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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

Nombre: REGUERA RODRIGUEZ, MARIA DEL CARMEN
Referencia: RYC2020-030121-I
Área Temática: **Ciencias matemáticas**
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Título:

Harmonic Analysis on and off homogeneous settings

Resumen de la Memoria:

The applicant works on Harmonic Analysis and its interplay with Operator Theory, Complex Analysis, and Geometric Measure Theory. She has solved some important problems that have been open for several decades that are detailed below. The applicant s contributions can be contained in three areas.

Sharp weighted estimates for singular integrals. In this area the applicant is responsible for three major results and a more recent one: the proof of a dyadic version of the A2 Conjecture later borrowed by Hytonen to solve the full conjecture (joint with Lacey and Petermichl); a counterexample to a famous 30-year-old question known as the Muckenhoupt--Wheeden Conjecture and providing new sharp weighted estimates for the Bochner-Riesz operators via a sparse domination result for Bochner-Riesz (joint with Lacey and Mena). More recently, we have developed a quadratic sparse domination for non-integral square functions coming from elliptic PDEs. This work is joint with my PhD student Gianmarco Brocchi and my postdoctoral researcher Julian Bailey.

Sarason Conjecture on the Bergman space. The applicant together with Aleman and Pott is responsible for solving the long-standing Sarason Conjecture on the Bergman space by treating the question as a two-weight problem for the Bergman projection. Connected to this are the applicant s work on the development of a theory of B_infinity; weights with applications to spectral theory (joint with Aleman and Pott) funded by a Marie Curie Incoming project and a related question with interesting applications to isoperimetric inequalities (joint with Olsen).

Fractional Riesz transforms. This area has been subject to several important breakthroughs in recent years. The operators considered are s-dimensional Riesz transforms with s non-integer and smaller than the Euclidean dimension. In a highly significant paper together with Tolsa the main quantitative conjecture in the area was proved in a very general Cantor-like case, assuming a certain restriction on the dimension s. A joint effort with another team of experts has resulted in a complete solution to the quantitative conjecture, with the same restriction on the dimension s. A natural extension of these results includes the study of Riesz transforms of integer codimension which arise from elliptic operators. This theory has been developed by Tolsa and collaborators in recent papers. With J.Bailey and A. Morris, we joined the recent efforts by providing a qualitative result for the boundedness of Riesz transforms of codimension 1 associated to Schrodinger operators with totally irregular underlying measures.

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Resumen del Currículum Vitae:

I obtained my Bachelor degree in Mathematics at the Universidad de Sevilla in 2004. In 2003, while still an undergraduate, I won a colaboracion scholarship from the government of Spain, which introduce me to research. The following year I won a Pre-doc fellowship from the EU network "Phenomena in High Dimensions", that resulted in a research stay at Christian Albrechts Universität, (Germany) from April to July of 2005. I started my PhD studies in 2005 at the University of Columbia-Missouri. In 2008 I transferred to the Georgia Institute of Technology, where I completed my PhD in Mathematics under the direction of Prof. M. Lacey in May 2011. From there I moved to Lund University in Sweden for a one-year postdoc position. The same year I won the Juan de la Cierva fellowship to work at the Universitat Autónoma de Barcelona under the direction of X. Tolsa, where I stayed from September 2012 to September 2013. In 2013 I obtained a Birmingham fellowship at the University of Birmingham (UK), a permanent lecturer position with special emphasis on research, and in April 2020 I was promoted to senior lecturer. I was on maternity leave from September 2017 until May 2018.
I have been the PI for a research project on weighted theory on Bergman spaces funded by the VINNOVA agency of innovation (Sweden) and the PI of another project on non-homogeneous Harmonic Analysis funded by EPSRC (UK) that has hired a postdoctoral researcher to work under my direction. I am also the coordinator of the The UK Harmonic Analysis and PDE research network , yearly funded by the LMS.

I have produced 18 papers (1 Memoirs of AMS, 1 Trans of AMS, 2 Advances in Mathematics, and 1 Mathematische Annalen among others). I have presented my work in 40 specialized seminars and I have been invited to give 35 talks at national and international conferences and special sessions. Some of these conferences include plenary talks at the New Trends in Complex and Fourier Analysis and Operator Theory conference, Instituto di Alta Matematic (INdAM), Rome (Sept. 23-27, 2019); IWOTA 2016, Washington University in St. Louis (Jul. 18-22,

AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

2016). Singular integrals and partial differential equations workshop, University of Helskinki, Finland (May 23-27, 2016).

My research interests are in Harmonic Analysis and Weighted Theory and its interactions with Complex Analysis, Operator Theory and Geometric Measure Theory. My first works were in classical homogeneous weighted theory, more precisely, Ap theory. I contributed to the solution of the A2 Conjecture in the dyadic case and disproved a long-standing conjecture by Muckenhoupt and Wheeden at the endpoint case. On a different direction, my work together with collaborators in Complex Analysis and Operator Theory uses two weight non-homogeneous Harmonic Analysis to resolve the infamous Sarason Conjecture on the Bergman Space. Finally, in connection with Geometric Measure Theory is the study of boundedness of Riesz transforms of non-integer dimension on Lebesgue spaces dotted with a non-homogeneous measure. Together with collaborators, we have proved the connection of Riesz transforms with the Wolff potential of the measure. We are able to do this in the special case of codimension less than one.

My long-term goal is to be the head of a group of international standing that specializes in Harmonic Analysis and its applications to other areas.

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

Nombre: GARCIA PORTUGUES, EDUARDO
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Título:

Statistical methods for directional and functional data

Resumen de la Memoria:

As a researcher, I focus on the development of statistical methodology for non-Euclidean data for which classical modelling is spurious. I work with: (a) primarily, directional data (i.e., constant-length vectors supported on the hypersphere); (b) secondarily, functional data (i.e., infinite-dimensional data measured over a continuum). In both thematic areas, I concentrate on methodology within (1) nonparametric statistics and (2) computational statistics.

I obtained my PhD in Statistics and Operations Research at the University of Santiago de Compostela in 2014. During my doctoral period, I developed new methodology for conducting nonparametric inference with directional and linear data, with special emphasis on the derivation of the asymptotic properties of various kernel-based estimators and goodness-of-fit tests, both for density and regression functions.

Throughout my two-year postdoctoral contract at the University of Copenhagen (2015 2016), I developed new diffusive processes on the torus and guided their applicability in collaborative works with evolutionary biologists. This experience taught me the benefits, and prepared me to face the challenges, of interdisciplinary research. It also induced me to produce software to enable end-to-end replicability of papers, something I have been doing since then.

At the Carlos III University of Madrid (2016), I have continued developing several projection-based goodness-of-fit tests for regression models involving functional data, a path I started parallel to my PhD. In the last few years, I have been particularly interested in developing new tests of uniformity on the hypersphere, from the perspective of projections and moments, in passing extending and relating several dimension-specific tests.

On the one hand, my research on (a) has been recognised with the national project PGC2018-097284-B-I00, a publication in the Journal of the American Statistical Association, an invited review paper in TEST (with discussion), and various designations as invited speaker in reference workshops on the analysis of non-Euclidean data. On the other hand, my advances on (b) have been recognised with a publication in The Annals of Statistics, the FBBVA-SEIO award in methodological statistics, and multiple designations as invited speaker in reference workshops in functional data analysis.
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Resumen del Currículum Vitae:

I received my PhD from the Univ. of Santiago de Compostela (USC) in Dec. 2014, financially supported by a FPU grant and under the supervision of Profs. W. González-Manteiga and R. M. Crujeiras. In Jan. 2015, I joined the DSIN interdisciplinary project at the Univ. of Copenhagen, where I worked with M. Sørensen and T. Hamelryck. Since Sept. 2016, I am Visiting Prof. at the Dept. of Statistics of Carlos III Univ. of Madrid (UC3M) and, from June 2019, Juan de la Cierva Incorporación fellow. In 2019, I did a 4-month stay at the Dept. of Mathematics of the Free Univ. of Brussels with Profs. T. Verdebout and D. Paindaveine.

My research focuses on the development of statistical methodology for non-Euclidean data for which classical modelling is spurious. I work with: (a) primarily, directional data (i.e., data comprised by constant-length vectors), the topic of my PhD and to which I actively continue to contribute; (b) secondarily, functional data (i.e., infinite-dimensional data measured over a continuum), an area that I have mainly been exploring during my postdoctoral stage. In both thematic areas, I focus on methodology within (1) nonparametric statistics and (2) computational statistics. The first one is, by training, my blood as a methodological statistician. The second one has been especially relevant in the last years, when I have developed software to enable transparent implementation and end-to-end replicability of my papers. Complementarily, and connected to (a), in my 2-year postdoc I gained expertise in diffusive processes, allowing me to produce cutting-edge interdisciplinary contributions with biologists from the Univ. of Oxford.

My publishing record to date includes 15 JCR papers (6 in D1; 10 in Q1 Q2), 10 of them as first author and 1 as a sole author. All but 2 lie within the Statistics & Probability area. I have also published 4 book chapters (3 in Springer, 1 in CRC Press), developed 6 R software packages (4 in CRAN, 2 in GitHub), and written 3 preprints. I have published in The Annals of Statistics (AOS) and Journal of the American Statistical Association, respectively regarded by the statistical community as the best journal in mathematical statistics and one of the best

AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

journals in statistics. The AOS paper was awarded the SEIO-FBBVA 2020 prize for the best methodological contribution in statistics within the last 5 years among Spaniards. According to WoS, my h-index is 7 and I have 121 citations. According to Google Scholar, my h-index rises to 9 and my citations to 283.

The following is some general evidence of my scientific trajectory s recognition: Titular de Universidad accreditation by ANECA (May 2020); UC3M s Excellence Award; SEIO s Ramiro Melendreras award; 27 conference presentations (14 invited); 19 seminars; referee for 41 papers in 19 JCR journals; participation in 13 research projects; co-PI in contracts with IBESTAT and UN-ESCWA. Specific evidence related to (a,b): invitation to two monographic Oberwolfach workshops related to (a,b); invited speaker at the reference workshops in (a) and (b): ADISTA2021 and IWFOS2021; accepted invited paper on (a) in TEST; co-PI of PGC2018-097284-B-I00 project, on (a).

I am supervising 1 PhD and have supervised 7 MSc diss. I am deputy director of the UC3M MSc in Statistics for Data Science since 2018 and have developed original online teaching materials with +430k views.

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

Nombre: PILAUD , VINCENT
Referencia: RYC2020-029113-I
Área Temática: **Ciencias matemáticas**
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Título:

Generalizations of permutahedra and associahedra

Resumen de la Memoria:

My research is in the field of geometric and algebraic combinatorics. The general philosophy is to study classical objects from discrete mathematics and computer science (such as permutations, binary trees, line arrangements, etc) through the prism of their combinatorial, geometric, and algebraic structures. My research gravitate around generalizations of the permutahedra and associahedra, at the interface between lattice theory, polytope theory, Coxeter groups, cluster algebras, and Hopf algebras. My main contributions can be divided into three directions.

1. GENERALIZATIONS OF THE WEAK ORDER

The weak order is a fundamental lattice structure on permutations defined by inclusion of inversion sets. It can also be seen as an orientation of the graph of the permutahedron. This extends to any finite Coxeter group and even to any simplicial hyperplane arrangement. I have studied generalizations of the weak order to all faces of the permutahedron or of the zonotope of a hyperplane arrangement, to all integer posets, and to all Coxeter posets of a crystallographic root system. These generalizations still define lattice structures and enable to transport lattice congruences from the classical weak order to these generalizations, which recovers existing and provides new lattice structures on the faces of quotientopes (like the associahedron). These results appeared in articles in Trans. AMS, Canadian J. Math. and Algebraic Combinatorics.

2. GENERALIZATIONS OF THE ASSOCIAHEDRON

The associahedron is a classical polytope whose vertices correspond to binary trees and whose edges correspond to rotations in these trees. It is a central object in many areas (computer science, topology and operads, cluster algebras, Hopf algebras). The core of my research work focuses on various generalizations of the associahedron arising from combinatorics and algebra. I worked in particular on graph associahedra and nestohedra (arising from wonderful compactifications), permutrees and quotientopes (arising from the theory of lattice congruences of the weak order), generalized associahedra and brick polytopes (arising from the theory of finite type cluster algebras), and gentle associahedra (arising from quiver representation theory). My most notable contributions on these topics are of two kind: either proving that certain fans are polytopal (in particular quotient fans of the braid fan, and g-vector fans of cluster algebras which closed long-standing open questions), or discover rich generalizations of the associahedron (in particular permutreehedra, brick polytopes and gentle associahedra). This research line led to several articles, in particular in Memoirs AMS, Adv. Math., Trans. AMS and Proc. AMS.

3. COMBINATORIAL HOPF ALGEBRAS

Hopf algebras are vectors spaces endowed with compatible product and coproduct structures. They are fundamental structures with applications in algebraic combinatorics, renormalisation, and theoretical physics. Starting from the prototypes of the Malvenuto-Reutenauer algebra on permutations and the Loday-Ronco algebra on binary trees, I have constructed such structures on relevant combinatorial families such as Cambrian trees, permutrees, non-crossing arc diagrams, integer posets, and pipe dreams. This research line has led to articles in Adv. Math. and in various journals in algebraic combinatorics.
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Resumen del Currículum Vitae:

After a Licence in Mathematics in 2003 and a Master in Computer Science in 2006, both obtained while I was a student at the École Normale Supérieure de Paris, I did a one year internship at Univ. Cantabria in 2006 2007. Between 2007 and 2010, I prepared my PhD under the supervision of Prof. Michel Pocchiola at the Univ. Paris Diderot and Prof. Francisco Santos at the Univ. Cantabria (where my thesis received the premio extraordinario). In 2010 2011, I was a teaching assistant at Univ. Paris Diderot, and I made postdoctoral stays at Univ. Politécnica de Cataluña (4 months), EPFL (1 month) and Fields Institute Toronto (6 months). Since 2012, I am a permanent full-time CNRS researcher at École Polytechnique, and since 2014 I also have an additional part-time teaching position. In 2020, I obtained the French Habilitation à Diriger des Recherches (required to become Full Professor).

My research is in the field of geometric and algebraic combinatorics at the interface between lattice theory, polytope theory, Coxeter

AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

groups, cluster algebras, quiver representation theory, and Hopf algebras. My most important contributions focus on generalizations of the classical permutahedron and associahedron, from the perspective of their lattice, polytope and Hopf algebra structures.
I have published 37 journal articles (including in Memoirs, Transactions and Proceedings of the AMS, and Advances in Mathematics), 28 conference articles (including 10 talks and 10 posters at the flagship conference in algebraic combinatorics FPSAC) and 8 preprints. My main collaborators are in France, Spain, Austria, Germany, Italy, and Canada. I have been invited to give 4 advanced courses in research schools or workshops, 12 communications in conferences or workshops, and 53 colloquium or seminar talks. My work has been cited 166 / 240 / 813 / 233 times according to WoS / Scopus / Google scholar / Mathscinet.

I have co-supervised 9 PhD students (4 of which have already completed their PhDs, 5 are in progress) and 1 postdoctoral student. Two of my PhD students received awards for the excellence of their results. In addition, I have been an examiner in 5 PhD committees, and the external referee for 2 PhD thesis.

I was PI of 1 research project (51k , including funding for a postdoc), and co-investigator in 4 research projects of the French ANR and 3 research projects of the Spanish MICINN.

I took part of the organisation committees of 4 major conferences (including FPSAC'13 and FPSAC'16 with 300 participants), 3 research schools (2 CIMPA schools ECCO'16 and ECCO'18 and in Paris), and various workshops. I have organized the main Parisian seminar series on combinatorics and discrete and computational geometry at the prestigious IHP, and the weekly seminar of our research group at École Polytechnique. I have been in the program committee of 3 international conferences (including FPSAC'17) and 2 workshops.

I have served as a scientific expert for recruiting committees of 7 Associate Professors and 6 Teaching assistants. I have served as an external evaluator for various grants (NSA-AMS, NSERG) and 3 tenure track positions. As a referee, I have evaluated 80 journal submissions, and 30 conference submissions.

Finally, I have taught about 100h per year since 2014 in Computer Science at École Polytechnique and in two Parisian master courses in Mathematics and Computer Science.

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

Nombre: BARROS CORREA JUNIOR , MAURICIO
Referencia: RYC2020-029043-I
Área Temática: **Ciencias matemáticas**
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Título:

Distributions and foliations in Algebraic, Complex and Poisson geometries.

Resumen de la Memoria:

My research is focused on the areas of Algebraic and Complex Geometry, and Holomorphic distributions and foliations. More recently, I have also dedicated myself to the study of Holomorphic Poisson Geometry and localizations on complex supermanifolds. The aim of my research is to study distributions and foliations and their interactions to Algebraic, Complex and Poisson geometries, where we propose to carry out the research employing a blend of different techniques.

The main innovations are: to provide a general formula for residues in the degenerate cases in (super)complex manifolds via a new point of view such as residual currents theory, and also a Baum-Bott formula in the context of logarithmic foliations will have as an important application a residue formula for singular varieties; classification of holomorphic distributions on projective manifolds which provides new interesting irreducibles component of the moduli spaces of stable reflexive sheaves.

In recent work I have introduced a concept of Morita equivalence, in the birational context, for Poisson modules on complex normal Poisson projective varieties. We show that Poisson modules, on projective varieties with mild singularities, are either rationally Morita equivalent to a flat partial homomorphic sheaf, or a sheaf with a meromorphic flat connection or a co-Higgs sheaf.

I have initiated a study of singular varieties which possess a holomorphic conformal structure. This is new research line and the understanding of such structure is interesting from the algebraic, differential, riemannian and topological point of views. Also, I have initiated an investigation on classification of foliations by J-holomorphic curves on 4-manifolds via Kodaira dimension.

In 2010 I received my PhD in Mathematics at the Federal University of Minas Gerais, which was awarded with the CAPES National Thesis Prize 2011 for the Best PhD Thesis in Mathematics. I was an Affiliate Member of the Brazilian Academy of Sciences, from 2013 to 2017. I have collaborated with researchers from Brazil, France, Italy, Spain, Mexico and Japan. I have accumulated international experience through two long stays at Oxford (March 2018-February 2019) and Ferrara (March 2019-July 2019) universities and several short visits to France, Spain, Italy Mexico, Scotland and Japan.

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Resumen del Currículum Vitae:

I am currently an Associate Professor at the Federal University of Minas Gerais (UFMG)-Brazil and a level 1D CNPq Research fellow, where I have a leadership role in the Algebraic and Complex Geometry group. In 2010 I received my PhD in Mathematics at the Federal University of Minas Gerais, which was awarded with the CAPES National Thesis Prize 2011 for the Best PhD Thesis in Mathematics. I was an Affiliate Member of the Brazilian Academy of Sciences, from 2013 to 2017. I have collaborated with researchers from Brazil, France, Italy, Spain, Mexico and Japan. I have accumulated international experience through two long stays at Oxford (March 2018-February 2019) and Ferrara (March 2019-July 2019) universities and several short visits to France, Spain, Italy Mexico, Scotland and Japan.

I have 38 publications (34 published + 4 accepted, 28 in Q1 and 6 Q2 according to SJR(SCImago Journal Ranks)) and 1 book. I also have 5 submitted papers. I have published papers in respectable general mathematical journals, including Advances in Mathematics(2 papers), International Mathematics Research Notices(2 papers), Transactions of the American Mathematical Society, Mathematische Annalen, Revista Matemática Iberoamericana, Journal of Pure and Applied Algebra, Journal of the London Mathematical Society, Mathematische Zeitschrift, Annales de l'institut Fourier, Mathematical Research Letters, Communications in Contemporary Mathematics (2 papers). My papers have received following citations:
- Scopus: 52 citations, h-index 4.
- Web of Science: 57 citations, h-index 4.
- Mathscinet: 64 citations, h-index 5.
- ResearchGate: 103 citations, h-index 5.
- GoogleScholar: 199 citations, h-index 8

I have taught several undergraduate and graduate mathematics courses at the Federal University of Minas Gerais (2013-) and Federal

AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

University of Viçosa(2010-2012).

I have supervised 9 PhD students, who have successfully completed their theses and published their results in respectable international journals. I also have supervised 4 Master students.

My research is focused on the areas of Algebraic and Complex Geometry, and Holomorphic distributions and foliations. More recently, I have also dedicated myself to the study of Holomorphic Poisson Geometry and localizations on complex supermanifolds.

I lead the following research groups:
-Algebraic Geometry and Foliations-Federal University of Minas Gerais;
-Localization and residues -UFMG/UFV/UFLA/UFSJ. (This a research group joint with my former PhD students).

I have participated in 9 competitive-funded projects, 6 of them as Principal Investigator.

I have given invited talks in seminars and conferences such as: The Third Pacific Rim Mathematical Association, Mathematical Congress of the Americas, Oxford Geometry and Analysis Seminar, The London Geometry and Topology seminar, DGE seminar Edinburgh, Ferrara Geometry seminar. IMPA-Brazilian Mathematics Colloquium, International Workshop on Real and Complex Singularities.

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Turno de acceso general

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Área Temática: **Ciencias matemáticas**
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Título:

From nonlinear to nonlocal differential equations: a theoretical/numerical perspective

Resumen de la Memoria:

I have two main areas of expertise: Partial Differential Equations and Numerical Analysis. My research covers a wide range of topics including nonlocal and local problems, nonlinear and linear ones. Most of my work includes both theoretical and numerical points of view and transfers techniques and results from one to the other.

I am currently an Assistant Professor at Universidad Complutense de Madrid (UCM). Supported by an FPU grant I completed my PhD studies under the supervision of Prof. Juan Luis Vázquez in 2015. The thesis entitled "Theoretical and numerical aspects for nonlocal equations of porous medium type" was awarded with the prize for the best PhD thesis in Mathematics of the academic year 2015/2016 at UAM. As a postdoc I have been a visiting researcher at École Normale Supérieure in Paris (ENS) and at BCAM before starting long term positions at the Norwegian University of Science and Technology (NTNU) in January 2017 and a Juan de la Cierva fellowship at BCAM in 2018. During this period my research has also been awarded with the Vicent Caselles prize.

My research interests include but are not limited to theoretical and numerical aspects of nonlinear and nonlocal/local partial differential equations related to the following topics: 1. Qualitative and numerical aspects nonlocal equation equations of porous medium or Stefan type. 2. Discretizations of nonlocal operators. 3. Liouville type results for monotone operators. 4. Mean value properties, representation formulas and convergent schemes for nonlocal and local p-Laplacian operators.

I coauthored research works with: J. L. Vázquez (UAM), D. Stan (U. Cantabria), J. Endal (NTNU), E. Jakobsen (NTNU), L. Gerardo-Giorda (BCAM), N. Cusimano (BCAM), G. Pagnini (BCAM), N. Alibaud (Lab. Math. Besançon), M. Parviainen (U. Jyväskylä), J. J. Manfredi (U. Pittsburgh), E. Lindgren (Uppsala U.), David Gómez-Castro (Oxford U.), M. Lewicka (U. Pittsburgh).

I have written 21 articles: 16 already published in prestigious JCR journals (14 in Q1 and 8 in D1) like:
Archive for Rational Mechanics and Analysis;
Journal de Mathématiques Pures et Appliquées;
Advances in Mathematics;
Mathematical Models and Methods in Applied Sciences;
SIAM Journal on Numerical Analysis;
Journal of Differential Equations;
ESAIM: Mathematical Modelling and Numerical Analysis;
Advanced Nonlinear Studies;
Nonlinear Analysis: Theory, Methods & Applications;
Advances in Calculus of Variations; and
Calcolo.

My research is receiving an increasing amount of attention in the last years: I have 24.4 citations/year in the postdoctoral period (2016-2020) according to Scopus and 49 according to Google Scholar.

I have presented my work in more that 25 communications in national and international institutions like: Isaac Newton Institute (UK), NTNU (Norway), BCAM, U. of Strathclyde (UK), Laboratory of Mathematics of Besançon (France), U. of Wroclaw (Poland), ICMAT, UCM, UPV/EHU, Centro Internazionale per la Ricerca Matematica (Italy), Brunel U. (UK) and Upsala U. (Sweden).

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Resumen del Currículum Vitae:

Education:

Licenciado en Matemáticas (2009), Máster en Matemáticas y Aplicaciones (2010) and Doctorado en Matemáticas (2015) at Universidad Autónoma de Madrid (UAM).

AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

Prizes:

"Premio extraordinario de Doctorado" 2016 at UAM and "Premio de investigación Matemática Vicent Caselles" from the RSME-Fundación BBVA.

Relevant grants:

Juan de la Cierva - Formación; Postdoctoral Fellowship (3-years contract) at the Norwegian University of Science and Technology; Alain Bensoussan" Postdoctoral Fellowship from the European Research Consortium for Informatics and Mathematics; Fellowship for postdoctoral Studies Technology from the Ramón Areces Foundation; and FPU PhD fellowship from the Spanish Ministry.

Publications:

I have written 21 articles: 16 already published in prestigious JCR journals (14 in Q1 and 8 in D1). (see "Resumen de la trayectoria y linea de investigación" for more precise information).

Impact:

My research is receiving an increasing amount of attention in the last years. I have 115 citations according to Mathscinet, 135 in ISI-Web of Knowledge, 142 in Scopus, 273 in Researchgate and 291 in Google scholar.

Research projects:

I have participated in 7 national and international research projects from Spanish and Norwegian sources of funding (MTM, PGA, Severo Ochoa and Research Council of Norway).

Coauthors:

I coauthored research works with 13 national and international researchers (some of them very recognized senior ones, others in a mid-stage of their careers, and also young ones like me).

Communications:

I have presented my work in more that 25 communications in national and international institutions like: Isaac Newton Institute (UK), Lab. Math. Besançon (France), U. Wroclaw (Poland) or Uppsala U. (Sweden).

Research stays:

During my career I did the several long-term research stays/postdoctoral positions. Some of them were at University of Pittsburgh, Norwegian University of Science and Technology, Ecole Normale Superieure Paris, Basque Center for Applied Mathematics and Universidad Complutense de Madrid. In total I have spent more than 63 months outside my home university (Universidad Autónoma de Madrid).

Teaching:

I have taught at Spanish and Norwegian universities: A) 7 courses at UAM and 2 at the Boston University International Program (problem sessions). B) 1 course at NTNU as a Main Lecturer. C) 4 courses (+2 ongoing) at the at UCM as a Main Lecturer. Evaluation: Very positive with 9.22/10 & 8.56/10.

Supervision:

I have supervised several students in diverse scopes: 2 students in an internship program at the BCAM (6 months each); 1 bachelor's degree work at UCM (+2 ongoing) with a qualification of 9.7/10; 6 introduction to research works at UCM (facultad de informática).

I have also participate in the thesis committee of Sergio Garcia Rincón, and in 2 master s degree thesis committee at UCM (Máster en Matemáticas Avanzadas).

Organization of scientific events:

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

I have participate in the organization of international scientific events. 1 of them as the secretary (Summer school Nonlocal interactions in partial differential equations and geometry) and 3 as a main organizer (Special session Ecuaciones diferenciales no lineales y no locales at the conference of young researchers, II IMI one-day workshop on PDEs , and Summer school From nonlinear to nonlocal differential equations).

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AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

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Área Temática: **Ciencias matemáticas**
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Título:

Algebraic methods for studying singularities

Resumen de la Memoria:

My primary research area is commutative algebra, especially its intersection with algebraic geometry and singularity theory. Within mathematics and in mathematical modeling in natural and social sciences, it is unavoidable to come across singularities, where a small change of a parameter may result in a drastic change in the behavior. I study singularities arising in solution spaces of systems of polynomial equations, which are the most used functions in mathematics and modeling.

My PhD thesis was on Hilbert-Kunz multiplicity, a measure of singularity native to positive characteristic. Since then my research interests greatly expanded, the major topics are positive characteristic methods broadly, multiplicity theory, local cohomology, and m-adic stability.

I made fundamental contributions to the algebraic theory of singularities in positive characteristic. In my thesis, I showed upper semicontinuity of Hilbert-Kunz multiplicity and was the first to consider equimultiplicity problems for invariants arising from Frobenius. Recently, I introduced a sought-after semicontinuous invariant that detects F-rational singularities and, in future, will use it to pursue open questions about F-rational singularities.

I was also able to use the techniques and intuition built in positive characteristic more generally. With Jeffries, we reshaped a recent breakthrough application of F-signature to give, in a wide number of cases, an effective bound on the local etale fundamental group of a Kawamata log terminal singularity over the complex numbers. Furthermore, my recent joint work with Ma, Huneke, and Quy applies Hilbert-Kunz theory to uncover a new striking uniformity phenomenon in multiplicity theory.

I made significant contributions to multiplicity theory and settled two long-standing conjectures. In 1996 Stückrad and Vogel conjectured that the ratio of multiplicity and colength of an m-primary ideal of a local ring is bounded away from 0. The Srinivas-Trivedi conjecture (1998) predicted the greatest level of generality at which the Hilbert-Samuel function does not change when perturbing the defining equation by arbitrary terms of sufficiently high order. I further studied the effect of such perturbations on positive characteristic invariants and classes of singularities. While this topic originates from singularity theory and is still active, it was forgotten by algebraists and my work is giving it new life.

I was awarded the Starting Grant of the Swedish Research Council (357823) to pursue a research program on Lech s inequality, a fundamental inequality uniformly bounding the ratio of the multiplicity and the colength of an m-primary ideal. We previously showed that the inequality is seldom sharp, so the actual sharp upper bound is a distinct invariant. Notably, Mumford showed that this invariant restricts singularities appearing on the "limits" of smooth varieties, i.e., on moduli spaces. This result was overlooked, and we are building with Ma a comprehensive theory for this invariant as a singularity measure.

I am also considering other ways of refining Lech's inequality, such as adding "correction terms". My research also uncovered a new uniformity phenomenon in a complete isolated singularity of positive characteristic: the ratio of multiplicity and colength tends uniformly to the smallest possible value as the colength increases.
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Resumen del Currículum Vitae:

I finished my undergraduate studies in Mathematics at the Lomonosov Moscow State University in 2011 and in 2015 I received a PhD in Mathematics from the University of Virginia under the direction of Craig Huneke. My first postdoc was at the University of Michigan where I worked with Mel Hochster and my second postdoc at the Stockholm University with Boris Shapiro. Currently, I am a researcher at the Charles University in Prague, and in Winter 2021 I will start a research position at the KTH Royal Institute of Technology funded by a prestigious Starting Grant of the Swedish Research Council, which will provide 3600000 SEK over 4 years.

I have 16 published papers, 11 of them in the last two years and 3 more are accepted. Out of these publications 5 appeared in the first and 5 in the second quartile by JCR. I have a wide collaboration network - my 13 coauthors are in Japan, Italy, Mexico, Sweden, Vietnam, UK, and USA. I travel frequently and in 2019-2020 I had stays in University of Genoa, Purdue University, Osnabrück University, Oberwolfach, and my stays at the Vietnam Institute of Advanced Study in Mathematics and at the University of Tokyo were cancelled due to pandemic. I

AYUDAS RAMÓN Y CAJAL
CONVOCATORIA 2020

Turno de acceso general

gave 9 invited conference talks and 16 invited seminar talks and colloquia and received a number of travel grants.

I co-organized research seminars at the University of Michigan and at the Stockholm University and I am co-organizing the Stockholm Master Class "Local cohomology and related topics", postponed from August 2020. I am the principal local organizer, responsible for the budget and local expenses.

My main research interests are at the intersection of commutative algebra, algebraic geometry, and singularity theory: I use algebraic methods to study singularities of systems of polynomial equations, often in the form of singularity measures, which are invariants that measure some aspects of the complexity of a singularity. My research covers different topics, such as positive characteristic methods, multiplicity theory, local cohomology, and finite determinacy.

I am an expert in positive characteristic methods and made fundamental contributions: I showed upper semicontinuity of Hilbert-Kunz multiplicity, introduced an invariant that detects F-rational singularities and has good geometric behavior, and was the first to consider equimultiplicity problems for the invariants arising from Frobenius.

I early started to expand my interests and already during the PhD worked on local cohomology and finite determinacy problems. These topics first arose in connection with the invariants in positive characteristic, but soon grew further than that. With my collaborators, we settled conjectures of Stuckrad-Vogel (1996), which asserted that the ratio of multiplicity and colength of m-primary ideals is bounded away from 0, and Srinivas-Trivedi (1998), predicting the greatest level of generality at which the Hilbert function does not change for perturbations of sufficiently large order.

The Starting Grant will fund my research program centered on Lech s inequality, a fundamental inequality that bounds above the ratio of multiplicity and colength. This inequality is never sharp in dimension at least two and we recently showed that it is seldom sharp even asymptotically. I will develop various refinements of Lech's inequality and will study related classes of singularities.

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Título:

Formas Modulares y Aproximación Diofántica, Teoría de números

Resumen de la Memoria:

My mathematical work addresses different areas of number theory, more particularly the interplays between the theory of modular forms and the areas of diophantine approximation and diophantine equations.
The theory of modular forms has widespread applications in mathematics, in the fields of arithmetic geometry, algebraic number theory, algebraic topology, combinatorics (notably sphere packing problems), representation theory and mathematical physics.
Diophantine approximation can roughly be described as a quantitative analysis of the property that every real number can be approximated by a rational number arbitrarily closely. It has applications to diophantine equations and graph theory, and to applied problems such as electronic communications, antenna design and signal processing.
Since 2017 I conduct my independent research project entitled Modular forms and diophantine approximation at ETH Zurich funded by an Ambizione grant from the Swiss National Foundation, where I study interrelations between both areas. I acquired the background on modular forms in my PhD defended at Paris VI, where I worked on the interrelations between modular forms and quadratic fields. I introduced a new family of explicit meromorphic modular forms which study has been pursued by several other mathematicians, particularly in Germany. I acquired the background in diophantine approximation during my first postdoctoral position by joining the EPSRC project New Frameworks in Metric Number Theory at the University of York. In collaboration with members of the project, we gave a new proof of the famous open p-adic Littlewood Conjecture for real quadratic irrationalities, and studied sets of badly approximable points in high dimensions and on manifolds.

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Resumen del Currículum Vitae:

I obtained my Degree and Master in Mathematics at Universitat de Barcelona (UB) in 2008. During my Master I worked simultaneously as an associate professor at UB. I defended my PhD at Paris VI in 2013, supervised by Don Zagier (director of the Max Planck Institute for Mathematics and professor at Collège de France at that time) and co-supervised by Pilar Bayer (UB) and obtained the maximal qualification (Mention Très Honorable). During my PhD, I was awarded with a grant from LaCaixa, funded by the Société Mathématique de Paris, and hired as a temporary researcher at Collège de France.

In 2013-2016 I joined the EPSRC research project New Frameworks in Metric Number Theory at the University of York (UK) as a postdoctoral researcher. Within this period, I published three articles in collaboration with members and guests of the project and four articles on my own in both specialized and general peer review journals. I was invited to present my works in many conferences and seminars all around UK (Cambridge, Oxford, Warwick, Durham, Bristol, Manchester, Nottingham, Exeter, Reading) and abroad (EPFL Lausanne, ETH Zurich, Max Planck Institute for Mathematics in Bonn, Lyon, Grenoble, Cologne, Moscow). I contributed with the department by giving two courses, by organizing the weekly Number Theory Seminar with international speakers, and by representing the postdocs in the Maths Department s Equality and Good Practice Committee.

In 2017, I obtained my own Ambizione grant (517 120 CHF) from the Swiss National Foundation (SNF) and became a Senior Research Assistant at ETH. Ambizione grants are aimed at young researchers who wish to conduct, manage and lead an independent project at a Swiss higher education institution. It covers the grantee's salary and the funds needed to carry out the project. Within the SNF project, I have published in leading international journals in mathematics, such as Mathematische Annalen, Algebra and Number Theory, IMRN, and Transactions of the American Mathematical Society. I have collaborated with O. Imamoglu (ETH) and S. Akthari (University of Oregon). I contributed with the mathematics department of ETH by giving two courses and supervising bachelor and master thesis.

I have been a member of several projects i+D+I at UB, as well as a regular speaker at the annual number theory seminars of the Number Theory Research Group at Barcelona. I have also a strong connection with the Max Planck Institute for Mathematics, that hosted me many times for exchanges of knowledge, research discussions and collaborations. I have been invited for mathematical exchanges and discussions to many research centers and research groups, such as ICTP (Trieste), Moscow State University, Hausdorff Research Institute for Mathematics, University of Cologne, and University of Luxembourg. My results have been announced in 34 seminars and conferences all around Europe.