



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

Nombre: GUARDIA MUNARRIZ, MARCEL

Referencia: RYC-2015-18322

Área Científica: Matemáticas

Correo Electrónico: marcel.guardia@upc.edu

Título:

Instability phenomena in Hamiltonian systems and dispersive Partial Differential Equations

Resumen de la Memoria:

My area of research is dynamical systems, with special attention to models coming from Celestial Mechanics and to Partial Differential Equations which can be seen as infinite dimensional dynamical systems.

I earned my PhD in the Dynamical Systems group at the Universitat Politècnica de Catalunya under the guidance of Prof. M. T. Martínez-Seara. During my PhD I worked on exponentially small phenomena related to instabilities in Hamiltonian Systems (chaotic orbits, Arnold diffusion), and bifurcation theory of Filippov systems (dynamical systems defined by discontinuous vector fields). During my PhD I did research stays with J. Hogan (University of Bristol), M. A. Teixeria (University of Campinas) and V. Kaloshin (University of Maryland).

As a postdoctoral researcher I have held positions in several research institutions in the United States (Penn State University, University of Maryland, Institute for Advanced Study in Princeton) and Canada (Fields Institute). In 2013, I moved to France (Université de Paris 7) with a IEF Marie Curie fellowship.

In my postdoctoral research I have broadened my area of research towards unstable phenomena in Celestial Mechanics (instabilities along mean motion resonances, oscillatory motions, secular dynamics) and towards the problem of transfer of energy in dispersive PDEs such as the nonlinear Schrödinger equation.

Since December 2014, I am a Juan de la Cierva postdoctoral fellow at the Dynamical Systems group of the Universitat Politècnica de Catalunya.

Resumen del Currículum Vitae:

Marcel Guardia (Barcelona 1982). PhD in Applied Mathematics (2010) by the Universitat Politècnica de Catalunya (UPC). Juan de la Cierva postdoctoral fellow at UPC since December 2014.

RESEARCH: My research has focused on the study of instability phenomena in dynamical systems, focusing on models coming from Celestial Mechanics and on Partial Differential Equations which can be seen as infinite dimensional dynamical systems.

PUBLICATIONS: I have 11 publications, all in top quartile journals, 1 proceedings and 4 preprints. I have published one article in the journal *Inventiones Mathematicae*, which has been awarded the first Barcelona Dynamical systems prize by the Societat Catalana de Matemàtiques, and two in the Journal of the European Mathematical Society.

TALKS: I have been invited to numerous conferences (16) and seminars (over 40) in prestigious research institutions such as Princeton University, Courant Institute, Cornell University, UCLA, Collège de France, Orsay, Institut Henri Poincaré, Università de Roma - La Sapienza. I have been invited to lecture three advanced courses (notably in a CIMPA school and in IMPA, Brasil).

RESEARCH STAYS: I have done four pre-doctoral research stays at the University of Bristol, University of Campinas and University of Maryland. I have done post-doctoral research stays at Penn State University, University of Maryland, Institute for Advanced Study (Princeton), Fields Institute (Toronto) and Université de Paris 7. I have done also short research stays in, among others, Cornell University, Courant Institute, University of Tel Aviv, MSRI in Berkeley, GeorgiaTech, Università de Roma 1 La Sapienza.

FUNDING: I have participated in 6 funded projects (Spain). I have obtained European funding through a Marie Curie IEF Fellowship competitive call.

TEACHING: I have taught undergraduate courses at UPC, Penn State University and the University of Maryland. I am currently teaching a Master course at UPC.

OTHERS: I have obtained the accreditation as "Professor Agregat" (2014) by the AQU (Generalitat de Catalunya). I have reviewed articles



MINISTERIO
DE ECONOMÍA
Y COMPETITIVIDAD



DIVISIÓN DE PROGRAMACIÓN
Y GESTIÓN ECONÓMICA Y
ADMINISTRATIVA

SUBDIVISIÓN DE
PLANIFICACIÓN Y GESTIÓN
ADMINISTRATIVA

AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

for six different journals. I have organized several scientific events and currently I am the coorganizer of two summer schools to be held in Barcelona and MSRI (Berkeley). I have been member of two PhD committees.



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

Nombre: ROSSELL RIBERA, DAVID
Referencia: RYC-2015-18544
Área Científica: Matemáticas
Correo Electrónico: rosselldavid@gmail.com

Título:

Statistical methods and applications in high-dimensional data analysis and experimental design

Resumen de la Memoria:

My research focuses on high-dimensional Bayesian methods, experimental design and bioinformatics, i.e. situations with an overwhelming amount of data or parameters. My goal is developing methods and transferring them into practice, thus my work balances theory and applications. Summary:

Theory: I co-proposed non-local priors (NLPs) for model selection and led their extension to parameter estimation. NLPs are a foundational contribution to Bayesian inference: we developed theory (e.g. sparsity, shrinkage), including a key result that they are a necessary condition for (frequentist) posterior probability consistency in high-dimensional regression, a representation in terms of latent truncations leading to simple computational algorithms, and R/C++ software. Most recently I am extending these ideas to methodology that is robust to model misspecification but still enjoys the analytical and computational tractability of standard formulations (e.g. linear model).

Applied statistics: I proposed several semi-parametric and hierarchical models for massive multiple testing (e.g. gene expression) and a framework to infer isoform expression from RNA-sequencing data. I also worked in experimental design, e.g. posing the first fully sequential, decision-theoretic framework to design high-throughput studies (thus avoiding a priori guesses for thousands of unknown parameters), a framework I recently extended to RNA-sequencing. I also developed methods for quality control for sequencing data and dimensionality reduction to integrate large heterogeneous data.

Cross-discipline collaborations: I led the analysis of several high-profile genomics projects, e.g. showing that genomic mechanisms in flies are useful to model cancer, with large ethic-economical implications, or demonstrating the role of stem cells and the stroma in colon cancer progression, with the paradigm shift that the tissue surrounding the tumour rather than just the tumour drives metastasis. The findings led to 2 personalized medicine patents of which I am one of 3 inventors, which we're currently developing for commercial applications.

Resumen del Currículum Vitae:

I started my career at the clinical research company Biometrica (Spain) where after 2 years I was appointed head of its new Statistics Department. I led the department for 2 years (growing to 7 members), where we engaged in the design, data analysis and manuscript preparation for a large number of clinical studies. Sadly publication rights belonged to our clients (mostly pharma companies), resulting in numerous acknowledgements but no authorships. In 2003 I moved to the USA for a PhD at Rice University, followed by a postdoc at MD Anderson Cancer Center (Biostatistics Dept.). During that time I worked on statistical methods for the design of clinical and high-throughput studies (e.g. gene expression), data analysis methods for bioinformatics applications, and foundations on Bayesian hypothesis testing and model selection. In 2008 I moved to Spain to create a Biostatistics & Bioinformatics Unit at the biomedical institute IRB Barcelona, which I led for 5 and a half years and grew up to 5 members. I was the first statistician at the institute, thus in the first years a main challenge was to establish collaborations and convince researchers of the value of our field, including the need to conduct methodological research. In this we were highly successful, as shown by an ample collaboration record and various initiatives at the institute to incorporate mathematically-inclined researchers. At IRB Barcelona I focused my research on foundations and applications of high-dimensional statistical methodology. In 2013 I joined the Statistics Department at the University of Warwick to expand my expertise in statistics, where I remain to this date and am expected to undergo the tenure review in a few months. I am currently involved in undergraduate and graduate teaching at Warwick and in the joint Oxford-Warwick OxWaSP PhD centre for next-generation statistical science, where I currently supervise 2 PhD students. I also participate in the inter-disciplinary MASC centre for Molecular Analytical Sciences at Warwick, where I co-supervise a PhD student in petroleomics-related applications.

In terms of scientific production, as detailed elsewhere I co-authored 27 peer-reviewed publications (1,190 citations, h-index=13, i10 index=14 according to Google scholar) featuring in leading journals in statistical methodology, statistical applications and biomedicine. I also implemented 8 open-source software packages for R/Bioconductor (>13,000 downloads from distinct IP addresses last year). I have delivered over 40 invited talks and seminars and been the main organizer for several conferences and workshops on statistical methodology, and am currently part of the scientific committee of the ISBA 2016 World Meeting. Regarding funding, I have been PI in several projects and fellowships in Spain and the United Kingdom, and an abroad-based co-investigator in a USA National Institutes of Health R01 grant to develop high-dimensional statistical methods (currently under application for renewal). Finally, I am part of a team of three inventors in two patents related to predicting prognosis for colon and liver cancer patients, which arose from a collaboration with



MINISTERIO
DE ECONOMÍA
Y COMPETITIVIDAD



DIVISIÓN DE PROGRAMACIÓN
Y GESTIÓN ECONÓMICA Y
ADMINISTRATIVA

SUBDIVISIÓN DE
PLANIFICACIÓN Y GESTIÓN
ADMINISTRATIVA

AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

wet laboratory research groups and to which I contributed with the development and application of high-dimensional statistical data analysis methods, which we currently seek to extend to actual clinical practice.



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

Nombre: LAHOZ VILALTA, MARTÍ
Referencia: RYC-2015-19175
Área Científica: Matemáticas
Correo Electrónico: marti.lahoz@imj-prg.fr

Título:

Geometría biracional y espacios de moduli de objetos de la categoría derivada

Resumen de la Memoria:

My field of research is Algebraic Geometry. My research focus on some applications of abstract constructions in homological algebra to study problems in algebraic geometry. More concretely, the considered applications could be divided in two lines of research.

- The first line is focused on the study of the bounded derived category of coherent sheaves on a smooth projective variety in order to obtain interesting geometric informations regarding the variety itself.
- The second line is focused on the geometry of abelian varieties and, more generally, of irregular projective varieties using the derived category of the Albanese variety.

I have started working on the first line of research during my postdoctoral position at the Mathematisches Institut of the Universität Bonn, especially in collaboration with E. Macrì and P. Stellari.

We focus on the study of the derived category of coherent sheaves of a cubic hypersurface, as well as their interesting admissible subcategories. We study the birational geometry of certain interesting moduli spaces of stable objects. In particular, we consider wall-crossing phenomena that occur by varying the stability conditions in the space of Bridgeland stability conditions. We are mainly interested in moduli spaces whose canonical bundle is trivial and the conjectural rationality questions related to them.

I have started to work on the second line of my research during my Ph.D. thesis at the Universitat Politècnica de Catalunya - BarcelonaTech and I have continued this project basically in collaboration with Z. Jiang during his stay in Bonn and also nowadays in Paris.

We focus on the study of subvarieties of abelian varieties and the birational geometry of irregular varieties. We are interested in their pluricanonical systems and the relation between topology and geometry among these varieties. The basic tools we use are again the derived category of coherent sheaves and deep results in Hodge theory.

Resumen del Currículum Vitae:

Current Position

Maître de Conférences (MdC) of the UFR en Mathématiques of the Université Paris Diderot - Paris 7. I am member of the project "Topologie et géométrie algébrique" (TGA) of the "Institut de Mathématiques de Jussieu - Paris Rive Gauche" (IMJ-PRG \diamond UMR7586).

Publications & Preprints

- 1.- O. Debarre, Z. Jiang, and M. Lahoz, with an Appendix by W. Sawin Rational cohomology tori.
- 2.- M. Gulbrandsen and M. Lahoz, Schottky via the punctual Hilbert scheme. To appear in Tohoku Math. J.
- 3.- M. Lahoz, E. Macrì, and P. Stellari, Arithmetically Cohen-Macaulay bundles on cubic fourfolds containing a plane. To appear in the Proceedings of the AIM workshop "Brauer groups and obstruction problems: moduli spaces and arithmetic" (Palo Alto, 2013).
- 4.- M. Lahoz, E. Macrì, and P. Stellari, Arithmetically Cohen-Macaulay bundles on cubic threefolds. Algebraic Geometry 2 (2015), no. 2, 231-269.
- 5.- Z. Jiang, M. Lahoz, and S. Tirabassi, Characterization of products of theta divisors. Compos. Math. 150 (2014), no. 8, 384-412.
- 6.- Z. Jiang, M. Lahoz, and S. Tirabassi, On the Iitaka fibration of varieties of maximal Albanese dimension. Int. Math. Res. Not. 2013 (2013), no. 13, 2984-3005.
- 7.- M. Lahoz and J.C. Naranjo, Theta-duality on Prym varieties and a Torelli theorem. Trans. Amer. Math. Soc. 365 (2013), no. 10, 5051-5069.
- 8.- M. Lahoz, Generic vanishing index and the birationality of the bicanonical map of irregular varieties. Math. Z., 272, (2012), no. 3-4, 1075-1086.
- 9.- M.A. Barja, M. Lahoz, J.C. Naranjo, and G. Pareschi, On the bicanonical map of irregular varieties. J. Algebraic Geom. 21 (2012), no.3, 445-471.
- 10.- M. Gulbrandsen and M. Lahoz, Finite subschemes of abelian varieties and the Schottky problem. Ann. Inst. Fourier, 61 (2011), no. 5, 2039-2064.
- 11.- S. Casalaina-Martin, M. Lahoz, and F. Viviani, Cohomological support loci for Abel-Prym curves. Matematiche 63 (2008), no. 1, 205-222.



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

Events Co-organized

June 2016

Summer School and Conference New Methods in Birational Geometry. [webpage] Toulouse, France.

June 2016

Nordfjordeid Summer School Stability conditions on triangulated categories and geometric applications. Sophus Lie Conference Center, Nordfjordeid, Norway.

September 2015

Workshop Derived Categories and Moduli Spaces. [webpage] Stavanger, Norway.

May 2013

Summer School Compactifying Moduli Spaces. [webpage] Barcelona, Spain.

Editor of the notes by Valery Alexeev: Moduli of Weighted Hyperplane Arrangements, Birkhäuser, 2015.

Editor of the notes by Paul Hacking, Radu Laza and Dragos Oprea: Compactifying Moduli Spaces, Birkhäuser, 2016.

July 2012

Short Summer School The derived category of cubic hypersurfaces. [webpage] Barcelona, Spain.

Previous Positions

2012 - 2013 Sophie Germain postdoc at the AGA research group of the Université Paris Sud 11.

2010 - 2012 SFB TR 45 postdoc at the Universität Bonn.

2008 - 2010 Profesor ayudant at the Universitat de Barcelona.

2005 - 2008 Becario FPU at the Universitat Politècnica de Catalunya (UPC).

Education

May 2010

Doctor (PhD) in Mathematics (UPC).

Title dissertation: Theta-duality in Abelian Varieties and the Bicanonical Map of Irregular Varieties.

Doctorate Extraordinary Award.

1999-2004

Licenciatura in Mathematics (UPC).



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

Nombre: SICBALDI , PIERALBERTO
Referencia: RYC-2015-18730
Área Científica: Matemáticas
Correo Electrónico: pieralberto@gmail.com

Título:

Geometry of overdetermined elliptic problems

Resumen de la Memoria:

Pieralberto Sicbaldi (Italy, 1982), received a Bachelor's and a Master's degrees in Mathematics from the University of Bologna (Italy) and a Master's degree in Fundamental Mathematics from the University of Paris 7 (France). He received also Master's degrees in Music and Interdisciplinary studies. He received a Ph.D in Mathematics in 2009 from the Paris-Est University, under the advisory of F. Pacard, enjoying from 2006 to 2009 a Ph.D fellowship of the French Ministry of Higher Education and Research. He awarded the first Prize of the Conseil Général du Val-de-Marne for the best Ph.D thesis of the year 2009 among all the universities of Paris.

Since November 2010, Sicbaldi holds a tenure position of Maître de Conférences at the Aix-Marseille University (France), being French civil servant.

Sicbaldi participated in 3 competitive international research projects: from 2009 to 2012 he has been a member of the international research project *Cage* (partnership France-Brazil), supported by the French institution ANR (head researcher: F. Pacard, budget: 150.000 euros); from 2012 to 2015 has been a member of the international research project *Surfaces* (partnership France-Brazil), supported by the French institution ANR (head researcher: L. Hauswirth, budget: 201.760 euros); from 2012 to 2016 is the head researcher of the national French research project *Analyse appliquée*, supported by the French institution FRUMAM (budget: 12000 euros). He is also a member of the French-Spanish network of Geometric Analysis.

All the scientific papers of Sicbaldi are published in highly ranked journals, in the first quarter of the main citation reports. Some of them in the first 10%: Journal of Differential Equations (Rank 14 over 312 in 5-year JCR), Calculus of Variations and PDE (Rank 18 over 312 in 5-year JCR), Advances in Mathematics (Rank 22 over 312 in 5-year JCR). Sicbaldi is reviewer for the American Mathematical Society, and has been referee for many journals, among which some of the most important ones, as Duke Mathematical Journal (Rank 12 over 312 in 5-year JCR). Sicbaldi has been invited to give plenary lectures or mini-courses in 15 international conferences or workshops, and to give more than 20 seminars in many prestigious research centers. He spent invited research stays in Switzerland, Italy, United Kingdom, Germany, Spain.

In February 2013 Sicbaldi obtained the Prime of Scientific Excellence from the French Ministry of Higher Education and Research, with pay increase since 2013.

Sicbaldi participated also to important scientific advisory committees: he has been titular member of two committees for positions of Maître de Conférences at the Aix-Marseille University, invited member in the committee to deliver the Ph.D Prize of the Conseil Général du Val-de-Marne, and president of the committee of the Baccalaureat's degree in Marseille.

Sicbaldi taught a total of 1200 hours at all the levels of the undergraduate degrees in Mathematics, Physics, Computer Sciences and Engineering, giving complete lectures of Mathematical Analysis, Linear Algebra, Topology and Discrete Mathematics. He has been advisor of undergraduate students during the supervised research work (final degree project).

In June 2014 Sicbaldi obtained the Spanish national accreditation to the position of Profesor Titular de Universidad from ANECA.

Resumen del Currículum Vitae:

The research interests of Pieralberto Sicbaldi are in the fields of Geometric Analysis, Differential Geometry, Partial Differential Equations and Calculus of Variations.

The study of minimal and constant mean curvature (CMC) surfaces is one of the major topics of Differential Geometry, tightly linked to the isoperimetric problem. On the other hand, the study of overdetermined elliptic problems is one of the major topics of Analysis of Partial Differential Equations and Applied Analysis, extremely important for applications to Mechanics, Cosmology, Electrodynamics.

The major achievement of Sicbaldi has been to connect the two theories, providing new geometrical methods to study and classify the solutions to overdetermined elliptic problems. Such methods come from the theory of minimal and CMC surfaces. The papers of Sicbaldi published from 2009 and 2012 have been the pioneer works of a completely new research line, that now is a very active focus of research in Geometric Analysis.

In 2010, using ideas coming from one of his previous paper and based on the relationship between the isoperimetric problem and overdetermined elliptic problems in manifolds, Sicbaldi was able to disprove the conjecture of Berestycki, Caffarelli and Nirenberg about overdetermined problems, discovering a new nontrivial solution to a classical elliptic system. In 2012 Sicbaldi, in a joint work with F. Schlenk, was able to established a strong parallel between such new solutions and CMC surfaces, showing that the structure of the solutions of overdetermined elliptic problems is nontrivial and is extremely rich and interesting. In 2013 in a joint work with A. Ros, and in a recent joint work with A. Ros and D. Ruiz of 2015, Sicbaldi explored the deep analogy between overdetermined elliptic problems, CMC surfaces and the De Giorgi conjecture, obtaining, for overdetermined problems, the counterparts of some important works about CMC surfaces in Differential Geometry and an affirmative answer to a stronger statement of the conjecture of Berestycki, Caffarelli and Nirenberg.



MINISTERIO
DE ECONOMÍA
Y COMPETITIVIDAD



DIVISIÓN DE PROGRAMACIÓN
Y GESTIÓN ECONÓMICA Y
ADMINISTRATIVA

SUBDIVISIÓN DE
PLANIFICACIÓN Y GESTIÓN
ADMINISTRATIVA

AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

After his earliest results, many Differential Geometry's researchers started to work on the theory of overdetermined elliptic problems, developing the bridge with CMC surfaces. On the other hand, researchers in Analysis of Partial Differential Equations started to look at the theory of CMC surfaces to investigate old questions about overdetermined elliptic problems. This new research line is now a very active focus of research. More than 30 senior and junior researchers in the world are working on it. The international research project **Surfaces** (partnership France-Brazil), supported by the French institution ANR with a budget of more than 200.000 euros, was focused mainly on this new research line. In 2015 the first big international conference about minimal surfaces and overdetermined elliptic problems took place at Santiago de Chile, where Sicbaldi has been invited to give a course. The new research line is also one of the major focus of research of the French-Spanish network of Geometric Analysis.



AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

Nombre: MASDEU SABATE, MARC
Referencia: RYC-2015-17768
Área Científica: Matemáticas
Correo Electrónico: marc.masdeu@gmail.com

Título:

Analytic constructions of arithmetic cycles

Resumen de la Memoria:

My research interests lie in the area of arithmetic geometry. More concretely, I am interested in analytic constructions of objects of arithmetic nature, focusing in their computability.

In 2011 I begun the study of a class of points defined on elliptic curves by analytic methods, which go by various names, like Stark-Heegner points, ATR points or Darmon points. These were introduced by Henri Darmon at the turn of the century, and they are extremely fascinating analogues to the well-known Heegner points. To date, algebraicity of these "Darmon points" is still a mystery, but we have succeeded in providing extensive numerical evidence in various setups (through several projects with Xavier Guitart), as well as extending the constructions (with Guitart and Haluk Sengun).

In a collaboration with Xavier Guitart and Santiago Molina, we intend give an adelic description of these points, which we hope will provide a valuable insight in the passage to higher rank groups (so far these points are defined for GL_2 only). This could yield (conjectural) constructions of points on elliptic curves defined over cubic extensions of the base, which to date are inexistent.

In a joint project with Aurel Page, of a more computational nature, we seek to provide an algorithm to compute Darmon points in setting for which the relevant cohomology classes arise in degree 2 or higher. So far all the computed examples (and thus all evidence for the conjecture) have involved computations in degree 1, for which a plethora of techniques exists and is well-known. However, in this higher-degree setting we hope to adapt the resolutions known as "sharply complex" to produce a working algorithm.

Finally, I propose to extend the existing cohomological techniques, by introducing and developing a theory of "nearly overconvergent modular symbols". This will be a non-geometric version of the nearly overconvergent modular forms, which have been used by Urban to construct the Rankin-Selberg p -adic L-function on the product eigencurves. One can envisage an integration theory akin to the one attached to modular symbols, which would allow for the computation of certain non-cohomological classes appearing in works of Darmon-Rotger.

Resumen del Currículum Vitae:

The main result of my thesis work appeared in *Compositio Mathematica*: let f be a modular form of weight k at least 4 and level N , let K be a quadratic imaginary field, and assume that there is a prime p exactly dividing N . This the natural generalisation to the condition one puts for elliptic curves to have a p -adic uniformisation. Under certain arithmetic conditions on the level and the field K , Bertolini-Darmon-lovita-Spiess attach to this data the so-called anti-cyclotomic p -adic L-function $L_p(f, K, s)$. When p is inert in K this analytic function of a p -adic variable s vanishes in the critical range $s=1, \dots, k-1$, and one studies the derivative in this range. I give a geometric interpretation to the other values, by introducing a variety fibered over a Shimura curve, which is the quaternionic analogue to a variety considered by Bertolini-Darmon-Prasanna. I could show that this variety is endowed with a distinguished collection of algebraic cycles which encode, also via a p -adic Abel-Jacobi map, all the values in the critical range of $L_p(f, K, s)$. In recent work with Marco Seveso (ArXiv preprints 1409.1949 and 1409.1895) we extend the construction of the motive to odd weights.

In January 2011 I initiated a long-term collaboration with Xavier Guitart (Barcelona/Bonn) to study explicit methods for Darmon points. In our first two papers we generalised the cycle decompositions of Darmon-Logan, and computed Darmon "ATR points" for curves with non-unit discriminant over a large class of real quadratic fields. Next we generalised the overconvergent modular symbols algorithms developed by Darmon-Green and Darmon-Pollack to allow for curves of non-prime conductor. We later extended some overconvergent cohomology techniques of Pollack-Pollack to allow for the efficient calculation of such points. This allowed us to provide the first evidence supporting the conjectures of Greenberg on the rationality of quaternionic Darmon points.

We realised that the experience of Haluk Sengun (Sheffield) with Bianchi modular forms would be invaluable to extend the constructions to the non-totally real case, and we invited him to join our collaboration. That resulted in two papers, in which we present new constructions of complex and p -adic Darmon points on elliptic curves over base fields of arbitrary signature. We also conjecture that these points are global, and present numerical evidence to support our conjecture both in the archimedean and non-archimedean settings. We also used these new constructions to find new (modular) elliptic curves.



MINISTERIO
DE ECONOMÍA
Y COMPETITIVIDAD



DIVISIÓN DE PROGRAMACIÓN
Y GESTIÓN ECONÓMICA Y
ADMINISTRATIVA

SUBDIVISIÓN DE
PLANIFICACIÓN Y GESTIÓN
ADMINISTRATIVA

AYUDAS RAMÓN Y CAJAL CONVOCATORIA 2015

Turno de acceso general

A related problem is that of computing Heegner points arising from Shimura curves. For it, one needs to describe fundamental domains for the action of a certain Mumford Fuchsian group acting on the Bruhat-Tits tree. In collaboration with Franc, I developed a suite of algorithms that computes the dual graph to the fibre of a Shimura curve at a place of bad reduction (as a quotient of the Bruhat-Tits tree), as well as the corresponding Hecke modules of harmonic cocycles of arbitrary weight. These systems of Hecke eigenvalues can, for example, be used to compute equations for Shimura curves. Incorporating these algorithms into the computer algebra system Sage was one of the goals of SageDays 44, and the code is due to be released in the next version.