposa també de connexió a Internet sense cables i de tres canons de projecció, dos dels quals estan instal·lats a les aules.

1.9. Serveis externs

El CRM té contractats els serveis de les empreses externes següents:

Accounting and labour: Consultors Rodao & Associats (until October 2008)

Computer technical service: GetPut Software S.L.

Data base management: Àgil Grup

Labour management: 3F Consultors (since October 2008)

1.10. Contracte programa

El primer contracte programa del CRM amb la Generalitat de Catalunya es va signar el 18 de juny de 2003. Es va mantenir vigent fins a 2006 i es va prorrogar durant l'any 2007. El 14 de febrer de 2009 s'ha signat un segon contracte programa que cobreix el període de 2008 a 2013. Aquest contracte programa emana del pla estratègic del Centre, que va ser aprovat pel Consell de Direcció, i és la concreció dels eixos de desplegament continguts en el pla.

El desenvolupament del contracte programa s'analitza cada any en una reunió d'una comissió mixta de seguiment.

En el mateix marc institucional, el CRM participà el 10 de novembre de 2008 en l'acte d'adhesió al Pacte Nacional per a la Recerca i la Innovació (PNRI), conjuntament amb la resta dels centres de recerca participants pel Govern de la Generalitat.

used as a back-up and as an SQL server (data base for the CRM's management software). This LAN net is connected to Internet through the UAB net by means of a 1.000 Mbps connection, with a NetScreen 5 acting as a router, firewall and VPN. Wi-fi connection is also available. The Centre has three projectors, two of them installed in the lecture rooms.

1.9. External Services

The following companies had service contracts with the CRM in 2008:

1.10. Contract Programme

The first contract programme of the CRM with the Catalan Government was signed on June 18, 2003. It remained into force until 2006 and was extended over 2007. On February 14, 2009, a new contract programme was signed for the period 2008-2013. This contract programme stems from the CRM's strategic plan, which was approved by the Governing Board, and specifies the main axes of the strategic plan.

The development of the contract programme is analysed and discussed in an annual meeting of a Monitoring Commission.

In the same institutional framework, the CRM participated in the presentation of the PNRI (National Agreement for Research and Innovation) on November 10, 2008, jointly with the other research centres sponsored by the Catalan Government.

1.11. Convocatòries internacionals

El CRM manté permanentment obertes diverses convocatòries al seu web:

- Estades de recerca al Centre
- Estades de recerca en col·laboració (*research in pairs*)
- Organització de congressos i *workshops*
- Organització de cursos d'estiu/hivern
- Organització de jornades temàtiques

D'altres convocatòries s'obren només durant períodes concrets:

- Programes de recerca
- Places de personal investigador sènior
- Places Lluís Santaló per a visitants d'Amèrica Llatina
- Beques postdoctorals (EPDI, Marie Curie i beques pròpies)
- Beques de doctorat en àrees estratègiques
- Beques per a treballs de recerca de final de màster o similars

1.12. Ingenio Mathematica

El CRM és un dels promotores i un node d'un projecte anomenat *Ingenio Mathematica*, finançat pel Ministeri de Ciència i Innovació durant cinc anys dins del programa Consolider-Ingenio 2010. La data d'inici d'aquest projecte va ser el 3 d'octubre de 2006.

L'investigador coordinador del projecte és actualment Marco Antonio López Cerdá, de la Universitat d'Alacant, i l'entitat gestora és la Universitat de Cantàbria. La direcció científica del projecte correspon a un consell de direcció format per investigadors de diverses institucions de l'estat espanyol. Els nodes del projecte són: CRM, CESGA (Centro de Supercomputación de Galicia), CIEM (Centro Internacional de Encuentros Matemáticos, Castro Urdiales),

1.11. International Calls

The CRM keeps several calls open in its website:

- Visiting the CRM
- Research in pairs
- Organisation of conferences and workshops
- Organisation of summer/winter courses
- Organisation of thematic days

Other calls are only open in specific periods:

- Research programmes
- Senior research positions
- Lluís Santaló positions for Latin American visitors
- Post-doctoral grants (EPDI, Marie Curie, CRM)
- Doctoral grants for work in strategic areas
- Grants for master's or similar projects

1.12. Ingenio Mathematica

The CRM is one of the promoters, and a node, of a project called *Ingenio Mathematica*, which is being funded by the Spanish Ministry of Science and Innovation for five years, starting on October 3, 2006, within the Ministry's Consolider-Ingenio 2010 programme.

The coordinator of the project is currently Marco Antonio López Cerdá, from Alicante University, and the management center is located at Cantabria University. The scientific direction of the project lies under the responsibility of a Board of Directors formed by researchers from several Spanish institutions. The nodes of the project are: CRM, CESGA (Galicia Supercomputing Centre), CIEM (International Centre for Mathematical Meetings, Castro Urdiales), ICMAT (Mathematical Sciences Institute, Madrid), and IMUB (Institute of Mathematics, University of Barcelona). Several platforms, named Future, Consulting,

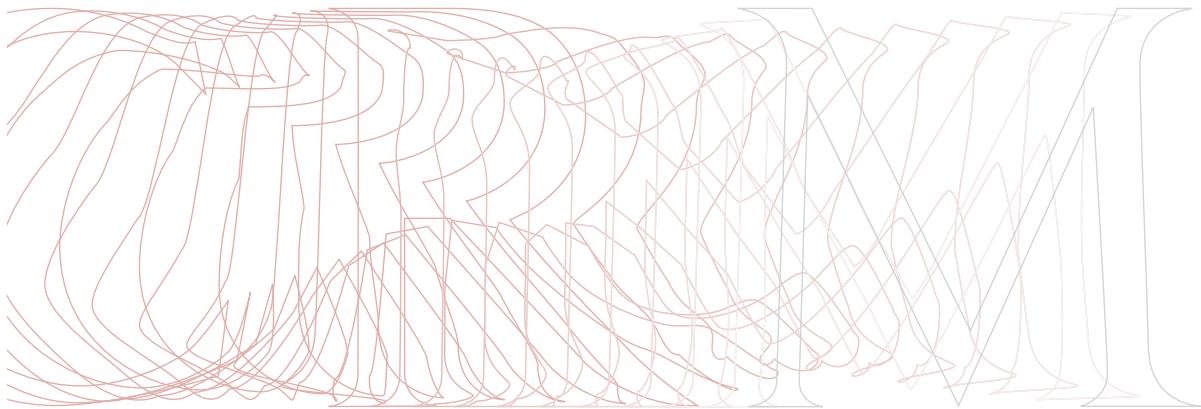
ICMAT (Instituto de Ciencias Matemáticas, Madrid) i IMUB (Institut de Matemàtiques de la Universitat de Barcelona). Les activitats del projecte s'emmarquen en diverses plataformes, anomenades *Future*, *Consulting*, *Computing*, *EDU*, *PMII*, *SARE*, *SAIRT* i *MIGS*.

Les activitats següents del CRM varen obtenir finançament del projecte *Ingenio Mathematica* durant 2008:

- Research Programme on Homotopy Theory and Higher Categories
- Research Programme on Geometric Flows and Equivariant Problems in Symplectic Geometry
- Research Programme on Stability and Instability in Mechanical Systems
- DocCourse Combinatorics and Geometry 2008
- Barcelona Financial Engineering Summer School 2008
- International School on Mathematical Cryptology 2008
- Barcelona Conference on Asymptotic Statistics (BAS 2008)
- Mathematics and Technology Study Groups (GEMT 2008)

Computing, EDU, PMII, SARE, SAIRT, and MIGS, provide a framework for the actions of Ingenio Mathematica.

The following CRM activities were partially funded by Ingenio Mathematica in 2008:



1.13. Programa d'incentivació d'àrees estratègiques

El seguiment de les possibles àrees emergents de la matemàtica i les seves aplicacions és un objectiu prioritari per al CRM, així com l'aportació d'incentius i de recursos per tal que els investigadors en àrees tradicionals o els més joves s'hi puguin incorporar. Per aquest motiu, el CRM impulsa el Programa IAE d'incentivació d'àrees estratègiques des de 2007, com a continuació de diverses iniciatives d'anys anteriors i amb el propòsit de fomentar la investigació multidisciplinària en àrees considerades interessants i importants en aquests moments.

El CRM pretén continuar fomentant la recerca en les àrees del projecte europeu MATHFSS, que s'ha desenvolupat entre els anys 2005 i 2008. Al final del període de vigència d'aquest projecte, el CRM s'ha compromès a seguir donant suport a tres temes específics: neurociència matemàtica, matemàtica financer i criptografia. El CRM ha organitzat diverses activitats en aquests temes durant els darrers anys i manté seminaris periòdics sobre dos d'ells. En segon lloc, el CRM vol potenciar àrees interdisciplinàries representades de manera insuficient en els departaments universitaris. En tercer lloc, el CRM vol comprometre's en temes de matemàtica industrial. Aquest terme s'ha d'entendre en un sentit ampli, per tal d'encabir-hi problemes aplicats no exactament industrials, com els originats en moltes branques de la tecnologia o la medicina.

Les accions que està fent el CRM dins del programa IAE són dels tipus següents:

- Organització de *workshops*, seminaris i cursos.
- Ajuts als grups que treballen en àrees estratègiques.
- Suport a la creació i desenvolupament de nous grups de qualitat en aquestes àrees, dedicant-hi beques i altres recursos.

1.13. Strategic Areas Incentive Programme

The monitoring of possible emerging areas in mathematics and their applications, as well as the contribution of incentives and resources so that researchers in traditional areas or younger researchers can join these emerging sectors, must be a high priority objective for a mathematical research centre. This is how the CRM views its Strategic Areas Incentive Programme (IAE), which is currently being planned for the coming years.

*The CRM aims to continue promoting work in the areas of the MATHFSS project (*Shaping New Directions in Mathematics for Science and Society*), which was developed between 2005 and 2008 with European funding. At the end of the project period, the CRM declared its commitment to continue supporting three specific areas: mathematical neuroscience, financial mathematics, and cryptography. On these themes the CRM has organised several activities in the past years and currently offers periodical seminars on the first two. Secondly, the CRM wishes to strengthen emerging interdisciplinary areas, under-represented in university departments. Thirdly, the CRM wishes to extend its commitment to the areas of industrial mathematics. This topic should be understood in its broadest sense in order to remain open to the application of problems that are not exactly industrial, such as those which originate in many branches of technology or medicine.*

Actions undertaken by the CRM within the IAE programme include the following:

- Organisation of events such as workshops, seminars, and courses.
- Support for local groups working in these areas.
- Participation in the creation and development of new quality groups in these areas, by allocating resources (doctorate scholarships and post-doctoral grants) as in recent years.

Concretament, durant l'any 2008, el CRM ha organitzat les activitats següents en el marc del programa IAE. Hi ha més informació sobre elles a la secció d'activitats.

- Grups d'estudi de matemàtica i tecnologia (GEMT 2008)
- *Barcelona Financial Engineering Seminar*
- *Seminar Cycle on Computational and Systems Neuroscience*

El CRM va obrir el 2008 una convocatòria per tal d'incentivar treballs de màster en àrees emergents, dins la qual fou seleccionada l'estudiant Ania Kedzierska, la qual, sota la direcció de la Dra. Marta Casanellas, va realitzar un treball titulat *Estudi de xarxes bayesianes per a elements de regulació de splicing*. A més, tres estudiants estan duent a terme projectes de doctorat en àrees del programa IAE a les universitats catalanes amb finançament del CRM des de 2007 (vegeu 1.6.3).

1.14. ERCOM

ERCOM és l'acrònim del comitè *European Research Centres on Mathematics* de la Societat Matemàtica Europea (EMS), format pels directors científics de diversos centres de recerca europeus. Els centres representats a ERCOM són aquells el nombre de visitants dels quals supera essencialment el nombre d'investigadors permanents o de llarga durada i que cobreixen un espectre ampli de les matemàtiques. El CRM és membre d'ERCOM des de la fundació del comitè l'any 1997.

El president d'ERCOM és nomenat per un període de quatre anys pel comitè executiu de l'EMS. Des de 2006, ERCOM és presidit per Jan Karel Lenstra, director del Centrum voor Wiskunde en Informatica d'Amsterdam. La reunió anual d'ERCOM de 2008 tingué lloc els dies 7 i 8 de març al Centro Internacional de Matemática de Coimbra.

Specifically, the following activities were organised by the CRM in 2008. More information about these is given in the activities section.

- *Mathematics and Technology Study Groups (GEMT 2008)*
- *Barcelona Financial Engineering Seminar*
- *Seminar Cycle on Computational and Systems Neuroscience*

The CRM launched a call in 2008 to promote research in emerging areas at master's level. The first grant was awarded to Ania Kedzierska for work on Study of Bayesian networks for splicing regulation elements, under the direction of Dr. Marta Casanellas. Moreover, three students have been carrying out doctoral projects in IAE areas at Catalan universities with CRM full financing since 2007 (see 1.6.3).

1.14. ERCOM

ERCOM is the acronym of the European Research Centres on Mathematics committee of the European Mathematical Society (EMS), consisting of the scientific directors of European research centres in the mathematical sciences. Only centres for which the number of visiting staff substantially exceeds the number of permanent and long-term staff, and which cover mathematical sciences broadly, are eligible for representation in ERCOM. The CRM has been a member of ERCOM since the committee's creation in 1997.

The Chair of ERCOM is appointed for a period of four years by the EMS Executive Committee. Since 2006, ERCOM has been chaired by Jan Karel Lenstra, director of the Centrum voor Wiskunde en Informatica, Amsterdam. The annual meeting of ERCOM took place at the Centro Internacional de Matemática de Coimbra on March 7 and 8, 2008.

For more information: www.ercom.org

1.15. Beques EPDI

Des de desembre de 2000, el CRM és membre de l'EPDI (*European Post-Doctoral Institute for the Mathematical Sciences*), que agrupa deu prestigiosos instituts d'investigació europeus: Institut des Hautes Études Scientifiques, Bures-sur-Yvette (el director del qual, J.-P. Bourguignon, n'és el coordinador); Max-Planck-Institut für Mathematik, Bonn; Isaac Newton Institute for the Mathematical Sciences, Cambridge; Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig; Institute Mittag-Leffler, Djursholm; Banach Center, Varsòvia; Erwin Schrödinger Institut, Viena; Forschungsinstitut für Mathematik, Zuric; Mathematisches Forschungsinstitut Oberwolfach; i el CRM.

L'EPDI convoca anualment beques postdoctorals de dos anys de durada en l'àmbit de les matemàtiques i de la física matemàtica, ofertes a joves investigadors de països europeus. Els candidats han de proposar un itinerari de dos anys que passi per almenys dos centres del grup, basat principalment en la programació científica dels centres.

A la crida de 2007-2008 es varen escollir tres candidats per a fer estades al CRM: Pierre Berger, de setembre de 2008 a febrer de 2009; Vincent Calvez, de setembre de 2008 a agost de 2009; Julien Roques, de setembre a desembre de 2009. A la crida de 2008-2009 s'han escollit Cécile Armana i Simon Riche per a fer estades al CRM a partir de setembre de 2009. El Comitè Científic de l'EPDI es va reunir el 19 de gener de 2008 al CRM.

For more information: seven.ihes.fr/EPDI/index.html

1.15. EPDI Fellowships

*Since December 2000, the CRM has been a member of the EPDI (*European Post-Doctoral Institute for the Mathematical Sciences*), which currently groups ten European research institutes: the Institut des Hautes Études Scientifiques in Bures-sur-Yvette (the Director of which, J.-P. Bourguignon, is the coordinator), the Max-Planck-Institut für Mathematik in Bonn, the Isaac Newton Institute for the Mathematical Sciences in Cambridge, the Max-Planck-Institut für Mathematik in den Naturwissenschaften in Leipzig, the Institute Mittag-Leffler in Djursholm, the Banach Center in Warsaw, the Erwin Schrödinger Institut in Vienna, the Forschungsinstitut für Mathematik in Zürich, the Mathematisches Forschungsinstitut Oberwolfach, and the CRM.*

The EPDI annually awards post-doctoral grants in mathematics (pure and applied) and mathematical physics, which are offered to young researchers in European countries. Candidates must propose a two-year plan including stays at two or more centres of the group, principally taking into account their scientific programmes.

Three candidates had been selected in the 2007-2008 call for stays at the CRM: Pierre Berger (September 2008 to February 2009), Vincent Calvez (September 2008 to August 2009), and Julien Roques (September to December 2009). In 2008-2009, Cécile Armana and Simon Riche were selected for stays at the CRM starting in September 2009. The EPDI Scientific Committee met on January 19, 2008 at the CRM.



2

Activitats *Activities*

2.1. Llistat de visitants

Diversos investigadors varen fer estades al CRM durant l'any 2008, fins a una quantitat total de 400 mesos. La majoria varen ser participants als programes de recerca del CRM i alguns d'ells varen venir invitats a través de les convocatòries públiques del CRM per a estades de visitants i estades de recerca en col·laboració. El llistat de visitants de 2008 es detalla a continuació. Aquest llistat no inclou els investigadors propis.

Maria Agureles
Jaume Amorós
Michael Batanin
Michael Benedicks
Henri Berestycki
Clemens Berger
Julie Bergner
Pedro Berrizbeitia
Massimiliano Berti
Georg Biedermann
Sergey Bolotin
Haïm Brezis
Montserrat Bruguera
Henrique Bursztyn
Renato Calleja
Gabriel Calsamiglia
Huai-Dong Cao

2.1. List of Visitors

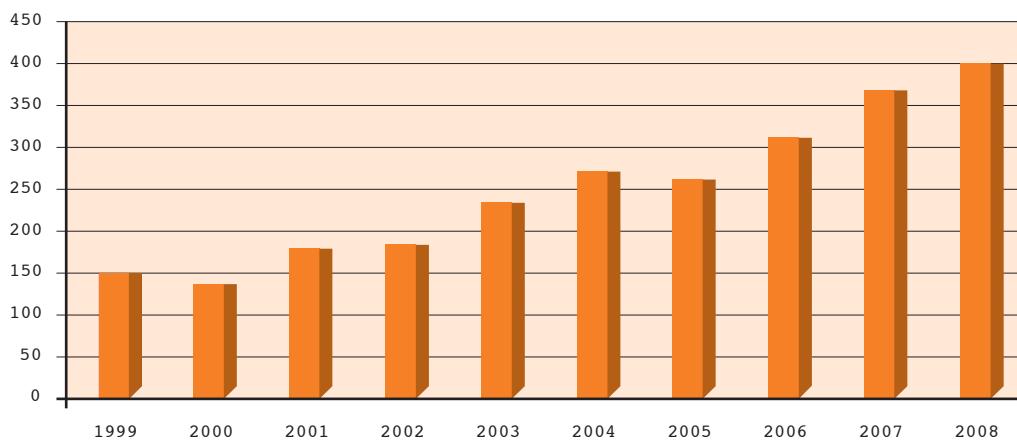
The total number of visitor months at the Centre was 400 in 2008. Most of these visitors came as participants at CRM Research Programmes, and some of them were invited through CRM open calls for visiting researchers and research in pairs. The list of 2008 visitors is the following (this list does not include CRM staff):

Universitat Politècnica de Catalunya
Universitat Politècnica de Catalunya
Macquarie University Sydney
Matematik Institutionen KTH
École des Hautes Études en Sciences Sociales
Université de Nice Sophia Antipolis
Kansas State University
Universidad Simón Bolívar
Università di Napoli
Max-Planck-Institut für Mathematik
University of Wisconsin-Madison
Rutgers University
Universitat Politècnica de Catalunya
Instituto Nacional de Matemática Pura e Aplicada
University of Texas at Austin
Universidade Federal Fluminense
Lehigh University

Maciej Capinski	AGH University of Science and Technology
Carles Casacuberta	Universitat de Barcelona
Raquel Caseiro	Universidade de Coimbra
Giovanni Catino	Università di Pisa
Alberto Cattaneo	Universität Zürich
Alessandra Celletti	Università di Roma "Tor Vergata"
Alain Chenciner	Université de Paris VII
Chong-Qing Cheng	Nanjing University
Luigi Chierchia	Università Roma Tre
Francisco Javier Cilleruelo	Universidad Autónoma de Madrid
Laura Ciobanu	Universität Freiburg
Federico Coglitore	Albert-Ludwigs-Universität
Robert Coquereaux	CIRM Luminy
Marius Crainic	Universiteit Utrecht
Rafael de la Llave	University of Texas at Austin
Amadeu Delshams	Universitat Politècnica de Catalunya
Bertrand Deroin	CNRS
Jean-Marc Deshouillers	Université de Bordeaux 1
Lucia Di Vizio	Institut de Mathématiques de Jussieu
Zindine Djadli	Université de Grenoble I
Karim Driss	Université Mohammed Premier
L. Hakan Eliasson	Université de Paris VII
Christian Elsholtz	Royal Holloway University of London
Emilio Faro	Universidad de Vigo
Albert Fathi	École Normale Supérieure de Lyon
Jacques Féjoz	Institut de Mathématiques de Jussieu
Jörg Flum	Universität Freiburg
Stefano Francaviglia	Università degli studi di Pisa
Vincent Franjou	Université de Nantes
Gregory A. Freiman	Tel Aviv University
Sakaé Fuchino	Chubu University
Wojciech Gajda	Uniwersytet Adama Mickiewicza
Yboon Victoria García	Universidad de Chile
Vassili Gelfreich	University of Warwick
Alfred Geroldinger	Karl-Franzens-Universität Graz
Marian Gidea	Northeastern Illinois University
Sergey Gonchenko	Res. Inst. for Applied Math. and Cybernetics
Maria Pia Gualdani	University of Texas at Austin
Yahya Ould Hamidoune	Université de Paris VI
Mark Hamilton	University of Tokyo
Norbert Hegyvari	Eötvös University
Michael Heusener	Université Blaise Pascal
Philip Holmes	Princeton University
Sergei Ivanov	Steklov Institute of Mathematics
Chris Jones	University of North Carolina at Chapel-Hill
André Joyal	Université du Québec à Montréal
Vadim Kaloshin	The Pennsylvania State University
Gyula Károlyi	Eötvös Loránd University
Bernhard Keller	Université de Paris VII

Carlos Kenig	University of Chicago
Boris Khesin	University of Toronto
Joachim Kock	Universitat Autònoma de Barcelona
Robert V. Kohn	New York University
Oswaldo Larreal	Universitat Politècnica de Catalunya
Camille Laurent-Gengoux	Université de Poitiers
Joan Andreu Lázaro	Universidad de Zaragoza
José Tomás Lázaro	Universitat Politècnica de Catalunya
Tom Leinster	University of Glasgow
Xuemei Li	University of Texas at Austin
Ugo Locatelli	Università di Roma "Tor Vergata"
Rui A. Loja	Instituto Superior Técnico
Héctor Lomelí	Instituto Tecnológico Autónomo de México
John Lott	University of Michigan
Sylvain Maillot	Université de Strasbourg
Leonid Makar-Limanov	Wayne State University
Georges Maltsiniotis	Université de Paris VII
Carlo Mantegazza	Scuola Normale Superiore di Pisa
Jean-Pierre Marco	Université Pierre et Marie Curie
Antonio Martínez	Universitat de València
David Martínez	Universiteit Utrecht
Tere Martínez-Seara	Universitat Politècnica de Catalunya
Vicente Miquel	Universitat de València
Eva Miranda	Universitat Autònoma de Barcelona
Ieke Moerdijk	Universiteit Utrecht
Philippe Monnier	Université Paul Sabatier
Ignasi Mundet	Universitat de Barcelona
Víctor Muñoz	Universidad de Valladolid
Melvyn B. Nathanson	Lehman College
Amnon Neeman	Australian National University
Anatoly Neishtadt	Moscow Space Research Institute
Jaroslav Nesetril	Univerzita Karlova
Frank Neumann	University of Leicester
San Vu Ngoc	Université de Rennes I
Laurent Niederman	Université de Paris-Sud
Behrang Noohi	University of Florida
Marc Noy	Universitat Politècnica de Catalunya
Daniel Clyde Offin	Queens University
So Okada	Australian National University
Arturo Olvera	Universidad Nacional Autónoma de México
Juan-Pablo Ortega	Université de Franche-Comté
Hinke Osinga	Cornell University
Paul Arne Østvær	Universitetet i Oslo
Chin How Jeffrey Pang	Cornell University
Vladimir Peller	Michigan State University
Ernesto Pérez-Chavela	Universidad Autónoma Metropolitana
Duong Phong	Columbia University
Joan Porti	Universitat Autònoma de Barcelona
Rafael Ramírez	Universitat Politècnica de Catalunya

Manuel M. Ritoré	Universidad de Granada
Vered Rom-Kedar	Weizmann Institute of Science
Jirí Rosický	Masarykova Univerzita
Shane D. Ross	Virginia Tech
Imre Ruzsa	Hungarian Academy of Sciences
David Sauzin	IMCCE
Oriol Serra	Universitat Politècnica de Catalunya
Eli Shlizerman	Tel Aviv University
Carlo Sinestrari	Università di Roma "Tor Vergata"
Yannick Sire	Université Aix-Marseille 3
Jozsef Solymosi	University of British Columbia
Alexandru Stanculescu	McGill University
Xifeng Su	Nanjing University
Eberhard Teufel	Universität Stuttgart
Gang Tian	Princeton University
Myles Tierney	Université du Québec à Montréal
Mikhail Tkachenko	Universidad Autónoma Metropolitana
Bertrand Toën	Université Paul Sabatier
Andrew Tonks	London Metropolitan University
Peter Topping	University of Warwick
Dmitry Treschev	Moscow State University
Rodrigo Treviño	University of Texas at Austin
Turgay Uzer	Georgia Institute of Technology
Enrico Valdinoci	Università di Roma "Tor Vergata"
Pol Vanhaecke	Université de Poitiers
Wang Wei-Min	Université de Paris-Sud
Burkhard Wilking	Universität Münster
Ping Xu	The Pennsylvania State University
Jun Yan	Fudan University
Xiang Zhang	Shanghai Jiaotong University
Vadim Zharnitsky	University of Illinois at Urbana



Nombre de mesos d'investigadors visitants

Number of visitor months

2.2. Programes de recerca

Un programa de recerca del CRM consisteix en un període intensiu de recerca en una àrea determinada de les matemàtiques i les seves aplicacions, durant el qual s'apleguen al CRM investigadors procedents de diferents institucions per treballar en problemes oberts del seu àmbit d'especialització i per analitzar-ne l'estat i les perspectives.

Els programes de recerca del CRM poden durar entre tres mesos i un curs acadèmic sencer. Cada programa té un comitè científic responsable de planificar les activitats incloses en el programa, elaborar la llista dels participants i lluir un informe final. Típicament, en un programa hi participen investigadors locals a temps complet, investigadors visitants a temps complet (per a estades d'una durada mínima d'un mes), becaris postdoctorals i estudiants de doctorat avançats. Les activitats d'un programa inclouen generalment un o dos seminaris setmanals, un *workshop* intensiu (preferentment obert a investigadors que no participin en el programa), un congrés internacional i un curs avançat dirigit a estudiants de doctorat.

A continuació es descriuen els programes de recerca organitzats durant l'any 2008, corresponents als cursos acadèmics 2007-2008 i 2008-2009.

2.2.1. Homotopy Theory and Higher Categories

Duration: September 2007 to July 2008

Coordinators: Carles Casacuberta, Universitat de Barcelona
Joachim Kock, Universitat Autònoma de Barcelona

Scientific Committee: Carles Casacuberta, Universitat de Barcelona
André Joyal, Université du Québec à Montréal
Joachim Kock, Universitat Autònoma de Barcelona
Amnon Neeman, Australian National University, Canberra
Frank Neumann, University of Leicester

Research Topics: Derived categories; triangulated categories; higher categories; quasi-categories; operads; differentiable and topological stacks; higher stacks; moduli problems; derived moduli; higher structures in model categories; simplicial localization; brave new algebra; modular representation theory.

2.2. Research Programmes

The CRM Research Programmes consist of periods of intensive research in a given area of the mathematical sciences and their applications, bringing together researchers from different institutions to work on open problems in the chosen area and to analyse its present state and perspectives.

Research programmes can run for periods from three months to a whole academic year. Every programme should have a scientific committee, which is fully responsible for the planning of all activities included in the programme, the elaboration of the list of participants, and the submission of a final report. Typically, participants in a programme include local full-time researchers, visitors on a full-time basis (for stays of at least one month), post-doctoral fellows and advanced doctoral students. A research programme generally includes one or two weekly seminars, one intensive workshop (preferably open to researchers not participating in the programme), a conference and an advanced course addressed at graduate students.

The CRM Research Programmes that took place in 2008 are described below, corresponding to the academic years 2007-2008 and 2008-2009.

Participants: 103 person months
Post-doctoral Fellows: Mathieu Anel, September 2007 to July 2008
Nicola Gambino, September 2007 to July 2008
Javier J. Gutiérrez, September 2007 to August 2009

Activities: **Advanced Course on Simplicial Methods in Higher Categories**
February 4 to 14, 2008
66 participants



André Joyal, Université du Québec à Montréal
The theory of quasi-categories and its applications (8 hours)

Ieke Moerdijk, Universiteit Utrecht
Dendroidal sets (8 hours)

Bertrand Toën, Université de Toulouse
Simplicial presheaves and derived geometries (8 hours)

Homotopy Structures in Geometry and Algebra; Derived Categories, Higher Categories (HOCAT 2008)

June 30 to July 5, 2008
87 participants

Plenary Speakers: John Baez (Riverside), Paul Balmer (UCLA), David Benson (Aberdeen), Julia Bergner (Kansas), Tom Bridgeland (Sheffield), Søren Galatius (Stanford), Ezra Getzler (Northwestern), Bernhard Keller (Paris VII), Ralf Meyer (Göttingen), Charles Rezk (Urbana), Bertrand Toën (Toulouse), Michel Van den Bergh (Hasselt)



Workshop on Derived Categories

November 5 to 14, 2007

68 participants

Coordinators: Leovigildo Alonso Tarrío (Santiago), Ana Jeremías López (Santiago), Amnon Neeman (Canberra)

Workshop on Categorical and Homotopical Structures in Proof Theory

February 16 and 17, 2008

25 participants

Coordinators: Nicola Gambino (CRM), Joachim Kock (UAB)

Workshop on Algebra and Geometry of Groups and Classifying Spaces

February 18 to 22, 2008

49 participants

Coordinator: Wolfgang Pitsch (UAB)

Workshop on Topological and Differentiable Stacks

April 1 to 5, 2008

36 participants

Coordinator: Frank Neumann (Leicester)

Higher Operads Week

April 14 to 19, 2008

Coordinators: André Joyal (Montréal), Joachim Kock (UAB)

Workshop on Categorical Groups

June 16 to 20, 2008

Jointly with Institut de Matemàtiques de la Universitat de Barcelona
37 participants

Coordinators: Pilar Carrasco (Granada), Antonio Rodríguez Garzón (Granada),
Josep Elgueta (UPC), Joachim Kock (UAB)

Seminars: A weekly seminar during the whole academic year

Working Groups: Well generated triangulated categories, September to December 2007
Support varieties, October to December 2007
Homotopy limits in model categories, October to December 2007
Cardinality of metric spaces, February 2008
Model structures for presheaves, March and April 2008
Goodwillie calculus, May 2008
Polynomial functors, June and July 2008

Final Report: *Homotopical methods pervade topology, category theory, algebra, and algebraic geometry, among other potential areas of application. For example, as witnessed at the CRM during this research programme, homotopy is also permeating logic and computer science. However, traditional homotopy theory is nowadays insufficient for some of the most promising directions. Therefore new categorical tools are being developed, and this research programme aimed at the study of some of these tools, mainly focusing on derived categories and higher categories.*

From September to December 2007, the main emphasis of the programme was the study of triangulated categories, which play a fundamental role in certain branches of algebraic geometry (for instance in mirror symmetry, birational geometry, and duality theory) and of representation theory (notably modular representations and quiver representations). The research programme continued in 2008 with a twist towards higher-categorical methods, in which simplicial enrichments, higher coherence and operads play an important role.

Progress achieved or presented during the programme will influence the work of a number of people in the coming years. Highlights include Leinster's new concept of cardinality of metric spaces; Neeman's treatise on dualising complexes in derived categories; Rosický functors and generalised Brown representability in triangulated categories; the current development of derived algebraic geometry; presheaf methods in the homotopical study of operads (e.g., Moerdijk's dendroidal sets, abstract nerve theorems as in the work of Weber, and Cisinski's theory of minimal model structures); implications of large-cardinal principles on the solution of open problems in stable homotopy; higher-categorical semantics for intensional identity types in Martin–Löf type theory; applications of polynomial functors to combinatorics, logic, and quantum algebra; higher-operadic approaches to deformation theory and the Deligne conjecture; and model structures for multiple categories and omega-categories related to theoretical computer science, among other novelties.

Twenty-seven manuscripts were submitted to the CRM preprint series during the programme, and several more came in the following months as a result of work done at the Centre.

2.2.2. Geometric Flows and Equivariant Problems in Symplectic Geometry

Duration: January to July 2008

Coordinators: Eva Miranda, Universitat Autònoma de Barcelona
Joan Porti, Universitat Autònoma de Barcelona

Scientific Committee: Eva Miranda, Universitat Autònoma de Barcelona
Joan Porti, Universitat Autònoma de Barcelona
Rui Loja Fernandes, Instituto Superior Técnico, Lisboa
Vicente Miquel, Universitat de València
Jaume Amorós, Universitat Politècnica de Catalunya
Carles Currás, Universitat de Barcelona
San Vu Ngoc, Institut Fourier, Grenoble

Research Topics: Geometric flows: mean curvature flow; constant curvature convexity;
Ricci flow. Symplectic geometry: Poisson geometry; moment maps;
integrable systems; symplectic groupoids.

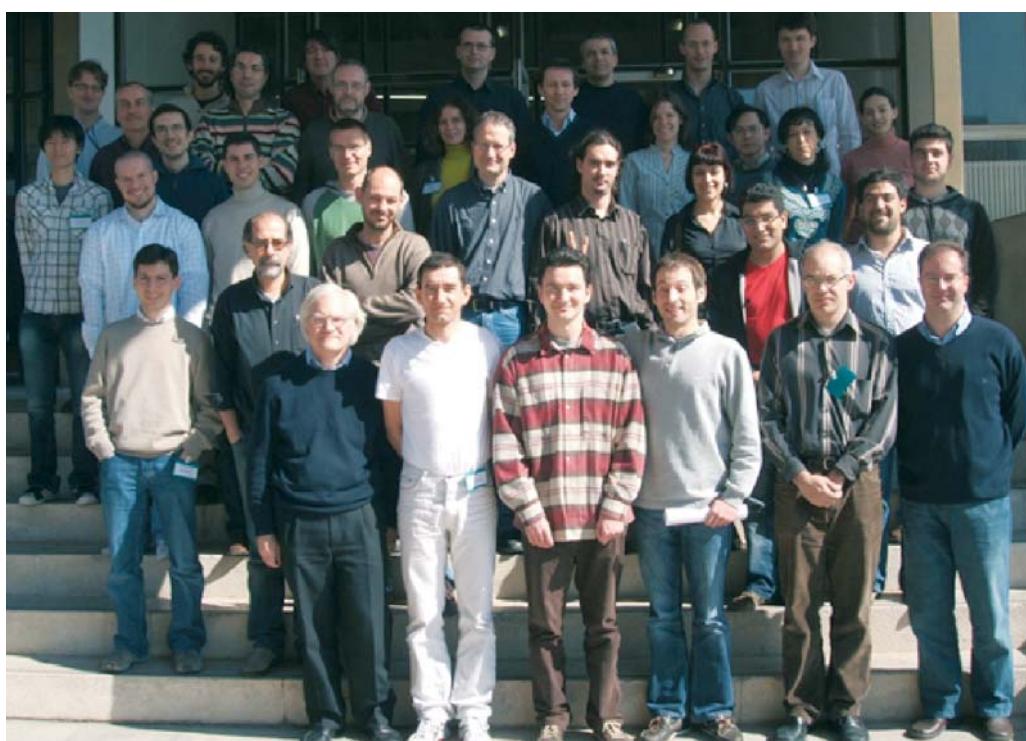
Participants: 59 person months

Post-doctoral Fellows: Anne Pichereau, October 2007 to September 2008
Marco Zambon, January to August 2008

Activities: **Advanced Course on Geometric Flows and Hyperbolic Geometry**

March 12 to 19, 2008

38 participants



Zindine Djadli, Université de Grenoble
An introduction to the Ricci flow (6 hours)

Manuel Ritoré, Universidad de Granada
Geometric flows, isoperimetric inequalities, and hyperbolic geometry
(7.5 hours)

Carlo Sinestrari, Università degli Studi di Roma “Tor Vergata”
Formation of singularities in mean curvature flow (7.5 hours)

Geometría simpléctica con técnicas algebraicas (GESTA 2008)

May 21 to 23, 2008
16 participants

Speakers: Marius Crainic (Utrecht), Yakov Eliashberg (Stanford), Rui Loja Fernandes (Lisboa), Gang Tian (Princeton), Pol Vanhaecke (Poitiers), Jean Yves Welschinger (Lyon)

Geometry and Physics (GAP VI)

June 16 to 21, 2008
40 participants

Speakers: Yves Colin de Verdière (Grenoble), Hans Duistermaat (Utrecht), Hakan Eliasson (Jussieu), San Vu Ngoc (Rennes)

Conference on Moment Maps

June 25 to 28, 2008
60 participants

Plenary Speakers: Miguel Abreu (Lisboa), Anton Alekseev (Genève), Viktor Ginzburg (Santa Cruz), Rebecca Goldin (George Mason), Victor Guillemin (MIT), Megumi Harada (McMaster), Tamás Hausel (Oxford), Tara Holm (Cornell), Shengda Hu (Montréal), Frances Kirwan (Oxford), Dusa McDuff (Stony Brook), Eckard Meinrenken (Toronto), Juan-Pablo Ortega (Franche-Comté), Duong Phong Hong (Columbia), Leonid Polterovich (Tel Aviv), Tudor Ratiu (Lausanne), Reyer Sjamaar (Cornell), Ben Weinkove (Harvard)



New Trends in Poisson Geometry

June 13, 2008

Coordinator:

Rui Loja Fernandes (IST, Lisboa)

Speakers:

Henrique Bursztyn (IMPA), Camille Laurent-Gengoux (Poitiers),
David Martínez-Torres (Utrecht), Eva Miranda (UAB), Ping Xu (Penn State)

Seminars:

Two weekly sessions during the whole semester

Working Groups:

Invariant curvature conditions, January and February 2008
Optimal transport and Ricci flow, January to March 2008
Super-manifolds, February 2008

Final Report:

The programme focused on two active fields of differential geometry: evolution flows in Riemannian geometry (January-March) and equivariant problems in symplectic geometry (April-June).

Research in evolution equations in Riemannian geometry has enormously increased since the breakthrough of Perelman in 2002-2003, when he proved Thurston's geometrization conjecture, and in particular Poincaré's. Perelman introduced new functional and geometric notions that allowed a complete understanding of the singularities of Ricci flow. Perelman solved the main difficulty up to then in Hamilton's program, and was able to complete it. The proof was not published in a standard way —just three short preprints were available on the web containing the main ideas. Understanding the proof and making it accessible to the whole mathematical community is a long-term job

that is not yet complete, and to which this research programme has contributed. On the other hand, Perelman's ideas also allowed Huisken and Sinestrari (one of the lecturers in the advanced course) to understand singularities of some special cases of the mean curvature flow. Among other applications, geometric flows, especially mean curvature flow, have been used to obtain isoperimetric inequalities.

Regarding symplectic geometry, the interest in the equivariant point of view is motivated by the relevance of group actions in many problems coming from quantum and classical mechanics. Clear examples are given by moment maps, as well as the study of rigidity of compact Lie group actions, not necessarily Hamiltonian, motivated by recent work of Guillemin, Karshon and Ginzburg, deeply related to normal form questions and often related to the Poisson manifolds setting.

Among the research subjects studied during this programme, we point out the following:

- *Ricci flow. The understanding and the applications of Perelman's ideas and further developments are currently an active research field, and the researchers of the semester have obtained relevant results. We particularly mention results about understanding Perelman functionals that give new interpretations and applications, by Topping and by Catino, Djadli and Mantegazza. We also mention the work on the proof of the geometrization conjecture by Maillot and Porti, and the results about curvature conditions by Wilking.*
- *Mean curvature flow, hyperbolic geometry, and isoperimetric inequalities. Teufel, in collaboration with Gallego, Reventós and Solanes, has obtained results about envelopes of families of horocycles.*
- *Equivariant normal form for symplectic and Poisson structures: study of the existence of normal forms for symplectic and Poisson structures with the action of a compact Lie group, as well as questions about rigidity for Hamiltonian actions of compact Lie groups.*
- *Hamiltonian integrable systems (classical and quantum), with a geometric study of singularities in integrable systems (symplectic determination and study of stability and infinitesimal stability), as well as the quantum version.*
- *Geometry of the moment map, by studying several aspects, geometric and topological.*
- *Aspects related to algebraic geometry. Lefschetz pencils are an example of a moment map. Tools coming from algebraic geometry can be used in this field to deduce topological and geometric properties of fibrations.*
- *Dynamical aspects of integrable systems.*

2.2.3. Stability and Instability in Mechanical Systems

<i>Duration:</i>	September to December 2008
<i>Coordinators:</i>	Amadeu Delshams, Universitat Politècnica de Catalunya Rafael de la Llave, University of Texas at Austin Tere M. Seara, Universitat Politècnica de Catalunya
<i>Scientific Committee:</i>	Chong-Qing Cheng, University of Nanjing Vadim Kaloshin, University of Maryland and Penn State University Carles Simó, Universitat de Barcelona Turgay Uzer, Georgia Institute of Technology
<i>Organising Committee:</i>	Gerard Gómez, Universitat de Barcelona Àngel Jorba, Universitat de Barcelona Jaume Llibre, Universitat Autònoma de Barcelona Josep Masdemont, Universitat Politècnica de Catalunya
<i>Research Topics:</i>	Geometric, variational, heuristic, numerical and experimental methods in the study of stability and instability in mechanical systems without friction.
<i>Participants:</i>	59 person months
<i>Post-doctoral Fellows:</i>	Gemma Huguet, September to December 2008
<i>Activities:</i>	Advanced Course on Stability and Instability in Mechanical Systems September 15 to 19, 2008 66 participants
	Amadeu Delshams, Universitat Politècnica de Catalunya Anatoly Neishtadt, Moscow Space Research Institute <i>Background in Hamiltonian systems and averaging methods</i>
	Chong-Qing Cheng, University of Nanjing Massimiliano Berti, Università di Napoli <i>Classical and global variational methods</i>
	Chris Jones, University of North Carolina Rafael de la Llave, University of Texas at Austin <i>Invariant objects: KAM theorem and normally hyperbolic invariant manifolds</i>
	Ernest Fontich, Universitat de Barcelona Marian Gidea, Northeastern Illinois University <i>Shadowing lemmas and topological methods</i>
	Dmitry Treschev, Moscow State University Rafael Ramírez-Ros, Universitat Politècnica de Catalunya <i>Homoclinic connections and separatrix map</i>

Carles Simó, Universitat de Barcelona
Turgay Uzer, Georgia Institute of Technology
Applications to celestial mechanics and chemistry

**Conference on Stability and Instability in Mechanical Systems:
Recent Progress and Mathematical Theory**

September 22 to 26, 2008
82 participants

Plenary Speakers: Massimiliano Berti (Napoli), Alain Chenciner (Paris VII), Chong Qing Cheng (Nanjing), Luigi Chierchia (Roma 3), Alessandra Celletti (Roma 2), Hakan Eliasson (Paris VII), Vassili Gelfreich (Warwick), Marian Gidea (Northeastern), George Haller (MIT), Àlex Haro (UB), Gemma Huguet (CRM), Robert Mackay (Warwick), Anatoli Neishtadt (Moscow), Ernesto Pérez-Chavela (México), Joaquim Puig (UPC), Vered Rom-Kedar (Weizmann), David Sauzin (IMCCE), Dmitry Treschev (Moscow), Turgay Uzer (Georgia), Yingfei Yi (Georgia)

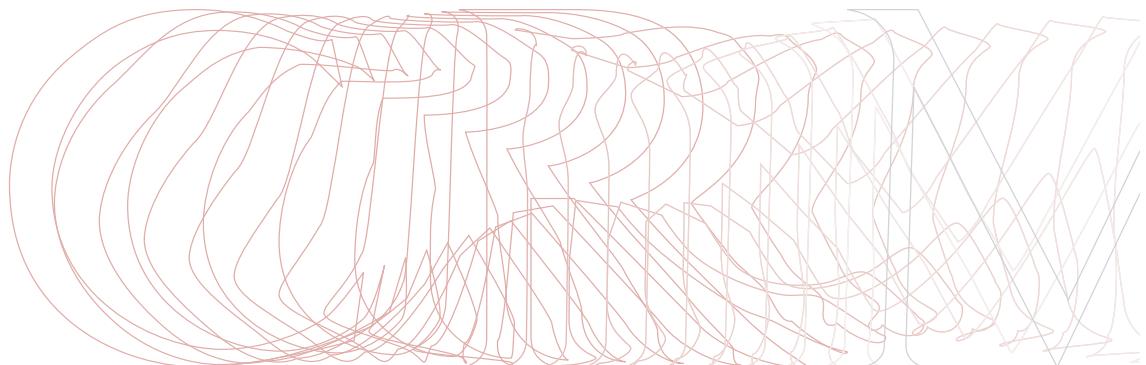
**Workshop on Stability and Instability in Mechanical Systems:
Applications and Numerical Tools**

December 1 to 5, 2008
Jointly with Institut the Matemàtiques of the Universitat de Barcelona
83 participants

Seminars: A weekly seminar during the whole trimester

Summary: There are many systems appearing in applications that have negligible friction, like the models of celestial mechanics and astrodynamics, the models for motion of charged particles in magnetic fields (for example the motion on the magnetosphere, particle accelerators, some models in collisionless plasmas), chemical reactions, etc. One problem that has attracted attention for a long time is whether the effect of perturbations on these models accumulate over time and lead to large effect (instability) or whether these effects average out (stability).

The aim of this research programme was to compare and unify the different methods (geometrical, variational, heuristic, numerical, experimental, etc.) for stability and instability and to make contact with recent applications.



2.3. Congressos i workshops

En aquest apartat i en els següents es detallen els congressos, *workshops*, cursos avançats i jornades temàtiques que va organitzar el CRM durant l'any 2008 al marge dels programes de recerca.

Els congressos poden reunir fins a 100 participants i segueixen els estàndards i els protocols establerts pel CRM. La inscripció es fa a través del web del Centre i s'estableix una quota d'inscripció en cada cas.

Els *workshops* són menys formals que els congressos i no cal que tinguin un programa fixat amb antelació. Generalment el nombre de participants no passa de 30 i la participació és només per invitació, sota la responsabilitat dels organitzadors científics.

2.3. Conferences and Workshops

This section and the following ones contain information about conferences, workshops, advanced courses and thematic days organised by the CRM outside the research programmes in 2008.

Conferences may gather up to 100 participants and follow the standards and procedures of previous CRM conferences. An electronic registration form is available at the Centre's website. A registration fee is set by the CRM for each event.

Workshops have a less formal frame than conferences and need not have a full programme arranged in advance. Generally, the number of attendants should not exceed 30, and participation should be by invitation only, under the responsibility of the scientific organisers.

2.3.1. Barcelona Conference on Asymptotic Statistics (BAS 2008)

Dates: September 1 to 5, 2008
Place: Centre de Recerca Matemàtica
Attendance: 64 participants
Coordinator: Vladimir Zaiats, Universitat de Vic

Plenary Speakers: Ildar Ibragimov (Steklov), Iain Johnstone (Stanford), Rafail Khasminskii (Wayne State), Yury Kutoyants (Maine), Thomas Mikosch (Kobenhavns)

2.3.2. ESF Exploratory Workshop on Computational Disease Modeling

Organised jointly with the European Science Foundation

Dates: September 24 to 26, 2008
Place: Institut d'Estudis Catalans, Barcelona
Attendance: 22 participants
Coordinators: Johan Björkegren, Karolinska Institute, Stockholm
Albert Compte, IDIBAPS, Barcelona
Carme Junqué, Universitat de Barcelona
Jesper Tegnér, Linköpings Institute for Technology

2.3.3. CIM-CRM Workshop on Financial Time Series

Organised jointly with the Centro Internacional de Matemática, Coimbra

<i>Dates:</i>	June 12 to 14, 2008
<i>Place:</i>	Centro Internacional de Matemática, Coimbra
<i>Attendance:</i>	44 participants
<i>Coordinators:</i>	Pilar Muñoz, Universitat Politècnica de Catalunya Paulo Teles, Porto School of Economics
<i>Invited Speakers:</i>	Nuno Crato (Lisboa), Frank Diebold (Pennsylvania), Philip Hans Franses (Rotterdam), João Nicolau (Lisboa), Daniel Peña (Carlos III), Esther Ruiz (Carlos III), Feridun Turkman (Lisboa)

2.3.4. Interactions Between Representation Theory and Commutative Algebra

Organised jointly with the Institut de Matemàtica de la Universitat de Barcelona

<i>Dates:</i>	September 25 to 27, 2008
<i>Place:</i>	Institut de Matemàtica de la Universitat de Barcelona
<i>Attendance:</i>	41 participants
<i>Scientific Committee:</i>	Lidia Angeleri-Hügel, Università dell'Insubria Dolors Herbera, Universitat Autònoma de Barcelona Henning Krause, Universität Paderborn
<i>Plenary Speakers:</i>	Luchezar Avramov (Nebraska), Silvana Bazzoni (Padova), Alberto Facchini (Padova), Srikanth Iyengar (Nebraska), Helmut Lenzing (Paderborn), Graham Leuschke (Syracuse), Rosa Maria Miró-Roig (Barcelona), Osamu Iyama (Nagoya), Idun Reiten (Trondheim), Wolfgang Rump (Stuttgart), Roger Wiegand (Nebraska)

2.4. Cursos avançats

A més dels cursos avançats inclosos en els programes de recerca, el CRM vol mantenir una sèrie de cursos d'estiu o hivern a nivell de doctorat o postdoctoral avançat, enfocats a avenços recents en qualsevol àrea de les matemàtiques o en altres disciplines on s'utilitzin mètodes matemàtics d'alt nivell. Aquestes activitats duren normalment dues setmanes i consisteixen en fins a cinc sèries de curssets de 8 a 10 hores en temes ben definits, impartits per experts. Les classes teòriques es poden complementar amb sessions pràctiques, sessions de resolució d'exercicis o de problemes de recerca i altres activitats.

2.4. Advanced Courses

Besides the advanced courses included in research programmes, the CRM aims to maintain a yearly series of summer/winter training courses at an advanced postgraduate or doctoral level, focusing on recent developments in any area of mathematics or in other disciplines where high-level mathematical methods are used. Events in this series will normally have a duration of two weeks and will consist of up to five series of lectures of 8 to 10 hours each on well-defined sub-topics, given by leading experts in the field. Lectures may be complemented with practical training sessions, discussion of exercises or research problems, and other activities.

Els apunts d'aquests cursos es poden publicar a la sèrie *Advanced Courses in Mathematics CRM Barcelona*, distribuïda per l'editorial suïssa Birkhäuser des de 2001.

Properly written lecture notes can be submitted for publication in the series entitled Advanced Courses in Mathematics CRM Barcelona, which has been published by Birkhäuser since 2001.

2.4.1. DocCourse Combinatorics and Geometry 2008: Additive Combinatorics

The DocCourse spanned three months with two main intensive courses and several thematic seminars. During the period of the course, the participants undertook a research project under the supervision of a local advisor.

Dates: January to March 2008
Place: Centre de Recerca Matemàtica
Attendance: 49 participants
Coordinators: Javier Cilleruelo, Universidad Autónoma de Madrid
Marc Noy, Universitat Politècnica de Catalunya
Oriol Serra, Universitat Politècnica de Catalunya

Courses: Alfred Geroldinger, Universität Graz
Additive group theory and the theory of non-unique factorizations

Imre Ruzsa, Rényi Institute, Budapest
Sumsets and structure

Thematic Seminars: Jean-Marc Deshouillers, Christian Elsholtz, Melvin B. Nathanson,
Ben J. Green, Yahya O. Hamidoune, Gyula Károly, Jaroslav Nešetřil,
József Solymosi



2.4.2. Topics in PDE's and Applications 2008

Organised jointly with FISYMAT, Universidad de Granada

Dates: May 5 to 9, 2008

Place: Centre de Recerca Matemàtica

Attendance: 72 participants

Coordinators: Xavier Cabré, ICREA-UPC
Juan Soler, Universidad de Granada

Courses: Henri Berestycki, EHESS, Paris

Reaction-diffusion equations and propagation phenomena

Haïm Brezis, Rutgers and Technion

New results about the topological degree of maps from a sphere into itself.

Intriguing connections with Fourier series and Sobolev norms

Carlos Kenig, University of Chicago

Global well-posedness and scattering for critical non-linear Schrödinger and wave equations

Robert Kohn, Courant Institute

Energy-driven pattern formation

Gang Tian, Princeton University

Ricci flow and geometrization



2.4.3. International School on Mathematical Cryptology 2008: Mathematical Foundations of Cryptology

Organised jointly with OSRM, Universitat Politècnica de Catalunya

- Dates:* September 22 to 26, 2008
Place: Universitat Politècnica de Catalunya
Coordinators: Ronald Cramer, CWI, Amsterdam, and Mathematical Institute, Leiden
Carles Padró, Universitat Politècnica de Catalunya
Ángel del Río, Universidad de Murcia
- Research Seminar:* Venkatesan Guruswami, University of Washington
List error-corrections: New constructions and algorithms
- Nigel Smart, University of Bristol
Beyond the 80 bit barrier
- Tutorials:* Serge Fehr, CWI, Amsterdam
Quantum information theory and crypto
- Dennis Hofheinz, CWI, Amsterdam
Public key encryption from a mathematical perspective
- Alp Bassa, EPFL, Lausanne
Algebraic function fields and applications in coding theory
- Carles Padró, Universitat Politècnica de Catalunya
Ronald Cramer, CWI, Amsterdam
Combinatorial and algebraic aspects of secret sharing and secure multiparty computation

2.4.4. Barcelona Financial Engineering Summer School 2008: The Practice of Derivatives Modelling

Organised jointly with Barcelona Stock Exchange and Barcelona European Financial Centre

- Dates:* June 30 to July 8, 2008
Place: Barcelona Stock Exchange
Attendance: 71 participants
Organising Committee: Jesper Andreasen, Bank of America
Vladimir Piterbarg, Barclays Capital
Sebastian del Baño, CRM
- Speakers:* Adrian Campbell-Smith, RBS Global Financial Markets
Trading and modeling

Zareer Dadachanji, Credit Suisse
A tour through the world of equity derivative modeling

Daniel J. Duffy, Datasim
Advanced PDE techniques for option pricing and finite differences

Daniel Dufresne, University of Melbourne
The distribution of realized volatility in stochastic volatility models

Philippe Lintern, RBS Global Financial Markets
Trading and modeling

Emile Ben Nasatyr, RBS Global Financial Markets
FX trading and modeling

Roger Nelsen, Clark College
A course on copulas

Wim Schoutens, Katholieke Universiteit Leuven
How to use Levy processes

William Shaw, Kings College London
Modern numerical and analytical methods for computational finance

Javier Vindel, CitiBank
The practice of IR derivatives modeling



2.5. Curs de màster

El màster de Matemàtiques per als instruments financers va tenir lloc per onzena vegada el 2008 gràcies a la col·laboració del Departament de Matemàtiques de la UB, el CRM i diverses entitats: la Borsa de Barcelona (patrocinadora), els departaments d'Economia Aplicada, d'Economia de l'Empresa, i d'Economia i d'Història Econòmica de la UAB, i el Departament d'Estadística de la UB, juntament amb destacats especialistes que treballen en contacte directe amb els mercats. Les empreses col·laboradores que hi donen suport, mitjançant les beques per a la realització de pràctiques, aporten el component necessari d'aprenentatge pràctic. Així s'estableix una línia directa de col·laboració entre els mons acadèmic i professional, que permet desenvolupar i ensenyuar les últimes tècniques de valoració de productes financers derivats, càcul d'estrategies de cobertura i avaluació i control de riscos.

El màster està estructurat en tres etapes, dues de teòriques (cadascuna amb 120 hores de docència) i una tercera etapa pràctica en una empresa de finances. La responsabilitat del màster recau en una Comissió Acadèmica i un Comitè Executiu.

L'any 2008 varen acabar el curs 14 alumnes.

2.6. Jornades temàtiques

El CRM acull propostes de jornades temàtiques, concentrades normalment en un únic dia. El CRM actua com a entitat organitzadora, oferint suport administratiu, assessorament i finançament. Els proponents són responsables de la tria dels conferenciants i del disseny del programa de la jornada. Aquesta convocatòria és oberta a investigadors o equips que treballin en qualsevol àrea de les matemàtiques o en altres disciplines on s'utilitzin mètodes matemàtics.

2.5. Master's Course

The CRM master's course on Financial Mathematics was held for the eleventh time in 2008 thanks to the collaboration of the Mathematics Department of the UAB, the CRM, and several financial companies such as the Barcelona Stock Exchange, which is the sponsoring institution. Other collaborating institutions are the departments of Economics and Economics History, Applied Economics, and Business Economics of the UAB, the Statistics Department of the UB, and several outstanding specialists who work in direct contact with the markets. The collaborating companies offer practical training opportunities to the students by offering them grants. This allows a direct contact between the academic community and the professional world allowing them to develop and teach innovative techniques about the valuation of derived financial products, calculation of coverage strategies, risk assessment and risk control.

The course is structured in three terms, two theoretical, each with 120 hours of teaching, and a third practical in a financial company. The master's responsibility lies on an Academic Commission and an Executive Committee.

Fourteen students completed the course in 2008.

2.6. Thematic Days

Proposals of thematic days to be held at the CRM are welcome. Events of this kind will normally be scheduled within one single day. The CRM acts as organisational unit, by offering secretarial support, advice, and funding. The proposers are responsible for the selection of speakers and design of the programme of the event. This call is open to researchers or teams working in any area of mathematics or in other disciplines where mathematical methods are used.

2.6.1. Computational Neuroscience

Date: June 6, 2008
Place: CRM
Coordinator: Albert Compte, IDIBAPS, Barcelona

2.6.2. New Perspectives on Malliavin Calculus

Date: June 25, 2008
Place: CRM
Coordinator: Marta Sanz-Solé, Universitat de Barcelona

2.6.3. Can Mathematics Help Research in Biomedicine?

Organised jointly with the Catalan Mathematical Society

Date: September 27, 2008
Place: Institut d'Estudis Catalans
Coordinator: Albert Compte, IDIBAPS, Barcelona

2.6.4. Barcelona Topology Workshop

Date: December 19, 2008
Place: CRM
Coordinator: Jaume Aguadé, Universitat Autònoma de Barcelona

2.7. Altres activitats

2.7. Other Activities

2.7.1. Mathematics and Technology Study Groups (GEMT 2008)

Organised jointly with OSRM, Universitat Politècnica de Catalunya

Dates: July 8 to 10, 2008
Place: Universitat Politècnica de Catalunya
Coordinators: Aureli Alabert, Universitat Autònoma de Barcelona
Enric Fossas, Universitat Politècnica de Catalunya
Joan Solà-Morales, Universitat Politècnica de Catalunya

2.7.2. Scientific Session at ESOF 2008

El CRM va organitzar, conjuntament amb la Societat Matemàtica Europea, una sessió científica a l'Euroscience Open Forum (ESOF 2008) que va tenir lloc a Barcelona del 18 al 22 de juliol de 2008.

<i>Date:</i>	July 21, 2008	<i>The CRM organised jointly with the European Mathematical Society a scientific session of the Euroscience Open Forum (ESOF 2008), which was held from July 18 to 22 in Barcelona.</i>
<i>Title of the Session:</i>	Can Mathematics Help Medicine?	
<i>Coordinator:</i>	Marta Sanz-Solé, CRM and Universitat de Barcelona	
<i>Speakers:</i>	Dominique Chapelle, INRIA-Rocquencourt <i>Modelling and estimation of the cardiac electromechanical activity</i>	
	Peter Deuflhard, Zuse-Institut Berlin <i>The challenge of electrocardiology: model hierarchy and multiscale simulation</i>	
	Alfio Quarteroni, Politecnico di Milano and EPFL Lausanne <i>Mathematical models for the cardiovascular system</i>	

2.7.3. Series of Talks at CosmoCaixa

CosmoCaixa va organitzar un cicle de conferències mensuals sobre l'impacte de les matemàtiques a la ciència i la societat, amb la col·laboració del CRM. El Departament d'Educació de la Generalitat de Catalunya va reconèixer aquest cicle com una activitat de formació permanent per al professorat no universitari.

<i>Dates:</i>	January to May 2008	<i>CosmoCaixa and the CRM organised together a series of monthly talks about the impact of mathematics on science and society. The Department of Education of the Government of Catalonia granted recognition of a permanent training activity for non-university teaching staff.</i>
<i>Title of the Series:</i>	Great Mathematical Conjectures	
<i>Coordinator:</i>	Manuel Castellet, CRM and Universitat Autònoma de Barcelona	
<i>Talks:</i>	Marcus du Sautoy, University of Oxford <i>Music of the primes</i>	
	Jaume Llibre, Universitat Autònoma de Barcelona <i>La conjectura $3x + 1$ i els límits de la matemàtica</i>	
	Antonio Córdoba, Universidad Autónoma de Madrid <i>Matemáticas en los dominios de Eolo y Neptuno: las ecuaciones de Navier-Stokes</i>	
	Robert Devaney, Boston University <i>The fractal geometry of the Mandelbrot set</i>	

Avi Wigderson, IAS Princeton
P versus NP and the limits of knowledge

Gang Tian, Princeton University
The Poincaré conjecture is solved

2.7.4. Barcelona Financial Engineering Seminar

Durant el curs acadèmic 2007-2008, el CRM va organitzar per primer cop un seminari d'Enginyeria financer conjuntament amb la Borsa de Barcelona i l'Associació Barcelona Centre Financer Europeu. Normalment es programa una sessió al mes, sota el lema "A monthly forum where financial practice meets academia".

In the academic year 2007-2008, the CRM organised a financial engineering seminar for the first time with the Barcelona Stock Exchange and the Barcelona European Financial Centre. One session is normally held every month, under the motto "A monthly forum where financial practice meets academia".

Dates: December 2007 to June 2008, and since September 2008

Place: Barcelona Stock Exchange

Coordinator: Sebastian del Baño, CRM

Talks: Martin Baxter, Director, Fixed Income, Nomura International, London
Gamma process dynamic modelling of credit

Stephen McCauley, Principal Managing Scientist, Winton Capital Management
Volatility arbitrage: a practitioner's approach to cross asset implementation

Jesper Andreasen, Managing Director, Fixed Income Quantitative Research, Bank of America, London
Modeling liquidity and feedback effects from dynamic hedging

Peter Jaeckel, Head of Credit, Hybrid, Inflation and Commodity Derivative Analytics, ABN AMRO
Hyp hyp hooray!

Vladimir Piterbarg, Managing Director, Global Head of Quantitative Analytics, Barclays Capital
Generic methods for volatility calibration in term structure models

Robert Dargavel Smith, Managing Director, Banco Santander
Efficient pricing and calibration of multi-currency interest rate products with FX skew

Wim Schoutens, Katholieke Universiteit Leuven
Levy base correlation

2.7.5. Seminar Cycle on Computational and Systems Neuroscience

També durant el curs acadèmic 2007-2008, el CRM va iniciar un seminari de Neurociència computacional i de sistemes, amb sessions mensuals que tenen lloc a la Universitat Pompeu Fabra i al CRM.

During the academic year 2007-2008, the CRM also started a seminar on computational and systems neuroscience. One monthly session is held at the Pompeu Fabra University or at the CRM.

Dates: January to June 2008, and since September 2008

Coordinators: Albert Compte, IDIBAPS, Barcelona

Gustavo Deco, Universitat Pompeu Fabra

Antoni Guillamon, Universitat Politècnica de Catalunya

Jordi G. Ojalvo, Universitat Politècnica de Catalunya

Talks: Viktor Jirsa, CNRS, Marseille

Noise during rest explores the brain's dynamic repertoire

Christian Machens, École Normale Supérieure

Design of continuous attractor networks with monotonic tuning using a symmetry principle

Rubén Moreno-Bote, University of Rochester

Noise-induced alternation in attractor models of perceptual bistability

Martin Paul Nawrot, Neuroinformatics and Theoretical Neuroscience, Bernstein Center for Computational Neuroscience, Freie Universität, Berlin

Spatio-temporal structure of spontaneous state transitions in the neocortex

Lutz Schimansky-Geier, Humboldt-Universität zu Berlin

Waiting time densities of excitable neurons and their usage

Daniel Durstewitz, University of Plymouth

Adapting cortical dynamics to varying cognitive demands

Stephen Coombes, University of Nottingham

Gap junctions and emergent brain rhythms: A mathematical study

Zachary Mainen, Instituto Gulbenkian de Ciênciа, Oeiras

Neural mechanisms for odor-guided decisions in the rat

Benjamin Lindner, Max-Plack-Institut für Physik komplexer Systeme, Dresden

Analytical approaches to stochastic neural models

Alexandre Pouget, University of Rochester

Probabilistic population codes for Bayesian decision making

2.7.6. CRM Open Day

El 13 de juny de 2008, el CRM va organitzar una jornada que ha esdevingut anual i que té dos propòsits: aplegar la comunitat matemàtica local per a un intercanvi informal d'impressions i comptar amb la presència del Comitè Científic Assessor del CRM, que celebra la seva reunió anual coincidint amb la data d'aquesta jornada.

On June 13, 2008, the CRM organised a meeting which is held annually and serves two purposes: to gather together the local mathematical community for an informal exchange of views about current developments, and to assemble the CRM Scientific Advisory Board for a meeting on the same day.

Talks:

Alfredo Bermúdez de Castro, Universidade de Santiago de Compostela
Some Spanish initiatives for research in mathematics and its applications

Ari Laptev, European Mathematical Society
Promotion of mathematics in Europe from the EMS perspective

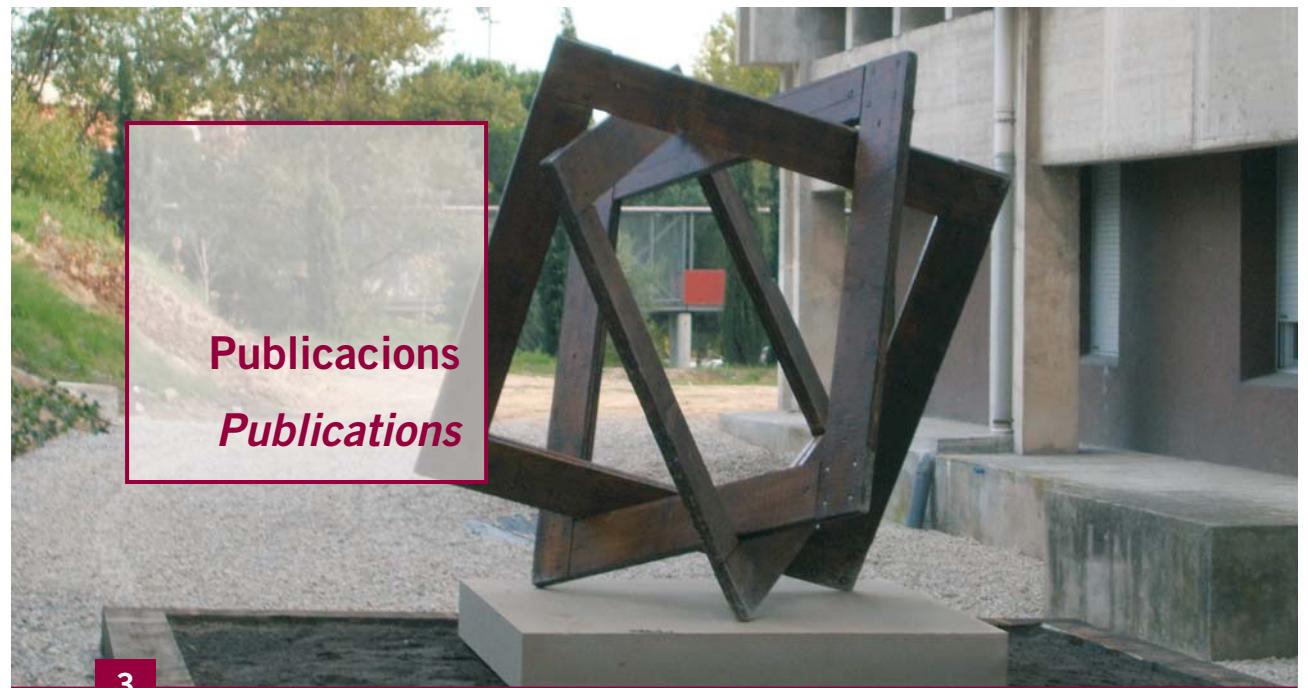
Andreu Mas-Colell, Universitat Pompeu Fabra
The ERC: a new instrument for the support of frontier research in Europe

Carles Simó, Universitat de Barcelona
Research topics in mathematics: what and how

Gerhard Frey, Universität Duisburg-Essen
Fermat's last theorem and data security: elliptic curves are always around!

José Luis Fernández, Universidad Autónoma de Madrid and AFI
Finance, mathematics, academia





Publicacions Publications

3

3.1. Articles de recerca

Els articles següents varen ser publicats l'any 2008 pels investigadors del CRM en revistes i sèries científiques:

A. Corral, L. Telesca, R. Lasaponara
Scaling and correlations in the dynamics of forest-fire occurrence
Phys. Rev. E **77**, 016101 (2008)

F. Dai, Z. Ditzian, **S. Tikhonov**
Sharp Jackson inequality
J. Approx. Theory **151** (2008), no. 1, 186–112

M. Dyachenko, **S. Tikhonov**
A Hardy–Littlewood theorem for multiple series
J. Math. Anal. Appl. **339** (2008), 503–510

E. Liflyand, **S. Tikhonov**
Extended solution of Boas' conjecture on Fourier transforms
C. R. Math. Acad. Sci. Paris **346** (2008), no. 21–22, 1137–1142

M. K. Potapov, B. V. Simonov, **S. Tikhonov**
An inequality of Ul'yanov
Moscow Univ. Math. Bull. **63** (2008), no. 3, 115–118
Russian translation: *Vestnik Mosk. Univ. Ser. I* **63** (2008), no. 3, 33–36

B. Simonov, **S. Tikhonov**
Norm inequalities in multidimensional Lorentz spaces
Mathematica Scandinavica **103** (2008), 278–294

3.1. Research Articles

The following articles were published by CRM researchers in scientific journals or series in 2008:

B. Simonov, **S. Tikhonov**
Embedding theorems in constructive approximation
Sbornik: Mathematics **199** (2008), no. 9, 1365–1405

S. Tikhonov
Best approximation and moduli of smoothness: computation and equivalence theorems
J. Approx. Theory **153** (2008), 19–39

S. Tikhonov
On L^1 -convergence of Fourier series
J. Math. Anal. Appl. **347** (2008), no. 2, 416–427

S. Tikhonov
Addendum to: Trigonometric series of Nikol'skii classes
Acta Math. Hungarica **120** (2008), no. 1–2, 9–20

M. Dyachenko, **S. Tikhonov**
General monotone sequences and convergence of trigonometric series.
In: *Topics in Classical Analysis and Applications in Honor of Daniel Waterman*, World Scientific, 2008, 88–101

P. Berger
Persistence of stratifications of normally expanded laminations
C. R. Math. Acad. Sci. Paris **346** (2008), no. 13–14, 767–772

N. Gambino
The associated sheaf functor theorem in algebraic set theory
Ann. Pure Appl. Logic **156** (2008), no. 1, 68–77

N. Gambino, R. Garner
The identity type weak factorisation system
Theoret. Comput. Sci. **409** (2008), no. 1, 94–109

N. Gambino
Homotopy limits for 2-categories
Math. Proc. Cambridge Philos. Soc. **145** (2008), no. 1, 43–63

M. Fiore, **N. Gambino**, M. Hyland, G. Winskel
The Cartesian closed bicategory of generalised species of structures
J. London Math. Soc. (2) **77** (2008), no. 1, 203–220

S. Bonaccorsi, **C. Marinelli**, G. Ziglio
Stochastic Fitzhugh–Nagumo equations on networks with impulsive noise
Electron. J. Probab. **13** (2008), no. 49, 1362–1379

C. Marinelli, S. Savin
Optimal distributed dynamic advertising
J. Optim. Theory Appl. **137** (2008), no. 3, 569–591

V. Barbu, **C. Marinelli**

Variational inequalities in Hilbert spaces with measures and optimal stopping problems

Appl. Math. Optim. **57** (2008), no. 2, 237–262

F. Matucci

Cryptanalysis of the Shpilrain–Ushakov protocol in Thompson’s group

J. Cryptology **21** (2008), no. 3, 458–468

A. Pichereau, G. Van de Weyer

Double Poisson cohomology of path algebras of quivers

J. Algebra **319** (2008), no. 5, 2166–2208

Y. Hua, **R. Saghin**, Z. Xia

Topological entropy and partially hyperbolic diffeomorphisms

Ergodic Theory Dynam. Systems **28** (2008), no. 3, 843–862

F. Dahmani, **A. Yaman**

Symbolic dynamics and relatively hyperbolic groups

Groups Geom. Dyn. **2** (2008), no. 2, 165–184

M. Zambon

An example of coisotropic submanifolds C^1 -close to a given coisotropic submanifold

Differential Geom. Appl. **26** (2008), no. 6, 635–637

F. Falceto, **M. Zambon**

An extension of the Marsden–Ratiu reduction for Poisson manifolds

Lett. Math. Phys. **85** (2008), no. 2–3, 203–219

3.2. Sèries del CRM

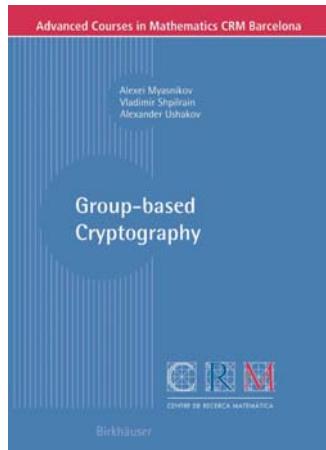
3.2. CRM Series

3.2.1. Advanced Courses in Mathematics CRM Barcelona

Els volums d'aquesta sèrie, publicada per l'editorial suïssa Birkhäuser, recullen el contingut d'alguns dels cursos avançats impartits al CRM, a partir de les notes prèvies lliurades als participants i reelaborades pels autors. Es tracta de llibres de text, especialment adreçats a estudiants de doctorat avançats i a investigadors postdoctorals. Des de setembre de 2008 l'editor responsable d'aquesta sèrie és Carles Casacuberta. Ha substituït en aquest càrec a Manuel Castellet, que va iniciar la sèrie l'any 2001.

The volumes of this series, published by the Swiss publishing company Birkhäuser, cover the content of some of the advanced courses taught by specialists at the CRM. They are based on notes handed out to students and later reworked by the authors. These volumes are especially addressed to advanced doctoral and young postdoctoral students. Since 2008, the responsible editor of this series is Carles Casacuberta. He replaced Manuel Castellet, who started the series in 2001.

L'any 2008 ha aparegut un volum d'aquesta sèrie:

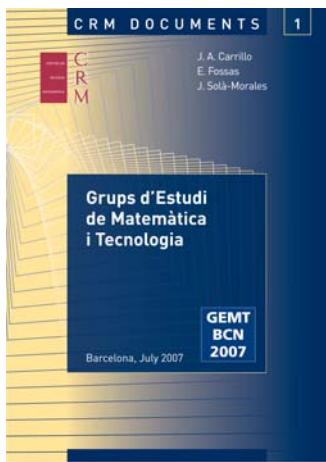


One volume of this series was published in 2008:

Group-based Cryptography
by A. Myasnikov, V. Shpilrain, and A. Ushakov
ISBN: 978-3-7643-8826-3

3.2.2. Documents

El CRM ha iniciat una nova sèrie de volums amb ISBN l'any 2008, anomenada *Documents*. En aquesta sèrie s'hi publicaran monografies, actes de jornades o congressos, informes de projectes de recerca i altres reculls de material de qualitat. El primer volum de la sèrie ha estat el següent:



The CRM launched a new series of volumes with ISBN in 2008, called Documents. These include monographs, proceedings of events, reports of research programmes, and other quality material. The first volume of this series was the following:

Grups d'Estudi de Matemàtiques i Tecnologia (GEMT 2007)
edited by J. A. Carrillo, E. Fossas, and
J. Solà-Morales
ISBN: 978-84-612-4771-4

3.2.3. Quaderns

La sèrie *Quaderns* recull el contingut d'activitats especialitzades, principalment els apunts lliurats prèviament pel professorat de cursos avançats del CRM. Durant l'any 2008 s'han imprès els exemplars següents:

Booklets in this series contain specialised texts, mostly preliminary notes delivered by lecturers of CRM Advanced Courses. The following issues were printed in 2008:

- A. Geroldinger
Advanced Course in Combinatorics and Geometry: Additive Combinatorics
January 2008
- A. Joyal, M. Tierney
Simplicial Homotopy Theory
February 2008
- I. Moerdijk, B. Toën, A. Joyal
Advanced Course on Simplicial Methods in Higher Categories, I and II
February 2008
- B. Chow, Z. Djadli, M. Ritoré, C. Sinestrari
Advanced Course on Geometric Flows and Hyperbolic Geometry
March 2008
- H. Berestycki, H. Brezis, C. Kenig, R. V. Kohn, G. Tian
Topics in PDE's and Applications 2008, I and II
May 2008
- Y. C. de Verdière, S. V. Ngoc
GAP VI – Workshop on Geometry and Physics
June 2008
- S. del Baño
Barcelona Financial Engineering Summer School
July 2008
- M. Berti, C. Cheng, A. Delshams, E. Fontich, M. Gidea, R. de la Llave,
A. Neihstadt, R. Ramírez-Ros, C. Simó, D. Treschev, T. Uzer
Advanced Course on Stability and Instability in Mechanical Systems
September 2008

3.2.4. Preprints

La sèrie de prepublicacions del CRM s'ha incrementat amb els 62 títols següents durant l'any 2008:

The CRM preprint series grew with the following 62 issues in 2008:

- P. Průša
Classifying big projectives over some noetherian rings
- M. Noy, J. Rué
Counting polygon dissections in the projective plane
- O. Bernardi, M. Noy, D. Welsh
On the growth rate of minor-closed classes of graphs
- C. Casacuberta, A. Neeman
Brown representability does not come for free

- W. Dicks, S. V. Ivanov
On the intersection of free subgroups in free products of groups
- L. El Fadil
A public-key cryptosystem based on second-order linear sequences
- F. Liu, J. Llibre, X. Zhang
Heteroclinic orbits for a class of Hamiltonian systems on Riemannian manifolds
- J. Llibre, X. Zhang
Hopf bifurcation in higher dimensional differential systems via the averaging method
- J. Llibre, X. Zhang
Rational first integrals in the Darboux theory of integrability in \mathbf{C}^n
- N. Gambino
Weighted limits in simplicial homotopy theory
- A. Neeman
Derived categories and Grothendieck duality
- J. Bolte, A. Daniilidis, O. Ley, L. Mazet
Characterizations of Lojasiewicz inequalities and applications
- T. Leinster
The Euler characteristic of a category
- J.-M. Deshouillers, F. Luca
On the distribution of some means concerning the Euler function
- B. Keller, M. Van den Bergh
On two examples by Iyama and Yoshino
- L. Di Vizio
Local analytic classification of q -difference equations with $|q| = 1$
- W. Chacholski, W. Pitsch, J. Scherer, D. Stanley
Homotopy exponents for large H -spaces
- V. Barbu, C. Marinelli
Strong solutions for stochastic porous media equations with jumps
- D. J. Grynkiewicz
On extending Pollard's theorem for t -representable sums
- E. Nursultanov, S. Tikhonov
Net spaces and boundedness of integral operators
- E. Nursultanov, S. Tikhonov
Convolution inequalities in Lorenz spaces

- N. Gambino, R. Garner
The identity type weak factorisation system
- S. Cleary, J. Taback
Tree automorphisms and quasi-isometries of Thompson's group F
- L. Ciobanu, A. Martino, E. Ventura
The generic Hanna Neumann conjecture and post correspondence problem
- E. Gallego, A. Reventós, G. Solanes, E. Teufer
Horospheres in hyperbolic geometry
- S. Kaliszewski, J. Quigg, I. Raeburn
Proper actions, fixed-point algebras and naturality in nonabelian duality
- L. W. Baggett, N. S. Larsen, K. D. Merrill, J. A. Packer, I. Raeburn
Generalized multiresolution analysis with given multiplicity functions
- R. Saghin, Z. Xia
The entropy conjecture for partially hyperbolic diffeomorphisms with 1-D center
- E. Duchi, D. Poualhon
On square permutations
- R. Coquereaux, G. Schieber
Quantum symmetries for exceptional $SU(4)$ modular invariants associated with conformal embeddings
- F. Falceto, M. Zambon
An extension of the Marsden–Ratiu reduction for Poisson manifolds
- E. Morozov, R. Delgado
Stability analysis of regenerative queues
- H. Krause
Localization for triangulated categories
- A. Pichereau
Formal deformations of Poisson structures in low dimensions
- T. M. Fiore, I. Kriz
What is the Jacobian of a Riemann surface with boundary?
- C. Casacuberta, J. J. Gutiérrez, I. Moerdijk, R. M. Vogt
Localization of algebras over coloured operads
- L. El Fadil
Computation of an integral basis of a quartic number field
- B. Keller
Cluster algebras, quiver representations and triangulated categories

- A. E. Stanculescu
Note on a theorem of Bousfield and Friedlander
- A. E. Stanculescu
A model category structure on the category of simplicial multicategories
- A. E. Stanculescu
On the homotopy theory of spectral categories
- A. S. Crans, T. M. Fiore, R. Satyendra
Musical actions of dihedral groups
- L. Baratchart, F. L. Nazarov, V. V. Peller
Analytic approximation of matrix functions in L^p
- V. V. Peller
Differentiability of functions of contractions
- J. Kock
Polynomial functors and trees
- C. Berger, I. Moerdijk
On an extension of the notion of Reedy category
- T. M. Fiore, S. Paoli
A Thomason model structure on the category of small n -fold categories
- J. Belk, F. Matucci
Conjugacy in Thompson's groups
- J. Belk, F. Matucci
Dynamics in Thompson's group F
- L. Makar-Limanov
A conjecture of Bavula on homomorphisms of Weyl algebra
- M. Halic
Strong exceptional sequences of vector bundles on certain Fano varieties
- L. El Fadil
Computation of an integral basis of a cubic number field
- E. Faro
On the trace of an endofunctor of a small category
- A. Corral
Point-occurrence self-similarity in crackling-noise systems and in other complex systems
- F. Matucci
Mather invariants in groups of piecewise-linear homeomorphisms

Y. Chen, J. Flum, M. Müller
Lower bounds for kernelizations

S. del Baño
Spot inversion in the Heston model

P. Díaz, J. A. Lázaro
Monopoles in arbitrary dimension

M. Kassabov, F. Matucci
The simultaneous conjugacy problem in groups of piecewise linear functions

A. Neeman
Dualizing complexes – The modern way

A. Delshams, G. Huguet
Geography of resonances and Arnold diffusion in a priori unstable Hamiltonian systems

A. Guillamon, G. Huguet
A computational and geometric approach to phase resetting curves and surfaces

