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Editorial

ICMAT organizes the 2014 AIMS Conference

A great mathematical event is due to take place in Madrid from July 7th to July 11th, 2014. This is the 10th biennial AIMS (American Institute of Mathematical Sciences) Conference on Dynamical Systems, Differential Equations and Applications. The congress is organized by the Institute of Mathematical Sciences (ICMAT) and the Autonomous University of Madrid (UAM), on the Spanish side, and by the AIMS and the University of North Carolina Wilmington on the American side. It will be the second biggest mathematical event in our country in terms of attendance, after the International Congress of Mathematicians (ICM) held in Madrid in 2006.

This is a wonderful opportunity for the ICMAT to demonstrate to the international community all its organizational and scientific potential, proof of which it has already shown since the start of activities in its new headquarters. It is also a great opportunity for the UAM, as this is the biggest scientific event to be held on its campus. Last but not least, the context of a large conference also provides the Spanish mathematical community with the chance once again to show its scientific wealth and the extraordinary development it has undergone in recent decades.

This cycle of conferences provides a forum for scientists and mathematicians from all over the world who work in the field of mathematical analysis and its applications, including dynamical systems, differential equations, and applications to real-world problems. The venues for this conference alternate between the United States and other locations around the world in order to reach the widest possible audience. This will be the first time that it has been held in Spain, and will provide mathematicians from this country who are engaged in these fields with the chance to participate in scientific sessions with leading international figures, learn all the latest results, exhibit their work and open up new avenues of collaboration. *(Continued in p.2)*

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Report

ICMAT Laboratories: Capturing Brains

During the years of economic prosperity before the current crisis, the growth of science in Spain was such that it seemed we could start attracting some of the best researchers from abroad. Now harsh reality has impeded this possibility and reactivated the opposite phenomenon - which has traditionally affected our R+D system - the so-called brain drain. It is true that our country has never been a paradise for the most outstanding figures in world science, since we find it difficult to compete with institutions in the United States, Japan and Europe in terms of facilities, salaries and highly competitive environments. While appointing leading scientists here is currently beyond the means of most of our research centers, the Instituto de Ciencias Matemáticas (ICMAT - Institute of Mathematical Sciences) has managed to find a way to do it, an innovative tool called ICMAT Laboratories, which enables the Institute not only to attract but keep some of the most renowned mathematicians.

Ignacio Fernádez Bayo. Charles Fefferman, professor at Princeton University and Fields Medal winner in 1978, is currently one of the most highly recognized mathematicians whose research work has had and continues to have a great impact in very different fields: analysis, partial differential equations, Fourier analysis, mathematical physics, fluid dynamics, neural networks and differential geometry. Furthermore, Fefferman is the director of the first ICMAT Laboratory, where he is joined by four other stars in the mathematical firmament; Marius Junge, Nigel Hitchin, Viktor Ginzburg and Stephen Wiggins, the latter being appointed just this summer.

The formula resides in setting up a team consisting of a senior ICMAT researcher and other pre-doctoral or post-doctoral researchers, with an eminent mathematician at its head, to work *(Continued in p.2)*

Editorial

The conference consists of various keynote talks at the highest scientific level, as well as sessions specially chosen from among the proposals submitted. The list of speakers for 2014 is nothing short of spectacular: Nalini Anantharaman (France), Diego Córdoba (Spain), Ingrid Daubechies (USA), Weinan E (USA), Charles L. Fefferman (USA), Bernold Fiedler (Germany), Zhiming Ma (China), Philip Maini (UK); Sylvia Serfaty (France), Carles Simó (Spain), Cèdric Villani (France), Amie Wilkinson (USA), among whom are two Fields Medal winners. As regards the special sessions, there are currently 74 proposals, which indicate that the number of participants will be greater than ever. Indeed, the growing success of this conference is based on this twofold nature: the quality of the speakers and the flexibility of the special sessions.

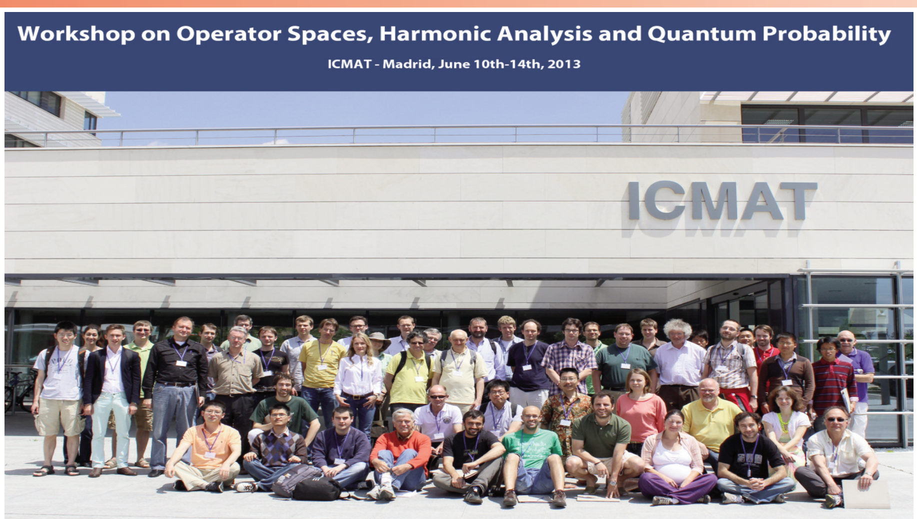
This series of conferences emerged under the auspices of Professor Shouchuan Hu. The first was held at the Southwest Missouri State University (USA) in May, 1996, and was followed by eight more. The number of people taking part has grown on each occasion, with 700 participants in 2006 in Poitiers, 1,100 in Dresden, 1,200 in Orlando and now an estimated 1,400 in Madrid. If this figure is confirmed, the conference in Madrid will be the second largest mathematical congress ever held in Spain after the ICM in Madrid in 2006, exceeding the AMS-RSME Joint Meeting held in Seville in 2003 and the 3ECM in Barcelona in 2000.

The American Institute of Mathematical Sciences is an international organization whose aim is "to advance mathematical knowledge and increase awareness of the mathematical sciences in society". Thanks to its many activities including schools, conferences and publications, AIMS contributes to the training of mathematicians and their interaction scientists from other fields. Although it addresses a broad spectrum of mathematics, AIMS is primarily centered on differential equations, dynamical systems and their many applications to science and engineering, by means of analysis, modeling and mathematical computation. AIMS generates funds from its own activities and also receives backing from the University of North Carolina Wilmington and the National Science Foundation. Its director and founder is Professor Shouchuan Hu.

As regards this particular conference, in addition to the main organizing institutions, other collaborating bodies are the Consejo Superior de Investigaciones Científicas (CSIC), the Complutense University of Madrid, the Rey Juan Carlos University, the Carlos III University of Madrid, the Technical University of Madrid and the Spanish Society of Applied Mathematics.

Here in Madrid we welcome the international mathematical community with open arms, in the assurance that the conference will be a great event which will undoubtedly give rise to excellent prospects for mathematics.

Report



ICMAT

The Worshop on Operator Spaces, Harmonic Analysis and Quantum Probability was held as part of the Laboratory Marius Junge 10th-14th June 2013

together on a particular project or research line. In the words of ICMAT Director Manuel de Léon: "The international leader, who lends his or her name to each laboratory, remains in permanent contact with the group and visits at least once a year for two or three months, as well as attending other activities such as symposia, workshops, courses and work meetings organized by each laboratory". He goes on to say that, "our researchers reciprocate these visits and interact with their teams". It is virtually like having a leading mathematician under contract at very little cost, since "they receive no remuneration for their collaboration except of course for travel and accommodation expenses, courses and talks".

The Charles Fefferman Laboratory got under way in 2011 after an agreement between the ICMAT and the CSIC General Foundation, which according to Manuel de Léon "was seeking an alternative formula to permanent appointments and sabbatical stays. They thought of the name for the laboratories on the basis of extending five-year contracts with the commitment of appointees devoting several months every year to work with a local team. They suggested we set up a pilot laboratory and Fefferman was delighted to accept the proposal". As Diego Córdoba, the local head of the laboratory, explains: "We had been collaborating with Fefferman for years. We had a consolidated relation with him and the laboratory enabled us to put his name to this joint activity. We are interested in analytical problems arising from fluid mechanics; in particular, the question whether or not solutions exist to models that describe the dynamics of incompressible flows. One of the most recent achievements of this collaboration is that we have obtained important results on the study of the formation of singularities in the interface dynamics of an incompressible flow". The team also consists of the researchers Francisco Gancedo, Ángel Castro, Javier Gómez-Serrano, Tania Pernas, Alberto MartÍn and Rafael Granero.

Marius Junge is a professor at the University of Illinois at Urbana-Champaign.

The other laboratories were obliged to wait until 2012, when funds became available to create them, thanks to the additional funding accorded to centers belonging to the Severo Ochoa Program of Excellence, a distinction awarded to the ICMAT as a result of the first call in the autumn of 2011. A call was then issued for ICMAT researchers to submit projects for the laboratories. Manuel de Léon tells us that, "the most active people and those with the most international contacts responded immediately, and submitted a report containing the names of the researchers who might wish to join, their curricula, work plans, program of activities and budget proposals. The submissions were to be highly documented with priority given to the scientific aspects". All the submissions were assessed by a selection committee and all received approval, which led to the formation of four groups; only those proposals with sufficient prior substance were submitted.

Professor at the University of Illinois at Urbana-Champaign, Marius Junge is universally recognized for his work in quantum probability, operator theory, non-commutative harmonic analysis and quantum information theory. The project to invite him to form part of a laboratory comes from Javier Parcet. "I had already been collaborating with Marius since 2003 and a group gradually arose around this collaboration in operator theory and non-commutative harmonic analysis", said Parcet during the break of a symposium organized precisely by this laboratory as one of its activities. "The laboratory enables us to interact more. Marius acts as a catalyst and guides many of the team members in the right direction, which helps us to make greater advances and to do it more quickly. For example, together with the quantum information group working with us, we've produced results in Hypercontractivity. The purpose is to increase applications in quantum information, which have yet to be found, although some problems in non-commutative harmonic analysis have been solved".

"There are three PhD students and three of my post-doctoral researchers in the team, Matilde Perrin, Carlos Palazuelos and Guixiang Hong. Carlos is continuing on his own account, but he has obtained a Ramón y Cajal grant and this is a qualitative leap forward in his training". Furthermore, a group belonging to the Universidad Complutense in Madrid is also participating as well as Junge's own researchers. Says Parcet: "Three of his students are attending the congress and are here for an intensive month".

Junge and the other leading figures have joined the program and have done so without any particular problems or demands. According to Manuel de León, "obviously, in all cases contacts existed beforehand and a more or less intensive collaboration was already taking place, but I also believe that the international prestige enjoyed by the ICMAT has also been an influence. Their response has been magnificent".

The Hitchin Laboratory arose from an initiative by Óscar García Prada, who heads the ICMAT Algebraic Geometry and Mathematical Physics Group. Nigel Hitchin is a professor at Oxford University and is one of the leading lights in the fields of differential and algebraic geometry and their relations with equations in mathematical physics. He is a member of the Royal Society and former chair of the London Mathematical Society, and has received many distinctions such as the Sylvester Medal and the Pólya Prize. In this case the interaction between the ICMAT group and Hitchin's group in Oxford is very intense and is focused on diverse topics in the area of interaction between geometry and physics, including moduli spaces, Higgs bundles, generalized geometry and Poisson geometry.

Says García Prada, "I have a very close relation with professor Hitchin. I met him in 1987 and finished my doctoral thesis in Oxford in 1991 under his supervision and that of Professor Simon Donaldson. We've had regular scientific contact with reciprocal visits since the mid-1990s, and in 2006 we organized a congress in his honor at the CSIC on the occasion of his sixtieth birthday". The laboratory's activities are extremely varied, the most original of which are think-tank meetings. As García Prada explains, "these are retreat-type get-togethers of a very few people devoted to a specific frontier subject in research in our field, when we discuss open problems in depth. We held one of these meetings last March and are planning to hold more".

Tomás Gómez and Luis Álvarez-Consul participate permanently in the Hitchin Laboratory, together with various post-doc and PhD students. Adds García Prada, "there are more or loss a dozen researchers, and of course it's open to all ICMAT members who wish to take part".

"The laboratory initiative benefits the entire Spanish mathematical community"

Viktor Ginzburg is a professor at the University of California in Santa Cruz. His work is particularly focused on the existence of periodic orbits in Hamiltonian dynamical systems from the point of view of symplectic topology, fields in which he is a leading world authority. At the ICMAT there is a team conducting research into dynamical systems to which Daniel Peralta belongs, and another represented by Francisco Presas working on symplectic topology, about which Presas has this to say: "We wanted to collaborate because these two fields are closely allied, but we couldn't manage to do it. So we decided that it would be a good idea if we could find someone to act as a bridge, because we were not very familiar with the area of intersection between both fields, which is in fact to do with

Hamiltonian systems. That person turned out to be Viktor Ginzburg, one of the professors of greatest renown in that particular area".

"The interesting thing about Viktor," says Peralta, "is the techniques he uses, which were not employed in Spain. He's devoted a lot of time to studying the periodic orbits of Hamiltonian systems, which appear when modeling mechanical systems; for example, the trajectories of an asteroid". The benefits of the laboratory extended to other centers. "Symplectic topology is a fashionable area that has grown a lot recently, and the very few of us in Spain who study this set up a group (GESTA) with which Viktor has always been associated. We organize an annual congress and this year we held it in France where Viktor gave a mini-course". Francisco Presas says that, "the Laboratory favors this relation and has benefitted everyone, even those in Europe who are working on symplectic topology, together with those like ourselves who form part of a network belonging to the European Research Foundation". And as Manuel de León states, the laboratory initiative benefits the entire Spanish mathematical community, all of whom many take part in the activities organized and enter into contact with the most outstanding researchers in the related fields.

The Ginzberg Laboratory consists of quite a few researchers, some such as Alberto Enciso and David Martín de Diego from the ICMAY itself, and others from elsewhere such as Eva Miranda from the Universidad Politécnica de Cataluña, as well as five or six doctoral students, five post-doctoral and a further two pre-doctoral in Barcelona.

The last laboratory to be established is the Stephen Wiggins Laboratory, which gets under way this summer. Wiggins is a professor of Applied Mathematics at Bristol University whose research work is based on the identification of those areas in science and engineering that require fresh mathematical and computational advances. This strategy seeks to provide an enhanced response to these demands by developing new tools. The project at the Laboratory that bears his name is an initiative coming from the ICMAT group on geophysical fluid dynamics, headed by Ana María Mancho, with the purpose of developing techniques for the evaluation and prediction of the behavior of particles transported in geophysical fluids, such as oceans and atmospheres.

Ana María Mancho says: "I was working as a post-doc student with Steve twelve years ago, and since then we've collaborated a lot. He has projects running at the Office of Naval Research, which has renewed his appointment, and he has joined our laboratory project. The prospect is for a very close collaboration, both with his visits here and our stays there".

She goes on to explain that, "we are trying to interpret how the particles move in a velocity field and we need tools coming from dynamical systems. These tools already exist for velocity fields that do not change over time or which change periodically, but in the ocean the fields change and not in a regular way. We interpret these variations and cross them with data derived from empirical sources; for example, from drifters or buoys used by oceanographers, or from weather balloons used in the stratosphere, which enable us to understand the behavior of contaminating particle transport or aerosols".

From left to right: Mathilde Perrin, Carlos Palazuelos, Jose Conde, Javier Parcet, Marius Junge, Luis Daniel López and Guixiang Hong.

The team belonging to the Wiggins Laboratory consists of the PhD student Jezabel Curbelo and Alfonso Ruiz Herrera, a researcher who is due to join the team in September. The appointment of a PhD student and a Juan de la Cierva fellow is still pending. Carolina Mendoza, a professor at the Universidad Politécnica de Madrid who worked with Mancho at the ICMAT as a post-doc student, and Álvaro de la Cámara, a former PhD student with Ana María Mancho who currently works in Paris at the Laboratoire de Météorologie Dynamique de la École Normale Supérieure, will also collaborate. Over the next few months they will spend some weeks working in the Laboratory, during which time researchers from the University of Delaware, the University of Maryland, the Virginia Tech and the US Naval Academy will also join the Laboratory on a temporary basis.

The laboratory strategy enables the ICMAT to be at the forefront of world research at a very reasonable cost. As Manuel de León points out: "There's a separate budget for each laboratory, which works out at an average of 250,000 Euros per laboratory over the three to four year period. The idea is to go ahead with these and whatever new laboratories may appear. We'll see what happens when funding from the Severo Ochoa Program comes to an end, but we hope to be able to renew it when the time arrives". He also adds that they are trying to acquire funds from other bodies such as foundations and companies in order to set up new laboratories.

The experience is also very interesting for the titulary heads of the laboratories themselves, which among other things ensures their commitment to the scheme and underpins the attainment of the ambitious goals set out. This interest is expressed through the words of Nigel Hitchin: "My relations with the ICMAT rest on the connections that already existed with Spanish mathematicians, but the opportunities arising from this new, more formal relationship are turning out to be highly beneficial. I found the workshop held in Miraflores in March this year to be particularly useful. The free exchange of ideas that took place there has provided me with material for new research work in which I am presently engaged".


The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications
July 07 - July 11, 2014
Madrid, Spain
Invited Main Speakers:
Nalini Anantharaman fr
Diego Córdoba es
Ingrid Daubechies us
Weinan E us
Charles L. Fefferman us
Bernold Fiedler de
Zhiming Ma cn
Philip Maini uk
Sylvia Serfaty fr
Carles Simó es
Cedric Villani fr
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"When I'm stuck with a problem I think 'Well, after all I won the Fields Medal'"

Charles Fefferman is a researcher at Princeton University.

Ágata Timón. Charles Fefferman (1949, EE. UU) started to read Physics books on his own when he was 9, because he wanted to know how rockets work. His impressive career in Mathematics began when he realized that he needed this science for a deep understanding of many problems that fascinated him. He graduated with the highest distinction at the University of Maryland at the age of 17 and was awarded his PhD in Princeton three years later. He lectured at Princeton for one year, and in 1970 he moved to the University of Chicago where after a year he was promoted to full professor, which earned him the distinction of becoming the youngest full professor ever appointed in the United States. In 1973 Fefferman returned to Princeton and he has stayed there ever since. He won the Fields Medal in 1978 for of his work on convergence and divergence on trigonometric series. When asked, he says that his favourite research contributions are the most recent ones. He collaborates with Diego Cordoba's team at the ICMAT in problems of fluid mechanics, through the ICMAT Laboratory that he leads. On one of his visits to Madrid, we had the great opportunity to speak to him about his interests, his career and his expectations for the future.

Question: When and how did you become interested in Mathematics?

Answer: When I was a little boy I was interested in children's science: how rockets work and things like that, but I wasn't satisfied with simple explanations, so I checked a Physics textbook out of the public library and I couldn't understand anything. I was nine years old, and my father told me: "Of course you can't understand this book, there's Math in it!" So I asked him if I could study Math. I was in the fourth grade, and he bought me a 4th grade Math textbook. That was the beginning.

> "If I hear about something that sounds interesting and if I am capable of understanding it enough to start thinking about it then I go ahead"

Q: How did you realize that you had a special talent for Mathematics?

A: Very soon after that, because I read the 4th grade Math textbook in a day or two. My father didn't believe me, so he asked me a few questions and realized that I understood. Then he bought me a 5th grade textbook, and I read it in a day or two, and so on until I studied calculus and that took longer than a day or two. But I was just a little boy studying Calculus so it was obvious that I had talent.

Q: You wrote your first scientific article when you were 15; could you tell us about that?

A: At that time I had a wonderful professor of mathematical logic: Carol Carp, who was interested in what you might you say if you could speak in infinitely long sentences. There was a question about how many different things could be distinguished depending on what kind of infinity was in the infinitely long sentence. I was supposed to present a very complicated solution in class and I couldn't understand the very complicated proof, so I thought about my own proof and it turned out that it could be generalized. My professor was very supportive and said: "Why don't you work this out and go further?", and then: 'Why don't you write it down?' After that he said: 'Let's send it to a journal and see what happens', and it was accepted.

Q: At this point you where already at the University of Maryland. What was that like?

A: When I was a boy I lived near the University and when I'd learnt so much Math that the public schools couldn't offer me anything else, the professors at the University of Maryland, a big state university, took an interest in me. Part of my education was leaving the school system and going to the University of Maryland as boy of fourteen.

Q: Did you take regular lessons there?

A: I took a lot of Math and Physics courses, maybe not enough Philosophy and Literature courses. But in addition to that I worked on projects outside of class. The professors suggested problems to me, and if I had any concerns they were always there for me. It felt to me like an army of private tutors; they where wonderful and they had a big impact on me.

Q: Which other people influenced you most?

A: My thesis advisor, Elias Stein, has had a tremendous influence on me; I think he was probably the best teacher of advanced Math in the world. He influenced me about what I learnt and formed my taste, and he taught me his spirit of optimism when facing hard problems.

Q: A few years later you became the youngest full professor ever appointed in the United States. What was that experience like for you?.

A: It felt great. The process of getting tenure is usually very arduous but for me it happened instantly. I got my PhD in Princeton, then I was very young faculty member at Princeton for a year, and after that an Assistant Professor in Chicago for one year. In the spring of my first year at the University of Chicago they offered me tenure. At first it felt strange to be around all the other professors because of the age difference, but they were very nice and it became natural.

Q: What happened after that?

A: I stayed in Chicago for four years (71-74) and then I came back to Princeton, and I've been there ever since.

Q: When you were at Princeton, you were awarded the Fields Medal in 1978; what can you tell us about that? What did it mean to you?

A: At the time it simply made me happy: it was the highest recognition that I could get. Afterwards, when as it often happens I was completely stuck on one problem for a very long time and was getting nowhere, developing no theorems, I could easily get depressed, but then I would think to myself: "Well, after all I won the Fields Medal".

Q: What areas have you been interested in?

A: I've been interested in Classic Fourier Analysis, Partial Differential Equations, Several Complex Variables, Quantum Mechanics, Fluid Mechanics, Interpolation and Approximation and some aspects of Differential Geometry.

Q: That's a lot of different fields!

A: Yes. If I hear about something that sounds interesting and if I am capable of understanding it enough to start thinking about it then I go ahead.ems arise.

Q: What would you say your main research contributions have been?

A: In general, my favourite research contributions are the most recent ones. There's something that I like very much that I did a long time ago, and that was the duality of H1 and BMO. In general, I work very hard to try to prove theorems, and the proofs are often complicated, but in this particular case the theorem was simple, the proof was simple and the process of discovering both the proof and the theorem was short and easy.

Q: What's that about?

A: H1 is a certain space of analytic functions on a disc. BMO (Bounded Mean Oscillation) is functions that are very slow. At that time, BMO was an interesting concept with interesting applications, and it seems to have absolutely nothing to do with analytic functions, so my result was an unexpected connection between two things which turned out to have applications.

Q: What would you say the most exciting application of your work has been?

A: The most practical application of that part of my work was the idea of wavelets. I'm not one of the inventors of them, but they are based on some mathematical discoveries that we'd made a couple of decades before they were first introduced.

Q: Could you explain us what wavelets are?

A: They are a way for breaking up complicated signals into simple pieces. A standard way to do that is to expand it on their Fourier series.

Q: What are the Fourier series?

A: If you have a vibrating string it has a fundamental note and a first overtone, a second overtone, etc. Each one is a very simple kind of vibration. However, if you put them together you get a very complicated vibration of the string. The Fourier series of the string sound would be the decomposition into simple vibrations. This analysis breaks things up in such a way that you can understand them very clearly in terms of frequency, but it's not localized in time. On the other hand, if you think of the original signal, let's say what the string is doing at each instance of time, you can understand very precisely for a particular time, but you loose the resolution in terms of frequency. You can't take perfect resolution in terms of both, but wavelets are a way of understanding as much as can be understood simultaneously about frequency and time.

> "I don't choose to work on a particular problem, the problem chooses me"

Q: Where are wavelets used?

A: They are used, for instance, in compressing signals, in taking the noise out of the signals. There was a project which applied mathematicians had undertaken for recovering one of the earliest Bramhs' recordings. If you listen to the tapes they sound very bad; you can't really tell what is going on, but if you analyse the signal using wavelets you can actually extract pretty reasonable sounds out of there and hear what Brahms was playing. I don't know whether wavelets play a role in the compression of a signal for high definition TV, but although I don't know I can promise that in the next generation they will.

Q: How do you arrive at the questions you work on?

A: I don't choose to work on a particular problem; the problem chooses me. I hear about it, I can't stop thinking about it, sometimes I solve it, sometimes I don't, and it could go on for a long time. Sometimes it emerges when speaking with other mathematicians, or just following my own thought processes, sometimes reading…

Q: And after the problem chooses you, how do you arrive at the answer? How do you usually work?

A: I try to find a simplified version of the problem: simple examples in which the main issue is possible and it's present but everything else has gone. The hope is to find a lead to follow, and you understand one step at a time. In the beginning it's not obvious how to find such a lead, and so usually I'm completely stuck for a very long time. But then eventually I get an idea and the idea turns out to be wrong, then there's more delay, but then I get another idea which also turns out to be wrong. However, pretty soon there are enough ideas to balance each other out and combine, and if there is some grain of truth there, then eventually I'm able to solve some easy version of the problem, and that's the first step of the lead. Then I can try to generalise the problem, although sometimes lose the lead, because I didn't realise that there was something wrong, so it's not all progress.

Q: What's the longest period you've invested in thinking about the same problem?

A: 15 years.

Q: What was that about?

A: It was a problem in Quantum Mechanics, I was wondering why atoms form. You can read in a quantum mechanics textbook that if you take one nucleus (let's say, a proton) and one electron it makes a hydrogen atom, but if you have 10^26 protons and 10^26 electrons and you put them in a box, nobody can tell you why they form 10^26 atoms.

Q: Did you finally solve that problem?

A: No. It took a very long time, I didn't prove it and it's still not known. I was able to prove that some related constants have some properties, but not the original question.

Q: What are you working on now?

A: It's been a very fruitful period for me, and I've been working on several problems. Right now, I'm working on some problems in Fluid Mechanics with the team at the ICMAT. There is an equation called 'the water wave equation' that is exactly what it sounds like: you have water and air and you want to know what the water wave does. One year ago, the team and I found that the water can form a splash. This seems natural if you go to the beach and look at the splash in the sea, but the way the equations were set up, for instance, there is no sea bottom, there is no wind… people didn't know what could happen. There is a lot of physics in water wave equations, but not quite enough. Now we are trying to see what happens if it's more physically realistic, if we put more physics in it.

Q: Are you working in other fields?

A: Yes, in several, but I'll point out the ones that are easier to explain. I'm working on Interpolation and Approximation, helping experimentalist to obtain good conclusions for their work. I'm working on another aspect of Quantum Mechanics now: there's a very interesting material called grapheme which is a two-dimensional material made of carbon atoms and has the symmetry of a honeycomb. It's made of little hexagons and has many remarkable physical properties: if you prepare the right kind of sample of grapheme then electrons can move along an edge from left to right as though they were moving without resistance in free space, but they can't move from right to left at all. There are some very strange properties like this and we are trying to understand mathematically why these things are true. These three problems are easier to understand than the others .

Q: And you also do a lot of work in mathematical education, don't you?

A: Yes, at the moment I have one PhD student. I enjoy teaching mathematics at all levels: I enjoy working with my PhD student, but I also enjoy teaching basic Calculus. At Princeton I used to teach an advanced and an undergraduate course every year. I often teach basic Calculus, which is the most elementary Math course at the university.

Q: You also work in doctoral and postdoctoral education with the ICMAT-Laboratory; what could you tell us about that?

A: I think it is a good model, I am very happy with my lab, they are so smart and nice. I understand that in other science laboratories part of the role of the lab leader is to manage conflicts, but I don't manage conflicts; everyone gets on well together and the work is a pleasure. It's been a great experience for me. I've produced some of my best papers, which I know I couldn't have written if it hadn't been for collaboration with the team.

Q: You have a close relation with the Spanish mathematical community. How did that start?

A: It began when I was supervising Antonio Córdoba (ICMAT) when I was a young professor at Chicago University and he was a graduate student. I remember being terrified of the responsibility of advising a student, and I didn't know how lucky I was; he was so brilliant. Since he was my first graduate student and I had nothing to compare the experience to, I thought: 'Okay, this is what it's like to be a supervisor'. After that we became close friends and we wrote papers together. When Antonio returned here, to Spain, he came in contact with brilliant students and he sent several of them to Princeton and I had the luck to work with them. Some of them made the terrible mistake of working with other people and that's fine (laughts), but I got several of the brilliant Spanish students. It was natural for me to visit here regularly; I'm working on several projects now with Diego Córdoba's team at the ICMAT. I knew Diego when he was a little baby, and then as a young man growing up. When he was ready for graduate school he went to Princeton with me, which was amazing for me. He is also brilliant and has done fabulous work, so it was natural for me to work with him and then with the team.

"I knew from the age of fourteen that my future would be in mathematics"

Ándrea Jiménez. Javier Gómez Serrano (1985, Madrid) is one of the Instituto de Ciencias Matemáticas young researchers. After reading his doctoral thesis in July of this year, supervised by Diego Córdoba, who is also a member of the ICMAT, he is due to take up a position as an Instructor at Princeton for three years, where he will continue the same line of research he has recently been following at the Institute. In spite of his youth, he has published various scientific papers on incompressible flows in high-impact journals, as well as being the author of educational and informative articles. He has to his credit more than fifty awards, including the Third National End-of-Course Prize, which he won in May 2013. He began his thesis in 2009 as part of Diego Córdoba's project on "Contour dynamics and singularities in incompressible flows", funded by the European Research Council.

Gómez was certain from the age of fourteen that his future would be shaped by theorems, so he had no hesitation in choosing Mathematics at university, obtaining his degree at the Technical University of Catalonia in 2009. Furthermore, he simultaneously studied a degree in Telecommunications Engineering, which he completed in the same year, and as he himself says "those were the years of telecommunications", which he believed would provide him with a settled professional future. At the same time he also managed to work at Google in Dublin as a software engineer for four months, thereby broadening his knowledge on computational systems and networks. He subsequently went on to do a Master in Applied Mathematics at the Universidad Autónoma de Madrid, with an end-of-course project devoted to Prandtl's boundary-layer equation, thanks to which he came top of his class in that year (2010).

Javier Gómez Serrano, one of the ICMAT young researchers.

In addition to the seminars, conferences and day-sessions in his curriculum, as well as his many other activities and the teaching experience acquired in different workshops, one of his most outstanding roles was as a collaborator in the district, national and international stages of the Spanish Mathematical Olympiad between 2010 and 2013, while also at an international level between 2009 and 2011 he sat on the jury for the "Southwestern Europe Regional Contest" as well as the committee for drawing up the tests. He has also been a professor in Estamalt program in Catalonia and Madrid, which was before the first class student project.

He is currently involved in one of the ICMAT Laboratories, specifically that headed by Diego Córdoba and the Princeton University professor and Fields medal winner (1978) Charles Fefferman, with whom Gómez has enjoyed a particularly rewarding experience. "Fefferman has a very broad outlook on mathematics and knows how to convey it very clearly. He is an inexhaustible source of ideas, and unlike other people he has no hang-ups with ego and no need to demonstrate his superiority. He is a very friendly person to deal with both professionally and personally." The laboratory in which he is engaged is devoted to the study of analytical problems arising from Fluid Mechanics, in particular, the existence or not of solutions for models describing the dynamics of incompressible flows.

In addition to Córdoba and Fefferman, the team consists of the researchers Francisco Gancedo, Ángel Castro, Tania Pernas, Alberto Martín and Rafael Granero, and is specifically engaged on modeling the mechanics of sea waves. One of the most recent results to emerge from this project, on the formation of singularities in the interface dynamics in an incompressible flow, was published last year in the prestigious scientific journal Annals of Mathematics. "We managed to demonstrate what you see on the beach: some waves break; that is, after a certain time the wave collapses and the curve of the water interface touches itself." Furthermore, in an earlier result the team proved that there exist certain solutions for equations that turn after a certain length of time. Now they would like to pursue their results in greater depth to the extent of demonstrating that certain solutions to equations share both of the above-mentioned properties. The ultimate aim is to calculate the water wave equations. In his latest sojourn abroad in Princeton University, Gómez will continue to work with Fefferman and his current collaborators on research into the problems in fluid mechanics that have engaged him in recent years. At present, his ambition is to carry on working on subjects that he likes, which means his commitment to the research he enjoys so much.

"Research in mathematics is similar to explore, to mapping an unknown land"

Viktor L. Ginzburg (1962, Moscow, Russia). He graduated from High School 57 in Moscow, a school specializing in Math and other sciences, which is where he became seriously interested in Math and realized that he wanted to become a mathematician. He worked with Vladimir Arnold in Moscow for two years when he was at college, and subsequently obtained his PhD from Berkeley, California, where his advisor was Alan Weinstein. He is currently a Full Professor at the University of California at Santa Cruz (USA). His main research interests are symplectic topology and Hamiltonian dynamical systems. He is working on the problem of the existence of periodic orbits in Hamiltonian dynamical systems, mainly analyzed from the point of view of symplectic topology.


ICMAT

Viktor Ginzburg is professor at the University of California at Santa Cruz.

Question: Why did you choose Mathematics overahead of any other subject?

Answer: I wanted to do science. What appealed to me in Mathematics is that it is a hard science with all the rigor and discipline of hard science, but the action happens in a purely intellectual domain requiring no equipment or lab. It's hard science you can do while going for a walk or working in your study and this, at least in theory, gives you a huge degree of independence.

Q: Besides Mathematics, which activities do you like most?

A: I enjoy hiking a lot, or just going for a walk in a park or by the sea. I' am interested in cooking and I appreciate good food, good wine and a good company. I can't say I' m an avid or serious reader, but books do make one's life much richer and so do movies.

Q: A movie, book or play you'd recommend?

A: I like "Porco Rosso" and "Howl's Moving Castle" by Miyazaki. Iain (M.) Banks is one of my favorite modern authors. I enjoyed "The Bridge" and Banks' science fiction, but not "The Algebraist". Another writer I like a lot is Haruki Murakami.

Q: What was your first encounter with mathematical research like?

A: I think it was by-and-large frustrating. Even though I knew some Math, I didn't not have much skill and understanding of how to do Math research and for a while I was on my own trying to work on various problems rather unsuccessfully. I have learned a lot from this experience.

Q: What did you like most about your early experiences with mathematical research?

A: Being somewhere where no one has been before. I still feel that doing math research is similar to exploring, mapping some unknown land.

Q: Which scientist has impressed you most during your career?

A: I was deeply influenced by Vladimir Igorevich Arnold in my early years.

Q: Do you have a particular theorem or formula you especially like?

The Gauss-Bonnet formula. It's a source of much of the 20th century geometry.

Q: What is your favourite mathematical book?

A: "Topology from the Differentiable Viewpoint" and "Characteristic Classes" by John Milnor, "Mathematical Methods of Classical Mechanics" by Vladimir Arnold.

Q: How would you describe your research interest in a few wordslines?

A: I work at the interface of dynamics and symplectic geometry. AI lot of my recent work is on periodic orbits of Hamiltonian systems.

Q: Which particular mathematical problem do you consider especially challenging?

A: That's a tough hard question because there are a great many challenging problems. Virtually any interesting and important open question is challenging. Otherwise, it would non't be open.

"Vladimir Igorevich Arnold influenced me deeply in my early years as a researcher "

Q: Which subjects in mathematics outside your field would you like to learn more about?

A: Some aspects of hard Analysis and Combinatorics. For me, hard Analysis is a tool, but I think there's a breathtaking beauty in some analysis arguments when you get beyond technicalities. As for Combinatorics, I' m not sure if it's a subject, but it's certainly a very useful skill.

"I´m interest in aspects of hard analysis and combinatorics"

Q: In the future, where do you think the interaction between different branches of Mathematics may be more fruitful?

A: Actually, I doubt there really is a division of Math into branches. Perhaps, this division was introduced by someone way back then for accounting purposes for teaching. Seriously, if when you look at many top-extra class mathematicians they work and think beyond this division. But back to answer your question.… Clearly, interactions between Math and Physics, e.g., mirror symmetry for instance, and Math have been extremely fruitful lately and I have no doubt they will remain fruitful for a while. Of course, it started with Geometry, but now the influence has gone beyond that and I think the whole brave new Algebra, needed to talk about Geometry, is going to come out of it.

Q: Do you have any message or advice you would like to share with young mathematicians?

A: Having a good advisor is extremely important. Picking an advisor who does not suit you for whatever reason is one thing that can ruin your math career before it begins. Working in an active area where there are a lot of ideas and a lot of things happening is good. Such areas are inevitably technical and mastering the required machinery is very helpful, often necessary. Be patient: doing difficult, interesting math requires patience and effort. But ultimately whatever math you do, you are doing it for yourself and if you don't enjoy it then something is not right.

"Doing difficult and interesting math requires patience and effort"

Differentiation of integrals in higher dimensions

Authors: Javier Parcet and Keith M. Rogers (Instituto de Ciencias Matemáticas, ICMAT).
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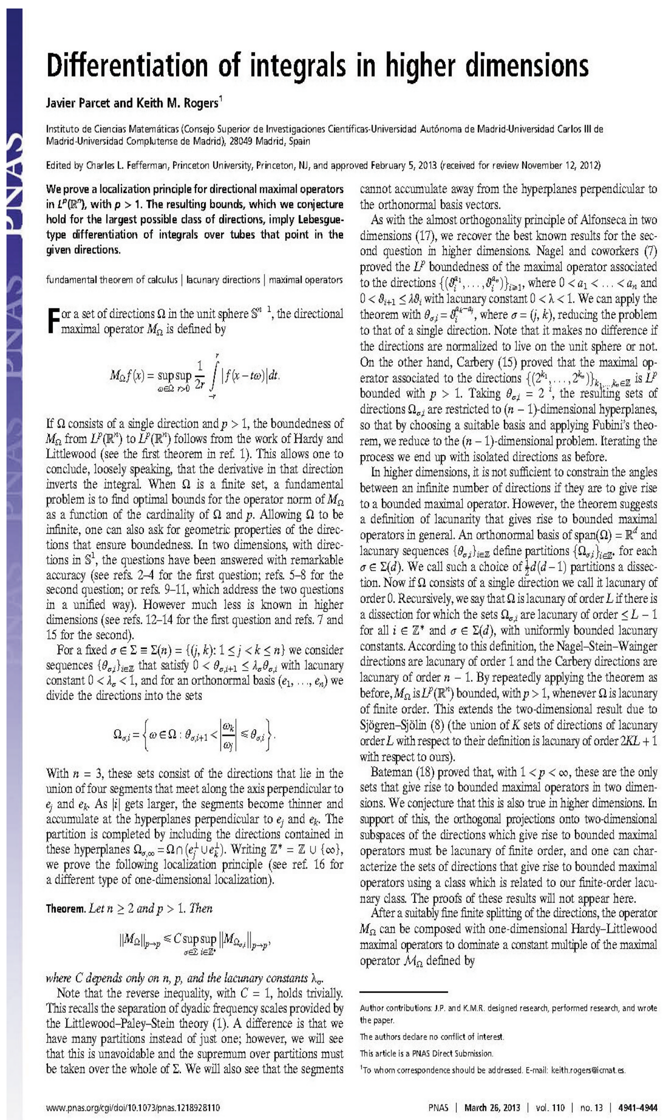
Web: http://www.pnas.org/content/110/13/4941.abstract

Leibniz and Newton's Fundamental Theorem of Calculus states that, in one dimension, differentiation is the inverse of integration; that is, every continuous integrable function verifies that the derivative of its integral is equal to itself. Lebesgue generalized the result to functions which are only locally integrable. In this article, published in the Proceedings of the Natural Academy of Sciences in March, 2013, Javier Parcet and Keith M. Rogers, researchers at the ICMAT, analyze the situation in dimensions greater than one. By employing a standard density argument, the problem is reduced to bounding directional maximal operators.

These operators are found in different fields such as Geometric Measure Theory or Harmonic Analysis where they control the behavior of the Fourier inversion formula. The Fourier transform codifies the information of a signal in its frequencies, while its inverse performs the opposite process; that is, it reconstructs the signal from the resulting frequencies. In order to return to the original signal, the frequencies can be added up in different ways, in cubes or balls, for example, and the geometry of the surface comes into play. The maximal operators in directions normal to the surface are vital in the analysis of the behavior of this formula.

The problem of characterizing the sets of directions for which the directional maximal operators are bounded was already solved for two dimensions, where the directions are contained within the unit circle centered at the origin. Parcet and Rogers analyze the case for three or more dimensions. In three dimensions the directions are included in the sphere, where there is no order (i.e., it is not known whether one direction comes before or after another, while this notion does exist in the circle), which made it difficult even to imagine the answer. However, in this article the authors characterize the directions whose associated maximal operators are bounded in any dimension greater than two.

This result does not close the problem entirely because it would be desirable to obtain a more descriptive characterization. Nevertheless, this is the first time that the problem has been treated in generality, since hitherto only particular examples had been known.



PNAS

Differentiation of integrals in higher dimensions

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We prove a localization principle for directional maximal operators in $L^p(\mathbb{R}^n)$, with $p > 1$. The resulting bounds, which we conjecture hold for the largest possible class of directions, imply Lebesgue-type differentiation of integrals over tubes that point in the given directions.

fundamental theorem of calculus | lacunary directions | maximal operators

For a set of directions Ω in the unit sphere $\mathbb{S}^{n-1}$, the directional maximal operator M_Ω is defined by

$$M_\Omega f(x) = \sup_{\omega\in\Omega} \sup_{r>0} \frac{1}{2r} \int_{-r}^{r} |f(x-t\omega)|dt.$$

If Ω consists of a single direction and $p > 1$, the boundedness of M_Ω from $L^p(\mathbb{R}^n)$ to $L^p(\mathbb{R}^n)$ follows from the work of Hardy and Littlewood (see the first theorem in ref. 1). This allows one to conclude, loosely speaking, that the derivative in that direction inverts the integral. When Ω is a finite set, a fundamental problem is to find optimal bounds for the operator norm of M_Ω as a function of the cardinality of Ω and p. Allowing Ω to be infinite, one can also ask for geometric properties of the directions that ensure boundedness. In two dimensions, with directions in $\mathbb{S}^1$, the questions have been answered with remarkable accuracy (see refs. 2–4 for the first question; refs. 5–8 for the second question; or refs. 9–11, which address the two questions in a unified way). However much less is known in higher dimensions (see refs. 12–14 for the first question and refs. 7 and 15 for the second).

For a fixed $\sigma \in \Sigma \equiv \Sigma(n) = \{(j,k): 1 \le j < k \le n\}$ we consider sequences $\{\theta_{\sigma,i}\}_{i\in\mathbb{Z}}$ that satisfy $0 < \theta_{\sigma,i+1} \le \lambda_\sigma \theta_{\sigma,i}$ with lacunary constant $0 < \lambda_\sigma < 1$, and for an orthonormal basis $(e_1, \ldots, e_n)$ we divide the directions into the sets

$$\Omega_{\sigma,i} = \left\{ \omega \in \Omega : \theta_{\sigma,i+1} < \left|\frac{\omega_k}{\omega_j}\right| \leqslant \theta_{\sigma,i} \right\}.$$

With $n = 3$, these sets consist of the directions that lie in the union of four segments that meet along the axis perpendicular to e_j and e_k. As $|i|$ gets larger, the segments become thinner and accumulate at the hyperplanes perpendicular to e_j and e_k. The partition is completed by including the directions contained in these hyperplanes $\Omega_{\sigma,\infty} = \Omega \cap (e_j^\perp \cup e_k^\perp)$. Writing $\mathbb{Z}^* = \mathbb{Z} \cup \{\infty\}$, we prove the following localization principle (see ref. 16 for a different type of one-dimensional localization).

Theorem. *Let $n \ge 2$ and $p > 1$. Then*

$$\|M_\Omega\|_{p\to p} \leqslant C \sup_{\sigma\in\Sigma} \sup_{i\in\mathbb{Z}^*} \|M_{\Omega_{\sigma,i}}\|_{p\to p},$$

where C depends only on n, p, and the lacunary constants λ_σ.

Note that the reverse inequality, with $C = 1$, holds trivially. This recalls the separation of dyadic frequency scales provided by the Littlewood–Paley–Stein theory (1). A difference is that we have many partitions instead of just one; however, we will see that this is unavoidable and the supremum over partitions must be taken over the whole of Σ. We will also see that the segments cannot accumulate away from the hyperplanes perpendicular to the orthonormal basis vectors.

As with the almost orthogonality principle of Alfonseca in two dimensions (17), we recover the best known results for the second question in higher dimensions. Nagel and coworkers (7) proved the L^p boundedness of the maximal operator associated to the directions $\{(\vartheta_i^{a_1}, \ldots, \vartheta_i^{a_n})\}_{i\ge1}$, where $0 < a_1 < \ldots < a_n$ and $0 < \vartheta_{i+1} \le \lambda\vartheta_i$ with lacunary constant $0 < \lambda < 1$. We can apply the theorem with $\theta_{\sigma,i} = \vartheta_i^{a_k - a_j}$, where $\sigma = (j,k)$, reducing the problem to that of a single direction. Note that it makes no difference if the directions are normalized to live on the unit sphere or not. On the other hand, Carbery (15) proved that the maximal operator associated to the directions $\{(2^{k_1}, \ldots, 2^{k_n})\}_{k_1,\ldots,k_n\in\mathbb{Z}}$ is L^p bounded with $p > 1$. Taking $\theta_{\sigma,i} = 2^{-i}$, the resulting sets of directions $\Omega_{\sigma,i}$ are restricted to $(n-1)$-dimensional hyperplanes, so that by choosing a suitable basis and applying Fubini's theorem, we reduce to the $(n-1)$-dimensional problem. Iterating the process we end up with isolated directions as before.

In higher dimensions, it is not sufficient to constrain the angles between an infinite number of directions if they are to give rise to a bounded maximal operator. However, the theorem suggests a definition of lacunarity that gives rise to bounded maximal operators in general. An orthonormal basis of span$(\Omega) = \mathbb{R}^d$ and lacunary sequences $\{\theta_{\sigma,i}\}_{i\in\mathbb{Z}}$ define partitions $\{\Omega_{\sigma,i}\}_{i\in\mathbb{Z}^*}$ for each $\sigma \in \Sigma(d)$. We call such a choice of $\frac{1}{2}d(d-1)$ partitions a dissection. Now if Ω consists of a single direction we call it lacunary of order 0. Recursively, we say that Ω is lacunary of order L if there is a dissection for which the sets $\Omega_{\sigma,i}$ are lacunary of order $\le L-1$ for all $i \in \mathbb{Z}^*$ and $\sigma \in \Sigma(d)$, with uniformly bounded lacunary constants. According to this definition, the Nagel–Stein–Wainger directions are lacunary of order 1 and the Carbery directions are lacunary of order $n-1$. By repeatedly applying the theorem as before, M_Ω is $L^p(\mathbb{R}^n)$ bounded, with $p > 1$, whenever Ω is lacunary of finite order. This extends the two-dimensional result due to Sjögren–Sjölin (8) (the union of K sets of directions of lacunary order L with respect to their definition is lacunary of order $2KL+1$ with respect to ours).

Bateman (18) proved that, with $1 < p < \infty$, these are the only sets that give rise to bounded maximal operators in two dimensions. We conjecture that this is also true in higher dimensions. In support of this, the orthogonal projections onto two-dimensional subspaces of the directions which give rise to bounded maximal operators must be lacunary of finite order, and one can characterize the sets of directions that give rise to bounded maximal operators using a class which is related to our finite-order lacunary class. The proofs of these results will not appear here.

After a suitably fine finite splitting of the directions, the operator M_Ω can be composed with one-dimensional Hardy–Littlewood maximal operators to dominate a constant multiple of the maximal operator $\mathcal{M}_\Omega$ defined by

Author contributions: J.P. and K.M.R. designed research, performed research, and wrote the paper.

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First page of the original scientific review published in PNAS.

Authors

Javier Parcet

Javier Parcet (Madrid, Spain, 1975) is a senior research scientist at the ICMAT, where he is the main investigator of the European Research Council (ERC) Starting Grant project on "Noncommutative Calderón-Zygmund theory, operator space geometry and quantum probability", which he obtained in 2010. Parcet graduated and gained his PhD in Mathematics at the Autonomous University of Madrid in 2003, obtaining the National Prize for University Studies and the Doctoral Thesis Prize. He joined the ICMAT in 2006 after three post-doctoral fellowships at the Texas A & M University, the University of Illinois at Urbana-Champaign, and the Centre de Recerca Matemática in Barcelona. Among other distinctions, including the ERC-SG, he achieved a position as a Ramón y Cajal Researcher in 2005 and was awarded the José Luis Rubio de Francia Prize in 2006.

Parcet's main field of research is Harmonic Analysis in noncommutative spaces. The emergence of Quantum Mechanics in the early 20th century - specifically, Heisenberg's matrix mechanics - revealed the need to extend several mathematical theories to noncommutative spaces. Parcet is engaged on generalizing harmonic analysis to these types of spaces, for which he uses tools from other fields of Mathematics, such as Probability, Functional Analysis and Geometry. Some of these results have an impact on Theoretical Physics and Quantum Information Theory.

In Parcet's research work, Noncommutative Harmonic Analysis is intermingled with Quantum Probability and the Theory of Operator Spaces. His most significant results are the proof, together with the mathematician Marius Junge (University of Illinois), of two open problems posed by G. Pisier on the Geometry in Noncommutative Lp Spaces, and his recent results concerning Fourier multipliers and Calderón-Zygmund operators in von Neumann algebra groups, on which he is working as part of the ERC project.

Keith Rogers (Kilmarnock, Scotland, 1977) is the main investigator of the ERC Starting Grant project "Restriction of the Fourier transform with applications to the Schrödinger and wave equations", which he obtained in 2011. He graduated in Mathematics at the University of Edinburgh in 1999 and was awarded the Napier Medal. He completed his master at Cambridge University in 2000 and was awarded a Tripos Prize in Mathematics from Trinity College. He gained his PhD at the University of New South Wales in Sydney (Australia) in 2004 under the supervision of Professor Michael Cowling. Finally, after stays in Pisa, Gothenburg and the Autonomous University of Madrid, he joined the ICMAT (Madrid) on a five-year Ramón y Cajal appointment.

Keith Rogers

Rogers works on diverse problems of Mathematical Analysis, many of which are related with Harmonic Analysis. One of the main problems in this field is the description of functions for which Fourier processing – decomposing harmonically and then rebuilding - is found to work. In other words, it deals with the identification of the properties of the functions that enable the Fourier transform (which codifies the harmonic parts of the function) to be recomposed.

He is engaged on certain problems that have been satisfactorily solved in two dimensions, but which still require much work in three dimensions (the space in which we live) and in four dimensions (including time). One of the most ambitious goals of Roger's ERC project is to make progress in these topics by linking the Fourier process with the Schrödinger equation, which underlies quantum mechanics.

José Luis Rubio de Francia Prize-winner María Pe Pereira joins the ICMAT

María Pe Pereira, winner of the 2012 José Luis Rubio de Francia Prize for the best young Spanish mathematician, is joining the Institute of Mathematical Sciences on a postdoctoral contract this September. Pe Pereira (Burgos, 1981) is the first woman to win this prize, which is awarded by the Spanish Royal Mathematical Society (Real Sociedad Matemática Española - RSME). This researcher graduated in Mathematics at the Complutense University of Madrid, where she also gained her PhD. Her doctoral thesis, supervised by ICMAT researcher Javier Fernández de Bobadilla, was entitled "On Nash Problem for Quotient Surface Singularities" and proved the validity of the conjecture stated by John Nash, Nobel Prize-winner for Economics in 1994, on whom the film "A Beautiful Mind" was based. In the mid 1960s, this famous mathematician stated a conjecture dealing with the concept of singularity, a mathematical object that appears in phenomena with instantaneous changes in behavior. Fernández de Bobadilla found a technique belonging to the field of topology to solve a problem in geometry, assuming the Nash conjecture to be correct, and on this basis María Pe Pereira subsequently solved the Nash problem for an important class of singularities. Some months later, in 2012, they published these results in the journal "Annals of Mathematics", which proved that Nash was right.

After a period of training in Paris, María Pe returns to Spain with a postdoctoral contract at ICMAT.

ICMAT Researcher Daniel Peralta obtains an ERF Starting Grant

In June of this year, Daniel Peralta, Ramón y Cajal researcher at the Institute of Mathematical Sciences (Instituto de Ciencias Matemáticas - ICMAT), was awarded a European Research Council (ERC) Starting Grant, worth 1,260,000 euros, for the development of new mathematical tools for the study of turbulent phenomena.

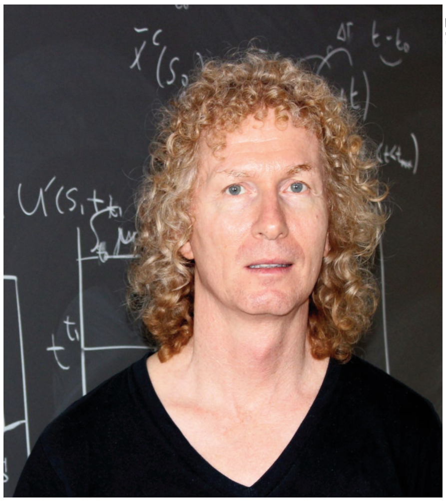
Daniel Peralta works on mathematical techniques that track the trajectories of each particle in the fluid and the structure of the lines of movement that are formed in this chaos. Peralta's project is ambitious and the research work involved has outcomes and applications in the fields of Physics and Engineering.

This is a highly interdisciplinary undertaking in mathematics, since it combines techniques of Dynamical Systems, Differential Geometry, Differential Topology and the Analysis of Partial Differential Equations, among others. Including Peralta, there are now six ICMAT researchers who are the beneficiaries of these prestigous ERC grants, which puts the center at the top of the European list in the field, ahead of other universities such as Oxford and Cambridge.

Daniel Peralta, is a Ramon y Cajal researcher at the ICMAT.

Start of the ICMAT Laboratory headed by Stephen Wiggins, professor at the University of Bristol

On July 1st, Stephen Wiggins, professor of Applied Mathematics at Bristol University (UK), arrived in Spain to start the latest ICMAT Laboratory. This marks the conclusion of the first stage of this program, which consists in formalizing agreements with prestigious mathematicians to lead research projects at the Institute of Mathematical Sciences. This program is funded through the Institute's Severo Ochoa program of scientific excellence. Professor Wiggins works on the development of mathematical tools in highly interdisciplinary fields such as oceanography and chemistry. He is an expert in identifying areas of science that require new mathematical or computational developments in order to move forward, and works on such problems with the backing, for example, of the Office of Naval Research (USA). One of his main fields of research is transport in fluid flows, both in ocean currents and in chemical reactions, and this will be the main subject addressed in the laboratory. As part of the program's activities, during the month of July, Stephen Wiggins, together with Ana María Mancho (ICMAT researcher), took the opportunity to give one of the courses at the Escuela JAE de Matemáticas, which is aimed at introducing graduate students to the world of research. The ICMAT Laboratories project is a pioneering undertaking in Spain and includes mathematicians of world renown in their respective fields, among whom there is a Fields medal winner and professors from the universities of Oxford, Princeton, Illinois and California.


ICMAT

Stephen Wiggins is a professor at the University of Bristol.

Mathematicians Manuel de León and Juan Luis Vázquez, new numerary members of the Royal Academy of Sciences

On May 28th, 2013, the Spanish Royal Academy of Exact, Physical and Natural Sciences (RAC) included among its 54 numerary academics Manuel de León Rodríguez, director of the Institute of Mathematical Sciences (Instituto de Ciencias Matemáticas - ICMAT), and Juan Luis Vázquez, National Research prize-winner and Professor of Applied Mathematics at the Autonomous University of Madrid (UAM). Also in the same session, Terence Tao, Professor at the University of California in Los Angeles (UCLA) and 2006 Fields Medal winner, was named foreign correspondent member. "This signifies an enormous enrichment for the RAC," said Jesús M. Sanz-Serna, director of the Mathematics Division of the Academy and professor at the University of Valladolid, "both these mathematicians are outstanding figures in the Spanish mathematical community".

According to the Web of Knowledge, the online citation indexing and search service. Juan Luis Vázquez is the most cited Spanish mathematician, and in the words of Sanz-Serna "he is a leading figure worldwide in the field of nonlinear parabolic equations". As for Manuel de León, he has made many important contributions in the field of differential geometry, with numerous ramifications in control theory and classical mechanics, among other fields. "Furthermore," said Sanz-Serna, "he has on many occasions devoted his services to both the Spanish and international scientific communities, particularly with the organization of the International Congress of Mathematicians ICM2006 in Madrid". De León has been a correspondent member of the RAC since 2005, and this new distinction will enable him to take part in the meetings and decisions of the institution. While the scientific sessions are largely a public affair, in order to participate in the ordinary activity of the academy and have the right to vote, one must be a full numerary member. De León and Vázquez will deliver their maiden speeches at the academy on subjects related to their research work next year.

ICMAT researcher Alberto Enciso receives recognition as the best young applied mathematician in Spain

Alberto Enciso, Ramón y Cajal researcher at the Institute of Mathematical Sciences (ICMAT) was awarded the 2012 Young Researcher Prize from the Spanish Society of Applied Mathematics (Sociedad Española de Matemática Aplicada - SEMA). Enciso Works on partial differential equations (PDEs) arising from problems in physics in fields such as fluid mechanics, quantum mechanics, cosmology and electrostatics. Says Enciso: "The PDEs that are important in physics are also important in mathematics. When one analyzes the equations appearing in these fields one discovers important things about reality. At the same time, they are basic equations by means of which mathematics has evolved". Enciso is the fourth ICMAT researcher to have been awarded this prize, after Marco Fontelos, Diego Córdoba and Jorge Cortés. Enciso is the first to have received the two most outstanding awards for young mathematicians in Spain. A little over a year ago he also won the young mathematician of the year prize from the Spanish Royal Mathematical Society (Real Sociedad Matemática Española - RSME). These awards are a confirmation of Enciso's versatility in the demonstration of difficult and important results, as well as his development of techniques that are useful in such diverse fields as mathematical physics, partial differential equations and differential geometry.

Alberto Enciso, Ramon y Cajal researcher at ICMAT.

Agenda

School and Workshop on Topics in operator algebras and applications
Dates: September 2-6, 2013
Place: ICMAT, Campus de Cantoblanco, Madrid (Spain)

Singularity Theory Month
Dates: September 9-27, 2013
Places: ICMAT and La Cristalera, Miraflores de la Sierra, Madrid (Spain)

European Science Foundation - Exploratory Workshop New Approaches To Multiple Zeta Values
Dates: September 30 - October 2, 2013
Place: ICMAT

Multiple Zeta Values, Multiple Polylogarithms and Quantum Field Theory
Dates: October 7-11, 201
Place: ICMAT

XX Topology Meeting
Dates: October 25-26, 2013
Place: ICMAT

Mathematics and Geosciences: Global and Local Perspectives
Dates: November 4-8, 2013
Place: ICMAT

CRM-ICMAT Conference Symplectic aspects of Dynamical Systems
Dates: November 11-15, 2013
Place: ICMAT

Recent Trends in Algebraic and Geometric Combinatorics
Dates: November 27-29, 2013
Place: ICMAT

deLeonfest 2013
Dates: December 16-19, 2013
Place: ICMAT

Primary school pupils measure the radius of the Earth like Eratosthenes

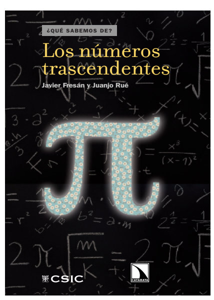
In the same way as many historical events are commemorated, on June 19th of this year, in collaboration with the Municipal Multimedia Library and the Luis Buñuel Primary School of Alcobendas, the Institute of Mathematical Sciences (ICMAT) participated in an international activity to celebrate the measurement of the radius of the Earth that Eratosthenes carried out 2,200 years ago. Hundreds of primary school pupils became budding scientists to measure the angle formed on the summer solstice. The event took place in three different cities, Madrid, Lyon and Alexandria, the latter being the place where the original measurements were made. After a talk given by ICMAT researcher David Martín de Diego, pupils from the 4th, 5th and 6th grades of the Luis Buñuel Primary School in Alcobendas repeated the measurements.

On the following day via a video link, the pupils compared their own data (the angle observed), and having determined the distance in meridians of the cities, they calculated the size of the Earth.

This is the second year in which the ICMAT has participated in this activity designed to enable primary school pupils to appreciate the power of ingenuity and to experience scientific work for themselves.

Juanjo Rué and Javier Fresán present a book that explains "Transcendental Numbers"

In June of this year, Juanjo Rué, researcher at the Institute of Mathematical Sciences (ICMAT), and Javier Fresán, PhD student at the University of Paris 13, presented their educational book aimed at a wide readership "Los Números Trascendentes" ("Transcendental Numbers"), published by the Consejo Superior de Investigaciones Científicas and Ediciones La Catarata. Says Juanjo Rué: "The main theme of our book is a classical problem in mathematics that all mathematicians should know about". However, in order to have a good understanding of what it is about, some advanced knowledge is required, as Rué himself explains: "Our aim is to explain this result by putting more emphasis on the ideas rather than on the technique, and in doing so explore some of the more fashionable mathematical objects in current number theory research". The result is an informative work with a broad appeal that readers can enjoy on several different levels, whether following the story superficially and skipping some of the more difficult parts, or tackling all the explanations armed with pencil and paper.



"Los números trascendentes", Juanjo Rué and Javier Fresán. Collection ¿Qué sabemos de?. CSIC and Ediciones La Catarata, 2013 (Madrid)
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