



# **Center for Mathematical Analysis, Geometry, and Dynamical Systems**

## **Report 2002**

**April 2003**

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## 1. Research Report for 2002

### 1.1 *Distinguished Visitors*

The following researchers visited the Center in 2002:

- E. Aldrovandi, Florida State University, USA, 7-11.7 and 15-27.7.02.  
K. Andersen, Centre de Recerca Matemàtica, Barcelona, Spain, 16.1.02.  
I. Anderson, Utah State University, USA, 15-18.7.02.  
V. Araújo, Universidade do Porto, Portugal, 28.1-1.2.02.  
M. Audin, Institut de Recherche Mathématique Avancée, Strasbourg, France, 28-30.10.02.  
D. Auroux, Ecole Polytechnique, Paris, France, 7-12.12.02.  
F. Balibrea, Universidad de Murcia, Spain, 19-22.3.02.  
A. Batkai, Technische Universität Wien, Austria, 26.1-2.2.02.  
J. Burgos Gil, Universitat de Barcelona, Spain, 30.10-3.11.  
H. Bursztyn, MSRI, Berkeley, USA and Université Libre de Bruxelles, Belgium, 11-16.5.02.  
J. Coffey, Institut des Hautes Études Scientifiques, Bures-sur-Yvette, France, 26.10-2.11.02.  
P. Collet, Ecole Polytechnique, Palaiseau, France, 4-23.2.02.  
A. Corso, University of Kentucky, USA, 8-14.7.02.  
D. Costa, University of Nevada, Las Vegas, USA, 1-31.5.02.  
J. Dias, Universidade de Lisboa, Portugal, 15.1.02.  
P. Doutor, Universidade Nova de Lisboa, Lisbon, Portugal, 25.11.02.  
D. Evans, Cardiff University, UK, 29.3-14.4.02 and 4-10.12.02.  
V. Fedorenko, Institute of Mathematics, National Academy of Sciences of Ukraine, 7-11.9.02.  
B. Fiedler, Freie Universität Berlin, Germany, 10-22.3.02.  
P. Freitas, Universidade de Lisboa, Portugal, 16.4.02.  
H. Frid, IMPA, Rio de Janeiro, Brazil, 5.2.02.  
G. Fusco, Università degli Studi L'Aquila, Italy, 22-31.5.02.  
M. Gordon, Universidade da Madeira, Funchal, Portugal, 26.11.02.  
P. Gothen, Universidade do Porto, Portugal, 26.3.02.  
J. Greenberg, Office of Naval Research, USA, 3-6.11.02.  
M. Grinfeld, University of Strathclyde, Glasgow, UK, 3-16.1.02.  
M. Gyllenberg, University of Turku, Finland 17-22.10.02.  
S. Hayes, Technische Universität München, Germany, 15-20.11.02.  
C. Ingalls, University of New Brunswick, Canada, 11-16.5.02.

G. Janelidze, Georgian Academy of Sciences, Tbilisi, Georgia, 5.4-5.6.02.  
T. Kahl, Universidade do Minho, Braga, Portugal, 16-17.4.02.  
N. Kamran, McGill University, Canada, 15-17.7.02.  
M. Kobayashi, Instituto Superior Técnico, Lisbon, Portugal., 7 and 22.2.02.  
P. Lambrechts, Université Catholique de Louvain, Belgium, 18-19.10.02.  
R. Laureano, ISCTE, Lisboa, Portugal, 16.2.02.  
J. Lopes Dias, University of Cambridge, UK, 2.4.02.  
K. Mackenzie, University of Sheffield, UK, 6-14.1.02.  
E. Makover, Connecticut College, USA, 3-11.6.02.  
M. Mariño, Harvard University, USA, 26.7-3.8.02.  
C. Martin Edwards, The Queen's College, Oxford, UK, 10.4.02.  
G. Mikhalkin, University of Utah, USA, 23-27.11.02.  
J. Mendes, Universidade de Aveiro, Portugal, 15.10.02.  
C. Mira, TLSE-INSA, Toulouse, France, 28-31.5.02 and 31.8-1.9.02.  
D. Martinez, Universidad Carlos III de Madrid, Spain, 28.5.02.  
S. Moroianu, Universität Hamburg, Germany, 9-21.2.02.  
S. Mueller-Stach, University of Essen, Germany, 11-16.11.02.  
P. Negrini, Università di Roma La Sapienza, Italy, 24.5-3.6.02.  
J. Neunhäuserer, Technische Universität Clausthal, Germany, 16-30.3.02.  
P. Newstead, University of Liverpool, UK, 5-16.1.02.  
J. Nunes da Costa, Universidade de Coimbra, Portugal, 9.4.02.  
P. Olver, University of Minnesota, USA, 5-9.6.02.  
R. Pandharipande, Princeton University, 7-15.12.02.  
S. Paul, Columbia University, USA, 30.11-6.12.02.  
A. Pereira, Universidade de São Paulo, Brazil, 1-31.12.02.  
R. Shafikov, State University of New York, Stony Brook, 5-20.6.02.  
A. Sharkosky, Institute of Mathematics, National Academy of Sciences of Ukraine, 7-27.9.02.  
C. Silva, Universidade da Beira Interior, 28.10 and 4.11.02.  
J. Smítal, Silesian University, Opava, Czech Republic, 11-17.11.02.  
L. Snoha, Matej Bel University, Banská Bystrica, Slovakia, 19-22.3 and 7-8.9.02.  
B. Steinberg, Universidade do Porto, Portugal, 29.1.02.  
J. Tafel, Institute of Theoretical Physics, University of Warsaw, Poland, 8-13.9.02.  
G. Terra, Universidade de São Paulo, Brazil, 4.11-23.12.02.  
C. Valls, University of Chicago, USA, 30.9-12.10.02.

L. Vandembroucq, Universidade do Minho, Braga, Portugal, 16-17.4.02.  
 P. Vanhaecke, Université de Poitiers, France, 13-27.1.02  
 F. Van Oystaeyen, University of Antwerp, 28.10-3.11.02.  
 J. Vázquez, Universidad Autónoma de Madrid, Spain, 30.10-2.11.02.  
 M. Vergne, Ecole Polytechnique, Paris, France, 29.4-8.5.02.  
 R. Vilela Mendes, Universidade Técnica de Lisboa, Lisbon, Portugal, 21.5.02.  
 J. Wattis, University of Nottingham, UK, 8-19.7.02.  
 M. Wolfrum, WIAS, Berlin, Germany, 3-12.6.02.  
 S. Zarzuela, Universitat de Barcelona, Spain, 24.2-2.3.02.

## 1.2 *Seminars*

### ➤ *Mathematical Analysis, Geometry, and Dynamical Systems Seminar*

This is the main seminar of the Center. It included the following talks in 2002:

C. Rocha (Instituto Superior Técnico), Morse-Smale flows and order preserving semigroups, 17.12.02.  
 R. Pandharipande (Princeton University), Gromov-Witten theory and integrable systems, 10.12.02.  
 J. Greenberg (Office of Naval Research, EUA), Congestion on multilane highways, 3.12.02.  
 M. Gordon (Universidade da Madeira), Um novo espaço de ultradistribuições, 26.11.02.  
 S. Hayes (Technische Universität München), Detecting chaos using time series, 19.11.02.  
 J. Smítal (Silesian University, Opava), Various kinds of chaos in compact metric spaces: recent results and open problems, 12.11.02.  
 G. Del Magno (Centro de Análise Matemática, Geometria e Sistemas Dinâmicos), Hyperbolic billiards, 5.11.02.  
 J. I. Burgos Gil (Universitat de Barcelona), Arakelov theory of noncompact Shimura varieties, 31.10.02.  
 J. Coffey (Institut des Hautes Études Scientifiques, Bures-sur-Yvette), Spaces of positive sections, 29.10.02.  
 C. Wolf (Centro de Análise Matemática, Geometria e Sistemas Dinâmicos), Dynamics of polynomial diffeomorphisms of  $C^n$ , 22.10.02.  
 M. Gyllenberg (University of Turku), The inverse problem of linear age-structured population dynamics, 18.10.02.  
 J. Mendes (Universidade de Aveiro), Efeito do crescimento acelerado no crescimento de redes, 15.10.02.  
 C. Valls (University of Chicago), Stability near appropriate oscillations for some ill-posed partial differential equations, 8.10.02.  
 L. Barreira (Instituto Superior Técnico), Stability of differential equations and the forgotten Lyapunov, 1.10.02.  
 J. Pimentel Nunes (Instituto Superior Técnico), Analytic and geometric aspects of theta functions, 24.9.02.

- A. Sharkovsky (Institute of Mathematics, National Academy of Sciences of Ukraine), Ideal turbulence: definition and models, 17.9.02.
- V. Fedorenko (Institute of Mathematics, National Academy of Sciences of Ukraine), Dynamics of a class of multi-valued interval maps, 10.9.02.
- N. Kamran (McGill University), A multi-dimensional method of Laplace, with applications to hyperbolic systems rich in conservation laws, 16.7.02.
- I. Anderson (Utah State University), The variational bicomplex and its applications in differential geometry and the calculus of variations, 16.7.02.
- J. Wattis (University of Nottingham), The kinetics of vesicle formation, 11.7.02.
- J. Santos (Instituto Superior Técnico), Holomorphic bundles on blown up surfaces, 25.6.02.
- R. Shafikov (State University of New York, Stony Brook), Holomorphic equivalence of domains in  $C^n$ , 18.6.02.
- M. Wolfrum (Weierstrass Institute for Applied Analysis and Stochastics, Berlin), Heteroclinic connections and order structures for scalar parabolic PDE, 11.6.02.
- E. Makover (Connecticut College, EUA), Random construction of Riemann surfaces, 6.6.02.
- C. Mira (TLSE-INSA, Toulouse), Qualitative behavior of two-dimensional maps with a vanishing denominator, 29.5.02.
- P. Negrini (Università di Roma La Sapienza), Chaotic behaviour in the  $n$  center problem (negative energy levels), 28.5.02.
- G. Fusco (Università degli Studi L'Aquila), Crystalline energy as  $G$ -limit of a constrained perimeter functional, 28.5.02.
- R. Vilela Mendes (Universidade Técnica de Lisboa), Expoente de Lyapunov em mecânica clássica e quântica. Uma abordagem tomográfica, 21.5.02.
- R. Loja Fernandes (Instituto Superior Técnico), Integrability of Poisson brackets, 14.5.02.
- D. Costa (University of Nevada, Las Vegas), The jumping nonlinearity problem revisited, 7.5.02.
- R. Coutinho (Instituto Superior Técnico), Frentes em sistemas extensos de aplicações bi-estáveis acopladas via convoluções, 30.4.02.
- M. J. Borges (Instituto Superior Técnico), Homoclinic and heteroclinic solutions of a singular hamiltonian system, 23.4.02.
- P. J. Freitas (Universidade de Lisboa), The dynamics of the Siegel upper half plane, 16.4.02.
- D. Evans (Cardiff University), Modular invariants and subfactors, 9.4.02.
- J. Lopes Dias (University of Cambridge), Renormalisation of vector fields, 2.4.02.
- J. Neunhäuserer (Technische Universität Clausthal), A result on overlapping self-similar measures and its applications, 26.3.02.
- R. Hric (Centro de Análise Matemática, Geometria e Sistemas Dinâmicos), Topological characterization of minimal sets in one dimension, 21.3.02.
- F. Balibrea (Universidad de Murcia), On the periodic structure of delayed difference equations on  $I$  and  $S^1$ , 21.3.02.
- L. Snoha (Matej Bel University, Banská Bystrica), Topological entropy of Devaney chaotic maps, 21.3.02.
- B. Fiedler (Freie Universität Berlin), Global Sturm attractors with circle symmetry, 12.3.02.
- M. Perlmutter (Centro de Análise Matemática, Geometria e Sistemas Dinâmicos), Dual pairs and conformal Hamiltonian systems, 5.3.02.

- S. Moroianu (Universität Hamburg), Adiabatic limits of eta and zeta functions, 19.2.02.
- H. Frid (IMPA, Rio de Janeiro e Centro de Matemática e Aplicações Fundamentais), A quasilinear parabolic system for three-phase capillary flow in porous media, 5.2.02.
- V. Araújo (Universidade do Porto), Sobre hiperbolicidade uniforme em sistemas não uniformemente hiperbólicos, 31.1.02.
- A. Batkai (Technische Universität Wien), Hyperbolicity of delay equations and the effect of small delays, 29.1.02.
- P. Girão (Instituto Superior Técnico), A family of sharp inequalities for Sobolev functions, 22.1.02.
- J. P. Dias (Universidade de Lisboa), Existência e unicidade de soluções fracas para um sistema hiperbólico quasilinear com um termo de fonte singular, 15.1.02.
- K. Mackenzie (University of Sheffield), The duality of double structures, 10.1.02.

➤ *Geometria em Lisboa Seminar*

This is a joint seminar with CMAF-UL. It included the following talks in 2002:

- D. Auroux (Ecole Polytechnique), Branched coverings, Luttinger surgery and non-isotopy, 10.12.02.
- G. Mikhalkin (University of Utah), Toric surfaces, Gromov-Witten invariants and tropical algebraic geometry, 26.11.02.
- S. Mueller-Stach (University of Essen), Motivic geometry, 12.11.02.
- M. Audin (IRMA Strasbourg), A redução simpléctica e o problema do satélite, 29.10.02.
- R. Loja Fernandes (Instituto Superior Técnico), Linearizing actions and Poisson brackets, 15.10.02.
- E. Aldrovandi (Florida State University), On characteristic classes related to uniformization, 24.7.02.
- D. Martínez (Universidad Carlos III de Madrid), Odd dimensional almost complex geometry, 28.5.02.
- H. Bursztyn (MSRI and Université Libre de Bruxelles), Dirac geometry, 14.5.02.
- M. Vergne (Ecole Polytechnique), Arrangement of hyperplanes, and number of points in convex polytopes, 30.4.02.
- C. Florentino (Instituto Superior Técnico), Classical and non-Abelian theta functions and the heat equation on Lie groups, 23.4.02.
- J. Nunes da Costa (Universidade de Coimbra), Jacobi manifolds and Lie algebroids, 9.4.02.
- P. Gothen (Universidade do Porto), Homological algebra of quiver bundles, 26.3.02.
- A. Cannas da Silva (Instituto Superior Técnico), Fold-forms on four-folds, 12.3.02.
- P. Vanhaecke (Université de Poitiers), Integrable systems and projective embeddings, 22.1.02.
- P. Newstead (University of Liverpool), Coherent systems on algebraic curves, 8.1.02.

➤ *Algebra Seminar*

This is a joint seminar with CLC-IST. It included the following talks in 2002:

- S. Paul (Columbia University), Bott-Chern classes and generalised resultants, 4.12.02.
- F. Van Oystaeyen (University of Antwerp), Noncommutative topology and geometry, 31.10.02.
- P. Lambrechts (Université Catholique de Louvain), On the rational homotopy type of blow-up of submanifolds, 18.10.02.
- A. Corso (University of Kentucky), Hilbert-Samuel coefficients of normal ideals, 12.7.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 7, 3.6.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 6, 27.5.02.
- T. Kahl (Universidade do Minho, Braga), Introduction to rational homotopy theory, 22.5.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 5, 20.5.02.
- C. Ingalls (University of New Brunswick), Noncommutative surfaces, 15.5.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 4, 13.5.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 3, 6.5.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 2, 29.4.02.
- G. Janelidze (Georgian Academy of Sciences, Tbilisi), Course on category theory 1, 24.4.02.
- L. Vandembroucq (Universidade do Minho, Braga), Embeddings up to homotopy of a CW-complex in a sphere, 17.4.02.
- C. Martin Edwards (The Queen's College, Oxford, United Kingdom), The algebraic structure of bounded symmetric domains, 10.4.02.
- S. Zarzuela (Universitat de Barcelona), Arrangements of linear varieties, D-modules and local cohomology, 27.2.02.
- B. Steinberg (Universidade do Porto), Some semigroup theoretic techniques in topology, 29.1.02.
- K. Andersen (Centre de Recerca Matemàtica, Barcelona), The classification of  $p$ -compact groups for odd primes  $p$ , 16.1.02.

➤ *Mathematical Physics Seminar*

This is a working seminar. It included the following talks in 2002:

- D. Gomes (Instituto Superior Técnico), Perturbation theory for Hamilton-Jacobi equations and stability of Mather sets 2, 27.11.02.
- D. Gomes (Instituto Superior Técnico), Perturbation theory for Hamilton-Jacobi equations and stability of Mather sets 1, 20.11.02.
- J. Tafel (Institute of Theoretical Physics, University of Warsaw), Solutions of the Einstein equations with 2 Killing vectors, 10.10.02.
- M. Mariño (Harvard University), Counting strings with knots and links, 31.7.02.
- T. Requeijo (Instituto Superior Técnico), Diástase de Calabi em variedades tóricas, 18.7.02.
- J. Mourão (Instituto Superior Técnico), Mirror symmetry on toric hypersurfaces, 7.6.02.
- L. Godinho (Instituto Superior Técnico), Topology of toric manifolds, 10.5.02.



- J. Mourão (Instituto Superior Técnico), Path integral and mathematics: love or hate?, 3.5.02.  
 M. Abreu (Instituto Superior Técnico), Kähler metrics on symplectic toric manifolds, 2.5.02.  
 S. Anjos (Instituto Superior Técnico), Toric Manifolds from polytopes, 18.4.02.  
 P. F. dos Santos (Instituto Superior Técnico), Algebraic toric varieties, 4.4.02.  
 A. Cannas da Silva (Instituto Superior Técnico), Symplectic toric manifolds, 21.3.02.  
 M. Kobayashi (Instituto Superior Técnico), On the Birkhoff approach to mechanics 2, 21.2.02.  
 M. Kobayashi (Instituto Superior Técnico), On the Birkhoff approach to mechanics 1, 7.2.02.

➤ *Ergodic Theory and Dynamical Systems Seminar*

This is a working seminar. It included the following talks in 2002:

- R. Laureano (ISCTE), Cohomologia e teorema de Livschitz, 16.12.02.  
 B. Maia (Instituto Superior Técnico), Construção de medidas de Patterson-Sullivan, 9.12.02.  
 C. Wolf (Centro de Análise Matemática, Geometria e Sistemas Dinâmicos), Measures of maximal dimension for hyperbolic diffeomorphisms, 2.12.02.  
 P. Doutor (Universidade Nova de Lisboa), Análise multifractal e princípio variacional, 25.11.02.  
 L. Radu (Instituto Superior Técnico), Medidas invariantes em dimensão infinita, 18.11.02.  
 L. Barreira (Instituto Superior Técnico), Fluxos geodésicos: geometria e dinâmica, 11.11.02.  
 C. Silva (Universidade da Beira Interior), Construções geométricas e teoria de dimensão, 4.11.02.  
 C. Silva (Universidade da Beira Interior), Expoentes de Lyapunov e teorema ergódico multiplicativo, 28.10.02.  
 S. Guerra (Instituto Superior Técnico), Conjuntos hiperbólicos e regularidade de distribuições, 21.10.02.  
 V. Saraiva (Instituto Superior Técnico), Repulsores e teoria de dimensão, 14.10.02.  
 V. Saraiva (Instituto Superior Técnico), Pressão topológica e medidas de Gibbs, 7.10.02.

➤ *Colloquium*

This is the Colloquium of the Department of Mathematics of Instituto Superior Técnico, jointly supported with CEMAT-IST AND CLC-IST. It included the following talks in 2002:

- I. Spitkovsky (College of William and Mary, Williamsburg, VA), Beautiful and mysterious properties of the numerical range, old and recent, 18.12.02.  
 F. Van Oystaeyen (University of Antwerp), Mathematical methods of technology, 30.10.02.  
 P. J. Olver (University of Minnesota), Moving frames for pseudogroups, 6.6.02.  
 D. E. Evans (Cardiff University), Operator algebras and mathematical physics: from XY to ADE, 11.4.02.  
 I. Gohberg (Tel Aviv University), Orthogonal systems and convolution equations, 14.3.02.  
 P. Collet (École Polytechnique, Palaiseau), Concentration phenomena in dynamical systems, 14.2.02.

### 1.3 *Conferences and Short Courses*

The following Conferences and Short Courses at IST were sponsored by the Center in 2002:

- Conference Poisson 2002, 2-7.9.02.
- Lisbon Summer Lectures in Geometry, 8-11.7.02.

The following Conference outside IST was partially sponsored by the Center:

- European Conference in Iteration Theory, Évora, Portugal, 2-7.9.02.

Details on the programs can be found at the Center's webpage.

### 1.4 *Invited Talks*

M. Abreu,

- Matemática simpléctica: geometria vs topologia (plenary lecture), Encontro Nacional da Sociedade Portuguesa de Matemática, Universidade de Coimbra, Portugal, 5-8.2.02.
- Introduction to pseudo-holomorphic curves and applications (short course), Oberwolfach-Seminar on Symplectic Geometry, Mathematisches Forschungsinstitut Oberwolfach, Germany, 17-24.11.02.

L. Barreira,

- Distribution of frequencies of digits, Recent Trends in Dynamics III, Departamento de Matemática Pura, Universidade do Porto, Portugal, 6-10.5.02.
- Estabilidade de equações diferenciais e o trabalho esquecido de Lyapunov, Seminário de Análise Funcional, Equações Diferenciais e Análise Numérica, Universidade de Lisboa, Portugal, 12.12.02.

A. Cannas da Silva, Fold forms for four-folds, Geometry seminar, University of Geneva, Switzerland, 31.10-3.11.02.

R. Cordovil, A note on Tutte polynomials and Orlik-Solomon algebras, Workshop Latino-Americano de Cliques em Grafos, UFRJ, Rio de Janeiro, Brazil, 17-19.04.02

F. P. da Costa, A hierarchical cluster system based on Horton-Strahler rules for river networks. Division of Theoretical Mechanics, School of Mathematical Sciences, University of Nottingham, UK, 5.02.

P. F. dos Santos, Introdução às variedades tóricas, Universidade do Minho, Braga, Portugal, 8.5.02

R. Loja Fernandes, Integrability of Lie brackets, Université de Genève, Switzerland, 6.02.

P. Freitas,

- Invariant spectrum and geometry, Workshop Spectrum and Geometry, Instituto Mittag-Leffler, Djursholm, Sweden, 8.02.
- Memory driven instability in a diffusion process, Instituto Elie Cartan, Universidade de Nancy, France, 5.02.

D. Gomes,

- Stochastic Mather measures and second-order Hamilton-Jacobi equations, Advances in Calculus of Variations and PDE's, Scuola Normale Superiore di Pisa, Italy, 11.02.

- Truncated Linstead series and uniform approximation of viscosity solutions and Mather sets, Universita di Roma III, 11.02.
- A stochastic analog of Aubry-Mather theory and applications, Workshop on Nonlinear Models and Analysis, Erwin Schrödinger Institute, Viena, Austria, 5.02.
- Perturbations of Hamilton-Jacobi equations, University of California at Berkeley, 3.02.
- A stochastic analog of Aubry-Mather theory, University of Texas at Austin, 2.02.

G. Granja, Homotopy decomposition of a symplectomorphism group of  $S^2 \times S^2$ , University of Chicago Topology Seminar, Chicago, USA, 10.02

R. Hric, An introduction to dynamical zeta functions, 6<sup>th</sup> Czech-Slovak Workshop on Discrete Dynamical Systems, Praded, Czech Republic, 9-16.6.02.

J. Matias, On a volume constrained variational problem in  $SBV^2$ , EPFL-Lausanne, Switzerland, 4.02.

J. Nunes, Aspectos geométricos e analíticos das funções theta, Encontro Nacional da Sociedade Portuguesa de Matemática, Universidade de Coimbra, Portugal, 2.02 and Universidade do Minho, Braga, Portugal, 4.02.

C. Rocha,

- Morse-Smale flows and order preserving semigroups, Freie Universität Berlin, Germany, 23.11.02.
- Atratores de sistemas dinâmicos gerados por problemas de reacção-difusão singulares, Encontro Nacional da Sociedade Portuguesa de Matemática 2002, Universidade de Coimbra, Portugal, 5-8.2.02.

### 1.5 *Postdoctoral Program*

The Center started a postdoctoral program in the academic year 1998/99. Positions are for one year, with the possibility of extension for a second year upon mutual agreement. Applicants must have earned a Ph.D. in mathematics preferably within a 2 year period before the date of the opening of the position. To be selected an applicant must show very strong research promise in one of the areas in which the members of the Center are currently active. There are no teaching duties associated with these positions. They are announced internationally including in Notices and in the Data Base of the American Mathematical Society.

- Postdocs 02/03:
  - G. Del Magno, PhD in Mathematics, Georgia Institute of Technology, Atlanta, USA, 2002. Research areas: dynamical systems.
  - R. Hric, PhD in Mathematics, Comenius University, Bratislava, Slovakia, 1999. Support: FCT grant. Research areas: dynamical systems.
  - P. Monnier, PhD in Mathematics, University of Montpellier, France, 2001. Research areas: Poisson geometry, singularities.
  - M. Perlmutter, PhD in Mathematics, University of California, Berkeley, USA, 1999. Support: FCT grant. Research areas: geometric mechanics, symplectic and Poisson geometry, geometric integrators.
- Postdocs 01/02:
  - G. Farkas, PhD in Mathematics, Technical University of Budapest, Hungary, 2001. Support: Project FCT POCTI/32931/MAT/2000. Research areas: dynamical systems, numerical dynamics.

R. Hric, PhD in Mathematics, Comenius University, Bratislava, Slovakia, 1999. Research areas: dynamical systems.

C. Wolf, PhD in Mathematics, Technical University of Munich, Germany, 1999. Research areas: dynamical systems, dimension theory, ergodic theory, complex analysis.

M. Perlmutter, PhD in Mathematics, University of California, Berkeley, USA, 1999. Research areas: geometric mechanics, symplectic and Poisson geometry, geometric integrators.

- Postdocs 00/01:

H. Spielberg, Docteur en Mathématiques, Université Louis Pasteur, Strasbourg, France, 1999. Research areas: algebraic geometry, symplectic geometry and topology.

- Postdocs 99/00:

S. Anisov, PhD in Mathematics, Independent University of Moscow, Russia, 1998. Research Areas: singularities, geometry and topology.

Y. Koo, PhD in Mathematics, University of Minnesota, USA, 1998. Research Areas: partial differential equations, geometric measure theory.

B. Saussol, Doctor in Mathematics, Université de Toulon et du Var, France, 1998. Research Areas: dynamical systems, ergodic theory.

- Postdocs 98/99:

S. Lillywhite, PhD in Mathematics, University of Maryland, USA, 1998. Research Areas: differential and symplectic geometry and topology.

B. Saussol, Doctor in Mathematics, Université de Toulon et du Var, France, 1998. Research Areas: dynamical systems, ergodic theory.

## **1.6 Special Events**

For the fifth time, the Center was involved in the program “Ciência Viva nas Férias”, organized this year by the Department of Mathematics. This program is directed at students finishing the 11th grade of High school, and has the purpose of attracting towards Mathematics young students interested in Science and Technology. At the same time, it helps increasing the visibility of the Center among the junior population in the Lisbon area. During two weeks in July, 4 students were involved in a program entitled “Nós e os Nós”.

## **1.7 Publications in 2002**

### **1.7.1 Publications which appeared in 2002**

#### **Books**

L. Barreira and Ya. Pesin, Lyapunov Exponents and Smooth Ergodic Theory, University Lecture Series 23, Amer. Math. Soc., 2002.

A. Galves, J. K. Hale and C. Rocha (eds.), Differential Equations and Dynamical Systems, Fields Institute Communications, vol. 31, AMS, 2002.

J. K. Hale, L. Magalhães and W. Oliva, Dynamics in Infinite Dimensions, Applied Mathematical Sciences 47, Springer, 2002.

W. Oliva, Geometric Mechanics, Lecture Notes in Mathematics 1798, Springer, 2002.

### Chapters in books

- L. Barreira, Non-uniform hyperbolicity and invariant manifolds, section in Dynamics in Infinite Dimensions, J. K. Hale, L. Magalhães and W. Oliva, Applied Mathematical Sciences 47, Springer, 2002, pp. 123-127.
- D. Gomes, Viscosity solutions and Aubry-Mather theory, appendix in Geometric Mechanics. W. Oliva. Lecture Notes in Mathematics 1798, Springer, 2002, pp. 245-257.
- J. Natário, Möbius transformations and the Lorentz group, appendix in Geometric Mechanics. W. Oliva. Lecture Notes in Mathematics 1798, Springer, 2002, pp. 195-221.
- J. Natário, Quasi-Maxwell form of Einstein's equation, appendix in Geometric Mechanics. W. Oliva. Lecture Notes in Mathematics 1798, Springer, 2002, pp. 223-244.

### Articles in International Journals with referees

- M. Abreu and P. Freitas, On the invariant spectrum of  $S^1$ -invariant metrics on  $S^2$ , Proc. London Math. Soc. (3) 84 (2002), no. 1, 213-230.
- J. Almeida and L. Barreira, Hausdorff dimension in convex bornological spaces, J. Math. Anal. Appl. 268 (2002), 590-601.
- S. Anjos, Homotopy type of symplectomorphism groups of  $S^2 \times S^2$ , Geometry and Topology 6 (2002), 195-218.
- L. Barreira, Hyperbolicity and recurrence in dynamical systems: a survey of recent results, Resenhas IME-USP 5 (2002), 171-230.
- L. Barreira and B. Saussol, Product structure of Poincaré recurrence, Ergodic Theory Dynam. Systems 22 (2002), 33-61.
- L. Barreira, B. Saussol and J. Schmeling, Distribution of frequencies of digits via multifractal analysis, J. Number Theory 97 (2002), 410-438.
- L. Barreira, B. Saussol and J. Schmeling, Higher-dimensional multifractal analysis, J. Math. Pures Appl. 81 (2002), 67-91.
- A. C. Barroso and J. Matias, On a volume constrained variational problem in  $SBV^2(\Omega)$ : Part I ESAIM Control Optimization and Calculus of Variations 7 (2002), 223-237.
- J. Chabrowski and P. M. Girão, Symmetric solutions of the Neumann problem involving a critical Sobolev exponent, Topol. Methods Nonlinear Anal. 19 (2002), 1-27.
- R. Cordovil, A commutative algebra for oriented matroids, Discrete and Computational Geometry, 27 (2002), 73-84.
- F. P. da Costa, M. Grinfeld, J. Wattis, A hierarchical cluster system based on Horton-Strahler rules for river networks, Stud. Appl. Math. 109 (2002), 163-204.
- B. R. Duffy, P. Freitas and M. Grinfeld, Memory driven instability in a diffusion process, SIAM J. Math. Anal. 33 (2002), no. 5, 1090-1106.
- L. C. Evans and D. Gomes, Linear programming interpretations of Mather's variational principle, Control, Optimization and Calculus of Variations 8 (2002), 693-702.
- L. C. Evans and D. Gomes, Effective Hamiltonians and averaging for Hamiltonian dynamics II, Archives of Rational Mechanics and Analysis 161 (2002), 271-305.
- R. Loja Fernandes, Lie algebroids, holonomy and characteristic classes, Advances in Math. 170 (2002), 119-179.
- R. Loja Fernandes and P. Damianou, From the Toda lattice to the Volterra lattice and back, Reports on Math. Phys. 50 (2002), 361-378.

- J. M. Ferreira and A. M. Pedro, Oscillatory behaviour in functional differential systems of neutral type, *J. Math. Anal. Appl.* 269 (2002), 533-555.
- C. Florentino, J. Mourão and J. P. Nunes, Coherent state transforms and Abelian varieties, *J. Funct. Anal.* 192 (2002), 410-424.
- P. Freitas, Closed nodal lines and interior hot spots of the second eigenfunction of the Laplacian on surfaces, *Indiana Univ. Math. J.* 51 (2002), no. 2, 305-316.
- P. M. Girão, A sharp inequality for Sobolev functions, *C. R. Math. Acad. Sci. Paris* 334 (2002), 105-108.
- P. M. Girão and M. Ramos, Sign changing solutions for elliptic equations with critical growth in cylinder type domains, *ESAIM Control Optim. Calc. Var.* 7 (2002), 407-419.
- D. Gomes, Stability of Rotating Liquid Films, *Quart. J. Mech. Appl. Math.* 55 (2002), 327-343.
- D. Gomes, A stochastic analog of Aubry-Mather theory, *Nonlinearity* 15 (2002), 1-23.
- D. Gomes, Viscosity solutions of Hamilton-Jacobi equations, and asymptotics for Hamiltonian systems, *Journal of Calculus of Variations and Partial Differential Equations* 14 (2002), 345-357.
- J. Natário, Warp drive with zero expansion, *Classical Quantum Gravity* 19 (2002), 1157-1165.
- J. Natário, Linking and causality in (2+1)-dimensional static spacetimes, *Classical Quantum Gravity* 19 (2002), 3115-3126.
- L. Silva and J. Sousa Ramos, Topological invariants and renormalization of Lorenz maps, *Physica D*, 162 (2002) 233-243.
- C. Wolf, Hausdorff and topological dimension for polynomial automorphisms of  $C^2$ , *Ergod. Theory Dynam. Sys.* 22 (2002), 1313-1327.

#### **Communications in Proceedings with referees**

- J. F. Alves and J. Sousa Ramos, Total variations and semiconjugacy, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., *Fields Inst. Comm.* 31, Amer. Math. Soc., 2002, pp. 1-11.
- L. Barreira and B. Saussol, Variational principles for hyperbolic flows, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., *Fields Inst. Comm.* 31, Amer. Math. Soc., 2002, pp. 43-63.
- J. M. Ferreira, On the stability and oscillatory behavior of a retarded functional equation, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., *Fields Inst. Comm.* 31, Amer. Math. Soc., 2002, pp. 143-150.
- B. Fiedler, C. Rocha, D. Salazar and J. Solá-Morales, Dynamics of piecewise-autonomous bistable parabolic equations, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., *Fields Inst. Comm.* 31, Amer. Math. Soc., 2002, pp. 151-164.
- J. Buescu, F. Garcia and I. Lourtie, Local stationarity of  $L^2(\mathbb{R})$  processes. *IEEE International Conference on Acoustic and Signal Processing 2002, Proceedings*, 2002, vol. II, pp. 1221-1224.
- N. Martins and J. Sousa Ramos, Cuntz-Krieger algebras arising from linear mod one transformations, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., *Fields Inst. Comm.* 31, Amer. Math. Soc., 2002, pp. 265-273.
- M. Rodríguez-Olmos and M. E. Sousa Dias, Symmetries of relative equilibria for simple mechanical systems, in *Symmetry and Perturbation Theory SPT 20002*, S. Abenda, G. Garta and S. Waldrek Eds, World Scientific, 2002, pp. 221-230.
- R. Severino and J. Sousa Ramos, Symbolic dynamics in nonlinear boundary value problems, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., *Fields Inst. Comm.* 31, Amer. Math. Soc., 2002, pp. 325-331.

L. Silva and J. Sousa Ramos, A genealogy for kneading sequences of two-piecewise monotonous maps of the interval, in *Differential Equations and Dynamical Systems*, A. Galves, J. Hale and C. Rocha Eds., Fields Inst. Comm. 31, Amer. Math. Soc., 2002, pp. 333-35.

### 1.7.2 Publications accepted in 2002

#### Books

R. Loja Fernandes and M. Ricou, *Introdução à Álgebra*, to appear in IST Press.

#### Articles in International Journals with referees

F. Balibrea, R. Hric and L. Snoha: Minimal sets on graphs and dendrites, to appear in *Internat. J. Bifur. Chaos Appl. Sci. Engrg.*.

L. Barreira and C. Wolf, Measures of maximal dimension for hyperbolic diffeomorphisms, preprint, to appear in *Comm. Math. Phys.*.

A. Cannas da Silva, Symplectic toric manifolds, to appear in the Birkhäuser series *Advanced Courses in Mathematics - CRM Barcelona*.

J. Canovas and R. Hric: Distributional chaos of tree maps, to appear in *Topology Appl.*.

R. Cordovil and D. Forge, Quadratic Orlik-Solomon algebras of graphic matróides, to appear in *Matemática Contemporânea*.

M. Crainic and R. Loja Fernandes, Integrability of Lie brackets, to appear in *Ann. of Math.*.

G. Del Magno and R. Makarian, Bernoulli Elliptical Stadia, to appear in *Comm. Math. Phys.*.

P. F. dos Santos, Algebraic cycles on real varieties and  $\mathbb{Z}/2$ -equivariant homotopy theory, to appear in *Proc. London Math. Soc.*.

P. F. dos Santos, A note on the equivariant Dold-Thom theorem, to appear in *J. Pure Appl. Alg.*.

R. Loja Fernandes, Invariants of Lie algebroids, to appear in *Differential Geometry and its Applications*.

C. Florentino, J. Mourão and J. P Nunes, Coherent state transforms and vector bundles on elliptic curves, to appear in *J. Funct. Anal.*.

D. Gomes, Perturbation theory for Hamilton-Jacobi equations and stability of Aubry-Mather sets, to appear in *SIAM J. Math. Analysis*.

D. Gomes, Regularity theory for Hamilton-Jacobi equations, to appear in *J. Differential Equations*.

N. Martins, R. Severino and J. Sousa Ramos,  $K_0$ -groups for Cuntz-Krieger algebras arising from real quadratic maps, to appear in *International Journal of Mathematics and Mathematical Sciences*.

J. Natário and P. Tod, Linking, Legendrian linking and causality, to appear in *Proc. London Math. Soc.*.

R. Shafikov and C. Wolf, Filtrations, hyperbolicity and dimension for polynomial automorphisms of  $\mathbb{C}^n$ , to appear in *Michigan Math. J.*.

C. Wolf, On measures of maximal and full dimension for polynomial automorphisms of  $\mathbb{C}^2$ , to appear in *Trans. Amer. Math. Soc.*.