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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **TIKHONOV , SERGEY** **Referencia:** RYC-2011-09302

Area: Matemáticas

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Titulo:

Weighted inequalities in harmonic analysis and approximation theory

Resumen de la Memoria:

This project is devoted to certain aspects of harmonic analysis and approximation theory. Our goal is to study different types of inequalities with weights and prove their sharpness. We study norm inequalities for integral operators, polynomial inequalities, inequalities for moduli of smoothness and K-functionals, and their applications in many different areas of mathematics: Fourier analysis, Constructive Approximation, Theory of Function Spaces, InterpolationTheory, Extremal Problems. The research involved in the project will contain new concepts, new results and also develop new methodology and techniques for obtaining these results. The project includes seven different topics. We study the strong type inequalities of the general integral operators with an emphasis on the Fourier transform type operators (1. Optimal Pitt's inequalities, 2. Two-sided weighted inequalities, 3. Sharp Pitt-type inequalities, 4. Convolution inequalities). Also, we investigate inequalities from approximation theory (5. Sharp Remez and Nikolskii inequalities, 6. Weighted Bernstein inequality, 7. Inequalities related to moduli of smoothness/K-functionals). We also discuss the applications of these problems to functional analysis (interpolation theory, embedding theorems of function spaces), and extremal problems (quadrature formulas, the Delsarte problems). We believe that successful solution of the problems proposed in our project will lead to the development of known and, more importantly, new areas in Fourier analysis and constructive approximation.First of all, this project deals with key problems in harmonic and functional analysis and approximation and their solutions will contribute a lot to the development of these research areas. Particularly, the solution of problems 1, 2, the classification of integral operators in terms of their boundedness properties will provide a powerful tool for further analysis of operators and many related questions. Next, the Fourier inequalities will lead to new results for theuncertainty principle and restriction theory. Also, new uncertainty principle relations will follow from 3, 5, namely, sharp Pitt-type inequalities for Fourier-type transforms and Remez-type inequalities for polynomials, which are usually considered as an approximation theory tool. Further, the norm inequalities for such important operator as convolution 4 can be fruitfully used in functional analysis. Finally, problems 7 on inequalities for moduli of smoothness will giveup-to-date methods to prove new embedding theorems for function spaces. Second, this project lies at the intersection of harmonic analysis and approximation theory. Compared to prior research, we are going to use not only known techniques from both areas, but several new ideas coming from newly introduced concepts (net spaces, general monotonicity) and techniques (net spaces' technique, new quadrature formulas, inequalities with regular weights). The novelty of our approach is also in using the methods of both harmonic analysis and approximation theory simultaneously, in contrast with previous research where usually only the methods of the research field itself were used. This gives us significant advantages in solving the problems of both research areas compared to traditionally used methods. In this way, this project is novel in its methodology part.

Resumen del Curriculum Vitae:

My research over the last 10 years has focused in the broad areas of Approximation theory and Functional analysis. After graduating with Diploma summa cum laude from Moscow State University in 1999, I became a graduate student in MSU. My PhD thesis (defended in Feb. 2003) concerns the description of moduli of smoothness of fractional order, embedding theorems of function spaces, and Fourier coefficients criteria. After obtaining my PhD degree, I was invited as a visiting professor to conduct joint research project with Z. Ditzian (Un. of Alberta) and D. Jakobson (McGill Un). The project dealt with various problems on measure of smoothness of a function with results published in J-l of Approx.Th.(JAT). In 2004, I started as a Marie Curie Fellow in Centre de Recerca Matematica(CRM), being awarded a 2-year Marie Curie postdoctoral Fellowship to conduct research on the topic Lipschitz classes, Fourier series, and moduli of smoothness. During my two-year period in CRM I fully solved the problem of describing the generalized Lipschitz spaces and Nikolskii spaces in terms of the behaviour of function's Fourier transforms, thereby extending the results obtained in my PhD dissertation. Also, I introduced the concept of general monotonicity that turned out to be very useful in many problems in harmonic analysis. In particular, this concept allows to solve the problem on the coefficients criteria of convergence of trigonometric series in Lp, Lorentz spaces, and Besov-Nikolskii spaces. These results were presented at several known seminars including the talks I gave in Princeton University and Isaac Newton Institute in Cambridge, and published in the JMAA(2007, 2008) and JAT(2008). Further, in a joint work with F. Dai and Z. Ditzian, I proved sharp inequalities for moduli of smoothness of different orders in one metrics, a long-standing problem in approximation. These results have recently been published in JAT (2008).During my postdoc period 2006-2008 in Scuola Normale Superiore (Pisa) working under supervision of Prof. F. Ricci, I concentrated my research on the boundedness of the integral operators in the Lorentz spaces. Jointly with E. Nursultanov, I introduced the concept of net spaces, which generalizes the Lorentz spaces, with the results published in J-l of Geom. Analysis. Further, I obtained sharp inequalities for moduli of smoothness in different metrics, a problem that has a great importance because of its connections with the embedding theorems of function spaces (JAT, JFAA 2010). I started as ICREA researcher in CRM in 2008. My latest work includes the topics on weighted Fourier inequalities (JMAA, JdAnalM). In 2009, I have been awarded the prize from International Society for Analysis, its Application and Computation (ISAAC) given for a young outstanding researcher under 40 years old. Currently, as a team leader for Approximation theory and Harmonic Analysis group in CRM. Since 2008, I have acted as an active host researcher inviting external visitors from Canada, Europe, Israel, Kazakhstan, Russia, USA for short to medium stays in CRM to conduct joint work. I am also a principal organizer of 6-months Research program ``Approximation Theory and Fourier Analysis" in CRM, taking place in Sept. 2011-Feb. 2012.

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **NAGY , PAUL ANDI** **Referencia:** RYC-2011-09470

Area: Matemáticas

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Titulo:

Einstein metrics, almost Hermitian geometry and conformal foliations

Resumen de la Memoria:

Broadly the aim is to study geometries and natural differential equations that are important for a range of problems in mathematics and mathematical physics. Many of the differential equations controlling symmetry and geometric structure, are overdetermined PDE. Similarly the equations controlling fields in physics and engineering are often of this type. These equations can often be replaced by an equivalent first order system, that involves more variables and a preferred connection with torsion but which is simpler and, in particular, has desirable geometric and algebraic properties. The exploitation of this point of view is a unifying idea in all strands of the proposal.Strict (non-K\"ahler) nearly K\"ahler structures (NK in shorthand) in dimension 6 have many properties similar to those of Calabi-Yau manifolds. They carry a non-integrable half-flat SU(3)-structure and also an Einstein metric with positive scalar curvature. The higher dimensional case has been thoroughly treated in work of Nagy. In dimension 6 the infinitesimal deformation space of NK-structures has been computed in joint work of Nagy and collaborators; one aim of this research proposal is to determine the obstruction to deformation space. This is governed by a canonical fourth order differential operator and a key step is to deal with the non-linear terms it contains. An immediate outcome here is solving the deformation problem for the flag manifold F(1,2).Adjacent proposed research consists in classifying Kaehler surfaces with constant eigenvalues of the Ricci tensor. Studied in a purely Kaehler context by Apostolov and al. they also appear in the nearly-Kaehler reduction procedure described by Moroianu, Nagy and Semmelmann. Work by diScala and Nagy suggests that techniques from submanifold theory relating to isoparametric surfaces should be used. In higher dimensions the aim is to study nearly-Kaehler Weyl(NKW) structures, which constitute the Weyl analogue of NK-geometry; important sub-classes are constituted by NK and locally conformally Kaehler structures. The closure of the differential system of constraints has been explored recently by Nagy; an immediate goal in order to obtain structure results, is to interpret geometrically these constraints in terms of the canonical connection(with torsion) present in the NKW set-up. Foliated structures and possible additional symmetries are expected to be read off the structure of its holonomy algebra. This programme is expected to lead to the classification of complex homothetic foliations on Kaehler manifolds; it has been recently completed for foliations by complex curves in work by Chiossi and Nagy where symplectic and complex techniques were combined to produce large classes of new examples.

Resumen del Curriculum Vitae:

Licenciado en Matemáticas por la Escuela Normal Superior de Lyon (Francia) en julio de 1995 y DEA de Matemáticas por la Escuela Normal Superior de Lyon y la Universidad Claude Bernard Lyon 1 (Francia) en septiembre de 1995, con la tesis titulada "Métricas con spinores armónicos". Doctor en Matemáticas por la Universidad de Savoie (Francia) en julio de 2001 con la tesis titulada "Un principio de separación de variables para el espectro del Laplaciano de formas diferenciables y aplicaciones". Ha superado la Habilitationsschrift alemana (similar a la Acreditación Nacional española) en la Universidad de Hamburgo (Alemania) con el titulo de "Torsión y curvatura en geometría casi-Kählera". Ha sido Profesor Temporal en el Departamento de Matemáticas de la Universidad de Avignon (Francia) durante 1 año, Profesor en el Instituto de Matemáticas de la Universidad de Neuchatel (Suiza) durante 3 años, Becario Posdoctoral en el Instituto de Matemáticas de la Universidad Humboldt de Berlin (Alemania) durante 2 años, e Investigador en el Departamento de Matemáticas de la Universidad de Auckland (Nueva Zelanda) durante 4 años. En la actualidad es Profesor en la Universidad Ernst-Moritz-Arndt de Greifswald (Alemania). Es autor de 14 artículos de investigación en revistas y publicaciones especializadas de prestigio y de alto factor de impacto, con 58 citas a sus trabajos en MatSciNet, destacando 1 artículo con 19 citas y otro con 14 citas. Ha participado en numerosos congresos, impartiendo conferencias, así como en numerosos seminarios de investigación. Ha dirigido 1 tesis doctoral (defendida en 2009) como director principal y en la actualidad está co-dirigiendo otra. Ha participado en diversoso proyectos de investigación, organizado conferencias y seminarios, y tiene experiencia docente a nivel de grado y de posgrado.

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **RODRIGUEZ PEREZ, MARIA MAGDALENA** **Referencia:** RYC-2011-09555

Area: Matemáticas

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Titulo:

Minimal and mean curvature surfaces

Resumen de la Memoria:

My research is included in the field of Geometric Analysis. Although the term "Geometric Analysis" was first used by Neobius in the nineteenth century, it has been quite recently when it has become a discipline independent of Mathematical Analysis and Geometry, with the help of Schoen and Yau, mainly. The proof by Perelman of Poincare's Conjecture using methods from Geometric Analysis has pointed out the importance of this field. This fact can be seen in the increasing number of quality works that appear almost daily in ArXiv database. In particular, the research lines I propose below focus on the study of minimal and constant mean curvature (CMC) surfaces in homogeneous 3-manifolds. This subject has a clear relevance, and there are many important researchers working in this field. I summarize here the main problems I would like to propose:1.Study of moduli spaces of properly embedded minimal surfaces with prescribed finite topology in complete flat 3-manifolds.2.Solve the Dirichlet problem for the equation of minimal and CMC Killing graphs in homogeneous 3-manifolds, with possibly infinite boundary values.3.Classification of complete minimal surfaces with prescribed finite total curvature in H2xR.4.Determine the homogeneous 3-manifolds N and the values of H for which it is possible to construct a complete surface in N with CMC H, genus zero and any number (possibly non-countable) of ends.5.Alexandrov Theorem in Heisenberg space Nil3: the only compact embedded CMC surfaces in Nil3 are the rotational spheres.6.Proof of the following conjecture: There are no complete stable surfaces with CMC H>1/2 in H2xR ; and its generalization to other homogeneous spaces.7.Construction of examples and study of the structure and geometry of properly embedded periodic minimal and CMC surfaces in homogeneous 3-manifolds.8.Construction of minimal and CMC surfaces in metric Lie groups.

Resumen del Curriculum Vitae:

I obtained my PhD in 2005 at the University of Granada, with Joaquín Pérez as advisor. While completing my PhD, I spent some periods at the University of Massachusetts, the University of Marné-la-Vallée, the University Paris 7 and the University François Rabelais (Tours).In 2006 I was awarded a one year postdoctoral grant in the University of Marne-la-Vallée.From 2007 to 2010 I had a teaching position at the Complutense University of Madrid. During this period I spent some periods at the Institute of Mathematics of Jussieu (Paris), at the University of Granada and at IMPA (Brazil).From February 2010 on, I have been enjoying a ¿Juan de la Cierva¿ postdoctoral grant at the University of Granada.I have 11 published/acepted papers, 7 of them in the first quarter of the JCR ranking ; 3 proceedings; and 5 preprints.I have participated in 14 research project, being main researcher of one of them (recently accepted).I have been invited to participate in several iternational meetings in USA, Brazil, France, Germany and Spain.I have been referee for important mathematical journals such as American Journal of Mathematics, Transactions of the AMS or Crelle's Journal.

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **KOROBEINIKOV , ANDREI** **Referencia:** RYC-2011-08061

Area: Matemáticas

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Titulo:

Emergence and spread of plant pathogens; their impact and control

Resumen de la Memoria:

Emerging pathogens are a constant threat to the humans and a burden on global economies. Pathogens are emerging at an alarming rate: 335 infectious diseases of humans emerged between 1940 and 2004; numbers of the emerged livestock infections and plant pathogens are considerably higher. The emergence of pathogens is driven largely by socio-economics, environmental and ecological factors. Thus, the climate change promotes emergence of new pathogens and leads to expansion of the traditional areas and habitats of their animal and plants carriers (invertebrates in particularly), encouraging invasions of the existing pathogens and pests into the regions that are currently free of them. Possible consequences of an invasion may be devastating for society and economy. While the humans might be considered to be reasonably well protected, the livestock and in particularly domesticated plants are virtually defenseless. This situation is particularly alarming as the horticulture remains to be the basis of the economy. Furthermore, introducing an animal species into a biosystem is also a potential threat, as, apart from the fact that the invader can damage the environment and agriculture, it also may serve as a carrier, a reservoir or a vector for a pathogen.There is growing public concern about the uncontrollable spread of artificially modified genes (GM-genes) escaping from the domestic stock (fish farms, plants, etc.). This problem can be viewed and treated as an invasion as well, and thus it is closely linked to the problem of invasion of a pathogen: both these problems can be mathematically addressed in a similar way.The objective of this research programme is to study the biological invasion mathematically, with a particular focus at the invasion of pathogens of domesticated (agricultural) plants. The ultimate goal is developing bio-rational intervention strategies that can achieve the objectives (protection of crop, elimination of a pest, etc.) sooner and at lower costs. Understanding the dynamics of an invader is the key to designing more effective intervention policies for possible outbreaks. It is obvious that the best possible intervention strategy is reversing the conditions that are necessary for persistence of an invader and creating the conditions that lead to its disappearance; therefore during this research project we will particularly concentrate on the conditions for persistence and disappearance. Since the particular properties of a pathogen are hardly known in detail, and are simply unknown in advance, we plan to formulate, consider and examine a hierarchy of mathematical models (in the form of partial and ordinary differential equations), which are as general as possible. The spread of plants' pathogens possesses a large scientific challenge, as the spatial aspect is crucial for this particular problem. Despite of its economical significance, this problem so far attracted less attention of mathematicians that it deserves. The methods and results of this project can be applicable for problems such as dynamics of a micro-parasite, immune response, plankton dynamics and pest control.

Resumen del Curriculum Vitae:

PhD in Mathematics, Sept. 2001, University of AucklandMSc in Engineering Physics, Jan. 1987, Tomsk State University, RussiaGrants and awards:2005-2007, Japan Society for the Promotion of Science, Project 17540099, Mathematical Exploring of Host-Microparasite Interaction and Immune Response, JPY 3,300,000 2004-2007, Hokkaido University, JPY 1,500,000 2002-2004 Research Fellowship of the New Zealand Foundation for Research, Science and Technology, BP 100,000.Employments: Since 02/04/07 Senior Research Fellow, Mathematics Applications Consortium for Science and Industry (MACSI), University of Limerick, Ireland02/10/04-30/03/07 Associate Professor, Research Institute for Electronic Science, Hokkaido University, Japan01/02/02-30/09/04 NZ FRST Post-Doctoral Research Fellow, Centre for Mathematical Biology, University of Oxford01/01/01-31/12/01 Research Fellow, Peter Read Consultancy Ltd., New Zealand2001 Lecturer, Department of Mathematics, University of Auckland1997-2001 Tutor, Department of Mathematics, University of Auckland1994-1995 Consultant, MegaConcept Consultancy Ltd., Tomsk branch, Russia1992-1996 Lecturer, Department of Physics-and-Technology, Tomsk State University1987-1992 Research Fellow, Institute of Applied Mathematics and Mechanics, Tomsk State University1984-1986 Programmer, Institute of Applied Mathematics and Mechanics, Tomsk State UniversityMembership of societies: SIAM (from 1997), ANZIAM (2000-2002), NZMS (1997-2002)Publications: 54 peer-refereed publications, incl. 7 chapters in books,33 publications in peer-refereed journals, 14 publications in peer-reviewed conference proceedings,16 research reports prepared for industrial enterprises.My H-index is 8 (by ISI Web of Science), about 100 citings in 2010. Editorials: A member of Editorial Board of Journal of Nonlinear Systems and Applications (JNSA)Reviewer for a dozen of international journalsMSc students supervision: 12 PhD projects where I participate as an advisor:Ms Suzanne O'Regan (2008-2010), Mr Jaime Rojas (2007-2010), Mr Roman Sedakov (from 2009)Current projects:Biosecurity, ecoepidemiology and ecotoxicology. Host-pathogen interaction. Invasion of emerging pathogenes. Control of infectious diseases. Stability and sustainability of marine and terrestrial ecosystems Waste water bio-treatment.Main Publications:A. Korobeinikov, Stability of ecosystem: Global properties of a general prey-predator model. Math. Med. Biol. 26, 309-321. A. Korobeinikov, Global asymptotic properties of virus dynamics models with dose dependent parasite reproduction and virulence, and nonlinear incidence rate, Math. Med. Biol. 26, 225-239. A. Korobeinikov, J. Norbury and G.C. Wake, Long-term coexistence for a competitive system of spatially varying reaction-diffusion equations, Nonlinear Analysis B 10, 93-103.S. Iwami, Y. Takeuchi, A. Korobeinikov and X. Liu, Prevention of avian influenza epidemic: What policy should we choose? J. Theor. Biol. 252, 732-741.A. Korobeinikov, Global properties of infectious disease models with non-linear incidence, Bull. Math. Biol. 69, 1871-1886.A. Korobeinikov, Global properties of basic virus dynamics models, Bull. Math. Biol. 66, 879-883.A. Korobeinikov, P.K. Maini and W.J. Walker, Estimation of effective vaccination rate: pertussis in New Zealand as a case study, J. Theor. Biol. 224, 269-275.

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **CAUBERGH CAUBERGH, MAGDALENA** **Referencia:** RYC-2011-07730

Area: Matemáticas

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Titulo:

Qualitative theory of differential equations: Topological and Analytic Geometry of Periodic Orbits

Resumen de la Memoria:

My most relevant research lines relate to the Qualitative Theory of Differential Equations which is a nice application of Global Analysis, Geometry, Algebra and Topology. Attention goes to Topological and Analytical Geometry of Periodic Orbits. The precise description of periodic solutions of differential equations is in general a highly nontrivial problem; e.g., there is no analytic algorithm to trace periodic orbits neither to decide whether a given point belongs to a periodic orbit.The specific research lines that I plan to develop in the future are a natural continuation of the current research and can briefly be listed as1. Bifurcation phenomena of limit cycles.a. Alien limit cycles (not controlled by Abelian integral).b. Small and Medium Amplitude limit cyclesc. Large amplitude limit cycles.2. Mechanism for centers.3. Slow-fast systems.4. Application to Neuroscience.5. Weierstrass Preparation Theorem for regular non-smooth functions.These lines all are mutually related and are of interdisciplinary nature as is shown by the techniques used in obtaining previous results in this context. The approach is both theoretical and practical of nature keeping in mind to provide with results that can be used in concrete situations and that reduce the necessary calculations to a minimum. The subjects under study are motivated by classical mathematical problems as well as applications such as Mathematical Biology, Neuroscience, Medicine, Engineering, Technology and Industry.To end, I want to stress on the competence that I developed during my academic career up to now and that will be useful in the next stage of this career. During my postdoctoral position at Universitat Autònoma de Barcelona (UAB) I showed to be open minded for new research lines and different approaches to problems and to have the capacity to adapt myself easily in a new research environment, to start new collaborations with different members of the group and to collaborate in the overall responsibilities of the group (e.g., organizing weekly seminar and teaching PhD course of Dynamical Systems). I have a broad interest in Mathematics and I am interested to learn from other experts, to interchange ideas with them and to take new directions or approaches to a problem. For instance during a 1-month stay at UBourgogne I learned from a local specialist about Analytic Geometry and it enabled me to reduce the dimension of a multi-parameter problem in Dynamical Systems to 1 (Comptes Rendus de l¿Académie des Sciences, 2001). The interchange of different approaches and techniques at the UAB has lead to 2 publications in J. of Mathematical Analysis and Applications (2010) and International J. of Bifurcation and Chaos (2011) and 3 works in progress in collaboration with A. Gasull, J. Llibre and J. Torregrosa.Also after obtaining the PhD-title my interest remains to learn new techniques, e.g. by attending Intensive Course Schools, autonomous study or by communications with other experts. For instance a progress to Hilbert¿s 16th Problem for Liénard equations was made by the analysis of ¿large amplitude limit cycles¿ that required besides previous experience on limit cycle bifurcations a Poincaré-Lyapunov compactification of the phase space and the use of specific normal forms near semi-hyperbolic saddles (J. Differential Equations, 2008).

Resumen del Curriculum Vitae:

CURRENT POSITION: 3-year postdoctoral research fellowship at UAB (Universitat Autònoma de Barcelona) in program Juan de la Cierva (first ranked for MTM), starting Sept. 2008 and supervised by J. Llibre. DEGREE STUDIES: Degree in Mathematics at UAntwerp (Belgium), July 1998. PhD: Research Assistant at Department Mathematics of UHasselt (Belgium), Research group Dynamical Systems and Course group Pure Mathematics; Doctoral training at UAntwerp (1998-2004); PhD in Mathematics at UHasselt with director F. Dumortier (UHasselt) and co-director R. Roussarie (UBourgogne), 13/09/2004. POSTDOC 1: Postdoctoral Research Assistant at UHasselt (September 2004-August 2005, supervised by F. Dumortier). POSTDOC 2: Postdoctoral Research Fellowship at UHasselt funded by European Regional Development Fund (Sept. 2005-Aug. 2007, supervised by F. Dumortier). POSTDOC 3: Postdoctoral Research Fellowship at UAB in program Beatriu de Pinós (September 2007-August 2008, supervised by A. Gasull). RESEARCH PROJECTS: Participation in 5 projects during my pre-doctoral phase: 1 funded by the European Union, 1 by the European Science Foundation and 3 other ones by the Fund for Scientific Research Flanders. Participation in 5 projects during my postdoctoral phase: 1 funded by the Fund for Scientific Research Flanders, 2 by the Ministerio de Ciencia e Innovación, another 2 by the Generalitat de Catalunya. PUBLICATIONS: I obtained several results in the domain of Dynamical Systems and Analytic Geometry, using techniques from Global Analysis, Geometry, Algebra and Topology. I have 14 publications in international journals in Mathematics and Applied Mathematics, 11 of them in JCR journals including Journal of Differential Equations, Journal of Mathematical Analysis and Applications, Discrete and Continuous Dynamical Systems, A and Communications on Pure and Applied Analysis (all in the first quartile); furthermore 1 book chapter in Mathematics and 1 publication in Industrial Mathematics. I have 15 co-authors, 9 of which regarding to results on Dynamical Systems. RESEARCH STAYS: BELGIUM, 6-year pre- (and 3-year post-) doctoral stay at UHasselt; 1 postdoctoral visit at UHasselt; SPAIN, 3 postdoctoral visits at UAB, 3.5-year postdoctoral stay at UAB, 1 postdoctoral visit at ULleida; FRANCE, 4 pre-doctoral and 1 postdoctoral visits one of which of 1-month at UBourgogne, 2 pre-doctoral and 1 postdoctoral visits at Univ. P.M. Curie (Paris 6), 1 visit at UToulouse. At almost all of these stays and visits I presented some of my research results in their seminar of Dynamical Systems. CONFERENCES: I participated to several international conferences and workshops, in 11 of which I presented my research results and four times by invitation (Belgium, France, Germany, Spain, Canada). ORGANIZATION: I took part in the organization of 2 international conferences in Belgium (2003, 2007) and I am organizer of the regular weekly seminar of the research group at UAB from Sept. 2010. TEACHING: I taught about 17 different courses at UAB and UHasselt: 1 PhD course on Dynamical Systems in the Master of Advanced Mathematics at the UAB, 1 course on Alien Limit Cycles for PhD-students and experts in Dynamical Systems in Spain, 9 courses on Pure Mathematics, 2 on Applied Mathematics (UHasselt, UAB) in the Degree program of Mathematics, Physics and Informatics and 4 on General Mathematics for Science students (in three different languages). OTHER MERITS: Accreditation of Professor-Lector by AQU.

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **GONZALEZ SANCHEZ, JON** **Referencia:** RYC-2011-08885

Area: Matemáticas

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Titulo:

Representation growth

Resumen de la Memoria:

One way of studying infinite groups is through subgroup or representation growth. If G is a group, we define r_n(G) to be the number of irreducible representations of degree n. If G is a profinite group we only need to count continuous irreducible representations. A finitely generated profinite group G has a finite number of representations of degree n for all n if and only if G is FAB (a group is FAB if and only if the abelianizers of finite index subgroups are finite). In this case one could define the zeta function associated to the numbers r_n(G) by Zeta^G(s)= Zeta_n(G)n^(-s). Andrei Jaikin Zapirain proved that for G is a p-adic analytic pro-p group, Zeta^G(s) is a racional function in p^(-s) (for p=2 this is only proved for the uniform case).In this research project we propose to study the zeta function associated to the growth of irreducible representations over number fields. The advantage in this case is that we do not need to restrict to the FAB case. In this project we will study the rationality of these zeta functions and the existence of functional equations. Rational representation growth can be used tu study coverings Riemann surfaces. We pose the following questions:1. Let G be a p-adic group and K a number field. Denote by r^(n,k)(G) the number of irreducible K-representations of degree n and consider the function Zeta^(G,k)(s)=r^(n,k)(G)n^(-s). Proof that there exists natural numbers n_1,¿,n_k and a polynomial f such that Zeta^(G,k)(s)=(n1^(-s)+¿+n_k^(-s))/ f(p^(-s)).2. Let G be an Fp[[t]]-analytic FAB pro-p group. Prove that Zeta^G(s) is a rational function over p-s.3. Let G be a group scheme over Z such that G(Z_p) and G(F_p[[t]]) are FAB (e.g. SLn). Prove that Zeta^G(Z_p)(s)=Zeta^G(F_p[[t]])(s). This will mean that the group algebras C[G(Z_p)] and C[G(F_p[[t]])] are isomorphic.4.Let X be a Riemann surface. Find the maximal number a(n,g) of non-equivalent coverings P:X->Y of degree n for a surface of genus g.

Resumen del Curriculum Vitae:

Jon González Sánchez defended his Ph.D. thesis, entitled ¿Estructura de potencias en p-grupos finitos y functores exp-log entre grupos y álgebras de Lie¿ and supervised by Andrei Jaikin Zapirain, at the University of the Basque Country in September 2005. After defending his Ph.D. thesis, between October 2005 and September 2007, the candidatehe obtained a two year postdoctoral fellowship at the University of Groningen (The Netherlands). From January 2008 till december 2010 he enjoyed a Juan de la Cierva research contract at the University of Cantabria. From December 2010 he has a position of ¿Ayudante Doctor¿ in the Autonoma University of Madrid.His research areas are finite p-groups, pro-p groups, cohomology of groups and more recently algebraic geometry (del pezzo surfaces) and asymptotic group theory (representation growth). He has collaborated with mathematicians from The Netherlands, Italy, Germany, The UK, ¿ .He has the following publications: [1] On the structure of normal subgroups of potent p-groups, Journal of Algebra, 2004. [2] The power structure of fi nite p-groups satisfying conditions like those of Lazard, Quarterly Journal of Mathematics, 2004. [3] On p-saturable groups, Journal of Algebra, 2007. [4] Omega subgroups of pro-p groups, Israel Journal of Mathematics, 2008. [5] Analyzing group based matrix multiplication algorithms, Proceedings of the 2009 International Symposium on Symbolic and Algebraic Computation, 2009. [6] Analytic pro-p groups of small dimensions, Journal of Group Theory, 2009. [7] Bounding index of the agemo in finite p-groups, Journal of Algebra, 2009. [8] Kirillov's orbit method for p-groups and pro-p groups, Communications in Algebra, 2009. [9] A p-nilpotency criterion. Archiv der Mathematik, 2010. [10] Four-dimensional polytopes: Alicia Boole Stott's algorithm. Mathematical Intelligencer, 2010. [11] A bound for the exponent of the Schur multiplier of a p-group, Journal of Algebra, 2010. [12] On w-maximal groups, Journal of Algebra, 2011. [13] Finite p-central groups of height k, Israel Journal of Mathematics, to appear.[14] Uniform groups and Lie algebras, Journal of Algebra, revised by the authors. [15] Algorithms for Del Pezzo Surfaces of Degree 5, submitted for publication, arXiv:1009.4044. [16] Birationally trivial real smooth cubic surfaces, submitted for publication, arXiv:1010.0294.

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SUBPROGRAMA RAMON Y CAJAL

CONVOCATORIA 2011

Nombre: **ESCUDERO LIEBANA, CARLOS** **Referencia:** RYC-2011-09025

Area: Matemáticas

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Titulo:

Matemática aplicada y física matemática

Resumen de la Memoria:

La matemática aplicada se puede entender como un amplio campo de investigación en el cual se intentan resolver problemas motivadosen otras disciplinas científicas o en las ingenierías mediante técnicas matemáticas. De la misma manera, la matemática aplicadatambién se puede entender como un punto de partida para el desarrollo de teorías fundamentales basadas en fenómenos naturales osociales. Esta línea de investigación pretende desarrollar esta doble vertiente, basándose en una serie de problemas de relevancia enotras disciplinas como la física o la biología. Un ejemplo es el crecimiento epitaxial, por medio del cual un cristal crece mediante ladeposición de átomos. Durante el proceso de crecimiento, diferentes estructuras espacio-temporales aparecen en su superficie,dificultando las aplicaciones prácticas del procedimiento. Uno de nuestros objetivos es el estudio teórico de estos fenómenos, yaque su compresión facilitaría el desarrollo de protocolos de control en contextos tecnológicos. Otro punto de interés son los sistemasbiológicos. Auto-organización y formación de patrones ocurren en este caso en todos los niveles, desde el bioquímico hasta lainteracción entre las especies. Entender los diferentes problemas que aparecen en las diversas escalas es de una granimportancia. Las reacciones bioquímicas que ocurren en las células se producen con números bajos de reactivos. Esto implica unfuerte carácter estocástico en el que los efectos no gaussianos van a tener un papel dominante, convirtiendo al problema en interesantedesde el punto de vista teórico también. Desde el punto de vista aplicado entender el funcionamiento de procesos como el ciclo celular esde una gran trascendencia. A nivel de especies, uno de los problemas más en boga actualmente es el comportamiento cooperativo deenjambres u otros colectivos animales. Adicionalmente, permiten una mejor compresión de fenómenos como las plagas de langostas,lo que podría mejorar las estrategias de control usuales. El objetivo final es entender todos estos al igual que otros fenómenos medianteun estudio matemático sistemático que vaya desde la construcción de una teoría rigurosa de existencia de soluciones de los modelos a laobtención de conclusiones y respuestas de utilidad en los campos de aplicación.

Resumen del Curriculum Vitae:

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