

**CENTRE DE RECERCA MATEMÀTICA**

**RECORD OF ACTIVITIES 2001**

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## Presentation

Nations that are not rich financially, industrially, or in natural resources must know how to exploit their human capital with imagination. This is the present situation of Catalonia, as rich as its neighbours —perhaps even more so— in its citizens' capacity to respond, probably because the constant struggle over centuries to survive as a nation, to preserve our identity, has strengthened us, and we know how to harmoniously combine perseverance in work with initiative and ingenuity, basic conditions for successful research.

Good scientific policy and reasonable and justified investments in research —pure and applied— contribute to improving a nation's level of technological development, the quality of its production processes, and therefore its economy and its citizens' welfare. The achievement of these objectives will certainly also help us to increase our degree of sovereignty.

The Research Plans for Catalonia, especially the recently initiated third, have represented a great advance, but they consciously bow to other circumstances and do not sufficiently mark the line we wish to follow; they are still subsidiary or complementary to the Spanish government's plans, both in lines and

in actions, except for some isolated aspects, because Catalonia does not have full jurisdiction over its research.

The Third Research Plan for Catalunya 2001–2004 includes an innovation important for research in general and for mathematical research in particular: the Certified Research Centres, characterised by their excellence in fields of knowledge considered strategic. One of them will be in mathematics, the result of the restructuring of the Mathematical Research Centre (CRM), created in 1984 by the Institut d'Estudis Catalans (IEC), the Catalan National Academy, in a consortium between the Generalitat de Catalunya and the IEC with its own legal standing.

Mathematical research in Catalonia has undergone spectacular development in the last twenty-five years. It has gone from practically nothing to a situation fully competitive with the nations of our cultural surroundings, as attested by the *Report on Mathematical Research in Catalonia*, drawn up by the Institut d'Estudis Catalans in 1998 under the direction of Joan Girbau. Catalonia is among the world's foremost nations if we analyse the research articles published in leading journals in re-

lation to its population and GDP. A good example of what I was saying in my first lines.

However, for mathematical research, as for all research but more markedly in this discipline, human contact is fundamental. Our researchers must have facilities for establishing personal and direct contact with the international community, a contact which is for the mathematicians their true laboratory. As von Siemens said at the end of the nineteenth century, ‘laboratories are the fundamental base of knowledge and power.’ It is here that the Certified Research Centres’ policy of our Government can help consolidate the international prestige achieved by Catalan mathematicians, as its research is based less on the use of instruments and tools and more on strong human contact, in order to be able to develop those tools that will allow a better knowledge of the measurable aspects of the world and identify processes that arise in natural situations that are very disparate but essentially analogous.

As Peter Hilton wrote in *The Mathematical Intelligencer* several years ago, ‘A research institute is at least two things at once; it’s a building and an organization of people working together and dedicated to undertaking and encouraging research. But a research institute is much more: it starts as an idea in

someone’s mind or, occasionally, in the mind of few people with foresight and imagination, and then it starts to develop and grow, under the impulse of its founders, thanks to the work of all those who at the same time benefit from its existence and contribute to its future.’ This is the spirit that has allowed consolidation of the Mathematical Research Centre, one of the most active in Europe, and unique in the Mediterranean.

In the past few years, the growth of mathematical research in Catalonia, often individually carried out in university departments, has also been reinforced by the new dynamic of the *Societat Catalana de Matemàtiques*, which has bolstered the world-wide reputation of not only our researchers but of Barcelona and of Catalonia, as a nation that is scientifically strong in this field. This is a key point for a nation that wants to be considered as such: first its researchers must be recognised, but then it must go farther and the nation itself must be recognised in scientific and technological circles.

Catalonia’s status in the context of the international mathematical community is attested to not only by the numerous research articles published in well-regarded journals, some of them of the greatest international prestige, but also by a series of absolutely objective items, such as: its weight in the European

Mathematical Society, with members on its executive council; the Third European Congress of Mathematics in Barcelona in 2000 —the World Mathematical Year— with a level and number of participants much superior to previous editions; the CRM's admission as a member of the European Post-Doctoral Institute for the Mathematical Sciences (EPDI); the CRM director's assumption of the chair of ERCOM (European Research Centres on Mathematics) in 2002; the prestigious international Ferran Sunyer i Balaguer Prize, awarded by the Fundació Ferran Sunyer i Balaguer and published in the important series *Progress in Mathematics*; and the new series of textbooks *Advanced Courses in Mathematics, CRM Barcelona*, from the Swiss publisher Birkhäuser Verlag, based on the advanced doctoral and post-doctoral recent courses offered by the Mathematical Research Centre, of which we presented the first volume last year.

Catalonia's European vocation is also clear in the field of mathematics, not only through what I have already mentioned, but also through the many Marie Curie scholarship

recipients performing post-doctoral work on our research teams, especially at the CRM, one of the European Commission's three designated Marie Curie Training Sites, which last year welcomed its first students, from France and Israel; and through the success of the CRM's proposals to the European Community's High-Level Scientific Conferences program, with fourteen out of fifteen approved over the past three years.

This situation, which I am sure is irreversible, did not come about in a day or a year; it is the result of a scientific policy begun very modestly over twenty-five years ago, with students doing their doctoral theses abroad, with the selection of the best researchers, with contact with the international mathematics community, but above all with the effort of all the mathematical researchers and their enthusiasm, dedication, and sacrifice, which have sometimes compensated for the lack of more-material resources. Happily, our nation's scientific policy insures the growth, year after year, of institutional support, which lowers the risk of retrogression in research and guarantees its future.

Manuel Castellet  
Director



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# 1 The Centre de Recerca Matemàtica

The Centre de Recerca Matemàtica is a university institute of the Institut d'Estudis Catalans associated with the Universitat Autònoma de Barcelona.

## 1.1 The Institut d'Estudis Catalans

The *Institut d'Estudis Catalans*, founded in 1907, 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 the scientific research, in particular the research related to all aspects of Catalan culture. It contributes to the planning, coordination 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 nec-

essary, 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. Each section is formed by a maximum of twenty-eight full members. There are 26 societies affiliated to the IEC, with more than 9,000 members.

The headquarters of the IEC are located in the Convalescent Home of the former Hospital de la Santa Creu, carrer del Carme 47, Barcelona (CP 08001).

## 1.2 The Centre de Recerca Matemàtica

In 1984, the *Institut d'Estudis Catalans* created the *Centre de Recerca Matemàtica*, with the main goal of providing Catalan mathematicians with a research institute which would stimulate the improvement of mathematical research in Catalonia, both qualitatively and quantitatively. To achieve this aim, the CRM invites outstanding mathematicians for research visits, facilitates scientific contacts between these visitors and our young local researchers, carries out research programmes, organises lectures, conferences and other scientific

meetings, and disseminates research results through its preprints series.

The CRM is located in the Science building of the *Universitat Autònoma de Barcelona* (UAB), on its campus at Bellaterra, in accordance with an agreement signed by the IEC and the UAB.

The address of the CRM is:

Centre de Recerca Matemàtica (IEC)

Apartat 50, E-08193 Bellaterra

Telephone: (34) 935 811 081

Fax: (34) 935 812 202

Electronic mail: [crm@crm.es](mailto:crm@crm.es)

web: <http://www.crm.es>

## 2 Governing body and structure

### 2.1 The Council

The CRM is directed by a Council consisting of four members in the area of mathematics of the *Institut d'Estudis Catalans* and a representative of the *Societat Catalana de Matemàtiques* (SCM). The members of the Council are:

Eduard Bonet (IEC)  
Manuel Castellet (IEC)  
Joan Girbau (IEC)  
Josep Vaquer (IEC)  
Sebastià Xambó (SCM).

### 2.2 The Director

The Council elects a Director to serve for a period of four years. The current Director is Manuel Castellet who was re-elected for the period 2000–2003 at the meeting of October 1999.

### 2.3 The Scientific Committee

At the meeting of May 1994, the CRM's Council, following a suggestion made by some members of the mathematical community, agreed to create a Scientific Committee.

The members of the Committee are: Jaume Agudé (UAB), Lluís Alsedà (UAB), Pilar Bayer (UB), Josep Blat (UPF), Joan Elias (UB), Núria Fagella (UB), Jaume Moncasi (UAB), Artur Nicolau (UAB), David Nualart (UB), Mercè Ollé (UPC), Oriol Serra (UPC).

### 2.4 Secretariat

Maria Julià and Consol Roca are the persons in charge of the administration of the CRM. They also look after the guests and take care of the preparation of the scientific papers.

## 3 Facilities

### 3.1 Premises

The CRM is located in the Science building at the Universitat Autònoma de Barcelona (UAB). It occupies a total of 940 square metres, containing 8 single offices, 2 doubles, 3 triples, a secretarial office, a director's office, a computer room, a storage room, 2 lecture rooms (one for 50 people and another one for 25 people), a meeting room and an informal meeting space. All the rooms have central heating and air conditioning.

### 3.2 Computing facilities

The CRM has the following computer equipment:

One NT server (Netserver LH3) to provide network services for visitors, and allowing computing on the Unix machine.

In the computer room there are three laser printers, and three PCs

available to everyone. There are also 23 PCs, one in each office, and a good selection of scientific software such as TeX. There is also a computer administrator to help the visitors.

We also have a projector with a computer to make presentations in the conference room.

### 3.3 Library

The visitors to the CRM may use, without any limitation, the UAB's science library, which contains a mathematics corpus consisting of 450 journals and 11.850 books.

### 3.4 Accommodation

The CRM has 9 permanently rented furnished apartments for its guests. They are located in Sant Cugat del Vallès and in the Vila Universitària, in the Bellaterra Campus.

## 4 Visiting Scientists

### 4.1 List of visitors

<i>X. Zhang</i>	Dynamical Systems, 01.03.99 – 31.03.01 Nanjing University
<i>J. A. Crespo</i>	Algebraic Topology, 01.09.99 – 31.08.01 Universitat Autònoma de Barcelona
<i>F. X. Dehon</i>	Algebraic Topology, 01.10.99 – 30.09.02 École Polytechnique, Palaiseau
<i>M. Ollé</i>	Dynamical Systems, 01.09.00 – 31.08.01 Universitat Politècnica de Catalunya
<i>J. M. Font</i>	Logic, 01.09.00 – 15.02.01 Universitat de Barcelona
<i>G. Granja</i>	Algebraic Topology, 01.09.00 – 31.08.01 Instituto Superior Técnico, Lisboa
<i>F. Neumann</i>	Algebraic Topology, 01.10.00 – 30.09.01 Universität Göttingen
<i>N. Dutertre</i>	Differential Geometry, 01.10.00 – 30.09.02 Université de Rennes 1
<i>M. Sierakowski</i>	Dynamical Systems, 23.10.00 – 31.07.01 Uniwersytet Warszawski
<i>G. Swirszcz</i>	Dynamical Systems, 15.11.00 – 31.05.03 Uniwersytet Warszawski
<i>M. Cu villiez</i>	Algebraic Topology, 01.01.01 – 31.12.02 Université Catholique de Louvain, Louvain-la-Neuve
<i>A. Descheemaker</i>	Algebraic Topology, 01.01.01 – 31.09.02 Katholieke Universiteit Leuven, Kortrijk
<i>A. Rascanu</i>	Probabilities, 02.01.01 – 31.01.01 Alexandro Ioan Cuza University, Iasi
<i>R. Levi</i>	Algebraic Topology, 08.01.01 – 18.01.01 University of Aberdeen
<i>N. Yui</i>	Number Theory, 01.01.01 – 30.04.01 Queen's University, Kingston
<i>J. Garnet</i>	Analysis, 10.01.01 – 15.03.01 University of California at Los Angeles
<i>S. Zarati</i>	Algebraic Topology, 11.01.01 – 06.04.01 Université de Tunis

- A. Alexandrov* Analysis, 01.01.01 – 31.10.01  
Steklov Institute of Mathematics, Saint Petersburg
- S. Crans* Algebraic Topology, 31.01.01 – 05.02.01  
Université de Nice-Sophia Antipolis
- Y. Ouknine* Probabilities, 01.02.01 – 28.02.01  
Université Cadi Ayyad, Marrakech
- P. Koepke* Logic, 18.02.01 – 15.10.01  
Universität Bonn
- V. Khavin* Analysis, 01.03.01 – 30.06.01  
Saint-Petersburg State University
- G. David* Analysis, 15.03.01 – 15.05.01  
Université de Paris-Sud
- T. Jech* Logic, 15.03.01 – 15.05.01  
Pennsylvania State University
- J. M. Amigó* Applied Mathematics, 01.04.01 – 17.08.01  
Universitas Miguel Hernández, Elx
- M. Harris* Applied Mathematics, 10.04.01 – 22.04.01  
Université Paris VII
- S. Staleuskaya* Probabilities, 02.05.01 – 06.05.01  
Belarusian State University, Minsk
- Vi. Peller* Analysis, 30.05.01 – 30.07.01  
Kansas State University, Manhattan
- G. Bezhanishvili* Logic, 31.05.01 – 06.07.01  
Universiteit van Amsterdam
- A. Gulisashvili* Analysis, 01.06.01 – 25.07.01  
Ohio State University at Athens
- G. Banaszak* Number Theory, 01.07.01 – 30.07.01  
Unwersytet Adama Mickiewicza, Poznań
- M. Audin* Geometry, 10.07.01 – 15.07.01  
Université Louis Pasteur, Strasbourg
- A. Cannas da Silva* Geometry, 10.07.01 – 15.07.01  
Instituto Superior Técnico, Lisboa
- E. Lerman* Geometry, 10.07.01 – 15.07.01  
University of Illinois at Urbana
- C. Breuil* Number Theory, 18.07.01 – 28.07.01  
Université de Paris XI
- B. Edixhoven* Number Theory, 18.07.01 – 28.07.01  
Université de Rennes I

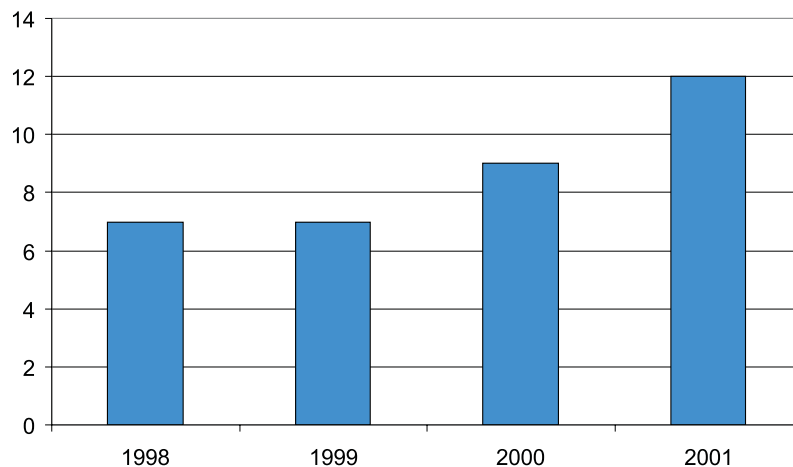
<i>J. Nesetril</i>	Combinatorics, 01.07.01 – 31.10.01 Charles University, Praha
<i>P. Vuillermot</i>	Probabilities, 01.09.01 – 30.09.01 Université Henri-Poincaré Nancy I, Vandoeuvre-lès-Nancy
<i>B. Chorny</i>	Algebraic Topology, 01.09.01 – 28.02.02 Hebrew University of Jerusalem
<i>L. Khachatryan</i>	Combinatorics, 01.09.01 – 30.09.01 Universität Bielefeld
<i>A. Delshams</i>	Applied Mathematics, 01.09.01 – 31.08.02 Universitat Politècnica de Catalunya
<i>K. Phelps</i>	Combinatorics, 01.09.01 – 31.12.01 Auburn University
<i>N. Wormald</i>	Combinatorics, 11.09.01 – 17.10.01 University of Melbourne
<i>A. Proskurowski</i>	Combinatorics, 01.09.01 – 31.12.01 University of Oregon, Eugene
<i>D. Welsh</i>	Combinatorics, 16.09.01 – 30.09.01 University of Oxford
<i>G. Mislin</i>	Algebraic Topology, 18.09.01 – 22.09.01 ETH Zürich
<i>A. Valette</i>	Algebraic Topology, 18.09.01 – 22.09.01 Université de Neuchâtel
<i>D. Chataur</i>	Algebraic Topology, 01.10.01 – 31.10.03 Université Catholique de Louvain, Louvain-la-Neuve
<i>G. Collinet</i>	Algebraic Topology, 01.10.01 – 31.01.02 École Polytechnique, Palaiseau
<i>A. Guillot</i>	Geometry, 01.10.01 – 15.11.01 École Normale Supérieure de Lyon
<i>A. Bodin</i>	Geometry, 01.10.01 – 31.10.02 Université Paul Sabatier, Toulouse
<i>P. Derbez</i>	Topology, 01.10.01 – 30.09.02 Université de Bourgogne, Dijon
<i>G. Keller</i>	Dynamical Systems, 06.10.01 – 12.10.01 Universität Erlangen-Nürnberg
<i>J. Okninski</i>	Algebra, 30.11.01 – 15.12.01 Uniwersytet Warszawski
<i>K. Andersen</i>	Algebraic Topology, 01.12.01 – 31.08.02 Kobenhavns Universitet

## 4.2 Post-Doctoral Fellows

Among the visiting researchers at the CRM during the year 2001 we note the presence of 12 post-doctoral fellows with stays of more than 9 months, fulfilling one of the founda-

tional aims of the CRM: to facilitate the work of young researchers and their contact with leading scientists. They were:

X. Zhang	01.03.99 – 31.03.01	(MECyD)
J. A. Crespo	01.09.99 – 31.08.01	(CRM)
F. X. Dehon	01.10.99 – 30.09.01	(CRM, Marie Curie)
G. Granja	01.09.00 – 31.08.01	(Fundação para a Ciencia e Tecnologia)
N. Dutertre	01.10.00 – 30.09.02	(Marie Curie)
F. Neumann	01.10.00 – 30.09.01	(Network Modern Homotopy Theory)
M. Sierakowski	23.10.00 – 31.07.01	(Agència Espanola de Cooperación Internacional)
G. Swirszcz	15.11.00 – 31.05.03	(CRM, Marie Curie, MECyD)
M. Cuivilliez	01.01.01 – 31.12.02	(Marie Curie)
A. Descheemaker	01.01.01 – 31.09.02	(Network Modern Homotopy Theory)
P. Derbez	01.10.01 – 30.09.02	(EPDI)
D. Chataur	01.10.01 – 31.10.03	(CRM, Marie Curie)
A. Bodin	01.10.01 – 31.10.02	(CRM, Marie Curie)
K. Andersen	01.12.01 – 31.08.02	(Network Modern Homotopy Theory)



Number of Post-Doctoral Fellows

## 5 Scientific Activities

### 5.1 Barcelona 2001 EuroPhD Topology Conference: Homotopy Theory and Applications (B2001ETC)

From July 3 to 7, 2001 the *Barcelona 2001 EuroPhD Topology Conference: Homotopy Theory and Applications* took place at the Centre de Recerca Matemàtica organised by the CRM. The organising committee was formed by J. A. Crespo (CRM, Barcelona), J. L. Rodríguez (Universidad de Almería), G. Bastardas (UAB), A. Ruiz (UAB). 61 researchers from all over the world attended the meeting. This meeting was supported by the European Commission in the programme High-Level Scientific Conferences, (HPCF-CT-1999-00059), by the Dirección General de Investigación (PGC2000-2585-E), by the Direcció General de Recerca (ARCS01-151) and by the Universitat Autònoma de Barcelona.

The following plenary lectures were given:

- W. Chachólski, *Cellular acyclic spaces and nilpotency*.
  - O. Cornea, *Periodic orbits of Hamiltonian flows and homotopy theory*.
  - D. J. Green, *Computing cohomology rings of  $p$ -groups*.
  - P. Lambrechts, *Lefschetz duality and algebraic models of homotopy types*.
  - F. Neumann, *Étale homotopy and moduli stacks*.
  - P. Salvatore, *Formality of configuration spaces*.
  - S. Schwede, *Realizing modules over cohomology algebras*.
  - N. Strickland, *Formal multicurves and equivariant cobordism*.
  - S. Whitehouse, *Bases for co-operations in complex  $K$ -theory*.
- Other lectures given:
- T. Beke, *Simplicial torsors*.
  - D. Chataur, *Deformations of  $E_\infty$ -algebras*.
  - A. Clément, *Some relationships between homotopy and homology exponents*.
  - A. Descheemaeker, *On the homotopy type of  $p$ -completions of infranilmanifolds*.
  - I. Gálvez, *Modular eta invariants and elementary number theory*.
  - A. Garvín, *Fibre self homotopy equivalences. A rational approximation point of view*.
  - P. Ghienne, *On the Mislin genus*.
  - J. J. Gutiérrez, *Homotopical localizations of module spectra*.
  - S. Kallel, *On morphisms of genus 3 curves and Gromov-Witten evaluation maps*.
  - G. Laures, *An  $E_\infty$ -splitting of spin bordism*.
  - P.-M. Moyaux, *Lower bounds for the relative LS category*.



- A. Ruiz, *Rank 2 Kac-Moody groups with the same classifying space.*
- L. Vandembroucq, *Fibrewise suspension and Lusternik-Schnirelmann category.*
- J. M. García Calcines, *External simplicial sets: a simplicial model for proper homotopy theory.*
- J. Remedios, *Pointed and generalized exact homotopy sequence.*
- J. Smrekar, *Compact open topology and CW-homotopy type.*
- P. van der Laan, *Some Hopf algebras of trees.*
- R. J. Flores, *A decomposition of the homotopy fibre of the natural map  $BG \rightarrow \underline{B}G$ .*
- A. Vavpetič, *On the mod  $p$  homotopy type of the classifying space of  $PU(p)$ .*
- M. A. García, *The Postnikov tower of a crossed complex.*
- A. Vavpetič,  *$N$ -determinism of  $Sp(n)$  as a 2-compact group.*

The following posters were presented:

## 5.2 EuroConference on Combinatorics, Graph Theory and Applications

From September 12 to 15, 2001 the *EuroConference on Combinatorics, Graph Theory and Applications* took place at the Facultat de Ciències de la Comunicació of the Universitat Autònoma of Barcelona organised by the CRM. The organising committee was formed by J. Díaz (UPC), J. Gimbert (UdL), F. Hurtado (UPC), A. Lladó (UPC), G. Lugosi (UPF), C. Martínez (UPC), M. Noy (UPC), J. Pujol (UAB), J. Rifà (UAB), and O. Serra (UPC) was the coordinator.

132 researchers from all over the world attended the meeting. This meeting was supported by the European Commission in the programme High-Level Scientific Conferences, (HPCF-CT-2000-00089), by the Di-

rección General de Investigación (PGC2000-2267-E), by the Direcció General de Recerca, by the Universitat Politècnica de Catalunya, by the Universitat Autònoma de Barcelona and by DIMATIA-ITI, Charles University, Praha.

The following plenary lectures were given:

- Noga Alon, *Polynomials in Combinatorics Speaker.*
- Peter J. Cameron, *Random Strongly Regular Graphs?*
- David Eppstein, *Triangles and Squares.*
- Levon Kachatrian, *Extremal problems under dimension constraint.*
- Jiří Matoušek, *Transversals of hypergraphs with geometric flavor.*

- Kevin T. Phelps, *Bounds on the Rank and Kernel of Perfect Codes*.
- Carsten Thomassen, *The chromatic number of graphs of fixed girth and genus*.
- Nick Wormald, *Analysing greedy algorithms on regular graphs*.

Other lectures given:

- D. Orden, *Asymptotic efficient triangulations of the  $d$ -cube*.
- J. Pfeifle, *Kalai's squeezed 3-spheres are polytopal*.
- M. Stojakovic, *On finding the limit shape of optimal convex lattice polynomials*.
- D. Wood, *Geometric thickness in a grid of linear area*.
- B. Bresar, *Cubes Polynomials and its derivatives*.
- I. Michos, *On the average Cartier-Foata height of traces*.
- J. Burillo, *Counting primitive elements in free groups*.
- P. Weil, *Graphs, intersections of subgroups of free groups and corank*.
- K. Ando, *Vertices of degree 6 in a 6-contraction critical graph*.
- J. Gimbert, *On the spectrum of a weakly distance-regular digraph*.
- T. Jordan, *Non separable detachments of graphs*.
- B. Zmazek, *Weak  $k$ -reconstruction of cartesian product graphs*.
- B. Doerr, *Vector balancing games with aging*.
- G. Hurlbert, *On the pebbling threshold spectrum*.
- G. Galbiati, *On optimum cycle bases*.
- S. Suzuki, *Average running time analysis of an algorithm to calculate the size of the union of cartesian products*.
- F. Mazoit, *Treewidth of planar graphs: connections with duality*.
- C. McDiarmid, *Channel Assignment on nearly Bipartite and Bounded Treewidth Graphs*.
- J. A. Telle, *Tree-decompositions of small pathwidth*.
- D. M. Thilikos, *Fast approximation schemes for  $K$ -minor free or  $K$ -minor free graphs*.
- C. Paul, *Split decomposition and distance labelling: an optimal scheme for distance hereditary graphs*.
- G. Fertin, *Neighborhood communications in networks*.
- J. Ozón\*, *On the universality of small-world graphs*.
- O. Togni, *Optical routing of uniform instances in Cayley graphs*.
- J. Körner, *Delta systems and qualitative independence*.
- G. Y. Katona, *Extremal  $k$ -edge hamiltonian hypergraphs*.
- M. Ruszinko, *On the maximum size size of  $(p, Q)$ -free families*.
- V. Cepulic, *Construction of symmetric block designs using normal subgroups of automorphism groups*.
- M. Villanueva, *Bounds on the rank and kernel of perfect codes*.
- V. A. Zinoviev, *On completely regular binary codes and  $t$ -designs*.
- S. Fekete, *Matchings as the intersection of matroids*.
- S. Hartmann, *Orthogonal directed covers by flowers*.

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- U. Leck, *On the orthogonal product of simplices and products of truncated Boolean lattices.*
  - O. Bodini, *Tiling a Manhattan polyomino with bars.*
  - P. Revuelta, *Infinite graph embeddings on tubular surfaces.*
  - S. Nicoloso, *Optimal partition of a bipartite graph into non-crossing matchings.*
  - A. E. Baert, *On the growth of components with non-fixed excesses.*
  - G. Melançon, *Random generation of directed acyclic graphs.*
  - J. Nešetřil, *Random homomorphisms from arbitrary graphs to  $Z$ .*
  - H. Bielak, *Local and Mean Ramsey Numbers for Some Graphs.*
  - O. Pikhurko, *Size Ramsey numbers and integer programming.*

Participants in the COMB01

### 5.3 CRM Advanced Courses

This year for the seventh time, the CRM organised a series of advanced courses on specific subjects that have seen recent development. These intensive courses are addressed to ad-

vanced Ph.D. students and recent Ph.D. graduates and taught by well known specialists in each area.

During the year 2001 the following courses were given:

#### 5.3.1 Symplectic geometry of integrable Hamiltonian systems

From July 10 to 15, 2001, coordinated by C. Currás and E. Miranda from the UB and lectures given by:

- MICHÈLE AUDIN (Institut de Recherche de Mathématique Avancée, Strasbourg). *Lagrangian and special Lagrangian submanifolds.*

The course gave a description of known examples of Lagrangian submanifolds of symplectic manifolds, problems with especial Lagrangian submanifolds, especially examples, deformation theorem, and relation with mirror symmetry.

- ANNA CANNAS DA SILVA (Instituto Superior Técnico, Lisboa). *Symplectic toric manifolds.*

Native to algebraic geometry, toric manifolds have been studied by symplectic geometers as examples of extremely symmetric Hamiltonian spaces. This course described the symplectic geometry of toric manifolds as Hamiltonian systems, including their classification (due to Delzant) in terms of special polytopes.

- EUGENE LERMAN (University of Illinois at Urbana-Champaign). *Symme-*

*tries of symplectic and contact manifolds.*

This course dealt with completely integrable geodesic flows, of which the study of global homogeneous action-angle variables turns out to be a special case. This leads to the study of completely integrable torus actions on contact manifolds and analogues of Delzant theorem for contact manifolds. As a corollary one gets a theorem of Zelditch: any toric-integrable geodesic flow on a torus comes from a flat metric.

Other lectures given:

- P. Molino, *Non degenerate systems in the totally non elliptic case.*
- J. P. Ortega, *Singular dual pairs and optimal momentum maps.*
- C. Tejero, *On the manifold of orbits of constant energy for the magnetic flow on Riemann surfaces.*
- N. Tien Zung, *Topological structure of singularities of integrable Hamiltonian systems.*

47 researchers and post-doctoral students attended the course, which was supported by the European

Commission in the programme High-Level Scientific Conferences, (HPCF-CT-2000-00110), by the Direcció

General de Investigación (PGC2000-2266-E) and by the Direcció General de Recerca (ARCS01-152).

### 5.3.2 Global Riemannian geometry: curvature and topology

From July 17 to 23, 2001, coordinated by V. Palmer (Universitat Jaume I) and lectures given by:

- STEEN MARKVORSEN (Technical University of Denmark). *Distance geometric analysis on Riemann manifolds.*

What is the effective resistance of, say, a hyperboloid or a helicoid if the surface is made of a homogeneous conducting material? In the course we studied the precise meaning of this question and analysed how the answer depends on the curvature and topology of the given surface. One key ingredient of this exploration is the comparison theory for distance functions in spaces which have well defined bounds on their curvature. It is in this setting that we then obtain information about diffusion processes, isoperimetric inequalities, transience, and effective resistance of the spaces in question.

- MAUNG MIN-OO (McMaster University). *K-area, mass and asymptotic geometry.*

$K$ -area and  $K$ -length are invariants introduced by Gromov to measure the  $K$ -theoretic size of a Riemannian manifold. The fundamental inequality relating  $K$ -area to scalar curvature is

based on the famous Lichnerowicz formula for Dirac operators. Sharp estimates of these invariants have relevant applications. Positive mass theorems are key results in general relativity and there is a recent flurry of research activity in physics on the AdS/CFT correspondence, which has intriguing relations to asymptotic geometry of hyperbolic spaces.

Other lectures given:

- J. Girbau, *The Laplacian in the hyperbolic space, Sobolev spaces and general relativity.*
- L. Guijarro, *Fiber bundles and curvature.*
- J. Lafontaine, *An invitation to affine symplectic geometry.*
- V. Miquel, *The role of spherical sections and the Weyl's formula for the volume of tubes.*
- S. Montiel, *Eigenvalues of the intrinsic Dirac operator on hypersurfaces.*

Short communications were given by young participants:

- P. Piccione, *Conjugate points along semi-Riemannian geodesics and the Maslov index.*
- S. Console, *Index number and topology of flag manifolds.*

- M. Czarnecki, *Boundary embedding of the Hadamard foliation of  $H^n$* .
  - A. J. Di Scala, *On an assertion in Riemannian's Habilitationvortrag*.
  - A. Fino, *Dolbeault cohomology of compact nilmanifolds*.
  - T. Foertsch, *Some interesting quasi-isometric embeddings of negatively curved manifolds into products of negatively curved manifolds*.
  - T. Foertsch, *Minkowski versus Euclidean Rank for Products of Metric Spaces*.
  - G. García, C. J. Rodríguez, *Prescribing the scalar curvature of the  $n$  dimensional half sphere and keeping the boundary minimal*.
  - S. Kokkendorff, *Isometric embedding of leaf spaces into constant curvature Riemannian manifolds*.
  - B. Reinold, *Hyperbolic behaviour of rank 1 vectors*.
  - G. Solanes, *Total mean curvature and support planes in hyperbolic space*.
  - M. Zambon, *Averaging of Riemannian submanifolds*.
  - J. A. Aledo, L. J. Alías, *On the curvatures of spacelike hypersurfaces in the sitter space*.
- 52 researchers and post-doctoral students attended the course, which was supported by the European Commission in the programme High-Level Scientific Conferences, (HPCF-CT-2000-00024), by the Dirección General de Investigación (PGC2000-2272-E) and by the Universitat Jaume I.

### 5.3.3 Modular forms and $p$ -adic Hodge theory

From July 18 to 28, 2001, coordinated by X. Xarles (UAB) and A. Quirós (UAM) and lectures given by:

- CHRISTOPHE BREUIL (Université Paris-Sud).  *$p$ -adic Hodge theory, deformations and local Langlands*.

The automorphic representation at  $p$  associated to an eigenform  $f$  only determines a small part of the  $p$ -adic representation attached to  $f$ , since one forgets the filtration on the corresponding Dieudonné-Fontaine module. Thus one can ask the natural question: Is there a way to recover this filtration by purely local con-

siderations on the automorphic side? This course presented a tentative approach to this question via Mazur's deformation theory. All objects introduced were carefully defined: potentially semi-stable representations, their associated filtered modules and Weil-Deligne representations, their associated strongly divisible modules, and deformation rings.

- BAS EDIXHOVEN (Université de Rennes 1). *Modular forms, Galois representations and local Langlands*.

Modular forms and modular curves were defined. It was shown how to attach an  $\ell$ -adic Galois representa-

tion to an eigenform  $f$  (of weight at least two). The aim of the course was to show (after Langlands, Deligne, Carayol) that the restriction to a decomposition group at a prime  $p \neq \ell$  of this representation is determined (up to F-semisimplification) by the local automorphic representation at  $p$  given by  $f$ , via a suitably normalized local Langlands correspondence, and that at  $p = \ell$ , it is Fontaine's module without its filtration that plays the role of the local Galois representation.

Other lectures given:

- D. Blasius, *Introduction to Deligne-Serre theory*.
- B. Conrad, *Compactification of modular curves over  $Z[1/N]$* .
- L. Dieulefait, *Explicit description of the local Langlands correspondent for  $GL_2$  and  $p$  not 2*.
- E. Ghate, *Dihedral congruence primes and class fields of real quadratic fields*.
- A. Quirós, *An overview of crystalline cohomology*.
- X. Xarles, *Comparison theorems between crystalline and étale cohomology*.

Short communications were given by young participants:

- F. Bars, *The Tamagawa number conjecture. Results on CM elliptic curves*.
- C. Bertolin, *The Mumford-Tate group of 1-motives*.
- J. Borger, *Conductors and the moduli of residual perfection*.
- K. Consani, *On a 4-dimensional Galois representation*.
- E. González, *Modular curves of genus at least 2*.
- O. Rizzo, *Root numbers of elliptic curves*.
- M. Trifkovic, *Conics over elliptic curves*.
- T. Yoshida, *Class field theory of curves over local fields and applications*.

72 researchers and post-doctoral students attended the course, which was supported by the European Commission in the programme High-Level Scientific Conferences, (HPCF-CT-2000-00028), by the Research Training Network *Arithmetic Algebraic Geometry* (HPRN-CT-2000-00120), by the Dirección General de Investigación (PGC2000-2265-E) and by the Direcció General de Recerca (ARCS01-153).

### 5.3.4 Proper group actions

From September 18 to 22, 2001, coordinated by C. Casacuberta (UAB).

This course was an introduction to a conjecture due to P. Baum and A. Connes, stating that there is a natural isomorphism  $K_*^G(\underline{E}G) \rightarrow K_*^{\text{top}}(C_r^*(G))$  between the equivariant  $K$ -homology of the classifying space  $\underline{E}G$  for proper  $G$ -actions and the topological  $K$ -theory of the reduced  $C^*$ -algebra of the group  $G$ . For simplicity, only the case of a discrete group  $G$  was treated.

The lectures were given by:

- GUIDO MISLIN (ETH Zürich). *Equivariant  $K$ -homology of the classifying space for proper actions.*

Mislin discussed the construction and the topological properties of  $\underline{E}G$ . In particular, results were presented concerning the (minimal) dimension of its  $G$ -homotopy type. An outline was given of the following topics: Bredon cohomology and Mackey functors; equivariant homology via spectra over orbit categories; assembly maps; equivariant Atiyah–Hirzebruch spectral sequence; equivariant Chern character; computations involving groups of finite vcd, groups of rational cohomological dimension one and some other special classes of groups; the relationship of the Baum–Connes Conjecture with other conjectures (Idempotent Conjecture, Zero-Divisor Conjecture, Atiyah Conjecture, Novikov Conjecture, Gromov–Lawson Conjecture, Bass Conjecture).

- ALAIN VALETTE (Université de Neuchâtel). *Topological  $K$ -theory of group  $C^*$ -algebras.*

Valette described the right-hand side of the conjectured isomorphism (topological  $K$ -theory for  $C^*$ -algebras) and gave the analyst's point of view on the left-hand side (analytical description of  $K$ -homology) and on the assembly map. The generalization with coefficients of the conjecture were described, having better stability properties under various group constructions. Positive and negative results were stated.

Other lecture given:

- I. Leary, *Some examples of  $BG$ .*
- B. Nucinkis, *Some examples of  $EG$ .*
- C. Thomas, *3-manifolds and  $PD3$ -groups.*
- J. Chabert, H. Oyono-Oyono, *Induction and application to the permanence properties of the Baum-Connes conjecture.*
- I. Chatterji, *On property (RD) for discrete groups.*
- M. Matthey, *A handcrafted Chern character for the source of the Baum-Connes assembly map.*
- C. Martínez, *On the Hattori-Stallings trace.*
- H. Glover, *A problem in the geometry of finite groups.*
- B. Chorny, *Equivariant homology and Euler characteristic.*



52 researchers and post-doctoral students attended the course, which was supported by the European Commission in the programme High-Level Scientific Conferences, (HPCF-CT-2000-00140), by the Research

Training Network *Modern Homotopy Theory* (HPRN-CT-1999-00119), by the Direcció General de Investigació (PGC2000-2199-E) and by the Direcció General de Recerca (ARCS01-154).

## 5.4 Semester on Combinatorics, Graph Theory and Applications

Under the scientific supervision of professors Marc Noy and Oriol Serra from the UPC, the CRM organised a Semester on Combinatorics and Graph Theory, held from September 1 to December 31, 2001.

This semester was possible thanks to the contribution of the MCyT, the DURSI and the Universitat Politècnica de Catalunya.

The following activities were done during the semester:

### 5.4.1 Workshop on Tutte Polynomials and Related Topics

This workshop took place from September 25 to 28, 2001, organised by M. Noy (UPC) and D. Welsh (Oxford University). 28 researchers and post-doctoral students attended it.

The following lectures were given:

- J. Bonin, *Weighted characteristic polynomials.*
- R. Cori, *Graph traversals and external activity of trees.*
- S. Eliahou, *Some knots with Jones polynomial trivial mod 2.*
- J. A. Ellis-Monaghan, *Exploring the Tutte-Martin connection.*
- G. Farr, *Some results on generalised Whitney rank generating functions.*
- E. Gioan, *Natural correspondance between basis and reorientations of an oriented matroid.*
- I. Gitler, *On spin models and generalized delta -wye transformations.*
- A. J. Goodall, *Tutte polynomials modulo a prime.*
- G. Gordon, *The Tutte polynomial, antimatroids and greedoids.*
- J. P. S. Kung, *Curious characterizations of projective and affine geometries.*
- M. Las Vergnas, *Active orders for matroid bases.*
- C. Merino, *The chip firing game and the Tutte polynomial.*

- A. de Mier, *Tutte uniqueness of some families of  $k$ -chordal matroids*.
- S. Noble, *A weighted graph polynomial from chromatic invariants of knots*.
- M. Noy, *On graphs characterized by polynomial invariants*.
- H. Qin, *Connected matroids with symmetric Tutte polynomials*.
- P. Reinfeld, *Algebraic methods for chromatic polynomials*.
- A. Ribó, *Recursive constructions of graphs*.
- B. Sagan, *Graph coloring and symmetric functions in noncommuting variables*.
- R. Shrock, *Chromatic and Tutte polynomials and related asymptotic limiting functions for families of graphs*.
- A. Sokal, *Potts models, chromatic polynomials, and all that*.
- W. T. Tutte, *Graph-polynomials*.
- D. G. Wagner, *Electrical networks, network reliability, and the half-plane property*.
- D. Welsh, *Approximation schemes for the Tutte polynomial*.

#### 5.4.2 Workshop on Graphs, Morphisms and Applications

This workshop took place from October 2 to 5, 2001, organised by J. Nešetřil (Charles University) O. Serra (UPC). 20 researchers and post-doctoral students attended it.

The following lectures were given:

- Jørgen Bang-Jensen, *Convex-round graphs are circular perfect*.
- Gena Hahn, *On the injective chromatic number of graphs*.
- Hanno Lefmann, *Independent sets in hypergraphs*.
- André Raspaud, *On flow and tension continuous maps*.
- Oriol Serra, *Highly arc transitive covers of regular digraphs*.
- Dimitrios Thilikós, *The complexity of restrictive  $H$ -coloring*.
- Xuding Zhu, *Graphs with  $\chi_c(G) = \chi(G)$ : some new sufficient conditions*.

#### 5.4.3 Workshop on Optimization Problems, Graph Classes and Width Parameters

The workshop took place from November 15 to 17, 2001, organised by A. Proskurowski (University of Oregon) and O. Serra (UPC). 33 researchers and post-doctoral students attended it.

The following lectures were given:

- Leizhen Cai, *Tree traversals and locally-connected spanning trees*.
- Victor Chepoi, *Weakly median graphs*.

- Derek G. Corneil, *On the relationship between clique-width and treewidth.*
- Mike Fellows, *Petri nets of bounded treewidth.*
- Fedor Fomin, *Algorithms for graphs with small octopus.*
- Sandi Klavžar, *Isometric subgraph of hypercubes: recognition complexity and the regular case.*
- Dieter Kratsch, *On  $(P_5, \text{gem})$ -free graphs.*
- Janos A. Makowsky, *Beyond clique width or algorithmic uses of the Feferman Vaught theorem.*
- Rolf Niedermeier, *Experiments on optimally solving NP-complete problems on planar graphs.*
- Peter Rossmanith, *Simpler separators for solving optimization problems on planar graphs via tree decompositions.*
- Robin Thomas, *Directed tree-width.*
- Ioan Todinca, *Treewidth of planar graphs: connections with duality.*

## 5.5 Mathematics for Finance

### 5.5.1 Master in “Mathematics for Finance”

This is a joint activity of the CRM and the Mathematics Department of the Universitat Autònoma de Barcelona together with several financial institutions. The activity is sponsored by the Barcelona Stock Exchange and has different university departments as collaborators, such as the Applied Economics, Commercial Economics and Economics and History of Economics departments of the UAB, the Statistics Department of the Universitat de Barcelona, and several distinguished specialists who work in direct contact with the markets. The aim of the Master’s course, now in its fourth edition, is to train specialists capable of developing new financial products, according to the needs of the moment, and prepared to understand and critically discuss the hypotheses

and limitations of existing financial models. The Master is structured in three terms, two theoretical, with 120 hours of class each, and one practical, working in the finance industry. The Master’s responsibility lies on the Academic Commission, consisting of professors Angel Calsina, Joan del Castillo, Jaume Llibre and Frederic Utzet who acts as coordinator, and the Advisory Council, consisting of Xavier Auguets (Caixa Catalunya), Antoni Giralt (Borsa de Barcelona), Pere Guinjoan (Caixa d’Estalvis i Pensions de Barcelona) and Joan Sueiro (Banc Sabadell). A maximum of 20 students are admitted each year, and they find in the CRM the most advanced technological implements to follow the financial markets.

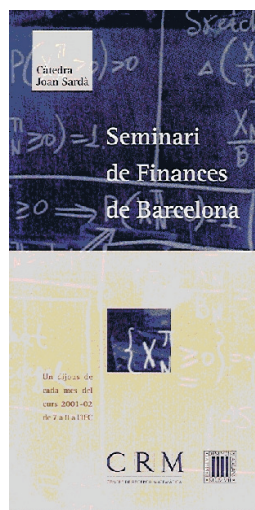
### 5.5.2 Barcelona Financial Seminar

The Institut d'Estudis Catalans, through its Joan Sardà Group and the CRM, has initiated, this year, the Barcelona Financial Seminar with the intention of establishing a solid relationship between quality research and the applications needed today by the leading businesses. This seminar, directed by professors Joan del Castillo of the Universitat Autònoma de Barcelona and David Nualart of the Universitat de Barcelona, is meant to be a forum of debate among professionals and academics, from mathematicians to economists and engineers. Joan Sardà i Dexeus (Barcelona 1910-1995), in whose honour the research group is named, was an economist, director of the Bank of Spain's in-

formation and publication service and one of the creators of the economics faculties at the Universitat de Barcelona and the Universitat Autònoma de Barcelona, and a full member of the Institut d'Estudis Catalans.

Lectures:

- Antoni Serra Ramoneda, (President of Caixa Catalunya), *Reflections on the Spanish financial system.*
- Hans Föllmer, (Professor at Humboldt Universität (Berlin)), *Financial risk and the role of Mathematics: some recent developments beyond Black-Scholes.*
- Joan del Castillo, (Professor at the Universitat Autònoma de Barcelona), *Heavy-tailed distributions in financial data.*



## 5.6 Other Lectures and Seminars

### January

- P. Ahern, *On the range of the Berezin transform.*
- A. Rascanu, *Inequations variationnelles stochastiques.*
- C. Lladó, *La producció i la prova de conjectures. Aproximació a l'escola de Gènova.*
- J. Garnett, *Large Sets of Zero Analytic Capacity.*
- D. Shafer, *Any two quadratic cycles can be connected with a smooth arc.*
- J. Llibre, *On the differentiability of first integrals of two dimensional flows.*
- V. Font, *Aproximació semiòtica-epistemològica a l'ensenyament de la demostració matemàtica.*
- E. Casanovas, *Subclases de teorías simples.*
- P. M. G. Urbaneja, *Origen i desenvolupament de la demostració en matemàtiques. Un punt de vista històric.*
- A. Rascanu, *Viability in moving sets for SDE.*
- N. Marco, *Generalized interpolation in the unit ball of  $C^n$ .*
- A. Rascanu, *Viability in moving sets for SDE.*
- R. Devaney, *Homoclinic points, Coliflowers and baby Mandelbrot Sets.*
- J. Garnett, *Analysis on metric spaces.* 16 hours course.
- J. Gascón, *Aproximació antropològica a l'anàlisi de la demostració com objecte matemàtico-didàctic.*

- A. Descheemaeker, *Localization of virtually nilpotent groups and spaces.*
- F. Peris, *La estadística en el desarrollo de nuevos fármacos.*
- A. Alexandrov, *Delation and translation invariant subspaces of  $L^p(\mathbb{R})$ .*
- E. Casanovas, *Teorías localmente supersimples.*

### February

- P. J. Cameron, *Elusive groups and the polycirculant conjecture.*
- S. Crans, *Weak  $n$ -categories are an environment for non-abelian homological algebra.*
- M. Sodin, *Dimension-free estimates of polynomials and analytic functions.*
- E. Freire, *Bifurcaciones de puntos críticos de la función de período.*
- J. M. Font, *Sistemas de Gentzen plenamente adecuados y el Teorema de la deducción.*
- M. Cuvilliez, *LS category of the total space in a fibration.*
- P. Thomas, *Algebras generated by two bounded holomorphic functions.*
- R. Martínez, *Del problema restringit al problema general de tres cossos.*
- A. Atserias, *Inexpressivitat de circuits de profunditat constant.*
- S. Zarati, *Depth and equivariant cohomology.*
- X. Tolsa, *Pesos per operadors de Calderón-Zygmund sense condicions de doblament.*
- P. Koepke, *A new hierarchy for the constructible universe.*
- G. Elliott, *The classification problem for amenable  $C^*$ -algebras.*

- S. Zarati, *Free actions of an elementary abelian 2-group on a finite product of spheres.*
- T. Sobukawa, *Brezis-Wainger inequality and Extrapolation theory.*
- J. Flum, *Grafos y Lógica.*
- G. Swirszcz, *Cyclicity of infinite contour around certain reversible quadratic center.*
- J. Borges, *Every  $Z_{2k}$ -code is a prope-linear code.*
- J. P. Díaz Varela, *Cuerpos de Galois y álgebras de post cíclicas.*
- R. Flores, *Compact Lie groups from a homotopy theorist point of view (II).*
- M. D. Riba, *PRINCALS: Una anàlisi general per a la reducció de tot tipus de dades.*

### March

- F. Neumann, *Some remarks on the functors  $K$ ,  $HH$ ,  $HC$ ,  $A$ ,  $THH$ ,  $TC$  and trace maps.*
- M. Manjarin, *Una classe de varietats complexes no kahlerianes.*
- M. Ollé, *Òrbites ferradura i les varietats invariants de les òrbites periòdiques al voltant de  $L_3$  en el problema restringit de tres cossos.*
- A. Drozdowskyj, *Data Mining: Un proceso para llegar al conocimiento a partir de los datos.*
- V. Havin, *Bounded separation of singularities of analytic functions.*
- A. Gasull, *Afitació i solucions periòdiques per a equacions diferencials del tipus  $x'' + g(x) = f(t)$ .*
- J. Rifà, *DNA Computing.*
- N. Yui, *Calabi-Yau varieties and the Mirror symmetry conjecture.*
- J. Aguadé, *Compact Lie groups from a homotopy theorist point of view (I).*
- P. Ghienne, *On the Mislin genus.*
- J. J. Risler, *Sur la courbure de la fibre de Milnor et des courbes algebriques planes affines.*
- Ch. Mouratides, *Blaschke Products in  $Q_p$  spaces.*
- G. David, *Monotonicity formulae and regularity of Mumford-Shah minimizers.*
- X. Jarque, *A question on a particular solution for a system of  $n$  differential equations.*
- V. Havin, *The uncertainty principle in harmonic analysis, (10 sessions course).*
- P. Veerman, *Dimensiones y fractales.*
- M. Villanueva, *Rank and Kernel of binary and  $q$ -ary 1-perfect codes.*
- P. Koepke, *Fields and Set-Theoretic Universes—Some Analogies.*
- J. A. Crespo, *Compact Lie groups from a homotopy theorist point of view (III).*

### April

- A. Nicolau, *Interpolation in the Bloch space.*
- V. Zinoviev, *On codes for which we know the coset weight distribution.*
- D. Welsh, *The complexity of coefficients of some combinatorial polynomials.*
- J. Aguadé, *Compact Lie groups from a homotopy theorist point of view (IV).*

- G. David, *How regular does the set  $E$  have to be if it is the support of measure with doubling constants that tend to  $2^d$  for small radii (after Kenig-Toro)*.
- M. Golubitsky, *Animal Gaits*.
- I. Stewart, *Symmetry-Breaking as an Origin of Species*.
- J. Quer, *Addició a la jacobiana d'una corba hiperel.líptica*.
- J. Fàbrega, *On the superconnectivity of digraphs with a given girth*.
- A. Ruiz, *Compact Lie groups from a homotopy theorist point of view (V)*.
- J. L. Rodríguez, *Finite simple groups and localization*.
- J. Ocaña, *Introducció a la metodologia Bootstrap*.

### May

- J. González-Rovira, *Cardinal del grup de punts de la jacobiana d'una corba hiperel.líptica*.
- A. Martínez, *Aproximació jurídica a la firma electrònica, certificats i entitats certificadores*.
- J. L. Balcázar, *Support vector machines: a (too) gentle introduction*.
- E. Pardo, *Teoria  $K$  per anells regulars simples purament infinits*.
- P. Muller, *Radial variation and universal covering maps*.
- D. Juher, *A note on the periodic orbits and topological entropy of graph maps*.
- S. Robles, *Towards a practical trust model for agent-oriented marketplaces*.
- A. Rio, *Logaritme discret sobre la jacobiana d'una corba hiperel.líptica*.
- F. Point, *Sur les groupes coset-minimaux*.
- Th. Jech, *Infinite games on Boolean algebras*.
- R. Flores, *Compact Lie groups from a homotopy theorist point of view (VI)*.
- A. Karlovich, *Lower estimate for the essential norm of the Cauchy singular integral operator in weighted rearrangement-invariant spaces*.
- A. Teruel, *Ciclos límite en sistemas lineales a trozos via integrales primeras*.
- E. Nart, *Corbes hiperel.líptiques amb jacobiana modular*.
- J. Domingo-Ferrer, *Asynchronous large-scale certification based on certificate verification trees*.
- A. Ruíz, *Compact Lie groups from a homotopy theorist point of view (VII)*.
- L. Prat, *Some real variable versions of analytic capacity, Riesz kernels and Hausdorff measure*.
- V. Mañosa, *Control de vibracions en cert tipus d'estructures*.
- J. Masdemont, *Punts de libració: noves missions i noves eines*.
- G. Granja, *The Transfer*.
- N. Marco, *Bonnes estimations pour les solutions du probleme de la cauronne*.
- F. Mañosas, *"Patterns" d'aplicacions de grafs*.
- D. Gavilan, *An approach to hyperspectral imagery and remote sensing*.
- E. Cobo, *Colinealidad: importancia y aspectos prácticos*.

**June**

- C. Broto, *Homotopy finite group theory: An overview*.
- A. Ruíz, *Compact Lie groups from a homotopy theorist point of view (VIII)*.
- Vl. Peller, *Approximation and factorization problems for matrix functions*.
- I. Mundet, *Homologia de Floer i la conjectura d'Arnold*.
- G. Solanes, *Varietats de plans i integrals de curvatura a l'espai hiperbòlic*.
- J. M. Basart, *Descartes, Pascal, Leibniz. (When  $3 + 3 <> 6$ )*.
- P. Hafner, *Some remarks on the (7,6)-cage*.
- F. Neumann, *Cohomology of compact Lie groups, stable invariants and the Serre spectral sequence*.
- S. Hollander, *A Homotopy Theory for Stacks*.
- S. Buckley, *When is the quasihyperbolic metric Gromov hyperbolic?*
- G. Bezhanishvili, *Topological perspective on modal logic*.
- E. Teufel, *Integral geometric relations in hyperbolic spaces*.
- J. Martí-Farré, *Some new results on the characterization of the access structures of ideal secret sharing schemes*.

**July**

- G. Banaszak, *A support problem for intermediate jacobians of l-adic representations*.
- V. Muñoz, *Invariantes de 4-variedades y formas modulares*.

- S. Lynch, *Multistability, bistability and chaos control*.

**September**

- A. Canton, *Imágenes conformes de conjuntos de Borel*.
- A. Granados, *Conjuntos de valores asintóticos para funciones meromorfas enteras de orden finito*.
- A. Borichev, *On the minimum of harmonic functions*.
- J.A. Amor, *Relaciones metalógicas entre compacidad y completud*.

**October**

- A. Nagel, *The dbar-b complex on decoupled domains*.
- Y. Dupain, *Plurisubharmonic functions and finite type pseudoconvex domains*.
- M. Zhitomirskii, *Normal forms for vector fields*.
- G. Keller, *Spectral perturbation theory for dynamical systems*.
- A. Käenmäki, *On the local behavior of the limit set of conformal iterated function systems*.
- Ch. Pantazi, *Darboux integrability for real planar polynomial differential systems*.
- J. Sorolla, *On the integrability and limit cycles of polynomial differential systems*.
- F. Bou, *Strict implication and intuitionistic logics*.
- A. Guillot, *Integración de campos de vectores cuadráticos complejos*.
- I. J. Dejter, *Graphical invariants for perfect codes*.
- B. Chorny, *Equivariant homotopy theory*.



- G. Majchrowska, *Wavelets in the Hardy Space  $H^2(\mathbb{R})$* .
- A. Bodin, *Irregular fibers of complex polynomials*.
- A. Descheemaeker, *On the homotopy type of  $p$ -completions of infranilmanifolds*.
- X. Tolsa, *Semiadditivitat de la capacitat analítica*.
- V. Mañosa, *Integrabilitat Darboux per Sistemes Dinàmics Discrets*.
- A. Bodin, *Résolutions des singularités à l'infini*.
- J.M. Rodriguez, *Superficies de Riemann hiperbólicas en sentido de Gromov*.
- J. Los, *Minimal entropy for 4-braids and some automatic normal forms*.
- S. Simanca, *Métricas canónicas en variedades de tipo Kähler*.
- Y. Venema, *Atomic Boolean Algebras with Operators*.
- A. Cianchi, *Optimal Orlicz-Sobolev embeddings*.
- J. Llibre, *Polynomial first integrals for quasi-homogeneous polynomial differential systems*.

### November

- V. Kolyada, *Inmersiones de espacios de Sobolev*.
- M. Stessin, *Analytic conditional expectation*.
- T. Guillamon, *The period function for perturbed isochronous centres*.
- P. Derbez, *Un théorème de rigidité pour les variétés Haken*.
- D. Chataur,  *$E_\infty$ -algebras and homotopy types*.
- A. Nagel, *The  $\bar{\partial}_b$  complex on model product submanifolds*.
- G. Swirszcz, *On a certain map of a triangle*.
- L.C. Silva, *Insuficiencias del paradigma frecuentista y el enfoque Bayesiano como alternativa*.
- N. Corral, *Modelos logarítmicos y curvas polares de foliaciones singulares*.
- Y. Venema, *Game logics and game algebras*.
- C. Broto, *Cohomologia de grups finits i espais classificadors*.
- J. Ribon, *Familias de gérmenes de difeomorfismos en  $(C,0)$  tangentes a la identidad. Clasificación formal*.
- N. Castellana, *Teoremas A i B de Quillen i descomposicions homològiques*.

### December

- E. Fontich, *Més resultats de varietats invariants*.
- M. Sakuma, *Comparing two convex hull constructions for cusped hyperbolic manifolds*.
- D. Rolfsen, *Orderable 3-manifold groups*.
- J. Okninski, *Algebras with quadratic relations of skew type*.
- J. Mateu, *The planar Cantor sets of zero analytic capacity*.
- M. Corbera, *Periodic orbits for the collinear restricted three body problem*.
- J. Bagaria, *Models de Solovay*.

## 5.7 Publications

During the year 2001 the CRM has continued its three series of publications, *Preprints*, *Confèrencies* and *Quaderns*.

PREPRINTS. During this year 30 preprints have been published:

- *A closure operation in rings*. P. Ara, G. K. Pederson, F. Perera (núm. 461).
- *On hyperbolic once-punctured-torus bundles*. J. W. Cannon, W. Dicks (núm. 462).
- *Courbures et singularités réelles*. N. Dutertre (núm. 463).
- *MU-cohomologie des espaces fonctionnels de source le classifiant d'un groupe de Lie compact commutatif*. F.-X. Dehon (núm. 464).
- *Distributional inequalities for non-harmonic functions*. M. J. González, P. Koskela, J. G. Llorente, A. Nicolau (núm. 465).
- *Profondeur et cohomologie équivariante*. M. Dammak, F. Grazzini, S. Zarati (núm. 466).
- *Actions libres d'un 2-groupe abélien élémentaire sur un produit fini de sphères*. D. Bourguiba, S. Hammouda, S. Zarati (núm. 467).
- *Properties of semi-trivial fibrations*. M. Cuvilliez (núm. 468).
- *Sharp estimates for the non-centered maximal operator associated to Gaussian and other radial measures*. P. Sjögren, F. Soria (núm. 469).
- *Stable finiteness of group rings in arbitrary characteristic*. P. Ara, K. C. O'Meara, F. Perera (núm. 470).
- *Classifying spaces of Kač-Moody groups*. C. Broto, N. Kitchloo (núm. 471).
- *Preserving asphericity of virtually nilpotent spaces under P-localization*. A. Descheemaeker, W. Malfait (núm. 472).
- *Homotopy finite group theory*. C. Broto, R. Levi, B. Oliver (núm. 473).
- *Accelerated Collatz dynamics*. J. M. Amigó (núm. 474).
- *On the Euler characteristic of semi-analytic and semi-algebraic sets*. N. Dutertre (núm. 475).
- *Colorings and Homomorphisms of minor closed classes*. J. Nešetřil, P. Ossona de Mendez (núm. 476).
- *Differential equations driven by fractional Brownian motion*. D. Nualart, A. Răşcanu (núm. 477).
- *Bi-asymptotic billiard orbits inside perturbed ellipsoids*. S. Bolotin, A. Delshams, Yu. Fedorov, R. Ramírez-Ros (núm. 478).
- *Classifying spaces for proper actions of locally-finite groups*. W. Dicks, P. H. Kropholler, I. J. Leary, S. Thomas (núm. 479).
- *Decomposition of  $B_n J(A)$  and extension of  $A_n$ -maps to  $A_\infty$ -maps*. M. Cuvilliez (núm. 480).
- *Darboux theory of integrability for discrete dynamical systems*. A. Gasull, V. Mañosa (núm. 481).
- *Besov regularity of stochastic integrals with respect to the fractional Brownian motion with parameter  $H > 1/2$* . D. Nualart, Y. Ouknine (núm. 482).

- *Relations among sums of reciprocal powers II.* J. M. Amigó (núm. 483).
- *Approximation to the  $\mathcal{F}$ -killing length of a space.* M. Cuvilliez, Y. Félix (núm. 484).
- *$K_0$  of purely infinite simple regular rings.* P. Ara, K. R. Goodearl, E. Pardo (núm. 485).
- *The geometry of quadratic differential systems with a weak focus of third order.* J. Llibre, D. Schlomiuk (núm. 486).
- *The acyclic edge chromatic number of a random  $d$ -regular graph is  $d + 1$ .* J. Nešetřil, N. C. Wormald (núm. 487).
- *Combinatorial structure of binary 1-perfect additive codes.* K. T. Phelps, J. Rifà (núm. 488).
- *On the homotopy type of  $p$ -completions of infra-nilmanifolds.* G. Bastardas, A. Descheemaeker (núm. 489).
- *Invariance of Milnor numbers and topology of complex polynomials.* A. Bodin (núm. 490).

CONFERÈNCIES. The sixth volume of this series has been published. It compiles the extended abstracts of the lectures and seminars given at the CRM during the year 2000.

QUADERNS. They compile the content of specialized activities. The following 4 issues have been published:

- *Advanced Course on Symplectic Geometry of Integrable Hamiltonian Systems.* Editors: Carles Currás, Eva Miranda (núm. 18).
- *Advanced Course on Global Riemannian Geometry: curvature and topology.* Editors: Vicent Palmer, Ximo Gual (núm. 19).
- *Advanced Course on Modular Forms and  $p$ -adic Hodge Theory.* Editors: Adolfo Quirós, Xavier Xarles (núm. 20).
- *Advanced Course on Proper Group Actions.* Editor: Carles Casacuberta (núm. 21).

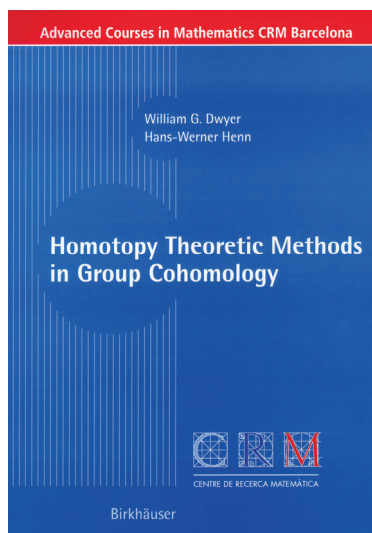
## 6 Advanced Courses in Mathematics, CRM Barcelona

Swiss publisher Birkhäuser-Verlag and the CRM have signed an agreement for the publication of the series *Advanced Courses in Mathematics, CRM Barcelona*, whose first volume came out last year.

These textbooks, in 24 x 17 cm format and with modest but high-quality printing and binding, 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 nec-

essary preliminaries, definitions and detailed proofs.

The first volume, published in October 2001, by W. G. Dwyer and H.-W. Henn, is entitled *Homotopy Theoretic Methods in Group Cohomology* and covers the material of the advanced course *Classifying spaces and cohomology of groups* taught by the authors at the CRM in the spring of 1998. The second volume, K. Brown and K. Goodearl's *Algebraic Quantum Groups*, is in press, while S. Markvorsen and M. Min-Oo's *Global Riemannian Geometry: curvature and topology* and G. Mislin and A. Valette's *Proper Group Actions* are in preparation.



## 7 Activities in Castelló de la Plana

In accordance with the collaboration agreement signed by the Universitat Jaume I and the Institut d'Estudis Catalans on the activities of the two institutions in the field of mathematical research, last year the first *Advanced Course* was given in Castelló de la Plana, organised by the CRM and the Mathematics Department of the Universitat Jaume I.

The course, *Global Riemannian Geometry: curvature and topology*, was coordinated by professor Vincent Palmer, and during a week

lectures were given by professors S. Markvorsen, M. Min-Oo, J. Lafontaine, J. Girbau, V. Miquel, S. Montiel, and L. Guijarro.

The Universitat Jaume I that has just celebrated the tenth anniversary of its founding, is located in the city of Castelló de la Plana, some 300 km from Barcelona and 70 from Valencia. It hosts a group of young mathematical researchers, principally in differential geometry and dynamical systems.

Participants to the course in Castelló

## 8 The EPDI

This year 2001 the CRM has, for the first time, taken part in the resolution of post-doctoral fellowships announced and awarded by the European Post-Doctoral Institute for the Mathematical Sciences (EPDI). After the candidates were selected, based on their applications and the reports by the specialists, two of them had selected the CRM as one of the institutes to carry out their post-doctoral research. Dr. Pierre Derbez, from the Université de Bourgogne joined the CRM in October 2001.

The EPDI is a network of European research institutes which awards every year a number of highly competitive post-doctoral grants. Created initially by the Institut des Hautes Études Scientifiques in Bures, the Max-Planck-Institut für Mathe-

matik in Bonn and the Isaac Newton Institute for the Mathematical Sciences in Cambridge, it currently consists of nine mathematics research institutes: the three above, the CRM, the Max-Planck-Institut für Mathematik in den Naturwissenschaften in Leipzig, the Institut Mittag-Leffler in Djursholm, the Banach Center in Warsaw, the Erwin Schrödinger Institut in Vienna and the Forschungsinstitut für Mathematik (FIM) in Zurich.

In October the EPDI invited applications for five two-year grants (2002–2004), offered to young European scientists who obtained their PhD in mathematics (pure or applied) or mathematical physics since 2000 or later.



<http://www.ihes.fr/IPDE/>

## 9 The Algebraic Topology Group

The *Barcelona Algebraic Topology Group*, headed by Jaume Aguadé, consists of 3 full university professors, 6 full-time lecturers, 5 doctors and 5 doctoral students. Most of them work at the Universitat Autònoma de Barcelona and at the Universitat de Barcelona, but there is also participation from the universities of Barcelona, Almería, Málaga and Granada. Last year, this group was designated a *Marie Curie training site* by the European Commission, one of only three such sites in Spain. It is a *Grup de Recerca Consolidat* of the CIRIT of Catalunya since 1995 and is part of the European research training network *Modern Homotopy Theory*, together with other groups from the universities of Aberdeen, Aarhus, Sheffield, Paris-Nord, Katholieke Leuven and the CNRS.

Since 1982 it has organised every 4 years the *Barcelona Confer-*

*ence on Algebraic Topology*, a series of conferences of worldwide reference, the proceedings of which have been published since 1986 in series of Springer or Birkhäuser Verlag. In July 2001, the younger members of the Algebraic Topology Group organised the *Barcelona 2001 EuroPhD Topology Conference* and in September the Euro Summer School *Proper Group Actions*. Both events received financial support from the European Commission. In 2002 the Group will organise the 6th edition of the *Barcelona Conference on Algebraic Topology*, which this year will celebrate its 20th anniversary, a remarkable event for this kind of activity.

The Group has several post-doctoral fellows, 5 in the year 2001, and from this year on it also takes on doctoral research students in algebraic topology programmes from several European universities.



<http://mat.uab.es/topalg/page.htm>

## 10 High-Level Scientific Conferences

The Centre de Recerca Matemàtica presented a total of 15 proposals of congresses and advanced courses in the three calls for applications of the European Community, in the framework of the *Increasing Human Research Potential* programme: 4 for the 1999 submission, 7 for the 2000 and 4 for the 2001. Three of the proposals of the 2001 were approved by the European Commission, meaning that, in a period of less than 3 years, from the summer of the year 2000 to that of 2002, the CRM will have organised 5 EuroConferences, 2 PhD EuroConferences and 7 Advanced Euro Summer Schools, as well as those which might be approved in the 2002 round. The following is a list of the events:

- *Barcelona 2001 EuroPhD Topology Conference: Homotopy Theory and Applications*
- *Advanced Course on Symplectic Geometry of Integrable Hamiltonian Systems*
- *Advanced Course on Global Riemannian Geometry: curvature and topology*
- *Advanced Course on Modular forms and p-adic Hodge Theory*
- *Combinatorics and Graph Theory: Algebraic, Algorithmic, Geometric and Probabilistic Aspects*
- *Advanced Course on Proper Group Actions*
- *Stochastic Inequalities and their Applications*
- *Advanced Course on Mathematical Finance: Further models*
- *2002 Barcelona Conference on Algebraic Topology*
- *Modular Curves and Abelian Varieties*
- *Advanced Course on Geometric 3-Manifolds*
- *PhD EuroConference on Complex Analysis and Holomorphic Dynamics*
- *The 6th Barcelona Logic Meeting*
- *Advanced Course on Algebraic Quantum Groups*





## 11 Ferran Sunyer i Balaguer Prize

The International Ferran Sunyer i Balaguer Prize was announced this year for the tenth time. This prize is awarded to a monograph which updates the progress in research in a mathematical area which has recently been developed. The prize consists of 10,000 euros and the winning monograph is published by Birkhäuser Verlag in the “Progress in Mathematics” series.

In the announcement of the year 2000, 11 monographs by authors from different countries were submitted. The Scientific Committee con-

sisting of Hyman Bass (University of Michigan), Pilar Bayer (Universitat de Barcelona), Antonio Córdoba (Universidad Autónoma de Madrid), Paul Malliavin (Université de Paris VI) and Alan Weinstein (University of California at Berkeley) recommended that the Foundation should award the prize to the monograph:

*The Symmetry Perspective*

from authors M. GOLUBITSKY (University of Houston) and I. STEWART (Warwick University). (Progress in Mathematics, n. 200).

## 12 Institutional awards

### 12.1 Visiting professors (MECyD, DURSI)

A. Alexandrov	01.01.01 – 31.10.01
A. Gulisashvili	01.06.01 – 25.07.01
M. Karonski	01.09.01 – 31.12.01
J. Nesetril	01.07.01 – 31.10.01
K. Phelps	01.09.01 – 31.12.01
A. Proskurowski	01.09.01 – 31.12.01
N. Yui	01.01.01 – 30.04.01

### 12.2 Marie Curie Individual Fellowships (EC)

A. Bodin	01.11.01 – 31.10.02
D. Chataur	01.11.01 – 31.10.03
M. Cuivilliez	01.01.01 – 31.12.02
F. X. Dehon	01.02.00 – 30.09.02
N. Dutertre	01.10.00 – 30.09.02
G. Swirszcz	01.11.01 – 31.10.02

### 12.3 Fellowships of the network *Modern Homotopy Theory* (EC)

K. Andersen	01.12.01 – 30.08.02
A. Descheemaker	01.01.01 – 31.09.02
F. Neumann	01.10.00 – 30.09.01

### 12.4 Agencia Española de Cooperación Internacional (AECI)

M. Sierakowski	23.10.00 – 31.07.01
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### 12.5 EPDI Fellowship

P. Derbez	01.10.01 – 30.09.02
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### 12.6 Marie Curie Training Site (EC)

B. Chorny	01.09.01 – 28.02.02
G. Collinet	01.10.01 – 31.01.02

## 12.7 Organisation of Conferences and Seminars

*Barcelona 2001 EuroPhD Topology Conference: Homotopy Theory and Applications* (ECE,<sup>1</sup> DURSI,<sup>2</sup> MCyT,<sup>3</sup> UAB<sup>4</sup>).

*Advanced Course on Symplectic Geometry of Integrable Hamiltonian Systems* (CE, DURSI, MCyT).

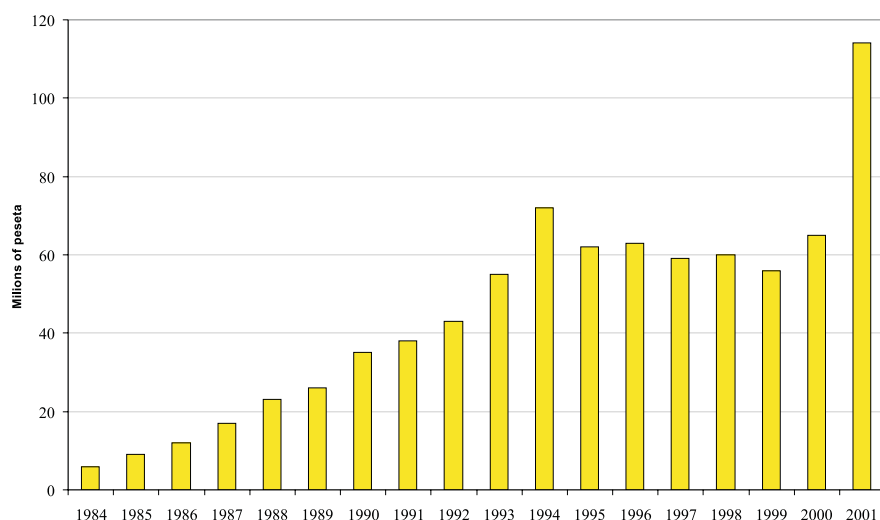
*Advanced Course on Global Riemannian Geometry: Curvature and Topology* (CE, MCyT).

*Advanced Course on Modular Forms and  $p$ -adic Hodge Theory* (CE, MCyT).

Semester on Combinatorics, Graph Theory and Applications (DURSI, UPC)<sup>5</sup>

*Combinatorics and Graph Theory: Algebraic, Algorithmic, Geometric and Probabilistic Aspects* (CE, MCyT)

*Advanced Course on Proper Group Actions* (CE, DURSI, MCyT, UPC)



Budget of the CRM

<sup>1</sup> European Commission

<sup>2</sup> Departament d'Universitats Recerca i Societat de la Informació.

<sup>3</sup> Ministerio de Ciencia y Tecnología.

<sup>4</sup> Universitat Autònoma de Barcelona

<sup>5</sup> Universitat Politècnica de Catalunya

## 13 Budget

### 13.1 Funding sources

	PTA	EUROS
DURSI (subsidy)	15.000.000	90.151,82
MECyD	9.150.000	54.992,61
MCyT	4.000.000	24.040,40
DURSI (applications)	8.950.000	53.790,58
EC	67.269.859	404.300,00
UAB (facilities)	3.500.000	21.035,42
UAB (activities)	830.000	4.988,40
UPC (activities)	760.000	4.567,69
Foundation FSB	2.000.000	12.020,24
Registration fees	2.725.052	16.377,89
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Total	114.184.911	686.265,05

### 13.2 Expenditure

	PTA	EUROS
Visitors	15.000.000	90.151,82
Post-Doctoral grants	32.601.340	195.938,00
Predocctoral grants	1.397.642	8.400,00
Conferences and Courses	27.430.895	164.863,00
Travels	1.620.000	9.736,40
Maintenance	3.500.000	21.035,42
Accommodation	6.998.179	42.059,90
Long-term material	2.200.000	13.222,27
Day-to-day material	1.345.170	8.084,63
Secretariat	10.650.333	64.009,79
Director	1.000.000	6.010,12
Publications	1.952.000	11.731,76
Miscellaneous	830.020	4.988,52
Remainder	7.659.332	46.033,51
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Total	114.184.911	686.265,05