

The Centre de Recerca Matemàtica, Barcelona

Institutional framework

The Centre de Recerca Matemàtica (CRM), the only Mathematics research institute in Spain, was created in 1984 as a personal initiative of Manuel Castellet by the *Institut d'Estudis Catalans* (Institute for Catalan Studies), an academic, scientific and cultural body whose aim is to promote research in science, technology and humanities, while supporting all aspects of Catalan culture. In this year 1984, precisely when the CRM was born, Peter Hilton wrote in *The Mathematical Intelligencer*: “A research institute is at least two things at the same time: it is a building and it is an organisation of people working together and dedicated to the pursuit and support of research. But at its best it is more. It starts life as an idea in the mind of one person —or, rarely, of persons— of insight and imagination, and then lives and grows by spreading the spirit, imbued by their founders, through the hearts and minds of all those benefiting from its presence and at the same time contributing to its future”.

Since 2002, the CRM is a consortium, with its own legal status, integrated by the *Institut d'Estudis Catalans* and the Catalan Government. It is a research institute associated with the Autonomous University of Barcelona (UAB) and located on the Bellaterra campus, about 15 km from Barcelona.

The Governing Board of the CRM is chaired by the Minister of Universities, Research and the Information Society of the Catalan Government, and has eight members. In 2002, the Governing Board re-elected Manuel Castellet as Director, who is assisted by Carles Casacuberta and Jordi Quer as Associate Directors. A Scientific Advisory Board meets three times per year to advise the Directorate Team.

Aims and scope

The CRM gives support to local research groups in all areas of Mathematics and fosters emerging research directions, by inviting outstanding mathematicians and organising specialised research programmes, conferences, workshops, and advanced courses.

Since 1989 it hosts post-doctoral fellows (11

in 2005), including several Marie Curie grant holders, and it also hosts doctoral students as a Marie Curie Training Site of the European Union from 2000 to 2004. The CRM has been a node of three different European Community Research Training Networks entitled “Elliptic Cohomology” (1994-1996), “Homotopy Theory and its Applications” (1995-1997) and “Modern Homotopy Theory” (2000-2003), jointly with teams in Aarhus, Aberdeen, Bonn, Cambridge, Glasgow, Lille, Louvain-la-Neuve, Milano, Paris and Sheffield.



Research programmes

The Governing Board of the CRM approved in 2002 a quadrennial plan that includes two research programmes every year, together with complementary activities. Each research programme offers the following positions during one academic year: one full-time local researcher, one full-time visiting researcher, two post-doctoral fellows, and 24 months of visiting researchers for periods of one to three months. Activities include a weekly seminar, a conference or a workshop and an advanced course at a doctoral or post-doctoral level. Partial funding for visitors and activities is provided by the Department of Universities, Research and the Information Society (DURSI) of the Catalan Government, under a contract programme that is revised every year, and by means of competitive calls. Other sources of funding through competitive applications are the Spanish Ministry of Education and Science and the European Commission.

An open call for research programmes is made every year. Each programme has to be ap-

proved by the CRM Governing Board. Proposals are presented by the Director on the grounds of evaluation reports prepared by the Scientific Advisory Board.

CRM Research Programmes

- 2003–2004 – Set Theory
- 2004–2005 – Geometry of the Word Problem
- 2005–2006 – Arakelov Geometry and Shimura Varieties
 - On Hilbert’s 16th Problem
- 2006–2007 – Enumerative Combinatorics and Random Structures
 - Discrete and Continuous Methods in Ring Theory
- 2007–2008 – Homotopy Theory and Higher Categories
 - Geometric Flows. Equivariant Problems in Symplectic Geometry

Recent CRM Research Thematic Quarters

- 2004–2005 – Control, Geometry and Engineering
 - Contemporary Cryptology
- 2005–2006 – Fourier Analysis and Geometric Measure Theory
- 2006–2007 – Non-Smooth Complex Systems
 - Group-Based Cryptography

Scientific meetings

In 1986 the CRM started the organisation of conferences (29 ever since) and workshops (25) and in 1995 a prestigious series of advanced courses (27). Amongst the conferences we should point out the series “Barcelona Conference on Algebraic Topology” (BCAT), organised in 1986, 1990, 1994, 1998 and 2002, and “Barcelona Logic Meeting” (BLM), organised in 1994, 1995, 1997, 1998, 1999 and 2000, two reference points in these fields.

Recent CRM Conferences, Workshops and Advanced Courses

- 2004 – Advanced Course on Ramsey Methods in Analysis
 - Workshop on the Foundations of Set Theory
 - Advanced Course on Contemporary Cryptology
 - Conference on Mathematical Foundations of Learning Theory
 - Workshop on Non-Linear Differential Galois Theory

- Advanced Course on Automata Groups
- HYKE Conference on Complex Flows
- 2005 – 4th Congress of the European Society for Research in Mathematics Education
 - Barcelona Conference on Geometric Group Theory
 - Workshop on Mathematical Problems and Techniques in Cryptology
 - Advanced Course on the Geometry of the Word Problem for Finitely Generated Groups
 - Advanced Course on Recent Trends on Combinatorics in the Mathematical Context
 - Advanced Course on Shimura Varieties
 - Workshop on Graphs, Morphisms and Applications
 - 2nd Workshop on Tutte Polynomials and Applications
- 2006 – Advanced Course on Arakelov Geometry and Shimura Varieties
 - Barcelona Conference on Planar Vector Fields
 - Workshop on Fourier Analysis, Geometric Measure Theory and Applications
 - Advanced Course on Limit Cycles of Differential Equations
 - Advanced Course on Combinatorial and Computational Geometry Trends and Topics for the Future
 - Conference on Mathematical Neuroscience
- 2007 – Advanced Course on Analytic and Probabilistic Techniques in Combinatorics
 - Advanced Course on Quasideterminants and Noncommutative Symmetric Polynomials
 - Conference on Cryptography and Digital Content Security
 - Advanced Course on Group-Based Cryptography
 - Barcelona Conference on C^* -Algebras and their Invariants
 - Conference on Enumeration and Probabilistic Methods in Combinatorics
 - 2007 Barcelona Conference on Asymptotic Statistics

Around the International Congress of Mathematicians (ICM 2006) in Madrid, the CRM organises a three months research programme on “Fourier Analysis” and an advanced course on “Combinatorial and Computational Geometry”, both co-ordinated jointly by researchers from Barcelona and Madrid, and a conference on “Mathematical Neuroscience”, the last two activities as ICM satellite conferences.

Links with European entities

Since 2003, the CRM is an institutional member of the European Mathematical Society (EMS). It is also a foundational member of ERCOM (European Research Centres on Mathematics), a committee of EMS consisting of scientific directors of European research centres in Mathematics. In fact the current CRM Director, Manuel Castellet, has been the Chairman of ERCOM from January 2002 to December 2005.

As done by other ERCOM centres, the CRM undertakes actions to reinforce the role of Mathematics in the thematic priority areas of the 6th Framework Programme of the European Commission. Funding is offered to young mathematicians in order to foster the development of the following topics, which were selected on the basis of reports prepared by local teams: Life sciences, genomics, and biotechnology for health; nanotechnologies and nanosciences; information society technologies; sustainable development, global change and ecosystems. Several activities, including doctoral training and workshops, are planned on neuroscience and cryptology for the years 2004, 2005 and 2006.



In December 2005, a project entitled “Shaping New Directions in Mathematics for Science and Society” (MATHFSS) started as one of the Support Actions that were approved in 2005 within the NEST (New and Emerging Science and Technology) programme of the European Commission. It will last two years and has been possible by the collaboration of the following ERCOM centres: Centre de Recerca Matemàtica (CRM), project coordinator; Emmy Noether Research Institute

for Mathematics (ENI), Israel; European Institute for Statistics, Probability and Operations Research (EURANDOM), The Netherlands; and Institut des Hautes Études Scientifiques (IHÉS), France. The goal of the project is 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.

The CRM is a member of the EPDI (European Post-Doctoral Institute for the Mathematical Sciences), a network of nine European research institutes which jointly offer post-doctoral fellowships in Mathematics and mathematical physics every year.

Publications

Besides its twenty-year old preprint collection, the CRM publishes since 2001 a monograph series entitled Advanced Courses in Mathematics CRM Barcelona, which is produced and distributed by Birkhäuser Verlag (Basel). The series is especially addressed to doctoral and post-doctoral students. Volumes contain carefully edited notes written by lecturers at CRM advanced courses. The following nine volumes has been published:

- *Homotopy Theoretic Methods in Group Cohomology*, by W. Dwyer and H.-W. Henn (2001).
- *Lectures on Algebraic Quantum Groups*, by K. Brown and K. Goodearl (2002).
- *Symplectic Geometry and Integrable Hamiltonian Systems*, by M. Audin, A. Cannas da Silva and E. Lerman (2003).
- *Global Riemannian Geometry: Curvature and Topology*, by S. Markvorsen and M. Min-Oo (2003).
- *Proper Group Actions and the Baum-Connes Conjecture*, by G. Mislin and A. Valette (2003).
- *Polynomial Identity Rings*, by V. Drensky and E. Formanek (2004).
- *Kolmogorov Equations for Stochastic PDE*, by G. Da Prato (2004).
- *Ramsey Methods in Analysis*, by S. A. Argyros and S. Todorćević (2005).
- *Contemporary Cryptology*, by D. Catalano, R. Cramer, I. Damgård, G. Di Crescenzo, D. Pointcheval and T. Takagi (2005).

– *String Topology and Cyclic Homology*, by L. Cohen, K. Hess and A. A. Voronov (2006).

Two more volumes are in preparation: *Automata Groups*, by R. I. Grigorchuk, and *The Geometry of the Word Problem*, by N. Brady, T. R. Riley and H. Short.

Facilities and infrastructure

The CRM occupies 1,300 square metres in the Science Building of the UAB. Office space allows to allocate up to 28 guests. Two lecture rooms are used for seminars and meetings. All offices and rooms are fully equipped and air conditioned. The CRM has a LAN Ethernet with 30 working stations and four printers. Access to major bibliographic data bases is provided.

In addition, visitors have free access to the scientific infrastructure of the Catalan universities, including the use of the UAB Science and Engineering Library. The CRM has several furnished apartments at its disposal in Barcelona, in the nearby town of Sant Cugat and in the *Vila Universitària* of the Bellaterra campus.

20th anniversary

In the Autumn of 2004 the CRM celebrated its 20th anniversary. On this occasion, Jean-Pierre Serre, first Abel Prize, delivered a lecture during an academic event on November 9, which was presided by the foremost academic and political authorities of Catalonia and Spain. The history of the CRM during its first twenty years of existence has been published in a commemorative volume and a CD. In this period, the CRM hosted 969 visitors from 58 different countries, including 44 post-doctoral fellows. Twenty-four congresses were organised, together with 21 workshops and 23 advanced courses. These events were attended by a total number of 3,480 participants, coming from 72 countries. Many of them —hopefully all— enjoyed Barcelona, the Catalan countryside, or the hospitality of their Catalan colleagues, and keep pleasant memories from their stay.

Jean-Pierre Serre, Collège de France
Groupes finis: Choix de théorèmes
November 9, 2004
Institut d'Estudis Catalans, Barcelona

A few final comments

In mathematical research the exchange of ideas plays a central role; the contact and the transmission of knowledge is the true laboratory for mathematicians. They work in one of the most international sciences, since, compared with other disciplines, it is based less on the use of instruments and more on a strong human contact. This is where the research institutes play a crucial role. They allow not only the exchange of ideas between specialists in the same field, but also the establishment of profound and sometimes surprising links between different lines of research.

For the first time in Catalonia the words of Konrad Knopp, pronounced at an inaugural lecture at the University of Tübingen, are being understood: “Mathematics is the basis of all knowledge and contains all other culture”. The complexity of any system and our world is one, increases with the degree of interconnection. A more interconnected world —more global—, is therefore a more complex system and at the same time a more fragile and unstable one. Mathematics has an increasingly decisive role to play in the management of complex systems, (be they technological, financial or social), and therefore it will increasingly be, for those countries which develop high quality research, an instrument of power. Our country, Catalonia, can be one of them.

There have always been internationally recognised Catalan researchers in some scientific areas, and in recent years this recognition has extended to areas where previously we had no presence, as is the case for Mathematics. It



is also true that our research groups are becoming more and more visible in the literature. But it is one thing to be known and recognised individually and quite another for the country to be recognised as a scientific community. Without the former we could not achieve the second, but the later must always be an objective of the Catalan mathematical community and of the society in general. In this sense, the Centre de Recerca Matemàtica has also been

an instrument for the international promotion of our country, an instrument that many other countries wish for but do not have.

Today we believe that our mathematical community is richer, that our country is scientifically more developed, and we congratulate ourselves for this and thank all of those who have made it possible.

Let us end this article with a sentence of the letter addressed by Sir John Kingman, Presi-

dent of the European Mathematical Society in occasion of the 20th anniversary of the CRM: “You have put Catalan Mathematics firmly and permanently on the map”.

Website

Additional information about the CRM, including full lists of visitors and activities, can be found at <http://www.crm.cat>.

Manuel Castellet
CRM Director

The Catalan mathematician Ferran Sunyer i Balaguer (1912-1967) and the Prize in his honor

Ferran Sunyer i Balaguer was a self-taught Catalan mathematician very active in classical Mathematical Analysis in the period 1940–1967. Each year, in honor of his memory, the Ferran Sunyer i Balaguer Foundation awards a mathematical research prize, which was awarded for the first time in April 1993.



Ferran Sunyer i Balaguer

A biographical sketch

Ferran Sunyer i Balaguer was born in Figueras (Girona) in 1912, with a practically complete physical disability that confined him for all his life to a wheelchair, and died in Barcelona in 1967. After the early death of his father, he moved in with Ferran’s maternal grandmother and his cousins Maria, Àngels and Ferran, who provided the pleasant and suitable environment in which the mathematician grew up. The sickly

boy was left with the option to learn by himself or through his mother’s lessons. After a period of intense reading, arousing a first interest in astronomy and physics, his passion for Mathematics awoke and dominated his further life. Ferran’s physical handicap did not allow him to write down any of his papers by himself. He dictated them to his mother until her death in 1955, and when, after a period of grief and desperation, he resumed research with new vigor, his cousins took care of the writing. His working power, paired with exceptional talents, produced a number of results which were eventually recognized for their high scientific value and for which he was awarded various prizes. In 1938, he communicated his first results to Prof. J. Hadamard of the Academy of Sciences in Paris, who published one of his papers in the Academy’s “Comptes Rendus” and encouraged him to proceed in his selected course of investigation. From this moment, Ferran Sunyer i Balaguer maintained a constant interchange with the French analytical school, in particular with Szolem Mandelbrojt and his students. In the following years, his results were published regularly. His research was recognized with a significant number of prizes: Agell Prize, of the Acadèmia de Ciències i Arts de Barcelona (1948); Premi Prat de la Riba, of the Institut d’Estudis Catalans (1949); Premi de l’Academia de Ciencias de Zaragoza (1950); two prizes “Torres Quevedo” and “Francisco