

CENTRE DE RECERCA MATEMÀTICA

2007

REPORT OF ACTIVITIES



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PRESENTATION

Once again, the CRM publishes its annual report, which, in addition to describing the activities of the Centre during 2007, renders accounts to the community, as is appropriate for institutions making use of public funds and whose purpose it to provide a service. The report offers a detailed view of the scope of the CRM, what it does and what resources it has available, etc. In short, it gives a precise view of the Centre in all its different aspects.

If I had to single out one thing in terms of academic activity, one of the highlights has been the start up of the *Ingenio Mathematica* project, for which the CRM is a node, and which has increased the involvement of the CRM in all Spain. In terms of economic parameters, I would emphasize the fact that one third of the budget was consolidated through the contract programme, and the remaining two thirds came from competitive bids. Given that the CRM submits applications academically backed by university research groups, this is a good sign of the high level of mathematical research in Catalonia, and also proves that the CRM is complying with its statutory objectives.

In this presentation we should refer to more qualitative aspects and mention the significant events that have occurred throughout the year. Institutionally, we should begin by mentioning that the signatory of this report took up the post of director of the CRM on April 1, 2007, accompanied by a team of directors composed of Carles Casacuberta, Marta Sanz-Solé and Joan Solà-Morales; friends to whom I am wholeheartedly grateful for having accepted the challenge of taking the CRM forward over the next few years. Following this, I would like to mention the start of a new Scientific Advisory Board, the composition of which is contained in the report, and I would like to take this opportunity to thank all the members who have accepted this responsibility. I would also like to express my gratitude to the CRM staff for their warm welcome and willingness to work with the new Team of Directors, which was so evident during our apprenticeship.

PRESENTACIÓ

Un cop més el CRM edita la seva memòria anual que, a banda de recollir les activitats del Centre al llarg de 2007, serveix per donar comptes a la comunitat, com pertoca a tota institució finançada amb fons públics i amb voluntat de servei. La memòria ofereix una imatge acurada del que és el CRM, de la seva dimensió, del que fa, amb quins recursos ho fa, etc.; en definitiva, si la llegiu tindreu una visió del Centre en tots els seus aspectes.

Si he de singularitzar quelcom, pel que fa a activitat científica crec que un fet destacable és la posada en marxa del projecte *Ingenio Mathematica*, del qual el CRM és un node, i que ha augmentat la implicació del CRM a nivell estatal. I pel que fa a paràmetres econòmics, destacaria el fet que la liquidació del pressupost ens mostra una tercera part consolidada mitjançant el contracte programa, mentre que les dues terceres parts restants provenen de convocatòries competitives. Atès que el CRM es presenta a les convocatòries recolzat científicament en els grups de recerca de les universitats, crec que això és un bon exponent de la competitivitat de la recerca matemàtica a Catalunya i alhora prova que el CRM està complint el seu objectiu estatutari.

Penso, però, que en aquesta presentació és més pertinent referir-nos a aspectes qualitatius i fer esment de fets significatius que s'han produït al llarg de l'any. Institucionalment, cal començar per assenyalar que qui signa aquesta presentació entrà en funcions com a director l'1 d'abril de 2007, acompanyat per un equip de direcció format per Carles Casacuberta, Marta Sanz-Solé i Joan Solà-Morales, amics als quals agraeixo de tot cor haver acceptat de conduir plegats el CRM els propers anys. Seguidament, s'ha de singularitzar l'entrada en funcions d'un nou Consell Científic Assessor, la composició del qual trobareu a la memòria. Vull aprofitar l'oportunitat per donar les gràcies a tots els seus membres per haver acceptat aquesta responsabilitat. També vull expressar el meu agraïment al personal del CRM pel magnífic acolliment, la disposició i les ganes de treballar mostrades envers el nou equip durant la nostra fase d'aprenentatge.

Notably, 2007 was a year of extension of the contract programme, that had been due to end in 2006. All new teams bring new projects, and we are introducing a new strategic plan for the CRM, which will sustain the contract programme from 2008 to 2013—a process that began in July 2007. I hope that the report for 2008 will be able to confirm that this is in place. The CRM continues to support internationalisation, and in this sense a series of programmes was already developed in 2007, all of them subject to international competition and diffusion. These projects are described in section 5 of the report. The highlights are the CRM postdoctoral grants, which existed until a few years ago at the CRM, and which have been revived now with a first call last autumn. Another element of the plan that we are carrying out and which was put into action in 2007 in a modest way is the Incentivation Programme for Strategic Areas, which you can find described in section 8.

On taking up their new responsibilities, the Team of Directors found a centre in a very good state of health. It is well organised internally and economically stable; it has many programmed activities, an international reputation, is a leading centre in Europe and, in short, makes any new incorporation easy and raises everyone's level of enthusiasm. Above all, the CRM would not exist today if it had not been for the immense task carried out by Prof. Manuel Castellet, founder and director of the CRM since it was conceived in 1983; a generous undertaking for which he sacrificed other aspects of his academic career, and for which I believe the Catalan mathematical community should be deeply grateful. I would like to take this occasion to express, in the name of the Team of Directors, our recognition of this, recognition which is at the same time institutional through his appointment as Honorary Director, in a decision passed by the Governing Board of the CRM.

L'any 2007 ha estat un any de pròrroga del contracte programa que el CRM tenia vigent fins el 2006. Tot nou equip té nous projectes, i en aquest cas els estem incorporant a un pla estratègic que ha de sustentar el nou contracte programa per al període 2008-2013, procés que va començar el juliol de 2007. Espero que a la memòria de 2008 podrem dir que ja ha començat. El CRM seguirà apostant per la internacionalització, i en aquesta línia ja dins l'any 2007 hem desplegat una sèrie de programes, tots ells competitiu i difosos internacionalment, que trobareu a l'apartat 5. De tots ells destaco les beques postdoctorals del CRM, que fa uns anys ja havien existit i que ara recuperem, i que foren convocades la tardor passada. Un altre element del pla que estem fent i que ja el 2007 hem posat en marxa d'una forma molt modesta és el Programa d'incentivació d'àrees estratègiques, que trobareu descrit a l'apartat 8.

A l'entrar en funcions, el nou equip de direcció s'ha trobat un centre amb molt bona salut. Ben organitzat a nivell intern, econòmicament sanejat, amb moltes activitats programades, amb reputació internacional i protagonisme a nivell europeu; en definitiva, una situació engrescadora que fa fàcil la incorporació de qualsevol. La magnífica realitat que és el CRM avui no existiria sense la tasca immensa del Dr. Manuel Castellet, fundador i director del CRM des del començament l'any 1983, tasca generosa a la qual ha sacrificat altres aspectes de la seva carrera acadèmica, i per la qual jo crec que la comunitat matemàtica catalana li hem d'estar profundament agraïts. Vull aprofitar aquesta ocasió per expressar-li en nom de l'Equip de Direcció el nostre reconeixement, que ho és també institucional mitjançant el seu nomenament com a Director Honorari del CRM aprovat pel Consell de Direcció.

Joaquim Bruna
Director

CONTENTS

1. The Centre de Recerca Matemàtica	1.1. The Institut d'Estudis Catalans 8
	1.2. The Generalitat de Catalunya 8
2. Governing Body and Secretariat	2.1. Governing Board 8
	2.2. Director 9
	2.3. Team of Directors 9
	2.4. Honorary Director 9
	2.5. Scientific Advisory Board 9
	2.6. Secretariat 10
	2.7. External Services 10
3. Facilities	3.1. Premises 10
	3.2. Computer Equipment 10
	3.3. Library 11
	3.4. Housing 11
4. Contract Programme with the Catalan Government	4.1. Meeting of the Monitoring Commission 11
5. International Calls	5.1. Visiting the CRM 12
	5.2. Collaboration Research Stays 12
	5.3. Summer/Winter Training Courses..... 12
	5.4. Conferences and Workshops 13
	5.5. Thematic Days 14
	5.6. Post-Doctoral Grants..... 14
	5.7. Research Programmes..... 14
ACTIVITIES IN 2007	
6. Visiting Researchers	6.1. List of Visitors 19
	6.2. Post-Doctoral Fellows..... 29
7. Scientific Activities	7.1. Research Programmes..... 30
	7.1.1. Discrete and Continuous Methods in Ring Theory 30
	7.1.2. Enumerative Combinatorics and Random Structures..... 32
	7.1.3. Mathematics and Digital Content Security 34
	7.1.4. Homotopy Theory and Higher Categories..... 35
	7.2. Specialised Quarters..... 37
	7.2.1. Complex Non-Smooth Dynamical Systems..... 37

7.3. Conferences	39
7.3.1. Conference on Cryptology and Digital Content Security	39
7.3.2. Conference on C^* -Algebras and Their Invariants	39
7.3.3. Conference on Enumeration and Probabilistic Methods in Combinatorics	40
7.4. Advanced Courses	40
7.4.1. Advanced Course on Analytic and Probabilistic Techniques in Combinatorics	40
7.4.2. Advanced Course on Quasideterminants and Universal Localization	41
7.4.3. Advanced Course on Group-Based Cryptography	42
7.4.4. Advanced School on Numerical Solutions of Partial Differential Equations	44
7.5. Workshops	44
7.5.1. Grups d'Estudi de Matemàtica i Tecnologia (GEMT 2007)	44
7.5.2. X Workshop on Celestial Mechanics	45
7.5.3. Workshop on Derived Categories	46
7.6. Barcelona Financial Engineering Seminar.....	46
7.7. Master's Course in Mathematical Finance	46
7.8. CRM Open Day	47
8. Strategic Areas Incentive Programme	47
9. Publications	
9.1. Advanced Courses CRM Barcelona	49
9.2. Quaderns	49
9.3. Preprints	49
10. The European Framework	
10.1. ERCOM	52
10.2. EPDI	52
10.3. Shaping New Directions in Mathematics for Science and Society	53
10.3.1. Project Outline	53
10.3.2. Activities during 2007	53
10.4. ESOF 2008	53
11. Ingenio Mathematica	54
12. CRM Doctorate Scholarships	55
13. CRM Post-Doctoral Grants	55
14. Financial Activity	
14.1. Revenue	56
14.2. Expenditure	56

1. THE CENTRE DE RECERCA MATEMÀTICA

The Centre de Recerca Matemàtica (CRM) is a consortium, with its own legal status, integrated by the Institut d'Estudis Catalans (IEC) and the Catalan Government. It is a research institute associated with the Universitat Autònoma de Barcelona.

The CRM is, in essence, a horizontal infrastructure that gives support to mathematical research groups and encourages the pursuit of emerging lines of research.

The CRM has the following goals:

- To carry out research programmes on high-level topics.
- To attract the best post-doctoral fellows by way of competitive programmes of various administrations and agencies.
- To consolidate mechanisms for an efficient service to mathematicians.
- To take further steps towards becoming as competitive as the best European research centres and those of other scientifically developed countries of similar characteristics.

To achieve these goals, the CRM invites outstanding scientists from around the world for research stays, gives the opportunity to both scientific institutions and young researchers to get in contact with senior visitors, carries out research programmes, organises conferences, courses, seminars and other scientific meetings, and spreads the results of research.

The statutes of the CRM provide for the following governing bodies:

- The Governing Board, composed of the Commissioner for Universities and Research, who acts as president, the President of the IEC, three members designated by the Government and three members designated by the IEC.
- The Director, who is appointed by the Governing Board.
- The Scientific Advisory Board, whose members are proposed by the Director and approved by the Governing Board.
- Administrative and technical support.

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1.1. THE INSTITUT D'ESTUDIS CATALANS



The Institut d'Estudis Catalans (Institute for Catalan Studies) was founded in 1907. It is an academic, scientific and cultural body whose sphere of activities includes all aspects of Catalan language and culture.

The aim of the IEC is to promote scientific research, in particular research related to all aspects of Catalan culture. It contributes to the planning, co-ordination and implementation of research in different fields of science, technology and humanities. Moreover, its own activities further the progress and development of society in general, and, when necessary, acts as an advisor to the government and other institutions.

The IEC is made up of five different sections defined by broad subject units in science, technology and humanities. There are twenty-eight societies affiliated to the IEC, with more than 9,000 members. One of them is the Catalan Mathematical Society (SCM).

1.2. THE GENERALITAT DE CATALUNYA



The Generalitat de Catalunya is the institution in which the self-government of Catalonia is politically organised through a Parliament and an Autonomous Government. It was created in the thirteenth century, bearing the same name, as an executive body, by the General Courts of the Confederation of the Catalan-Aragonese Crown.

The Generalitat de Catalunya participates in the CRM Consortium through its Commission for Universities and Research.

2. GOVERNING BODY AND SECRETARIAT

2.1. GOVERNING BOARD

During most of 2007 the CRM Governing Board had the following members:

The Commissioner for Universities and Research, Blanca Palmada (Chair)

The President of the Institut d'Estudis Catalans, Salvador Giner

The Director General of Research, Ramon Moreno

The Subdirector General of Research, Iolanda Font

The Director of the CIRIT, Joan Roca

Salvador Alegret, full member of the Institut d'Estudis Catalans

Joan Girbau, full member of the Institut d'Estudis Catalans

Ricard Guerrero, full member of the Institut d'Estudis Catalans

The Governing Board met only once in 2007. The meeting was held on March 26. In this meeting, the new CRM Director, Joaquim Bruna, was formally appointed after the election that had been made on November 22, 2006. In addition, a Team of Directors and a new Scientific Advisory Board were approved to the Director's proposal. The former director, Manuel Castellet, was nominated Honorary Director. The 2006 annual report of activities and the 2006 accounts were approved, as well as a budget and a programme of activities for 2007. The vision and project presented by the Director for the period 2007-2011 were heard and approved.

2.2. DIRECTOR



The Governing Board elects a Director to serve for a period of four years. The current Director is Joaquim Bruna, professor at the UAB, who was elected for the period 2007-2011. He started his term on April 1, 2007, taking over his position from Manuel Castellet.

2.3. TEAM OF DIRECTORS

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



2.4. HONORARY DIRECTOR

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

2.5. SCIENTIFIC ADVISORY BOARD

A new Scientific Advisory Board for the CRM was elected in 2007. The list of members is the following:

- Jaume Agudé, UAB
- 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, UB
- José Luis Fernández, UAM and Analistas Financieros Internacionales
- Gerhard Frey, Institut für Experimentelle Mathematik, Essen
- Oscar García Prada, CSIC, Madrid
- Antonio Huerta, UPC
- Andreu Mas-Colell, UPF
- 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



One meeting of the Scientific Advisory Board was held in July 18, 2007. At this meeting, three CRM research programmes for the academic year 2008-2009 were chosen. Flexibility in the length of research programmes was recommended for the coming years. The eventual involvement of the CRM in the Spanish Mathematical Institute (IEMath) was discussed, together with other features of the Centre's strategic planning.

2.6. SECRETARIAT

The staff of the CRM is in charge of organising the logistic aspects of scientific activities and to make sure that researchers have fruitful and trouble-free visits. The Secretariat gives support to the Director in all his duties. The members of the Secretariat were the following in 2007:

Mrs. Ana García-Donas
 agarcia@crm.cat
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Mrs. Núria Hernández
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Mrs. Neus Portet
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Mrs. Consol Roca
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 Phone: +34 935812953

Mrs. Mari Paz Valero
 mpvalero@crm.cat
 Phone: +34 935811081



The following people gave additional administrative support to the CRM in 2007: Neus Castells, Núria García-Donas, Pere Menal, and Patricia Quintero.

2.7. EXTERNAL SERVICES

In order to make the running of the CRM more flexible without increasing the number of work contracts, three companies offering external services perform the following tasks:

- Economic management and accounting: Consultors Rodao & Associats
- Computer technical service: GetPut Software S.L.
- Support for the data base management programme: Àgil Grup

3. FACILITIES

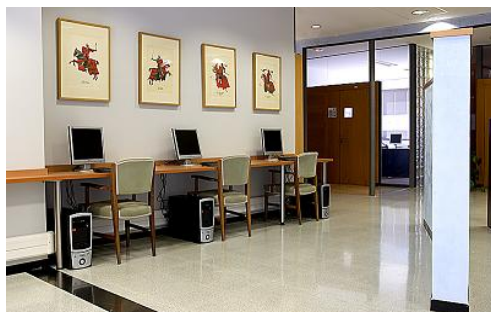
3.1. PREMISES

The CRM has facilities in the UAB Faculty of Sciences with a total floor space of 1,225 square metres, divided into seven individual offices, six double ones, three triple ones, a secretary's office with five work places, a management office, an office for deputy-management, a storeroom, an auditorium with capacity for one hundred people, a lecture room for twenty-five people, two meeting rooms, and a common leisure area which includes computers and network connections for general use. All the premises have heating and air conditioning.

3.2. COMPUTER EQUIPMENT

The CRM has a LAN Ethernet net of 100 Mbps. There are 48 working stations connected to the net and five printers. All workstations are part of a Windows Domain sup-

plied by a central server (HP Netserver LC10) 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 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. Wi-Fi connection is also available.



3.3. LIBRARY

CRM visitors have free access to all the scientific infrastructure of the UAB, consisting of essentially the Science and Engineerings Library, which contains 448 paper journals, 432 electronic journals and 14,415 books devoted to Mathematics. The catalog is available online.

3.4. HOUSING

The CRM has a few rented furnished apartments for the use of its visitors in Sant Cugat del Vallès (a small town connected by train to the UAB campus and to Barcelona), in Barcelona, and in the Vila Universitària of the UAB campus. Most of the apartments consist of a dining room with kitchen, a bathroom, and one bedroom with two single beds. A few of them have two or three bedrooms and are suitable for families.

The rent, including utilities, ranges from 600 to 800 euros per month. The apartments may be provided with a telephone connection upon request at the visitors' expenses.

4. CONTRACT PROGRAMME WITH THE CATALAN GOVERNMENT

As part of the relations between the Centre de Recerca Matemàtica and the Catalan Government, a contract programme was signed on June 18, 2003 by the Minister for the Department of Universities, Research and the Information Society and the Director of the Centre de Recerca Matemàtica for a period of four years covering the period 2003-2006, and which was extended to the year 2007.

This contract programme specifies an annual subsidy that is provided by the Catalan Government in order to provide the CRM with the necessary means to perform its duties, defines the overall strategic objectives and proposes a set of specific actions. Each of these actions is associated to one or more indicators that make it possible to measure the degree to which the Centre complies with its objectives, which are analysed once a year by the Monitoring Commission established by the same contract programme.

4.1. MEETING OF THE MONITORING COMMISSION

As in previous years, the Monitoring Commission of the contract programme met to evaluate the degree to which the objectives and commitments assumed by the CRM under terms of the contract programme have been accomplished, and also to propose any measures considered necessary to guarantee this compliance in the future.

The meeting analysed the indicators established by the contract programme in reference to CRM activity during the year 2006. Based on data presented in the report for the year 2006, complemented by additional information supplied by the Centre, the Commission was able to state that the contract programme had been complied with, and in some cases had been considerably surpassed.

5. INTERNATIONAL CALLS

Several international open calls were made public on the CRM website during the last quarter of 2007. Most of them do not have specific deadlines, but applications are handled by the Directorate at regular periods of time. Guideline texts for the main calls are as follows. Further details and application forms are available at the CRM website.

5.1. VISITING THE CRM

The CRM offers the possibility of hosting researchers wishing to stay at the Centre for a period normally ranging from one to six months, preferably having a research plan and a scientific connection with long-term CRM visitors or researchers based at a university in Catalonia. Researchers from Catalan universities can apply if they are free from teaching duties during the period of their stay at the CRM.

Visitors will be provided with office space and working facilities at the Centre, as well as house-finding assistance. Funding can be requested, although the CRM can only assign an overall small amount of support to visits outside its Research Programmes.

Applications can be submitted at any time by sending the required information to the CRM at crm@crm.cat, generally between 6 and 12 months before the start of the desired stay. An answer will be given by the CRM no later than three months after submission of the application.

5.2. COLLABORATION RESEARCH STAYS

Applications are welcome for stays at the CRM aiming to carry out collaborative research work of a small team of people, consisting of:

- A principal investigator, staying at the CRM for a quarter or a semester.
- One or two collaborators, staying at the CRM for at least one month.

Researchers from Catalan universities can apply as principal investigators if they are free from teaching duties during the period of their stay at the CRM.

Office space and working facilities will be provided by the CRM, as well as house-finding assistance. Funding can be requested, and priority will be given to applications with a self-funded principal investigator.

Applications can be submitted at any time by sending the required information to the CRM at crm@crm.cat, generally between 6 and 12 months before the start of the desired stay. An answer will be given by the CRM no later than three months after submission of the application.

5.3. SUMMER/WINTER TRAINING COURSES

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.

Calendar and format

Events in this series will normally have a duration of two weeks, either in January-February or July, and will consist of up to five series of lectures of 8 to 10 hours each on well-defined subtopics, given by experts in the field. Shorter training courses to be held in other months can also be considered. Lectures may be complemented with practical training sessions, discussion of exercises or research problems, and other activities.

CRM resources

The CRM has a fully-equipped auditorium with a maximum capacity of 100 people, and a smaller lecture room for 25 people. There is also suitable space for coffee breaks, internet access, and a meeting room. The Bellaterra campus offers hotel rooms and apartment rental service for participants, subject to availability.

Funding from the CRM can cover accommodation, travel expenses and honoraries of lecturers, as well as a number of grants and possibly other costs, upon negotiation with the proposers and assessment of cofinancing possibilities. A registration fee will be set by the CRM for each event.

Publication of lecture notes

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. Early preparation of such volumes is strongly encouraged.

Submission of proposals

Proposals should be submitted by sending the requested information to the CRM using the e-mail address crm@crm.cat, normally at least 12 months before the starting date of the course. Proposals will be reviewed by the CRM Scientific Advisory Board, and decisions will be taken in June and December of each year. If necessary, proposers may contact the CRM Secretariat at for assistance in the preparation of proposals.

5.4. CONFERENCES AND WORKSHOPS

The CRM launches an open call for proposals of conferences or workshops to be held at the Centre. The CRM will act as organisational unit, by offering secretarial support, advice, and funding. A scientific committee nominated by the proposers will be responsi-

ble for the selection of speakers and design of the programme of the event.

Conferences may assemble up to 100 participants and will normally follow the standards and procedures of previous CRM conferences. An electronic registration form will be available at the CRM website. Funding from the CRM can cover lodging expenses of plenary speakers, as well as a number of grants and possibly other costs, upon negotiation with the proposers and assessment of cofinancing possibilities. A registration fee will be set by the CRM for each event.

Workshops will 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. The CRM can offer a substantial contribution to the overall lodging and subsistence costs, upon negotiation with the proposers.

The CRM has a fully-equipped auditorium with a maximum capacity of 100 people, and a smaller lecture room for 25 people. There is also suitable space for coffee breaks, internet access, and a meeting room. The Bellaterra campus offers hotel rooms and apartment rental service for participants, subject to availability.

Submission of proposals

This call is open to researchers or teams working in any area of Mathematics or in other disciplines where high-level mathematical methods are used. Proposals should be submitted by sending the requested information to the CRM using the e-mail address crm@crm.cat, normally at least 15 months before the starting date of the conference or workshop. Proposals will be reviewed by the CRM Scientific Advisory Board, and decisions will be taken in June and December of each year. If necessary, proposers may contact the CRM Secretariat for assistance in the preparation of proposals.

5.5. THEMATIC DAYS

The CRM launches an open call for proposals of thematic days to be held at the Centre. Events of this kind will normally be scheduled within one single day. The CRM will act as organisational unit, by offering secretarial support, advice, and funding. The proposers will be 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 high-level mathematical methods are used. Proposals should be submitted by sending the requested information to the CRM using the e-mail address crm@crm.cat, normally at least six months before the starting date of the event. If necessary, proposers may contact the CRM Secretariat for assistance in the preparation of proposals.

5.6. POST-DOCTORAL GRANTS

Doctoral degree holders can apply for post-doctoral stays at the CRM, provided that their doctorate has been awarded no earlier than 5 years before the application date. A certificate of doctoral award must be presented before the starting date of the stay.

Applicants must have a written acceptance by a host research group, stating their conformity with the research plan of the applicant and their willingness to host him or her as a participant in the activities of the group during his or her stay at the CRM. A member of the host research group will act as responsible for liaison with the applicant and follow-up.

The normal duration of a post-doctoral grant is one year, although shorter stays are also possible with lower priority, and extensions for a second period may be negotiated. Applications can be submitted before Decem-

ber 14, 2007 by sending the required information to the CRM at crm@crm.cat. Submissions will be reviewed through the CRM Scientific Advisory Board. A decision will be taken no later than two months after the deadline. The net salary will amount to 19,200 euros per year. Successful applicants will be provided with office space and working facilities at the Centre, as well as house-finding assistance if necessary. They are expected to start their stay at the CRM in September 2008 under normal circumstances. Delayed arrivals are acceptable under request, provided that the starting date does not surpass February 2009.

5.7. 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. The CRM Research Programmes can run for periods from three months to a whole academic year (September to July). One-year programmes, possibly structured into two semesters, are especially encouraged.

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.
- The submission of a final report of the programme within two months after its completion.

One of the members of the scientific committee should act as coordinator of the programme. The scientific committee should include at least one member from a Spanish university. It is also recommended that at least one of the members of the scientific committee be a member of an academic institu-

tion in Catalonia. At least one member of the committee should be present at all times during the programme.

Typically, participants in a programme include:

- Local researchers on a full-time basis.
- Visiting established researchers on a full-time basis (minimum stay of one month, with exceptional cases to be considered). It is expected that some of them will stay for the whole programme.
- Post-doctoral fellows.
- Advanced PhD students.
- Others.

It is expected that local researchers negotiate with their home institutions their full-time commitment to the activity.

A research programme generally includes, besides the daily interactions among the participants, the following:

- One or two weekly working seminars.
- At least one intensive workshop, 3 to 5 days long, preferably open to researchers not participating in the programme.
- One advanced course addressed to graduate students. The CRM encourages the production of edited notes of the courses, which may be published in the Birkhäuser series *Advanced Courses in Mathematics CRM Barcelona*.
- A conference, in the case of year-long programmes.

Typically, CRM financial support for a programme includes:

- Four full-time visitors per month.
- Partial housing support for the rest of the visitors.
- A one-year post-doctoral grant in the case of year-long programmes.

Travel expenses will be covered only in very exceptional cases. Besides support coming from the CRM's own funding, additional support may come from:

- Competitive funding from Catalan, Spanish, and European agencies, through joint applications of the CRM and the Scientific Committee.
- Research grants from the participating groups.
- Private foundations or participating companies.

Success in the fund-raising process will make possible to host additional visitors, subject to space availability.

The CRM acts as the organisational unit for all activities (workshops, conferences, advanced courses, etc.) included in the programme, for accommodation arrangements, and general administration.

The CRM makes an annual call for CRM Research Programmes two academic years in advance. The Scientific Advisory Board is responsible for the review process of the proposals and their final evaluation. Main points in the decision-making are: scientific quality, interdisciplinary aspects, expected impact, participation of young researchers, and availability through the organisers of other sources of financial support.

ACTIVITIES IN 2007

6. VISITING RESEARCHERS

6.1. LIST OF VISITORS

J. Yu	Dynamical Systems, 26/09/2005 - 26/03/2007 Shangai Jiaotong University
S. Radomirovic	Number Theory, 31/08/2006 - 31/08/2007 Université du Luxembourg
J. Tan	Differential Equations, 31/08/2006 - 31/03/2008 Centre de Recerca Matemàtica
D. Herbera	Algebra, 01/09/2006 - 15/02/2007 Universitat Autònoma de Barcelona
A. Blanchet	Differential Equations, 01/09/2006 - 31/05/2007, 31/10/2007 - 09/11/2007 Université des Sciences et Technologies de Lille
M. Noy	Discrete Mathematics, 01/09/2006 - 31/07/2007 Universitat Politècnica de Catalunya
D. Welsh	Discrete Mathematics, 01/09/2006 - 31/07/2007 Merton College, Oxford
L. Ciobanu	Algebra, 01/09/2006 - 30/09/2007 Universität Fribourg
O. Bernardi	Discrete Mathematics, 12/09/2006 - 31/07/2007 Centre de Recerca Matemàtica
S. Bazzoni	Algebra, 15/09/2006 - 28/02/2007 Università degli Studi di Padova
P. Prihoda	Algebra, 18/09/2006 - 30/09/2007 Centre de Recerca Matemàtica
J. Dubois	Geometry, 18/09/2006 - 31/12/2007 Université Denis Diderot
G. Aranda	Algebra, 11/10/2006 - 31/08/2007 Universidad de Málaga
A. Tarta	Dynamical Systems, 11/11/2006 - 15/01/2007 Babes-Bolyai University

S. Elizalde	Discrete Mathematics, 01/12/2006 - 31/07/2007 Dartmouth College
A. Yaman	Algebra, 01/12/2006 - 30/11/2008 Centre de Recerca Matemàtica
P. Gauthier	Analysis, 03/01/2007 - 21/05/2007 Centre de Recherches Mathématiques, Montréal
F. Santos	Geometry, 08/01/2007 - 27/01/2007 Universidad de Cantabria
S. Simic	Dynamical Systems, 14/01/2007 - 21/01/2007 San José State University
M. Teixeira	Dynamical Systems, 14/01/2007 - 26/01/2007 UNICAMP
A. Jacquemard	Dynamical Systems, 15/01/2007 - 21/01/2007 Institut de Mathématiques de Bourgogne
P. Flajolet	Discrete Mathematics, 15/01/2007 - 27/01/2007 INRIA Rocquencourt
T. Luczak	Discrete Mathematics, 15/01/2007 - 27/01/2007 Uniwersytet Adama Mickiewicza
J. Trlifaj	Algebra, 15/01/2007 - 17/02/2007 Univerzita Karlova
S. Hogan	Differential Equations, 15/01/2007 - 23/03/2007 University of Bristol
E. Ponce	Dynamical Systems, 15/01/2007 - 15/07/2007 Universidad de Sevilla
Á. del Río	Algebra, 21/01/2007 - 28/01/2007 Universidad de Murcia
E. Jespers	Algebra, 21/01/2007 - 04/02/2007 Vrije Universiteit Brussel
F. Torres	Dynamical Systems, 22/01/2007 - 02/02/2007 Universidad de Sevilla
A. Colombo	Computer Science, 27/01/2007 - 10/03/2007 Politecnico di Milano
M. di Bernardo	Dynamical Systems, 27/01/2007 - 25/03/2007 University of Bristol

J. Okninski	Algebra, 28/01/2007 - 11/02/2007, 29/04/2007 - 08/05/2007 Uniwersytet Warszawski
P. Wahi	Dynamical Systems, 28/01/2007 - 11/02/2007 College Station
F. Angulo	Differential Equations, 29/01/2007 - 09/02/2007 Universidad Nacional de Colombia
T. Insperger	Dynamical Systems, 29/01/2007 - 09/02/2007 Budapest University of Technology and Economics
G. Stépán	Dynamical Systems, 29/01/2007 - 09/02/2007 Budapest University of Technology and Economics
G. Puninskiy	Algebra, 29/01/2007 - 11/03/2007 University of Manchester
G. Olivar	Applied Mathematics, 29/01/2007 - 23/03/2007 Universidad Nacional de Colombia
V. Retakh	Algebra, 30/01/2007 - 11/02/2007 Rutgers University
R. Wilson	Algebra, 30/01/2007 - 11/02/2007 Rutgers University
C. Krattenthaler	Discrete Mathematics, 01/02/2007 - 03/03/2007 Universität Wien
P. García	Mathematical Neuroscience, 01/02/2007 - 31/10/2009 Universitat Pompeu Fabra
D. Kucеровsky	Analysis, 02/02/2007 - 02/03/2007 University of New Brunswick
M. Drmota	Discrete Mathematics, 04/02/2007 - 02/03/2007 Technische Universität Wien
D. Barton	Dynamical Systems, 05/02/2007 - 16/02/2007 University of Bristol
A. Polynikis	Dynamical Systems, 05/02/2007 - 24/02/2007 University of Bristol
V. Avrutin	Dynamical Systems, 11/02/2007 - 22/02/2007 Universität Stuttgart
M. Schanz	Dynamical Systems, 11/02/2007 - 24/02/2007 Universität Stuttgart

S. Gerke	Discrete Mathematics, 11/02/2007 - 03/03/2007 ETH Zürich
G. Osorio	Differential Equations, 12/02/2007 - 24/02/2007 Università di Napoli Federico II
A. Kono	Algebraic Topology, 14/02/2007 - 26/02/2007 Kyoto University
D. Kishimoto	Algebraic Topology, 14/02/2007 - 31/07/2007 Kyoto University
F. Perera	Algebra, 15/02/2007 - 31/07/2007 Universitat Autònoma de Barcelona
D. Chillingworth	Dynamical Systems, 18/02/2007 - 17/03/2007 University of Southampton
W. Winter	Algebra, 19/02/2007 - 09/03/2007 Universität Münster
R. Alzate	Dynamical Systems, 24/02/2007 - 09/03/2007 Università di Napoli Federico II
M. Homer	Dynamical Systems, 25/02/2007 - 10/03/2007 University of Bristol
J. Mason	Dynamical Systems, 25/02/2007 - 10/03/2007 University of Bristol
S. Santini	Dynamical Systems, 25/02/2007 - 10/03/2007 Università di Napoli Federico II
P. Piironen	Applied Mathematics, 25/02/2007 - 11/03/2007 University of Bristol
M. Kang	Discrete Mathematics, 01/03/2007 - 26/03/2007 Humboldt-Universität zu Berlin
F. Wehrung	Algebra, 01/03/2007 - 31/03/2007 Université de Caen
E. Pardo	Algebra, 01/03/2007 - 30/04/2007 Universidad de Cádiz
A. Nordmark	Dynamical Systems, 11/03/2007 - 17/03/2007 Royal Institute of Technology
H. Dankowicz	Dynamical Systems, 11/03/2007 - 24/03/2007 University of Illinois at Urbana-Champaign

D. Pagano	Dynamical Systems, 12/03/2007 - 22/03/2007 Universidade Federal de Santa Catarina
A. Champneys	Dynamical Systems, 12/03/2007 - 23/03/2007 University of Bristol
M. LoebI	Discrete Mathematics, 17/03/2007 - 28/03/2007, 16/04/2007 - 23/04/2007 KAM MFF UK
M. Bousquet-Mélou	Discrete Mathematics, 17/03/2007 - 15/04/2007 Université de Bordeaux 1
M. Di Francesco	Differential Equations, 21/03/2007 - 02/04/2007 Università di L'Aquila
M. Rordam	Analysis, 28/03/2007 - 26/04/2007 Syddansk Universitet
S. Rourke	Algebra, 31/03/2007 - 10/04/2007 University College Cork
K. Goodearl	Algebra, 01/04/2007 - 01/07/2007 University of California at Los Angeles
M. Wolfram	Applied Mathematics, 02/04/2007 - 04/04/2007 Universität Münster
R. Rohde	Analysis, 07/04/2007 - 13/04/2007 Syddansk Universitet
M. Sierakowski	Analysis, 07/04/2007 - 13/04/2007 Uniwersytet Warszawski
D. Herzog	Logic, 12/04/2007 - 17/06/2007 Ohio State University at Lima
M. Mathieu	Analysis, 15/04/2007 - 28/04/2007 The Queen's University of Belfast
M. Siles	Algebra, 16/04/2007 - 20/05/2007 Universidad de Málaga
J. Marckert	Discrete Mathematics, 17/04/2007 - 17/05/2007 Université de Bordeaux 1
G. Elliott	Algebra, 23/04/2007 - 25/05/2007 University of Toronto
I. Raeburn	Analysis, 23/04/2007 - 10/07/2007 University of Wollongong

Z. Niu	Algebra, 01/05/2007 - 31/05/2007 University of Calgary
A. Bernini	Discrete Mathematics, 02/05/2007 - 30/06/2007 Università degli Studi di Firenze
M. Aschbacher	Algebra, 06/05/2007 - 11/05/2007 California Institute of Technology
E. Carlen	Analysis, 06/05/2007 - 04/06/2007 Georgia Institute of Technology
M. Carvalho	Mathematical Physics, 06/05/2007 - 04/06/2007 Universidade de Lisboa
C. Marinelli	Probability and Statistics, 07/05/2007 - 30/04/2008 Centre de Recerca Matemàtica
A. Toms	Algebra, 17/05/2007 - 15/06/2007 York University
N. Wormald	Discrete Mathematics, 17/05/2007 - 28/06/2007 University of Waterloo
L. Angeleri	Algebra, 26/05/2007 - 08/06/2007 Università degli Studi dell'Insubria
A. Miasnikov	Algebra, 27/05/2007 - 03/06/2007, 21/09/2007 - 26/10/2007 McGill University
V. Shpilrain	Algebra, 27/05/2007 - 03/06/2007 The City College of New York
A. Ushakov	Algebra, 27/05/2007 - 15/06/2007 Stevens Institute of Technology
D. Pask	Mathematical Physics, 28/05/2007 - 29/06/2007 The University of Newcastle
J. Ramagge	Algebra, 28/05/2007 - 29/06/2007 University of Wollongong
A. Ferreira	Mathematical Finance, 01/06/2007 - 30/05/2011 Universitat Autònoma de Barcelona
D. Stark	Discrete Mathematics, 05/06/2007 - 30/06/2007 University of London
S. Rinaldi	Discrete Mathematics, 10/06/2007 - 30/06/2007 Institute of Electronic Engineering

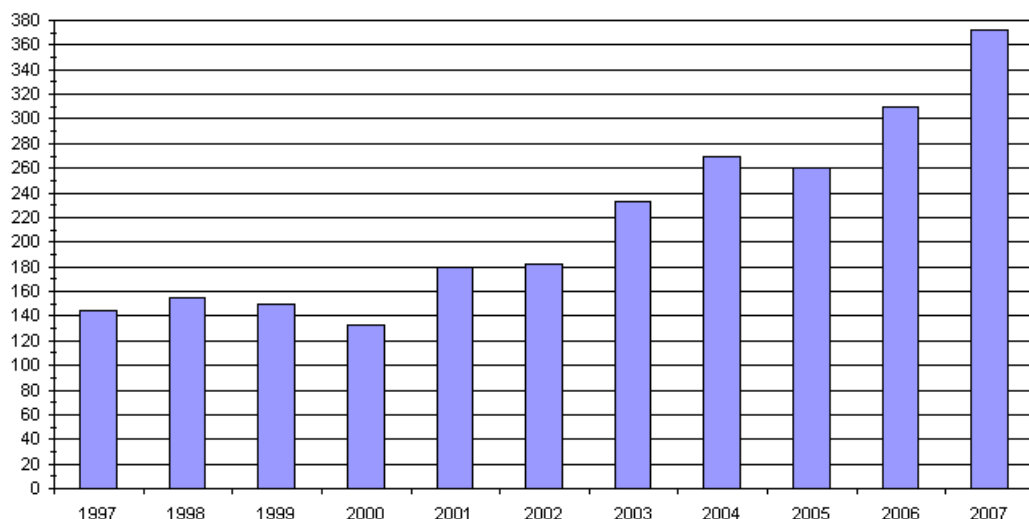
C. McDiarmid	Discrete Mathematics, 16/06/2007 - 29/06/2007 University of Oxford
E. Duchi	Discrete Mathematics, 20/06/2007 - 20/07/2007 Université Denis Diderot
G. Schaeffer	Discrete Mathematics, 20/06/2007 - 20/07/2007 École Polytechnique, Palaiseau
N. Larsen	Analysis, 25/06/2007 - 30/06/2007 University of Oslo
D. Wright	Number Theory, 02/07/2007 - 26/07/2007 Oklahoma State University
E. Essaky	Probability and Statistics, 09/07/2007 - 26/08/2007 Université Cadi Ayyad
J. Bolte	Analysis, 11/07/2007 - 31/07/2007 Université de Paris VI
G. Marinescu	Complex Analysis, 15/07/2007 - 31/07/2007 Johann-Wolfgang-Goethe-Universität
L. Vas	Algebra, 15/07/2007 - 03/08/2007 University of Sciences in Philadelphia
E. Gatto	Analysis, 01/09/2007 - 30/11/2007 DePaul University
C. Casacuberta	Algebraic Topology, 01/09/2007 - 29/02/2008 Universitat de Barcelona
M. Anel	Algebraic Geometry, 01/09/2007 - 31/08/2008 Centre de Recerca Matemàtica
R. Saghin	Dynamical Systems, 01/09/2007 - 28/02/2009 Centre de Recerca Matemàtica
J. Gutiérrez	Algebraic Topology, 01/09/2007 - 31/08/2009 Centre de Recerca Matemàtica
S. Heidarvand	Number Theory, 01/09/2007 - 30/09/2010 Universitat Politècnica de Catalunya
O. Bogopolskiy	Algebra, 06/09/2007 - 04/10/2007 Universität Dortmund
E. Morozov	Probability and Statistics, 06/09/2007 - 10/10/2007 Russian Academy of Sciences

D. Pasca	Dynamical Systems, 08/09/2007 - 15/09/2007 CUNY, Hunter College
J. González-Meneses	Algebra, 10/09/2007 - 23/09/2007 Universidad de Sevilla
H. Krause	Algebra, 10/09/2007 - 30/11/2007 Universität Paderborn
A. Neeman	Algebraic Geometry, 10/09/2007 - 05/12/2007 Australian National University
N. Gambino	Algebra, 12/09/2007 - 31/08/2008 Centre de Recerca Matemàtica
A. Duncan	Algebra, 17/09/2007 - 29/09/2007 Newcastle University
V. Remeslennikov	Algebra, 18/09/2007 - 08/10/2007 Omsk State University
I. Kazachkov	Algebra, 18/09/2007 - 14/10/2007 McGill University
R. Gilman	Algebra, 19/09/2007 - 26/09/2007 Stevens Institute of Technology
M. Alsina	Number Theory, 20/09/2007 - 08/11/2007 Universitat Politècnica de Catalunya
B. Shipley	Algebraic Topology, 22/09/2007 - 20/10/2007 University of Illinois at Chicago
D. Cisinski	Algebraic Topology, 23/09/2007 - 23/11/2007 Université de Paris XIII
D. Lee	Algebra, 24/09/2007 - 06/10/2007 Pusan National University
V. Franjou	Algebraic Topology, 01/10/2007 - 30/11/2007 Université de Nantes
A. Pichereau	Differential Geometry, 01/10/2007 - 30/09/2008 Centre de Recerca Matemàtica
X. Zhang	Dynamical Systems, 05/10/2007 - 31/08/2008 Shangai Jiaotong University

J. Garnett	Analysis, 07/10/2007 - 17/11/2007 University of California at Los Angeles
V. Romankov	Algebra, 11/10/2007 - 27/10/2007 Omsk State University
M. Aguares	Applied Mathematics, 15/10/2007 - 15/01/2008 Universitat Politècnica de Catalunya
S. Rees	Algebra, 19/10/2007 - 29/10/2007 Newcastle University
D. Murfet	Algebraic Geometry, 01/11/2007 - 28/11/2007 Australian National University
A. Joyal	Algebraic Topology, 01/11/2007 - 30/11/2007 Université du Québec à Montréal
M. Van den Bergh	Algebra, 01/11/2007 - 30/11/2007 Universiteit Hasselt
S. del Baño	Mathematical Finance, 01/11/2007 - 31/07/2008 Centre de Recerca Matemàtica
L. El Fadil	Algebra, 01/11/2007 - 30/04/2009 University Ibn Zohr
M. González	Applied Mathematics, 04/11/2007 - 16/11/2007 Universidad Rey Juan Carlos
P. Laurençot	Applied Mathematics, 05/11/2007 - 09/11/2007 Université Paul Sabatier
L. Avramov	Algebra, 09/11/2007 - 01/12/2007 University of Nebraska
J. Peraire	Differential Equations, 13/11/2007 - 19/11/2007 Massachusetts Institute of Technology
S. Bertoluzza	Applied Mathematics, 14/11/2007 - 18/11/2007 Istituto di Matematica Applicata e Tecnologie Informatiche del CNR
E. Fernández	Applied Mathematics, 14/11/2007 - 21/11/2007 Universidad de Sevilla

G. Puppo	Applied Mathematics, 14/11/2007 - 21/11/2007 Politecnico di Torino
B. Ayuso	Applied Mathematics, 14/11/2007 - 22/11/2007 Universidad Autónoma de Madrid
S. Fernández-Méndez	Applied Mathematics, 15/11/2007 - 21/11/2007 Universitat Politècnica de Catalunya
F. Filbet	Differential Equations, 15/11/2007 - 21/11/2007 Université Paul Sabatier
G. Russo	Applied Mathematics, 17/11/2007 - 22/11/2007 Università di Catania
C. Shu	Applied Mathematics, 18/11/2007 - 22/11/2007 Brown University
M. El Kalmoun	Applied Mathematics, 01/12/2007 - 28/02/2009 Université Cadi Ayyad
A. Corral	Physics, 31/12/2007 - 31/12/2009 Centre de Recerca Matemàtica

Visitor person-months



6.2. POST-DOCTORAL FELLOWS

Among the researchers who visited the CRM during 2007, there were 19 post-doctoral grant holders who stayed for several months and who contributed, one more year, to reaffirming one of the foundational aims of

the CRM: to facilitate research done by young researchers and the contact between these and senior scientists. The list of fellows is the following:

Asli Yaman	29.08.2005 – 30.11.2008
Jiang Yu	26.09.2005 – 26.03.2007
Sasa Radomirovic	31.08.2006 – 31.08.2007
Adrien Blanchet	01.09.2006 – 31.05.2007
Laura Ciobanu	01.09.2006 – 30.09.2007
Jérôme Dubois	01.09.2006 – 31.08.2008
Pavel Prihoda	08.09.2006 – 30.09.2007
Olivier Bernardi	12.09.2006 – 31.07.2007
Gonzalo Aranda	11.10.2006 – 31.08.2007
Sergi Elizalde	01.12.2006 – 31.07.2007
Daisuke Kishimoto	14.02.2007 – 31.07.2007
Carlo Marinelli	07.05.2007 – 30.04.2008
Mathieu Anel	01.09.2007 – 31.08.2008
Radu Saghin	01.09.2007 – 28.02.2009
Javier Gutiérrez	01.09.2007 – 31.08.2009
Nicola Gambino	12.09.2007 – 31.08.2008
Anne Pichereau	01.10.2007 – 30.09.2008
Sebastian del Baño	01.11.2007 – 31.07.2008
Mostafa El Kalmoun	01.12.2007 – 28.02.2009

7. SCIENTIFIC ACTIVITIES

7.1. RESEARCH PROGRAMMES

7.1.1. DISCRETE AND CONTINUOUS METHODS IN RING THEORY

Period

From September 1, 2006 to July 31, 2007

Scientists in charge

Silvana Bazzoni
Università di Padova

Ken Goodearl
University of California at Santa Barbara

Dolors Herbera
Universitat Autònoma de Barcelona

Francesc Perera
Universitat Autònoma de Barcelona

Activities

Seminar

A weekly seminar coordinated by Dolors Herbera and Silvana Bazzoni.

Conference

Barcelona Conference on C^* -Algebras and Their Invariants, from June 11 to 15, 2007, coordinated by Francesc Perera.

Advanced course

Advanced Course on Quasideterminants and Universal Localization, from January 30 to February 10, 2007, coordinated by Silvana Bazzoni and Dolors Herbera.

Visiting researchers

Lidia Angeleri
Università degli Studi dell'Insubria

Gonzalo Aranda
Centre de Recerca Matemàtica

Silvana Bazzoni
Università degli Studi di Padova

Ana Isabel Cárceles
Universidad de Murcia

Ángel del Río
Universidad de Murcia

Paul Eklof
University of California at Irvine

George Elliott
University of Toronto

Sergio Estrada
Universidad de Murcia

Kenneth Goodearl
University of California at Los Angeles

Pedro Antonio Guil
Universidad de Murcia

Dolors Herbera
Universitat Autònoma de Barcelona

Ivo Herzog
Ohio State University at Lima

Birge Huisgen-Zimmermann
University of California at Los Angeles

Eric Jespers
Vrije Universiteit Brussel

Dan Kucerovsky
University of New Brunswick

Martin Mathieu
Queen's University of Belfast

Jan Okninski
Uniwersytet Warszawski

Enrique Pardo
Universidad de Cádiz

David Pask
University of Newcastle

Francesc Perera
Universitat Autònoma de Barcelona

Pavel Prihoda
Centre de Recerca Matemàtica

Gennady Puninskiy
University of Manchester

Iain Raeburn
University of Newcastle

Jacqui Ramagge
University of Newcastle

Vladimir Retakh
State University of New Jersey

Mikael Rordam
Syddansk Universitet

Mercedes Siles Molina
Universidad de Málaga

Jan Stovicek
Norwegian University of Science and
Technology

Andrew Toms
University of New Brunswick

Jan Trlifaj
Univerzita Karlova

Friedrich Wehrung
Université de Caen

Robert Lee Wilson
State University of New Jersey

Wilhelm Winter
Universität Münster

Final report

This research programme belongs to the domain of Noncommutative Algebra. More specifically, it focused on Ring Theory, Module Theory, and Operator Algebras.

The programme was structured into two semestres. The first one was devoted to the so-called discrete methods, and was coordinated by Dolors Herbera (UAB) and Silvana Bazzoni (Università di Padova). The second semester was dedicated to continuous methods, and was coordinated by Francesc Perera (UAB) and Ken R. Goodearl (University of California). In each semestre, thematic seminars were organised along the main lines of the programme taking into account the interests of the participants. These seminars were run in weekly sessions of two hours. In each week the first hour was devoted to a chosen theme, while in the second hour more specialised talks were given by CRM visitors.

During the first semester, the thematic seminar focused on the theory of cotorsion pairs. The main topic was a proof of the fact that tilting modules are of finite type, with emphasis on techniques related with Set Theory. It was coordinated by Silvana Bazzoni and Dolors Herbera. In the second semester, the seminar was coordinated by Eduard Ortega and Francesc Perera. The topic was George Elliott's classification of simple AT algebras of zero real rank by means of their K -theory

In addition to these seminars, other working sessions were held without a periodicity. These sessions were more technical and addressed to small audiences.

The main activities of the programme were an advanced course and a congress. The course was held in February 2007, with the title Quasideterminants and Universal Localization. It was attended by 37 participants and the lectures were given by Robert Wilson and Vladimir Retakh, from Rutgers University. The central topic of the course was the theory of quasideterminants, which was presented as a theory aiming to play in the noncommutative world the same role played by the determinant in the commutative world.

The congress was devoted to C^* -algebras, their invariants, and their classification. It took place in June 2007 with 75 participants and 12 first-class speakers. In spite of the diversity of talks, the congress was guided by Elliott's classification programme, which has been considerably strengthened recently.

The flow of visitors was permanent during the whole programme. The duration of their stays was variable, typically around one month. Visitors were distributed along the two semestres, trying to achieve a balance between the discrete part and the continuous part. Post-doctoral grants had been awarded to Gonzalo Aranda (Málaga) and Pavel Prihoda (Prague) in order to enable their participation in the programme.

7.1.2. ENUMERATIVE COMBINATORICS AND RANDOM STRUCTURES

Period

From September 1, 2006 to July 31, 2007

Scientists in charge

Marc Noy
Universitat Politècnica de Catalunya

Dominic Welsh
University of Oxford

Activities

Seminar

A weekly seminar coordinated by Marc Noy.

Conference

Conference on Enumeration and Probabilistic Methods in Combinatorics, from June 25 to 29, 2007, coordinated by Marc Noy.

Advanced course

Advanced Course on Analytic and Probabilistic Techniques in Combinatorics, from January 15 to 26, 2007, coordinated by Marc Noy and Dominic Welsh.

Visiting researchers

Olivier Bernardi
Centre de Recerca Matemàtica

Antonio Bernini
Università degli Studi di Firenze

Mireille Bousquet-Mélou
Université de Bordeaux 1

Michael Drmota
Technische Universität Wien

Enrica Duchi
Université Denis Diderot

Sergi Elizalde
Centre de Recerca Matemàtica

Stefan Felsner
Technische Universität Berlin

Philippe Flajolet
INRIA Rocquencourt

Stephanie Gerke
ETH Zürich

Mihyun Kang
Humboldt Universität zu Berlin

Christian Krattenthaler
Universität Wien

Joseph P. Kung
University of North Texas

Martin Loeb
KAM MFF UK

Tomasz Luczak
Emory University

Jean-François Marckert
Université de Bordeaux 1

Colin McDiarmid
University of Oxford

Marc Noy
Universitat Politècnica de Catalunya

David Orden
Universidad de Alcalá

Simeone Rinaldi
Institute of Electronic Engineering

Francisco Santos
Universidad de Cantabria

Gilles Schaeffer
École Polytechnique, Palaiseau

Charles Semple
University of Canterbury

Angelika Steger
ETH Zürich

Dominic Welsh
University of Oxford

Nick Wormald
University of Waterloo

Final report

The main activities during the programme were the following:

- Hosting researchers and carrying out research work.
- Organisation of an advanced course in January 2007.
- Organisation of a congress in June 2007.

Information about the advanced course and the congress is given in later sections of this annual report. What follows is a summary of research work. Approximately 30 visitors and 10 local researchers participated in the programme. Dominic Welsh (Oxford University) and Marc Noy (UPC) were present at the CRM during the whole academic year 2006-2007 and acted as programme organisers. Olivier Bernardi and Sergi Elizalde were also present all the year with post-doctoral grants. Other participants stayed at the CRM between one and six weeks each.

In addition to working sessions run by programme participants, a seminar was held every week. In this seminar, recent research results were presented and current advances in the area were studied.

The main research topics were random graph theory, enumerative combinatorics, graph minors, graphs and surface maps, limit probability laws for discrete objects, and probabilistic methods in combinatorics. New results in these areas were obtained, among which the following are particularly worth being mentioned:

- Enumeration and structure properties of random graphs in surfaces, generalising recent results about planar graphs.
- Distribution of degrees in series-parallel random graphs.
- A complete classification of minor-closed graph families.
- Bijective proofs of enumerative results about k -triangulations.
- Enumerative results about lattices associated to Dyck paths.
- Study of orientations of quadrangulations and bipolar orientations.
- Counting polygon dissections in the projective plane and their generalisation to higher-genus surfaces.

The scientific objectives of the programme were fully achieved. On one hand, interaction between experts in diverse specialties (Combinatorics and Graph Theory, Probability, Computational Complexity, Analysis of Generating Functions) fostered common research projects where specific techniques were shared. On the other hand, new research collaborations started during the year between members of the different participating groups.

7.1.3. MATHEMATICS AND DIGITAL CONTENT SECURITY

Period

From September 1, 2006 to October 31, 2007

Scientists in charge

Enric Nart
Universitat Autònoma de Barcelona

Enric Ventura
Universitat Politècnica de Catalunya

Activities

Workshop

Practical Aspects of Cryptography, April 2007, organised by the Universidad de Oviedo and coordinated by Consuelo Martínez.

Conference

Conference on Cryptography and Digital Content Security, from May 14 to 18, 2007, coordinated by Enric Nart and Jorge Luis Villar.

Advanced course

Advanced Course on Group-Based Cryptography, from May 28 to June 2, 2007, coordinated by Enric Ventura.

Visiting researchers

Laura Ciobanu
Centre de Recerca Matemàtica

Sean Cleary
City College of New York

Volker Diekert
Universität Stuttgart

Andrew Duncan
Newcastle University

Benjamin Fine
Fairfield University

Robert Gilman
Stevens Institute of Technology

Alexei Miasnikov
McGill University

Sasa Radomirovic
Norwegian University of Science and Technology

Vladimir Shpilrain
City College of New York

Katherine St. John
Lehman College

Enric Ventura
Universitat Politècnica de Catalunya

Asli Yaman
Centre de Recerca Matemàtica

Final report

A considerable part of the scientific work carried out at the CRM within this research programme was concentrated, as planned, around the following two events: a conference on Cryptography and Digital Content Security and an advanced course on Group-Based Cryptography. The conference gathered together 70 participants and included sessions on background and training, together with a working session on Privacy and

Security for Citizens, Corporations, and Governments, followed by a round table discussion, and more specialised workshops on the main topics of the conference. The advanced course was attended by 33 participants and consisted of a series of lectures on Noncommutative Cryptography, given by Vladimir Shpilrain (City College, New York), and another series on Generic Case Complexity, given by Alexei Miasnikov (McGill University).

Besides these events, a number of researchers stayed at the CRM during the period of this programme. Their collaborative work was very useful in order to focus on several specific research themes and foster advances in those themes, particularly on applications of algorithmic and asymptotic group theory to cryptography. Articles resulting from this joint work have been included in the CRM Preprint series.

The events and results of this research programme were part of the contribution of the CRM to the NEST Coordination Action entitled *Shaping New Directions in Mathematics for Science and Society* (MATHFSS, 2005-2007).

7.1.4. HOMOTOPY THEORY AND HIGHER CATEGORIES

Period

From September 1, 2007 to July 31, 2008

Scientists in charge

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

Activities in 2007

Seminar

A weekly seminar coordinated by Carles Casacuberta and Joachim Kock.

Workshop

Workshop on Derived Categories, from November 5 to 14, 2007.

Visiting researchers

Mathieu Anel
Centre de Recerca Matemàtica

Luchezar Avramov
University of Nebraska

Michael Batanin
Macquarie University

Clemens Berger
Université de Nice – Sophia Antipolis

Julia Bergner
Kansas State University

Georg Biedermann
Max-Planck-Institut, Bonn

Carles Casacuberta
Universitat de Barcelona

Denis-Charles Cisinski
Université de Paris XIII

Vincent Franjou
Université de Nantes

Nicola Gambino
Centre de Recerca Matemàtica

Javier Gutiérrez
Centre de Recerca Matemàtica

André Joyal
Université du Québec à Montréal

Bernhard Keller
Université de Paris VII

Joachim Kock
Universitat Autònoma de Barcelona

Henning Krause
Universität Paderborn

Tom Leinster
University of Glasgow

Georges Maltsiniotis
Université de Paris VII

Ieke Moerdijk
Universiteit Utrecht

Daniel Murfet
Australian National University

Amnon Neeman
Australian National University

Frank Neumann
University of Leicester

Paul Arne Østvær
University of Oslo

Jirí Rosický
Masarykova Univerzita

Brooke Shipley
University of Illinois at Chicago

Alexandru Stanculescu
McGill University

Myles Tierney
Université du Québec à Montréal

Bertrand Toën
Université Paul Sabatier

Mid-term report

The following summary of activities and results intends to cover the first trimester of this research programme, which started in September 2007 and will end in July 2008. Homotopical methods permeate Algebraic Topology, Category Theory, Algebraic Geometry, Commutative Algebra, and Group Theory, among other potential areas of appli-

cation. Traditional model category theory in the sense of Quillen is nowadays insufficient for some of the most promising directions. Therefore new tools are being developed, and this research programme aimed at the study of some of these tools. During the year 2007, the programme focused mainly on derived categories, although the list of visitors included specialists in other programme topics.

Derived categories play a fundamental role in certain branches of Algebraic Geometry. Moreover, since the discovery of structured models of spectra, Stable Homotopy Theory has a big deal of intersection with the study of modules over rings, by way of derived equivalences of differential graded algebras and algebras over ring spectra. Hence, the CRM weekly seminar on recent results in Triangulated Categories was attended from September to December 2007 by algebraists as well as topologists and category-theorists. A considerable portion of this seminar was devoted to well-generated triangulated categories and problems related with Brown representability. Results by Neeman and Rosický were central to the presentations, together with contributions of Krause and coauthors on support varieties and localization, and work of Cisinski on a new approach to homotopy limits in model categories.

During two weeks of November 2007, a workshop was held on recent advances in Derived Categories, under the coordination of Amnon Neeman (Australian National University, Canberra) and Leovigildo Alonso Tarrío and Ana Jeremías López (Universidade de Santiago de Compostela). This workshop gathered over 70 participants working in very diverse disciplines.

The research programme continued in 2008 with a twist towards higher-categorical methods, in which simplicial enrichments and coherence diagrams up to higher levels play an important role. Besides triangulated categories and brave new algebra, key words for the rest of the research programme are presheaf categories, quasi-categories, dendroidal sets, higher operads, topological stacks, categorical groups, homotopy accessibility, and functor calculus.

7.2 SPECIALISED QUARTERS

7.2.1. COMPLEX NON-SMOOTH DYNAMICAL SYSTEMS

Period

From January 1 to March 31, 2007

Scientists in charge

Enric Fossas
Universitat Politècnica de Catalunya

Tere Martínez-Seara
Universitat Politècnica de Catalunya

Mario di Bernardo
University of Bristol

John Hogan
University of Bristol

Gerard Olivar
Universidad Nacional de Colombia

Visiting researchers

Ricardo Alzate Castaño
Università di Napoli Federico II

Fabiola Angulo García
Universidad Nacional de Colombia

Víctor Avrutin
Universität Stuttgart

David Barton
University of Bristol

Alan Richard Champneys
University of Bristol

David Chillingworth
University of Southampton

Alessandro Colombo
Politecnico di Milano

Harry Dankowicz
University of Illinois at Urbana-Champaign

Mario di Bernardo
University of Bristol

Stephen J. Hogan
University of Bristol

Martin Homer
University of Bristol

Tamás Insperger
Budapest University of Technology and
Economics

Alain Guy Jacquemard
Institut de Mathématiques de Bourgogne

Joanna Mason
University of Bristol

Gerard Olivar
Universidad Nacional de Colombia

Gustavo-Adolfo Osorio
Università di Napoli Federico II

Petri Piiroinen
University of Bristol

Athanasios Polynikis
University of Bristol

Stefania Santini
Università di Napoli Federico II

Michael Schanz
Universität Stuttgart

Slobodan Simic
San José State University

Gábor Stépán
Budapest University of Technology and
Economics

Marco Antonio Teixeira
UNICAMP

Francisco Torres
Universidad de Sevilla

Pankaj Wahi
College Station

Final report

The aim of this thematic quarter was to analyse the state of the art in the study of piecewise continuous dynamical systems. Up to 19 senior researchers and 10 younger participants presented their results.

The programme was structured into two-week emphasis periods, each of which focused on a specific subject among the following: theoretical analysis, delay equations, bifurcations, numerical analysis, and applications. Each two-week period started with an opening session in which the speakers presented cutting-edge material on the chosen subject, and ended with a summary highlighting those topics that had been initiated at the CRM. The following talks were given:

- First period: J. Llibre, *Limit cycles in piecewise differential systems via the averaging method*; E. Ponce, *Practical bifurcation analysis of piecewise smooth systems*; M. A. Teixeira, *Invariant varieties of relay systems*; S. Simic, *Structural stability of piecewise smooth and hybrid systems*.
- Second period: G. Stépán, *Time- and state-dependent delays*; T. Insperger, *Dynamics of time-periodic and time-delayed systems: milling processes and feedback control sys-*

tems; P. Wahi, *Self-interrupted turning dynamics: an example of a non-smooth delayed system*.

- Third period: G. Olivar, *Bifurcations in a buck DC-DC power electronics converter with control strategies*; V. Avrutin, *On some generic codimension two and three bifurcation phenomena in non-smooth dynamical systems*; M. Schanz, *How robust is robust chaos?*; D. Barton, *Numerical continuation for piecewise-smooth delay equations*.
- Fourth and fifth periods: D. Chillingworth, *Local and global geometry in the dynamics of an impact oscillator*; P. Piironen, *Future challenges in the analysis in piecewise smooth systems*; A. Champneis, *Towards a qualitative bifurcation theory for piecewise smooth systems*; H. Dankovicz, *On the stabilizability of near-grazing dynamics: thoughts on the control of (and using) discontinuity-induced bifurcations*.

Other talks were given by M. Homer, A. Jacquemard, A. Normark, and P. Torres. After the presentation of M. A. Teixeira, a reading group was created in order to study Teixeira's articles. This group continued to work during the whole quarter.



CONFERENCE ON CRYPTOLOGY AND DIGITAL CONTENT SECURITY

7.3. CONFERENCES

7.3.1. CONFERENCE ON CRYPTOLOGY AND DIGITAL CONTENT SECURITY

Dates

May 14 to 18, 2007

Place

Centre de Recerca Matemàtica

Coordinators

Enric Nart
Universitat Autònoma de Barcelona

Jorge Luis Villar
Universitat Politècnica de Catalunya

Scientific Committee

Ronald Cramer
CWI Amsterdam

Touradj Ebrahimi
EPF Lausanne

Franck Leprévost
Université du Luxembourg

This event included a round table on *Privacy and Security for Citizens, Corporations and Governments*, held on May 16.

7.3.2. CONFERENCE ON C*-ALGEBRAS AND THEIR INVARIANTS

Dates

June 11 to 15, 2007

Place

Centre de Recerca Matemàtica

Coordinator

Francesc Perera
Universitat Autònoma de Barcelona

Scientific Committee

Pere Ara
Universitat Autònoma de Barcelona

Ken R. Goodearl
University of California at Santa Barbara

George Elliott
University of Toronto

Marc A. Rieffel
University of California at Berkeley

Mikael Rørdam
University of Southern Denmark



CONFERENCE ON C*-ALGEBRAS AND THEIR INVARIANTS

7.3.3. CONFERENCE ON ENUMERATION AND PROBABILISTIC METHODS IN COMBINATORICS

Dates

June 25 to 29, 2007

Place

Centre de Recerca Matemàtica

Coordinator

Marc Noy
Universitat Politècnica de Catalunya

Scientific Committee

Marc Noy
Universitat Politècnica de Catalunya

Oriol Serra
Universitat Politècnica de Catalunya

Dominic Welsh
Oxford University

7.4. ADVANCED COURSES

This year brought the twelfth edition of the advanced courses organised by the CRM on specific mathematical subjects that are topical in terms of its research activity. These intensive courses are aimed at advanced doctorate students and doctors, and are given by experts of especially prestigious renown.

7.4.1. ADVANCED COURSE ON ANALYTIC AND PROBABILISTIC TECHNIQUES IN COMBINATORICS

Dates

January 15 to 26, 2007

Place

Centre de Recerca Matemàtica

Coordinators

Marc Noy
Universitat Politècnica de Catalunya

Dominic Welsh
University of Oxford



CONFERENCE ON ENUMERATION AND PROBABILISTIC METHODS IN COMBINATORICS

Lecturers

Philippe Flajolet
INRIA Rocquencourt

Tomasz Łuczak
Uniwersytet Adama Mickiewicza

Description

The main goal of the course was to introduce modern techniques from analysis and probability theory for studying discrete random structures. Random graphs and enumerative combinatorics are among the main topics that were covered.

7.4.2. ADVANCED COURSE ON QUASIDETERMINANTS AND UNIVERSAL LOCALIZATION

Dates

January 30 to February 10, 2007

Place

Centre de Recerca Matemàtica

Coordinators

Silvana Bazzoni
Università degli Studi di Padova

Dolors Herbera
Universitat Autònoma de Barcelona

Lecturers

Robert Lee Wilson
Rutgers University

Valdimir Retakh
Rutgers University

Description

The theory of determinants is one of the cornerstones of commutative algebra. As early as 1845, Cayley made the first attempt to extend the theory to matrices with noncommutative entries. However, while useful analogues of the determinant have been developed in a number of special situations, no generally applicable theory treating matrices with noncommutative entries was known until the development of quasideterminants. For an n by n matrix $A = (a_{ij})$, and for $1 \leq i, j \leq n$, the quasideterminant $|A|_{ij}$ is a rational function of the entries of A .

The rigorous study of quasideterminants necessarily requires the theory of localizations of noncommutative rings (a subject involving subtleties not present in commutative localization).



ADVANCED COURSE ON ANALYTIC AND PROBABILISTIC TECHNIQUES IN COMBINATORICS

One particularly striking application of the quasideterminants is the generalization of Viète's Theorem (expressing the coefficients of a polynomial over a field in terms of its roots) to the noncommutative case. This leads to a theory of noncommutative symmetric functions.

The course consisted of three series of lectures. The titles were:

- Noncommutative localization
- Factorizations of noncommutative polynomials and noncommutative symmetric functions
- Quasideterminants

7.4.3. ADVANCED COURSE ON GROUP-BASED CRYPTOGRAPHY

Dates

May 28 to June 2, 2007

Place

Centre de Recerca Matemàtica

Coordinator

Enric Ventura
Universitat Politècnica de Catalunya

Lecturers

Vladimir Shpilrain
City College of New York

Alexei Miasnikov
McGill University

Description

Noncommutative Cryptography

This was an interdisciplinary course focused on cryptography, which is considered an area of computer science. However, there are areas of cryptography (most notably, public-key cryptography), where several different areas of mathematics find their important applications. Until recently, mathematics used in cryptography was "commutative", which means that cryptographic primitives were based on commutative rings or commutative (finite) groups. This includes RSA, the most common public key cryptosystem in use today. It is employed, for instance, in the Netscape and Internet Explorer browsers.



ADVANCED COURSE ON QUASIDETERMINANTS AND UNIVERSAL LOCALIZATION

Although the security of the internet does not appear to be threatened at this time because of the weaknesses of the existing protocols such as RSA, it seems prudent to explore possible enhancements and replacements of such protocols which depend on finite commutative groups. This is the basic objective of the present mini-course. Non-commutative groups were introduced into public-key cryptography by Wagner and Magyarik more than 20 years ago, but only relatively recently did this direction get serious attention of professional cryptographers worldwide, due to seminal work of Anshel and Goldfeld (1999). Since then, a very active research in non-commutative cryptography is going on, and we are going to describe these new promising research avenues, most of which employ classical as well as modern combinatorial group theory, with a focus on algorithmic problems and their complexity.

Complexities of Algorithms

In this course some recent developments in asymptotic and computational algebra were discussed, as well as their applications to modern cryptanalysis.

It began with *Generic complexity of algorithms* describing the complexity of algo-

rithms on “most” or “generic” inputs. This type of complexity differs from the well-known worst-case and average-case complexities. It was argued that the generic-case complexity is precisely the type of complexity required in cryptanalysis of modern cryptoschemes.

It continued with *Random van Kampen diagrams and algorithmic problems in groups*. Some new “generically fast” algorithms were presented for solving the word, conjugacy, and membership problems in groups. The algorithms were based on some recent results on generic properties of van Kampen diagrams. For example, it was shown that generic van Kampen diagrams of finitely presented groups are “hyperbolic”. This sheds some light on security of cryptosystems based on the word and conjugacy problems.

Finally, *Asymptotically dominant properties and subgroup attacks* were studied, focusing on asymptotic properties of subgroups of infinite groups. It turns out that “generic subgroups” quite often have very specific properties that provide a basis for various subgroup attacks. It was discussed how one could avoid the attacks choosing the subgroups carefully.



ADVANCED COURSE ON GROUP-BASED CRYPTOGRAPHY

7.4.4. ADVANCED SCHOOL ON NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Dates

November 15 to 21, 2007

Place

Centre de Recerca Matemàtica

Coordinators

José Antonio Carrillo
ICREA-UAB

Rosa Donat
Universitat de València

Carlos Parés
Universidad de Málaga

Yolanda Vidal
Universitat Politècnica de Catalunya

Lecturers

Silvia Bertoluzza
Consiglio Nazionale delle Ricerche, Pavia

Jaume Peraire
Massachusetts Institute of Technology

Giovanni Russo
Università di Catania

Chi-Wang Shu
Brown University

Description

This school on simulation and numerical analysis of partial differential equations (PDEs) was aimed at master students, PhD students, recent PhD doctorates, and researchers in general willing to update their knowledge with recent developments on numerical techniques that play an important role in the international scene. The school was the first of a series, born with the objective of being an occasion for researchers to catch up with important developments in the field and/or to get in touch with state-of-the-art numerical techniques that are not covered in usual PhD

courses at national level. In this first edition the focus was on discontinuous Galerkin methods for hyperbolic, convection-diffusion and convection-dispersion equations, high order finite difference schemes for conservation laws and wavelets techniques in PDEs. From practical applications to more theoretical stability and error estimates issues were discussed. Each course consisted of two sessions of two/three hours each and a practical session of 2 hours in a computer lab using material provided by the speakers. The program was complemented by 5 seminars of researchers using related techniques in different problems of current research.

The following topics were covered:

- Wavelets and wavelet-like techniques in the numerical solution of partial differential equations
- Discontinuous Galerkin methods for systems conservation laws
- High order shock capturing schemes for balance laws
- Discontinuous Galerkin methods: general approach and stability

7.5. WORKSHOPS

7.5.1. GRUPS D'ESTUDI DE MATEMÀTICA I TECNOLOGIA (GEMT 2007)

Dates

July 9 to 11, 2007

Place

Universitat Politècnica de Catalunya

Coordinators

José Antonio Carrillo
ICREA-UAB

Enric Fossas
Universitat Politècnica de Catalunya

Joan Solà-Morales
Universitat Politècnica de Catalunya

Description

Following the tradition of the old Oxford Study Groups with Industry, workshops in the GEMT series are working days where mathematicians try to solve problems that have been suggested by either industries or technology researchers. The problems to be studied are presented on the first session. Afterwards, the participants start working in groups, in brainstorming sessions of mathematical modelling.

This workshop was co-organised with the Facultat de Matemàtiques i Estadística of the Universitat Politècnica de Catalunya.

7.5.2. X WORKSHOP ON CELESTIAL MECHANICS

Dates

September 5 to 7, 2007

Place

Centre de Recerca Matemàtica

Coordinators

Montserrat Corbera
Universitat de Vic

Jaume Llibre
Universitat Autònoma de Barcelona

Mercè Ollé
Universitat Politècnica de Catalunya

Scientific Committee

Roberto Barrio
Universidad de Zaragoza

Sebastián Ferrer
Universidad de Murcia

Jaume Llibre
Universitat Autònoma de Barcelona

Jesús Palacián
Universidad Pública de Navarra

Jesús Peláez
Universidad Politécnica de Madrid

Description

The Spanish Workshops in Celestial Mechanics (*Jornadas de Trabajo en Mecánica Celeste*) started in 1988 with the following main objectives:



ADVANCED SCHOOL ON NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS

- To facilitate scientific relations between the different research groups in Celestial Mechanics in Spain.
- To discuss the objectives of research in this area to short, medium and large period.
- To use the meetings for communicating the most relevant results obtained recently at a national and international level.

7.5.3. WORKSHOP ON DERIVED CATEGORIES

Dates

November 5 to 14, 2007

Place

Centre de Recerca Matemàtica

Coordinators

Leovigildo Alonso Tarrío
Universidade de Santiago de Compostela

Ana Jeremías López
Universidade de Santiago de Compostela

Amnon Neeman
Australian National University, Canberra

7.6. BARCELONA FINANCIAL ENGINEERING SEMINAR

During the academic year 2007-2008, the CRM organised for the first time a seminar on Financial Engineering, jointly with Borsa de Barcelona (Stock Exchange) and Associació Barcelona Centre Financer Europeu. The scientific coordinator was Sebastian del Baño. This was a monthly forum where financial practice met academia. It took place on the premises of Borsa de Barcelona (Passeig de Gràcia, 19).

The inaugural session was held on December 10, 2007, as follows:

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

7.7. MASTER'S COURSE IN MATHEMATICAL FINANCE

The Master's course *Matemàtiques per als Instruments Financers* was developed for the tenth time in 2007 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 to develop and teach innovative techniques about valuation of derived financial products, calculation of coverage strategies, risk assessment and risk control.

The goal of the Master's course is to train specialists capable of developing new financial products, according to the current needs, and prepare them to understand and critically discuss the hypotheses and limitations of the existing models. The Master's course was designed for young students with a mathematical talent, regardless of their previous training. Thus it is open to students with a degree in Mathematics, Physics, Economy, Engineering or similar disciplines. Job opportunities after the course are excellent at present.

The Master's 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 the Academic Commission, consisting of professors Joan del Castillo, Jaume Llibre, Frederic Utzet, Xavier Xarles, and Josep Vives (who has been the coordinator), and the Advisory Council, consisting of Xavier Auguets (Caixa Catalunya), Antoni Giralt (Barcelona Stock Exchange), Pere

Guinjoan (Caixa d'Estalvis i Pensions de Barcelona), Albert Cortés (Banc Sabadell), and Victòria Castellot (Caifor). The Executive Committee consists of Joaquim Bruna (CRM Director), Lluís Alseda (Chairman of the UAB Mathematics Department), and Josep Vives (Master's Coordinator).

Every year a maximum of twenty students are admitted to the course, and they have access at the premises of the CRM to the most advanced technology in order to follow the financial markets.

7.8. CRM OPEN DAY

A meeting was organised on July 18, 2007, which served two purposes: on one hand it was an occasion to gather together the local mathematical community for an informal exchange of views about current developments; on the other hand, the CRM Scientific Advisory Board was assembled for a meeting in the afternoon of the same day, so they had the opportunity to participate in a scientific event as well.



The programme was as follows:

- Francisco Marcellán, Secretary General of Scientific and Technological Policy, Ministry of Education and Science
Retos de la política científica en España
- Debate open to the floor
- Luis Caffarelli, University of Texas at Austin
Nonlinear problems involving anomalous diffusions

8. 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 the Strategic Areas Incentive Programme (IAE), the strategic planning for which is currently being carried out for the coming years.

Given the current state of research, it is natural to think that the strategic or emerging areas are related to new mathematical applications, in partnership activities with other sciences or with technology, or as the participation of mathematics in large-scale social projects. However, this is not always necessarily the case, and it is perfectly possible for pure mathematics themes to appear at any time as emerging areas, and so the naming of "strategic areas" is more appropriate than any direct references to their applicability or interdisciplinary character, although the programme does principally include these two aspects.

Firstly, the CRM aims to continue promoting work in the areas of the MATHFSS project (*Shaping New Directions in Mathematics for Science and Society*), which has been developed between 2005 and 2007. At the end of the project period, the CRM has declared its commitment to continue supporting three specific areas: mathematical neuroscience, financial mathematics and cryptography. On these three themes the CRM has organised several activities in the last two years and it currently offers periodical seminars on the first two.

Actions planned for the future are:

- Continuing events such as workshops, seminars and courses.
- Support for local groups working in these areas, as well as 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.

Secondly, the CRM wishes to strengthen emerging interdisciplinary areas, underrepresented in university departments and with which the CRM has not been involved until now. The following can be mentioned as initial examples:

- Astrodynamics, an area in which groups from the UB and the UPC have experience and have or have had financing through ESA and NASA projects.
- The dynamics of chemical reactions, with initial developments at UB and UPC.
- Computer vision, with groups at UB, UAB, UPC and UPF.
- Scientific computing, an area that is transverse to many other areas and can be considered together with some of its areas of application, such as computational fluid dynamics.

An especially appropriate framework for the initiation of these activities is offered by the CERCA network of research centres recognised by the Generalitat de Catalunya and of which the CRM is part. The list of members of this network appears at www.gencat.net/agaur_web and embraces such distinct subjects as genomics, nanotechnology, geomatics, and biomedicine.

Specific actions to be undertaken are the following:

- To hire a PhD holder to deal with tasks of prospective and promotion of interdisciplinary research, including the search of collaboration opportunities with teams in other areas of science or technology.
- To encourage jointly tutored PhD theses.
- To provide incentives for carrying out final Master's projects or similar to stimulate the involvement of young researchers in these areas. As an example of how to promote this type of action, the CRM is currently in contact with the Hospital de Sant Pau in Barcelona for collaboration in

the areas of pharmacokinetics and pharmacodynamics, through the Centre d'Investigació de Medicaments of the Hospital.

Website: www.cimsantpau.com

- To organise inter-Consolider activities. This programme has been conceived within the framework of the Consolider-Ingenio 2010 programme, benefiting from the fact that the CRM is one of the nodes of the Ingenio Mathematica project. It is planned to organise joint working sessions between mathematicians and researchers in other disciplines (engineering, physics, economics, medicine, etc.), mainly if they are also involved in Consolider programme projects, in order to exchange information and possible embark in joint research.

Thirdly, the CRM wishes to extend its commitment to the areas of industrial mathematics and mathematical applications. It is not easy to define industrial mathematics with great precision, but there is a tradition in the UK (www.smithinst.ac.uk/News/Roadmap), and it would seem highly necessary to carry out actions in this direction in order to overcome a delay of many years in this country in relation to mathematics and industry. However, industrial mathematics 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 medicine. Along these lines, the CRM is co-organiser of a scientific session in the EuroScience Open Forum (ESOF) 2008.

Among the actions to be carried out, the CRM will continue offering support to the Mathematics and Technology Study Groups (GEMT, www.fme.upc.es/gemt), as has been done in recent years, besides awarding doctorate scholarships and post-doctoral grants for the promotion of researchers in these areas and to participate in active policies for contracting senior researchers.

9. PUBLICATIONS

During 2007, work has continued on the Centre's series of publications: Advanced Courses in Mathematics CRM Barcelona, Quaderns, and Preprints.

9.1. ADVANCED COURSES IN MATHEMATICS CRM BARCELONA

The volumes of this series, published by the Swiss publishing company Birkhäuser, cover the content of some of the advanced courses taught by distinguished specialists at the CRM, based on the notes handed out to the students at the beginning of the course, which are later reworked by the authors. They are especially addressed to advanced doctoral and young post-doctoral students, and completely elucidate their content, with the necessary preliminaries, definitions and detailed proofs. The following volumes were published in 2007:

The Geometry of the Word Problem for Finitely Generated Groups, by N. Brady, T. Riley and H. Short, emanating from a course with the same title held in July 2005 at the CRM.

Limit Cycles of Differential Equations, by C. Christopher and C. Li, emanating from a course with the same title held in July 2006 at the CRM.

9.2. QUADERNS

The Quaderns compile the content of specialised activities. The following issues were published in 2007:

Advanced Course on Analytic and Probabilistic Techniques in Combinatorics
P. Flajolet (no. 40)

Advanced Course on Quasideterminants and Universal Localization
R. L. Wilson, V. Retakh (no. 41)

Advanced Course on Group-Based Cryptography
A. Miasnikov, V. Shpilrain (no. 42)

Advanced School on Numerical Solutions of Partial Differential Equations
S. Bertoluzza, J. Peraire, G. Russo, Chi Wang Shu (no. 43)

9.3. PREPRINTS

The following 51 issues were published in the CRM preprint series in 2007:

J. A. Carrillo, G. Toscani
Contractive probability metrics and asymptotic behavior of dissipative kinetic equations

P. C. Eklof
Shelah's singular compactness theorem

J. T. Baldwin, P. C. Eklof, J. Trlifaj
 $\perp N$ as an abstract elementary class

S. Blake Fordham, S. Cleary
Minimal length elements of Thompson's groups $F(p)$

A. Blanchet, J. A. Carrillo, N. Masmoudi
Infinite time aggregation for the critical Patlak-Keller-Segel model in \mathbb{R}^2

A. Boivin, P. M. Gauthier, C. Zhu
Weighted hardy spaces for the unit disc: approximation properties

J. Dubois, R. Kashaev
On the asymptotic expansion of the colored Jones polynomial for torus knots

S. Elizalde
Generating trees for permutations avoiding generalized patterns

A. Blanchet, V. Calvez, J. A. Carrillo
Convergence of the mass-transport steepest descent scheme for the sub-critical Patlak-Keller-Segel model

Y. Ding
Renormalization and alpha-limit set for expanding Lorenz maps

- J. Bagaria, C. Casacuberta, A. R. D. Mathias
Epireflections and supercompact cardinals
- A. Gasull, J. Yu
On the critical periods of perturbed isochronous centers
- G. Abrams, G. Aranda, F. Perera, M. Siles
Chain conditions for Leavitt path algebras
- D. Kucerovsky, G. A. Elliott
A relative double commutant theorem for hereditary sub- C^ -algebras*
- J. I. Burgos
Semipurity of tempered Deligne cohomology
- F. Perera, M. Siles
Strongly non-degenerate Lie algebras
- P. Ara, M. Mathieu
Maximal C^ -algebras of quotients and injective envelopes of C^* -algebras*
- O. Bernardi, N. Bonichon
Catalan's intervals and realizers of triangulations
- M. di Bernardo, D. J. Pagano, E. Ponce
Non-hyperbolic boundary equilibrium bifurcations in planar Filippov systems: a case study approach
- J. Llibre, E. Ponce, F. Torres
On the existence and uniqueness of limit cycles in Liénard differential equations allowing discontinuities
- B. Simonov, S. Tikhonov
Norm inequalities in multidimensional spaces
- J. Dubois, V. Huynh, Y. Yamaguchi
Twisted Reidemeister torsion for twist knots
- U. Baumgartner, J. Ramagge, B. Rémy
Contraction groups in complete Kac-Moody groups
- A. Bernini, F. Disanto, R. Pinzani, S. Rinaldi
Permutations defining convex permutominoes
- N. Dubrovin, P. Prihoda, G. Puninski
Projective modules over the Gerasimov-Sakhaev counterexample
- J. Tan
The existence of periodic solutions of a two dimensional lattice
- V. Barbu, C. Marinelli
Variational inequalities in Hilbert spaces with measures and optimal stopping
- S. Cleary, K. St. John
Data size sufficiency analyses of Haplotype inference algorithms
- J. Wildeshaus
Pure motives, mixed motives and extensions of motives associated to singular surfaces
- C. Marinelli
Well-posedness and invariant measures for HJM models with deterministic volatility and Lévy noise
- A. J. Duncan, I. V. Kazachkov, V. N. Remeslennikov
Orthogonal systems in finite graphs
- A. J. Duncan, I. V. Kazachkov, V. N. Remeslennikov
Parabolic and quasiparabolic subgroups of free partially commutative groups
- A. Neeman
Brown representability follows from Rosický
- E. de Santis, C. Marinelli
A class of stochastic games with infinitely many interacting agents related to glauher dynamics on random graphs
- O. Bogopolski, N. Buskin, A. Buturlakin
A classification, up to hyperbolicity, of groups given by 2 generators and one relator of length 8
- O. Bogopolski, R. Vikentiev
Subgroups of small index in $\text{Aut}(F_n)$ and Kazhdan's property (T)
- O. Bogopolski, A. Martino, E. Ventura
Orbit decidability and the conjugacy problem for some extensions of groups
- J. Dubois, I. G. Korpeanov, E. V. Martyshevo
Euclidean geometric invariant of framed knots in manifolds
- D. Dugger, B. Shipley
A curious example of two model categories and some associated differential graded algebras
- N. Gambino
Homotopy limits for 2-categories

M. Casals-Ruiz, I. V. Kazachkov

Elements of algebraic geometry and the positive theory of partially commutative groups

E. Gatto

Boundedness on inhomogeneous Lipschitz spaces of singular integrals associated to non-doubling measures

J. Burillo, S. Cleary

Metric properties of the braided Thompson's groups

C. Christopher, J. Llibre, C. Pantazi,
S. Walcher

Inverse problems for invariant algebraic curves: explicit computations

S. Awodey, N. Gambino, P. L. Lumsdaine,
M. A. Warren

A general construction of internal sheaves in Algebraic Set Theory

F. Muro

Maltsiniotis's first conjecture for K_1

R. Saghin

Note on homology of expanding foliations

A. Blanchet, J. A. Carrillo, P. Laurençot

Critical mass for a Patlak-Keller-Segel model with degenerate diffusion in higher dimensions

T. M. Fiore, S. Paoli, D. A. Pronk

Model structures on the category of small double categories

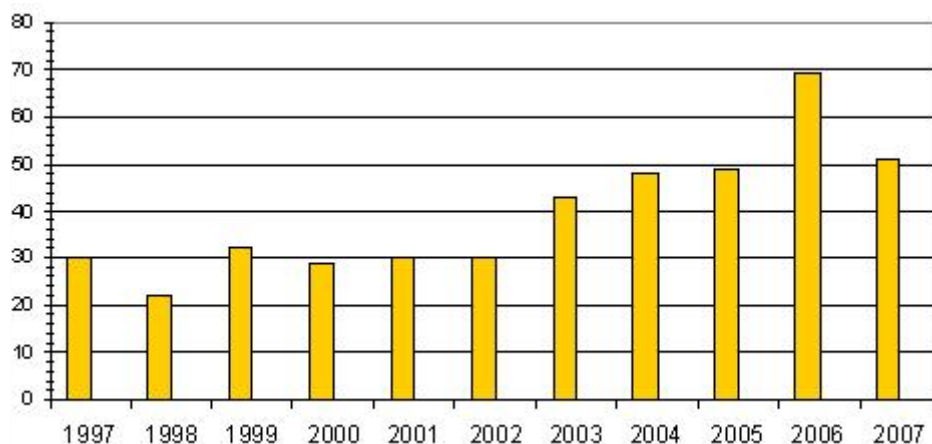
E. Morozov

Coupling and monotonicity of queueing processes

S. Bonaccorsi, C. Marinelli, G. Ziglio

Stochastic Fitzhugh-Nagumo equations on networks with impulsive noise

Number of preprints



10. THE EUROPEAN FRAMEWORK

10.1. ERCOM

ERCOM (European Research Centres on Mathematics) is a committee under 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 purposes of ERCOM are:

- To constitute a forum for communication and exchange of information and to foster collaboration and co-ordination among the centres themselves and between the centres and the EMS.
- To promote advanced research training on a European level.
- To advise the Executive Committee of EMS on matters related to activities of the centres.
- To contribute to make EMS more visible.
- To cultivate contacts with similar research centres within and outside Europe.

The CRM is a member of ERCOM from its foundation.

The Chairman of ERCOM is named for a period of four years (renewable for two further years) by the EMS Executive Committee by proposal of ERCOM. Since 2006 the Chairman is Jan Karel Lenstra, Director of the Centrum voor Wiskunde en Informatica, Amsterdam.

The ERCOM annual meeting for 2007 was held at the Abdus Salam International Centre for Theoretical Physics in Trieste. The next ERCOM meeting will be held in March 2008 in Coimbra, Portugal.

Website: www.ercom.org

10.2. EPDI

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 (IHÉS) in Bures-sur-Yvette (which was the promoter and the Director of which, J.-P. Bourguignon, is still 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 (FIM) 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.

In the 2006 call, a grant had been awarded to Anne Pichereau, who started her one-year stay at the CRM in October 2007 under the scientific responsibility of Eva Miranda. Two other candidates had been selected for stays at the CRM, although they later declined the offer.

In the 2007 call, three candidates were selected for stays at the CRM: Pierre Berger, from September 2008 to February 2009; Vincent Calvez, from September 2008 to August 2009; and Julien Roques, from September to December 2008.

Website: seven.ihes.fr/EPDI/index.html

10.3. SHAPING NEW DIRECTIONS IN MATHEMATICS FOR SCIENCE AND SOCIETY

10.3.1. PROJECT OUTLINE

The NEST programme (New and Emerging Science and Technology) is an activity of the 6th Framework Programme of the European Commission, whose aim is to promote highly innovative research, possibly opening new directions. Besides stimulating research aimed to the development of new techniques and supporting multidisciplinary scientific knowledge, the NEST programme aims to consolidate efforts made in emerging research fields. It also aims to help planning support activities for the European Research Area. The programme includes several complementary lines of action and also foresees support actions. These can be methodological studies or activities that promote links within the research community.

The project entitled *Shaping New Directions in Mathematics for Science and Society* (MATHFSS) is one of the Support Actions that were approved in 2005 within the NEST programme. It has lasted 2 years since December 2005. It has been made possible by the collaboration of the following ERCOM centres:

- CRM, project co-ordinator
- Emmy Noether Institute, Israel
- European Institute for Statistics, Probability and Operations Research (EURANDOM), The Netherlands
- Institut des Hautes Études Scientifiques (IHÉS), France

The goal of the project was to foster international contacts and draw training contents in Mathematics around the following emerging research topics:

- Systems Biology
- Risk Assessment
- Mathematical Neuroscience
- Digital Content Security

For each one of these topics, a group of experts has written a report on the current state of research, including proposals for training strategies aimed at young investigators and opinions about possible scientific developments in the coming years. The resulting reports will be the main content of a booklet that will be edited by the CRM upon termination of the project in December 2007. This booklet will also include policy recommendations to the European Commission.

10.3.2. ACTIVITIES DURING 2007

Several activities have been planned within the MATHFSS project, mainly workshops and round tables, addressed to cutting-edge researchers and scientific policy makers from European countries. The following events took place during 2007:

Being on Time, Emmy Noether Institute, Bar-Ilan University, Israel, January 3 and 4, 2007

Workshop on Mathematical Methodologies for Operational Risk, EURANDOM, Eindhoven, The Netherlands, April 16 to 18, 2007

Cryptography and Digital Content Security, CRM, May 14 to 18, 2007

What Are the Tools Most Useful for Understanding Biological Systems?, IHÉS, Bures-sur-Yvette, France, November 12 to 15, 2007

Website: www.mathfss.org

10.4. ESOF 2008

The 2008 EuroScience Open Forum (ESOF) will take place in Barcelona in July 2008. The CRM organises a scientific session to be held in July 21, jointly with the European Mathematical Society. This scientific session has been planned as follows:

Theme

Engineering the Body

Title

Can Mathematics Help Medicine?

Invited speakers

Alfio Quarteroni

Politecnico di Milano and EPF Lausanne

Mathematical models for the cardiovascular system

Dominique Chapelle

INRIA-Rocquencourt

Modelling and estimation of the cardiac electromechanical activity

Peter Deuffhard

Zuse-Institut Berlin

The challenge of electrocardiology: model hierarchy and multiscale simulation

11. INGENIO MATHEMATICA

The CRM is one of the promoters, and currently a node, of a project entitled Ingenio Mathematica, which is being funded by the Spanish Ministry of Education and Science (MEC) with 1.5 million euros per year during the period 2006-2011. This project was awarded to a large coalition of mathematical research groups in Spain on the first call of the Consolider-Ingenio 2010 programme of the MEC. The official starting date was October 3, 2006. The research coordinator of the project is Enrique Zuazua (UAM) and the management center is located at the Universidad de Cantabria.

The main goal of the project is to improve the role of mathematical research in the Spanish system of science, technology and innovation. More specific goals are to promote the use of computational methods both inside and outside mathematical research; to achieve greater recognition for Spanish research groups at an international level and to increase the presence of Spanish mathematicians in strategic areas, to create a Doctorate School of international status; to use research and innovation to improve education and mathematical training at all levels; and to

make the results of mathematical research more accessible, both from within and from outside Mathematics.

The scientific direction of the project lies under the responsibility of a Board of Directors, formed by Alfredo Bermúdez de Castro, Joaquim Bruna, Eduardo Casas Rentería, Antonio Durán, Laureano González-Vega, Manuel de León, Marco Antonio López-Cerdá, Ignacio Luengo, Consuelo Martínez, Marta Sanz-Solé, Oriol Serra, Carles Simó, Luis Vega, and Enrique Zuazua. The nodes of the project are the CRM, the CESGA (Centro de Supercomputación de Galicia), the CIEM (Centro Internacional de Encuentros Matemáticos, Castro Urdiales), the ICM (Instituto de Ciencias Matemáticas, Madrid), and the IMUB (Institut de Matemàtiques de la Universitat de Barcelona).

Four platforms, named Future, Consulting, Computing, and EDU, provide a frame for the actions of Ingenio Mathematica, running in parallel with two instruments, the International Graduate School and the Programmes of Intensive Research.

The CRM, thanks to its wide experience and suitable equipment, is defined within the project as a particularly well-suited node for the management of Programmes of Intensive Research. The following CRM activities were partially funded by Ingenio Mathematica in 2007:

- Research Programme in Enumerative Combinatorics and Random Structures
- Research Programme in Mathematics and Digital Content Security
- Research Programme in Homotopy Theory and Higher Categories
- Conference on C^* -Algebras and Their Invariants
- Advanced School on Numerical Solutions of Partial Differential Equations
- Grups d'Estudi de Matemàtica i Tecnologia (GEMT 2007)
- X Workshop on Celestial Mechanics

12. CRM DOCTORATE SCHOLARSHIPS

In 2003, the CRM initiated a new policy to stimulate mathematical research in lines of investigation linked to the different priority thematic areas of the European Union's Sixth Framework Programme, with different initiatives reflected in the Report of Activities for the year 2005. In order to promote impetus for this new line of action, in 2006 the CRM announced and awarded three scholarships of a duration of four years each, for a doctoral thesis in one of the following areas:

- Digital Content Security
- Mathematical Neuroscience
- Mathematical Finance

The three grant holders continued their activity in 2007 as follows:

- Mrs. Somayeh Heidarvand, graduate of Arak University, Iran, for a thesis on Digital Content Security under the supervision of Jorge Luis Villar, at the Universitat Politècnica de Catalunya.
- Mr. Pedro Ernesto García Rodríguez, graduate of Universidad de Oriente, Santiago de Cuba, for a thesis on Mathematical Neuroscience under the supervision of Antoni Guillamon and Gustavo Deco, at the Universitat Pompeu Fabra.
- Mr. Albert Ferreiro, graduated at the Universitat Autònoma de Barcelona, for a thesis on Mathematical Finance under the supervision of Frederic Utzet, at the Universitat Autònoma de Barcelona.

13. CRM POST-DOCTORAL GRANTS

In 2007 the CRM launched a new international open call for post-doctoral grants. Applicants need to hold a doctoral degree awarded no earlier than five years before the application date (December 14, 2007). A certificate of doctoral award is required before the starting date of the stay. Applicants are asked to have a written acceptance by a host research group, stating their conformity with the research plan of the applicant and their willingness to host him or her as a participant in the activities of the group during the stay at the CRM.

The normal duration of a post-doctoral grant is one year, although shorter stays are also possible with lower priority, and extensions for a second period may be negotiated.

Thirty-eight applications were submitted in response to this call. The CRM Scientific Advisory Board undertook the selection of up to four candidates. Successful candidates are expected to start their stays at the CRM in September 2008.

14. FINANCIAL ACTIVITY

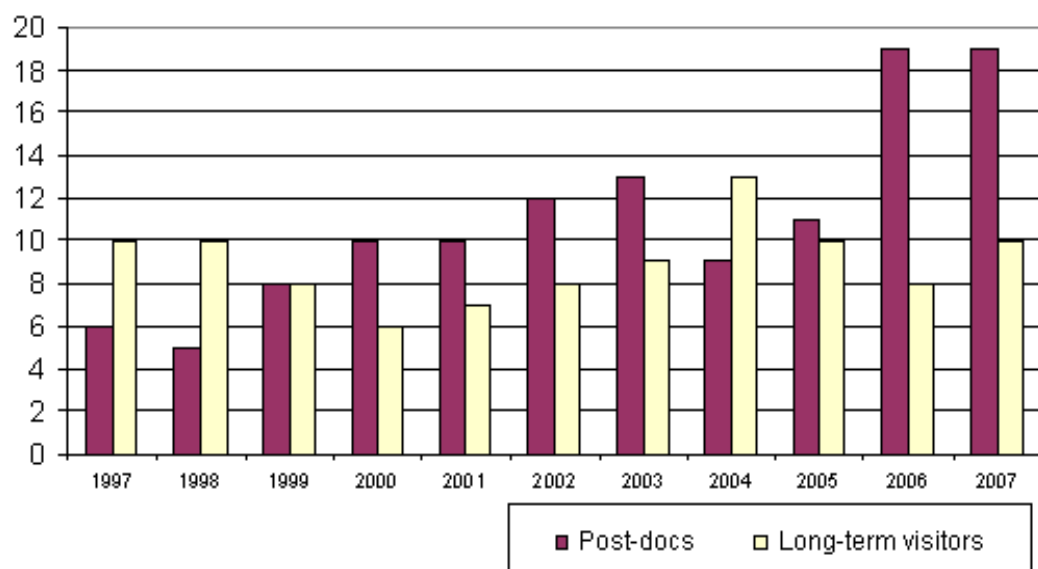
14.1 REVENUE

Registration fees	32,204.85 €
MEC	292,886.48 €
AGAUR	53,052.16 €
i-MATH	150,000.00 €
European Union	287,236.25 €
Contract programme	530,000.00 €
UAB	27,051.89 €
Other income	113,589.38 €
Funds operations	50,000.00 €
Applied provision	85,759.29 €
Total	1,621,780.30 €

14.2 EXPENDITURE

Administration	146,740.54 €
Directorate	34,854.14 €
MEC contracts	62,679.68 €
Beatriu de Pinós contracts	42,955.87 €
Marie Curie grants	161,299.69 €
Research grants	376,217.36 €
Doctoral grants	28,328.49 €
Conferences and courses	161,910.38 €
MATHFSS	66,622.71 €
Publications	11,682.20 €
Functioning	176,593.45 €
Long-term material	22,116.02 €
External services	33,636.61 €
Financial expenses	21,332.42 €
Loan repayment	50,000.00 €
Other expenses	22,267.18 €
Post-doctoral grant provision	130,000.00 €
MATHFSS provision	72,543.56 €
Total	1,621,780.30 €

Institutional funding



CRM budget

