ICMAT

Quarterly newsletter
Instituto de Ciencias Matemáticas
CSIC-UAM-UC3M-UCM

January-March 2013

Editorial

A window on the mathematical community

With this issue, the Instituto de Ciencias Matemáticas (ICMAT) newsletter sets out on its journey. This publication, which will be available every trimester, the ICMAT seeks to inform the national and international scientific community about the top-level scientific activity conducted at the center. It will also include additional mathematical content accessible to all readers with an interest in mathematics.

The bulletin aims to reflect in the broadest sense the ICMAT mathematical research activities pursued at this center of excellence. It will address subjects of interest concerning current mathematical research, in particular those that are carried out at the Institute.

The ICMAT is a center for mathematical research consisting of four institutions: the Consejo Superior de Investigaciones Científicas (CSIC-Higher Council of Scientific Research) and three Madrid universities, the Universidad Autónoma de Madrid (UAM), the Universidad Carlos III de Madrid (UC3M), and the Universidad Complutense de Madrid (UCM). The ICMAT headquarters was inaugurated in September, 2010, and is located on the UAM Campus in Madrid.

Since its inception, the ICMAT has pursued an ambitious project aimed at international excellence in mathematical research.

Continued on page 2

Contents

Report

Mathematics for movement and control

Students and researchers at the VI School of Geometry, Mechanics and Control.

Mónica G. Salomone/Lorena Cabeza. The equations that describe the movement of the planets in the solar system, a group of robots or heartbeats have much in common. The same may be said for those that enable the flow of ocean currents or the rebound of a spring to be simulated. Resolving these equations is practically impossible, but mathematicians do not aspire to do that. Their aim is to develop methods to learn as much as possible about them, and thus the systems they describe: Are they stable over time? With what degree of accuracy may one approximate the solutions?

These are the kinds of problems addressed at the School of Geometry, Mechanics and Control, which was held for the 4th time last summer and was organized by the Instituto de Ciencias Matemáticas (ICMAT) in the Severo Ochoa Program of Excellence. This meeting, which took place between June 22nd and June 27th at Miraflores de la Sierra (Madrid), has become a key international event in the field.

Continued on page 2

Editorial

A window on the mathematical community

From page 1. Proof of this aspiration is its award in 2011 (the first year for calls) of the Severo Ochoa Accreditation, by which the Spanish Ministry of the Economy and Competitiveness distinguishes the best Spanish research centers with the grant of special funding conditions.

It is thanks to this program that the ICMAT is able to issue this bulletin, which will be received by a long list, as exhaustive as possible, of international mathematical research and training centers, as well as all the individual parties, mainstream media, companies and institutions as so desire. The launching of this newsletter is in line with the ICMAT's aims of internationalization, and as such the contents will be published in both English and Spanish.

This project also arises from the ICMAT's vocation for the dissemination of mathematics. Thus, the burning issues of current research will be presented attractively, as well as news items concerning the mathematical community, schedules of coming activities, and extensive interviews with leading figures in international mathematics who visit the center.

In addition, the newsletter also aims to report on the work carried out by researchers belonging to the institute. With this in mind, space will be provided for the scientists themselves to explain their results, activities and topics of interest to their colleagues, more fully and without the simplifications usual in the mainstream media.

The authors of these articles will be the researchers themselves who belong to the Institute, as well as other mathematicians who collaborate with the ICMAT and a special team devoted to the communication of mathematics. While including a more scientific content than is usual in popular dissemination, these articles will be written so as to uphold the highest standards of journalism and reporting.

The bulletin is aimed at a heterogeneous readership: members of the national and international mathematical community; other scientists with an interest in mathematics; students of this discipline and scientific journalists, while anyone at all with an interest in this science is also invited on board.

Given the broad international scope envisaged for this project, the newsletter will be issued primarily in a digital format as a pdf document, although in special cases a hard copy will also be made available.

Subscriptions can be made via:
https://listas.csic.es/wws/subscribe/newsletter_icmat.

Report

Mathematics for movement and control

From left to right, James Montaldi, Edith Padrón, Arieh Iserles, Darryl Holm and David Martín.

From page 1. The organizers, Edith Padrón (Universidad de La Laguna), and David Martín de Diego (ICMAT), emphasize two main features of both the School and the field of Geometry, Mechanics and Control itself: their relevance for applications and their interdisciplinary nature. "This is a theoretical field, but closely allied to applications", they explain. "You can do the same kind of mathematics as in more pure fields, but here you also know that someone is going to put your work into practice, and that is very gratifying".

It is for that reason why almost half the forty students who attended the School this year, who came from different European countries and the United States, are physicists. And for many of them it was not the first time. The School is one of the activities that form part of the Spanish Network of Geometry, Mechanics and Control (GMCn), created in 2005to make the most of the collaboration that already existed among different groups. Over the years, this network has become increasingly international in scope, with members coming from Argentina, Brazil, Portugal and the United States, and at the same time has gained in prestige. Students are aware that it provides them with a rare opportunity to meet leading international researchers in the field at first hand and in a relaxed atmosphere.

As regards the interdisciplinary nature of the event, one only has to look at the profile of the professors who attend it. On previous occasions, participants have ranged from experts in Quantum Mechanics to researchers working on autonomous robots for the detection of contamination. Those who came on this occasion were Darryl Holm (Imperial CollegeLondon, UK), who has conducted research in Fluid Dynamics, Liquid Crystals and various applications associated with Biomedicine; Arieh Iserles (University of Cambridge, UK), expert in the resolution of complex mathematical problems by means of computation, and James Montaldi (University of Manchester, UK), who among other things conducts research in the mathematics involved in the movement of the planets in our solar system and the choreography of planets and asteroids.

The origin of some of these problems go back a long way —already in the 19th century Henri Poincaré was wondering whether the solar system was stable— but remain crucial for current technology. Those who work on the fleets of satellites, for example, or on future interferometer telescopes in space —consisting of several satellites that must maintain a precise position— while not requiring exact solutions to these equations, do need to approximate them as far as possible with a knowledge of the margin of error.

Darryl Holm, from Imperial College, London.

These are all problems that require the integration of many areas of mathematics, something that is not deeply rooted in the Spanish tradition. As Padrón and Martín explain: "In Spain, everything is divided into separate, self-enclosed compartments: Geometry, Topology, Analysis and so on. Interdisciplinarity is not easily understood. You either belong to one field or another. Interdisciplinarity may be seen as politically correct, but the truth of the matter is that it isn't encouraged. Evaluators, for instance, do not know how to span these fields".

Another distinguishing feature of the School is its emphasis on youth. For its organizers, the School of Geometry, Mechanics and Control constitutes the basis for generational renewal in this field.

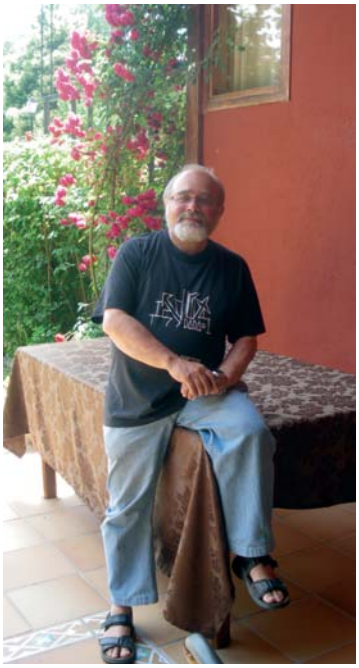
Darryl Holm: "Geometry is a framework of relations"

25 years ago, Darryl Holm and other colleagues went to visit the then director of the Los Alamos National Laboratory (New Mexico, USA) and said to him: "You don't want to be accused of not making the most of the extraordinary resources assigned to you… You need to be in contact with the scientific community". Out of this meeting came one of the country's most prestigious doctoral programs, the source of the best personnel for Los Alamos, the place where the North American atomic bomb program was developed. Holm has spent 34 years at Los Alamos, where he has been deputy director of the Applied Mathematics Group, Theoretical Division. He has conducted research in various fields, all closely connected with applications: Fluid Dynamics (ocean circulation, climate modeling), and nanoscience, etc. He has spent six years at Imperial College London, where one of his main projects is concerned with mathematical simulation of the working of the heart. He also develops mathematical methods for analyzing and comparing medical images.

"The ideas common to these problems are based on geometrical mechanics", Holm explains. "Geometry is a framework of relations; when you put your mathematical model within the framework of geometry it provides you with relations, which in turn give you information about the model. Thus, you are able to spot similarities between models that describe different phenomena. They appear to be different, but the framework is the same. My course at this School, for example, compares in a geometric framework the rotation of a rigid body with the shape of a wave in the water. It turns out that both phenomena are within the same framework, and what holds good for one holds good for the other; they have the same mathematics".

Arieh Iserles: "Devotion to a single application is always bad"

There are some problems that are so complex that is impossible to arrive at some of their multiple solutions, or even to at least determine some of the properties of the system that contains them. Is it a system that loses or conserves energy? Does it have some type of symmetry? The development of computers, which often approximate solutions to questions such as these in real time, has led to great progress in this regard, as well as speeding up the development of applications in virtually all the branches of science. It is in this field where Arieh Iserles, professor at the University of Cambridge, has applied his knowledge. He is one of the foremost researchers in the area of computational and applied mathematics and, in particular, in the sphere of differential equations: "I'm interested in mathematics that is too difficult and that one attempts to solve with computers. It's about taking a mathematical problem and formulating it in a language that the machine understands. I'm interested in these new mathematical problems and how they are related to the first".



Arieh Iserles, of Cambridge University.

In such complex questions like differential equations —those that study systems in movement such as ocean currents or biological flows— science either focuses on or finds a sufficiently precise quantitative solution that defines where the system is likely to be found at any given moment, or alternatively determines its qualitative properties. Iserles looks for "the synthesis of these two approximations: computational methods that provide us with the most precise solution possible, as well as the qualitative features of these solutions".

For Iserles, "the power of mathematics resides in the fact that you can apply the same tool to very different areas". And he recalls one of his projects, in pure mathematics, which is nevertheless fully relevant to our daily life: the resolution of certain differential equations that will enable mobile telephones to operate in a range dif-

ferent from the one that is most habitual. "We have already got it to work in some models, and now we're trying to integrate all of it. If we're successful, it could completely revolutionize the sector".

Furthermore, the best part about it is that "the same mathematical method used in the case of cell-phones also worked for extracting energy from waves". Iserles goes on the say that "perhaps it could work in ten or more applications", and concludes with a smile by saying that "devotion to a single application is always bad".

James Montaldi: "Mathematics for planets and molecules"

The apparent similarity between an atom and a planetary system such as our own has something real about it, because according to the mathematician James Montaldi, "the same mathematics that works for celestial mechanics holds good at the molecular level". Both form part of what is known as "Hamiltonian systems", characterized because, since there is no friction, there is either no loss of energy or energy loss is minimal, which enables these systems to be modeled by defining movement according to the way in which kinetic and potential energy is distributed.

"The same ideas have to work at both extremes"

James Montaldi, from Manchester University.

"The same ideas have to work at both extremes", on a diminutive scale and on a colossal scale, although "different questions are posed, such as in a molecule the atoms vibrate, while in a solar system the planets rotate". Furthermore, both systems have a characteristic of special interest for Montaldi: symmetry, which this researcher uses for analyzing and determining the dynamics of the whole, whether from the quantitative (solutions) or the qualitative (properties) point of view.

For example, one of his undertakings concerned the movement of rotation and vibration of especially small molecular particles with a symmetrical configuration, such as ozone. What began as a theoretical work was subsequently applied to the spectral analysis of ozone, a vital tool for measuring the amount of this gas in the atmosphere, and thereby for quantifying the thickness of the ozone layer surrounding the Earth. Ultimately, mathematics is to be found at the end of nature's work, and as such provides the tools required for understanding it.

"If you work on these subjects, this is where you should come"

From left to right, Angelo Scandaliato, Miguel Texeido, María Barberó, Ignazio Lacirasella and David Iglesias.

Young people are the real protagonists at this School and they know it. That is why the next edition will not be organized by senior members of the Geometry, Mechanics and Control Thematic Network (GMCn), but rather by the oldest students: María Barberó, doctoral assistant at the Universidad Carlos III, and David Iglesias, on a Ramón y Cajal appointment at the Universidad de La Laguna. Both have attended the School since it started. As they themselves say, "Over the years, young people have become increasingly involved in the School".

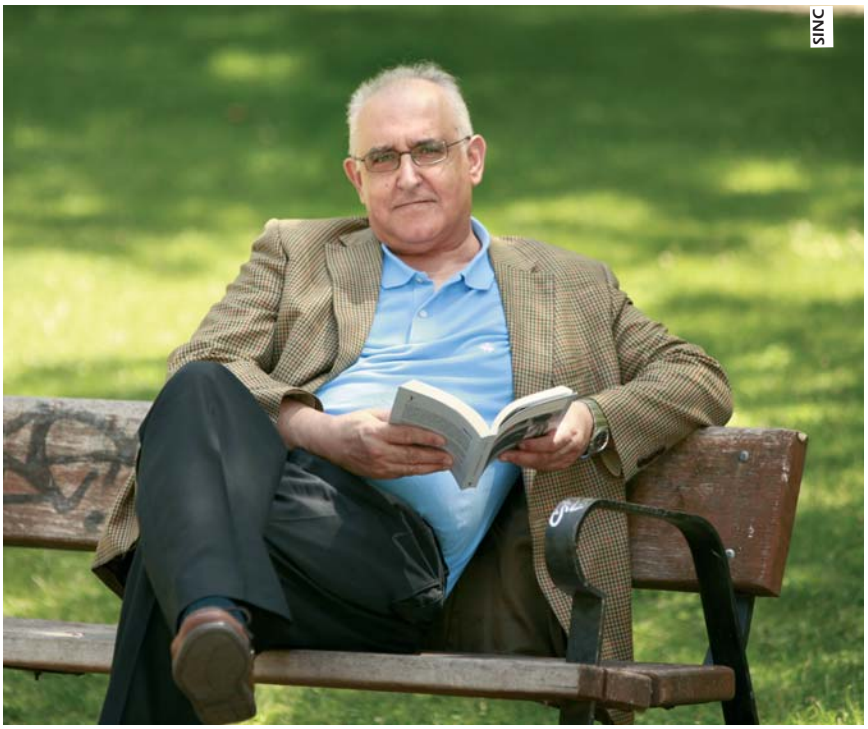
This trend is not only apparent in the greater workload for student-organizers. Young scientists have also increased their role in the structure of the School. For instance, on this occasion, and for the first time, those students who have presented posters have also been able to explain their work in brief talks lasting between 5 and 10 minutes. As David Iglesias says, "it brings teachers and students closer together. The role of the student here is not only to listen; you know that the leading figures in the field are sitting in front of you and listening to what you say".

Miguel Texeido, who is doing his PhD at the Universidad Politécnica de Catalunya, presented one of his posters and answered questions about it, and is delighted with the system. His opinion is shared by Ignazio Lacirasella, who attended this School for the second time. He is doing his PhD at the Università degli Studi di Bari (Italy), and is currently at the Universidad de La Laguna thanks to the collaboration set up through the Thematic Network. Lacirasella says that "if you're working on these subjects, you really have to be at this School, because the leading experts are also here".

Angelo Scandaliato, who is doing his PhD at the University of California in San Diego (USA), agrees completely: "There are many schools and congresses throughout the world, but this one provides a little about everything you need to know in this field". This is his first attendance and he intends to return next year.

Lacirasella and Scandaliato provide an example of something that the organizers have already pointed out: like the Thematic Network itself , the School is becoming increasingly international, which broadens the range of work subjects and also future collaboration.

"Mathematical research should be regarded as a tool for both technological and economic progress"



Mónica G. Salomone.

Question: What is the Institute for Mathematical Sciences (ICMAT)?

Answer: It is a research institute with the purpose of conducting research of the highest quality, as well as becoming a leading institute both in Spain and internationally. We want to be up there with the finest mathematical centers worldwide.

Q: Is research the only defining feature of the ICMAT?

A: We are first and foremost a research center, but we also give great importance to the training of young researchers and the dissemination of science. Dissemination is gaining importance in the big centers and is a service that we believe the Spanish mathematical community needs.

Q: How can the ICMAT become a leading center internationally?

A: By conducting research of the highest quality that draws international attention to our scientists, while at the same time organizing top-level events that attract the participation of the most important mathematicians in the world. One of our goals is to make ICMAT an international meeting point for the most active researchers in different fields. We already have a big turnover of visitors, with some 150 researchers from all over the world spending time at the ICMAT. And all Spanish researchers are welcome to come and interact with them. This is also one of the things that makes the ICMAT a reference point for young researchers —the chance to explore the frontiers of mathematics at first hand—.

Q: Is priority given to basic research, or does the ICMAT also pursue more applied lines?

A: One of our aims is to stimulate interdisciplinary research, given the fact that we are in a privileged location. Not only do we share the building with the Institute of Theoretical Physics, but we're also next door to research centers in nanoscience, new materials, food… We are on one of the strongest campuses in Europe and we have to forge links with our surroundings, explore synergies with other fields and create a space for the transfer of mathematics to other disciplines. At the same time, we're trying set in motion the transfer of mathematics to industrial processes.

Q: Does the ICMAT have researchers who are working on interdisciplianry problems?

A: Yes; the research that Ana María Mancho is conducting, for example, is very concerned with climatology, while Marco Fontelos is working on nanoscience... And the approach within mathematics itself is interdiscipinary; research at the internal frontiers of the discipline: the tendency in Spain has always been for everyone to stick to their own field, in isolation, but ICMAT wants its researchers to interact and extend beyond what each one does in his or her own office.

Q: Is this endeavour to open up and become more interdisciplinary compatible with priority research lines?

A: Yes, of course; mathematical research in Spain has never been aimed at priority objectives. Instead it's always been a matter of what each researcher has wanted to pursue. We believe that there are institutional objectives that are above individual aims, and we've set priorities by taking into account areas that in Spain have traditionally been neglected, such as Number Theory, Group Theory, Combinatorics and so on. Without relinquishing the main research lines, the institute has the opportunity (which is very difficult in universities) to strengthen these other lines, as well as lines that will no doubt arise in the coming years.

Q: And what are the results? What's scientific production like at the Institute?

A: The ICMAT publishes almost one hundred articles every year, which amounts to a significant production. These articles have a considerable impact, with a very high number of citations. We're still in our early days and have yet to appear in the international indicators, but the level of excellence is beyond doubt. Five of our researchers have obtained ERC (European Research Council) Starting Grants, the only ones in Spain to do so in mathematics. Two such grants have been awarded at Oxford University, four at Imperial College and Cambridge University… There were many good reasons for receiving the Severo Ochoa excellence award.

Q: You mention the Severo Ochoa Program. Can you outline that for us?

A: The Severo Ochoa Program included a human resources plan, a research plan and a follow-up plan. The ICMAT has pledged itself to the creation of Laboratories with mathematicians of international renown; a plan of activities consisting of schools, workshops and themed programs; the creation of an ICMAT Europe office to stimulate participation in the Framework Program, and an ICMAT Transfer office to strengthen the transfer of mathematical knowledge generated at the institute.

"Mathematics should have a place in the popular imagination"

Q: How is the project working out?

A: As planned, we have already organized top-level schools and workshops, as well as setting up and running four laboratories and various thematic programs (bringing together researchers at the institute around a topic for 3 or 6 months). Furthermore, we have appointed new post-doc researchers, created the support team for applications for European projects and a communication and dissemination unit.

Q: Why does the ICMAT give so much importance to mathematical dissemination?

A: First of all, because it is very important for mathematics itself that people in general understand the key role it plays in their lives; mathematics is hidden behind a multitude of things in daily life. We are convinced that mathematics should have a place in the popular imagination —a positive place— far removed from the cliché that it's a subject that gives you a bad time at school. Another reason is the need to encourage a vocation for mathematics. What's more, dissemination is a good way of raising the profile of the institute with the public at large, as well as opening up possibilities for patronage.

Q: In the past, mathematics hasn't had much success in Spain as far as patronage is concerned.

A: This is something we have to change. It won't be easy, and it won't be done overnight, but it's a cultural change we have to bring about. The ICMAT finds itself in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a privileged situation, associated with research excellence, and as such it makes a good working partner for institutions wishing to back mathematical research and dissemination at the institute. Mathematical research should be regarded as a tool for both technological and economic progress. It's a long-term task and we need help to do it, but we're already on the way.

Q: The ICMAT is a mixed center, with members that also belong to the universities of which it is composed. How is this integration working out?

A: One of the problems is that researchers with teaching duties have to work side by side with researchers who have none. However, the CSIC researchers often participate in teaching activities, which can help to lighten the load of institute members with teaching tasks and allow them to devote more time to research (the universities themselves ought to be more proactive in this sense, because one of the aims of ICMAT is to bring the best researchers from each institute together in the same space to achieve research excellence). I should also say that the ICMAT has brought about a radical change in the way that research is conceived, and obviously time is needed to make sure that the two structures, universities and CSIC, fit together properly.

Q: How has the ICMAT personnel been selected?

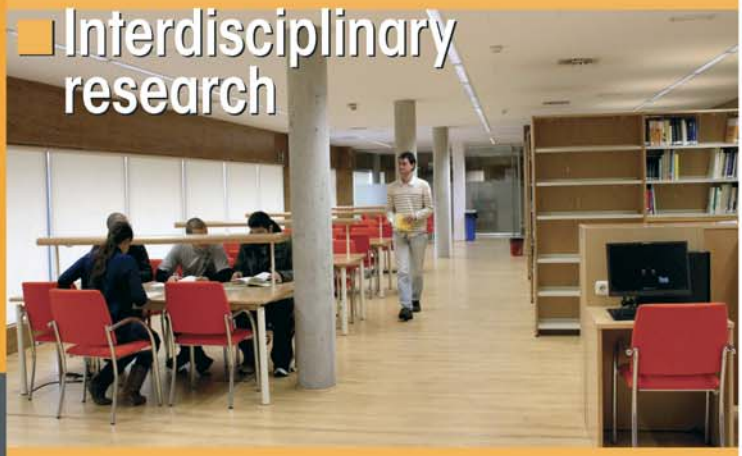
A: An initial call was launched to all interested parties and consisted of two categories, senior and junior researchers. The CVs were evaluated by an independent, anonymous commission belonging to the Agencia Nacional de Evaluación y Prospectiva (ANEP). The participation of each institution as that set out in the founding agreement and corresponds to the budgetary participation. At present, a mechanism is being studied for handling new appointments of permanent personnel, which will consist of just a few researchers, unlike at the beginning, when we started from scratch. Of course, the ICMAT still continues to take on grant students and postdoctoral researchers. Whatever the mechanism turns out to be, according to a decision that was taken on request from the three universities, all the Ramón y Cajal appointees who so wished could join the institute without additional evaluation. Those who did so have certainly noticed an improvement in their work.

ICMAT

Instituto de Ciencias Matemáticas

ICMAT is a joint research institute of the Consejo Superior de Investigaciones Científicas – CSIC (Spanish National Research Council) and three Madrid universities: the Universidad Autónoma de Madrid, Universidad Carlos III de Madrid, and the Universidad Complutense de Madrid.

www.icmat.es



Harmonic year 2012 / 2013

Scheduled

NEW TRENDS IN HARMONIC ANALYSIS AT ICMAT

Workshop on New Trends in Nonconmutative Harmonic Analysis
December 17-21, 2012

Introductory Courses on Analysis and Applications
March 2013

Research Term on Real Harmonic Analysis and Applications to Partial Differential Equations
April-June 2013

Harmonic Analysis, PDEs and Geometry: A joint workshop of the ARN-Harmonic Analysis at its boundaries
May 27-31, 2013

Research Term on Operator Algebra Methods in Harmonic Analysis and Quantum Information
May-July 2013

Workshop on Operator Spaces, Harmonic Analysis and Quantum Probability
June 10-14, 2013

Other Activities 2013

Scheduled

Nigel Hitchin LAB Workshop-Retreat: Topology of moduli spaces of representations
March 11-15, 2013

JAE School of Mathematics
June 2013

7th International Summer School on Geometry, Mechanics, and Control (ICMAT School)
July 1-5, 2013

Summer School on Analysis of Incompressible Fluids (IMUS-ICMAT School)
June 17-28, 2013

Topics in Numerical Analysis of Differential Equations (TNADE2013)
July 8-12, 2013

School and Workshop on Topics in operator algebras and applications
September 2-6, 2013

ICMAT Lecture Course Multiple Zeta Values in Madrid (MZVM2013)
September 2-13, 2013

Algebra and Geometry of Singularities
September 8-14, 2013

New Approaches To Multiple Zeta Values
September 29 – October 3, 2013

Encuentro de Topología. Red Española de Topología.
October 25-26, ICMAT

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

Recent Trends in Algebraic and Geometric Combinatorics
November 27-29, 2013

deLeonfest 2013
December 16-18, 2013

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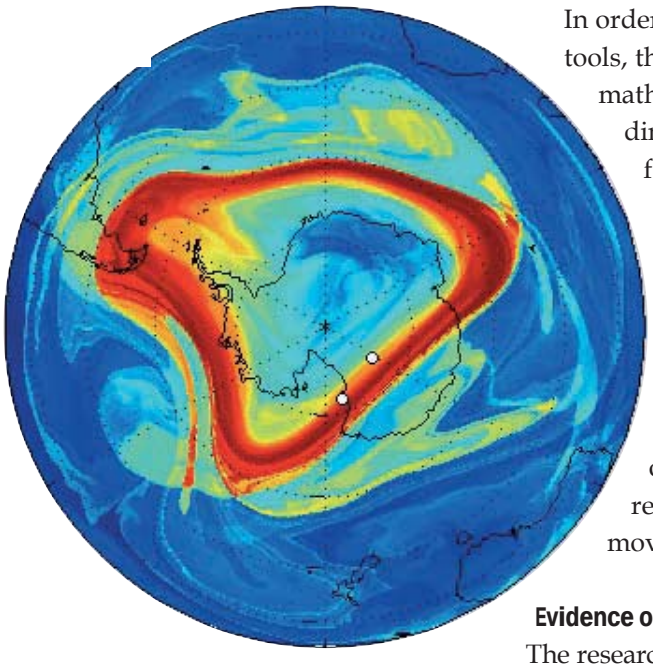
Deciphering the subtle order of fluids

Ágata Timón/Lorena Cabeza. In 2010, European aerospace remained paralyzed for several days. The ash expelled by the Icelandic volcano Eyjafjalla spread through the atmosphere in an apparently chaotic way. Since it was not known how the ash cloud might develop, and given the uncertainty about what areas might be affected, on the assumption that the whole region would be



Geometry of the South Pole vortex. (*Journal of Atmospheric Sciences*, 2012).

affected, the authorities decided as a preventive measure to cancel all flights over the continent. "Finding ordered patterns in the apparent disorder of the dispersion of these particles was, and continues to be a challenge", states Ana María Mancho, a researcher as the Instituto de Ciencias Matemáticas (ICMAT). "Greater precision of prediction would have saved the airline companies millions of euros", says this researcher.

Situations such as this could be managed better if complex phenomena such as the weather or sea and atmospheric currents could be predicted. To this end, mathematical techniques are applied to the study of the oil-spill that occurred in the Gulf of Mexico in 2010. "It is still not known how many liters leaked into the sea; it's a complicated problem", says Mancho. "The material that floated to the surface is light, and we use techniques that help us to understand the dispersion of these elements in the upper layers of the ocean". Determining the dispersion will help to control and reduce the resulting environmental impact.

In order to build good prediction tools, the interaction between mathematical models —including the main parameters for determining the situation and their relations— and observations taken in situ are vital. Ana María Mancho and her collaborators build mathematical techniques to analyze the dispersion of particles in the apparent chaos governing the movement of fluids.

Evidence on the ozone hole

The research team led by Mancho, which includes Álvaro de la Cámara, Jezabel Curbelo y Carolina Mendoza, has applied these tools to the study of the polar vortex over the Antarctic, the belt of hurricane-force winds surrounding the Antarctic in the middle layers of its atmosphere. This work helps in a better understanding of the impact of these winds in the formation of the hole in the ozone layer and the processes involved in the recovery of this layer over the Antarctic, which takes place each summer at the South Pole.

Certain physical conditions are necessary for the occurrence of this phenomenon, and particularly over the ice caps in the Southern Hemisphere. One basic condition is the presence of the polar vortex over the Antarctic, which surrounds the continent and isolates the mass of air within it almost completely from the air outside. This trapped air mass leads to the low temperatures required to produce a series of chemical reactions that give rise to large-scale ozone depletion. The new mathematical method enables the dynamic structure of this gigantic cyclone to be determined with greater accuracy.

Stratospheric dynamic

Specifically, this work reveals how these particles are carried through the atmosphere in this area, as well as how a mixture, however small, between the air within and that outside the polar vortex is formed. Outside the vortex the air is rich in ozone, but poor within. "Our tools help us to interpret the dispersion of chemical particles and elements carried on the currents of air", explains Mancho, and goes on to say that: "On the basis of velocity fields, they enable us to see geometric structures that explain with greater clarity the dynamics of the particles in the stratosphere".

This new method therefore helps to understand the processes of exchange of air within and without this enormous area of low pressure, and provides greater accuracy to what is already known about the effect of the polar vortex and its relation with ozone depletion. It also clarifies the transport mechanism of masses of air when the vortex becomes weaker each springtime in the Antarctic, which aids in the recovery of ozone values.

"The mathematical techniques used until now have not been able to detect accurately this exchange of particles between the inside and outside of the polar vortex", says Ana María Mancho, a researcher at the ICMAT and author of the mathematical technique employed in this work. "We are able to demonstrate

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First probe launched in the Concordiasi Campaign (2010).

that, although this wind belt continues to form a powerful barrier, particles can indeed pass through it, and we can describe how they do so".

"Traditionally, the way particles are carried through the atmosphere has only been studied by calculating the trajectories of the masses of air", explains Álvaro de la Cámara, the first author of this work that forms part of his doctoral thesis. We have been able to provide a description of its dynamic structure, which will help us to understand better the physical mechanisms underlying this phenomenon".

Likewise, these techniques provide advantages over those employed to date. Mancho points out that, "They are easier and quicker to implement and avoid misleading information".

Following balloons in the atmosphere

The researchers have been able to confirm the validity of the method with experimental data. As Álvaro de la Cámera explains; "We have found a relation between our results and the traces of ozone inside the polar vortex. We have also been able to determine the paths of the balloons released into the atmosphere, which provides more data on the behavior of the atmosphere itself. This has enabled us to verify that the technique works, because it coincides with all the information from the balloons".

One indirect result of this work is that it confirms the excellent quality of the data on velocity fields used by the team to make their predictions. These come from models belonging to the National Weather Service (USA) and the European Centre for Medium-Range Weather Forecasts. They use this information to characterize dispersion, and agreement with the observations obtained with the balloons confirms that the balloons really do "see" the stratosphere as it is described by the data.

The researchers are now considering how these techniques may be applied in other contexts to assist in discriminating between good and bad data. "We have seen how effective they have been in the atmosphere, and have also been able to substantiate the validity of the measurements. However, would they also be valid for the ocean?" asks Mancho. "We can also use measurements of dispersion of buoys on the sea to test for the characterization of the quality of the data used in these contexts. This would be vital, for example, for being able to predict accurately the impact of natural catastrophes such as toxic spills in the ocean".

The invisible order

The determination and prediction of the apparently erratic behavior of fluids such as oceanic and atmospheric currents or the evolution of tornados and hurricanes has been a problem for researchers since the 16th century, when Leonardo da Vinci traced the paths of whirlpools he saw in water. In the 18th century, the Italian mathematician Joseph-Louis Lagrange studied the motion of fluids and developed what is known as "Lagrangian structures", a defined pattern but one which is often invisible and varies with time, but which helps to understand the behavior of complex systems in continuous movement.

In order to understand better what a Lagrangian structure is, let us imagine a busy subway station in a big city. Some people are making their way to a suburban line, while some are going to another line and others are entering and leaving the station. If they all suddenly stopped and stood still the pattern would be practically invisible. However, although changing, the structure in movement would be clear, and defined above all by the borders separating the groups from each other. This structure constitutes the "skeleton" that shows the behavior of the crowd of people, and provides a better explanation of this behavior than a study of the path followed by each individual person.

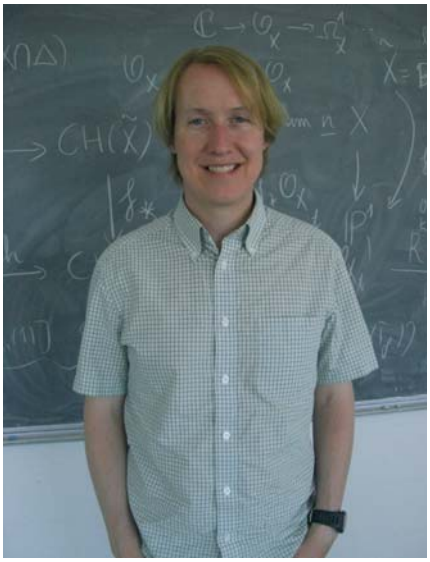
However, while Lagrange formulated his theories more than three centuries ago, it is not until now that powerful computers have enabled these ideas and their implications to be explored in greater depth. Their current enormous capacity of computation makes it possible to relate extremely complex equations, having a multitude of solutions, with the observations made in natural surroundings. The resulting intersection enables us to arrive at the best solution, and thereby the method that will allow us to explain and even predict the behavior of apparently chaotic complex systems.

LMD/CNRS

Balloon released in the Stratéole/Vorcore Campaign in 2005.

"The Millennium Problems are telescopes for seeing far into mathematical research"

Ágata Timón. The Clay Institute was the first private operating foundation devoted to mathematical research. David Ellwood has been at its center since it was founded, and was its Research Director from 2003 until 2012. Ellwood gained his doctorate in Theoretical Physics from Imperial College (London), but spent much of his time working under the guidance of mathematician Alain Connes in Paris. He was a Marie Curie Fellow at the Institut de Mathématiques de Jussieu (Sorbonne Université-UPMC), a Professeur Invité at the Institut des Hautes Études Scientifiques, and has held appointments at the ETH (Zurich), the University of Strasbourg and Harvard University, where he is currently a visiting scholar. His research career has been focused on non-commutative geometry, although as he himself says, his work at the Clay Institute left him little time for the joys of pure research. Indeed, Ellwood has organized hundreds of conferences and workshops around the world, touching on almost every field of pure mathematics. On the occasion of his visit to the Instituto de Ciencias Matemáticas for the workshop entitled "Periods and Motives: A Modern Perspective on Renormalization", held between July 2nd and 6th, 2012, we had the chance to talk to Ellwood about the private funding of science and the work of the Clay Institute.



Question: Can you describe the Clay Mathematics Institute (CMI) for us?

Answer: CMI is the vision of its founder Landon Clay, and first president Arthur Jaffe of Harvard University. One of the founding principles of CMI is that it does not compete with other mathematical institutes, but rather collaborates with them. This principle has allowed CMI to develop a large global presence despite its small physical base. The goal is to seek out the best opportunities wherever they might be, the "tipping points" and key individuals critical for the advancement of mathematical research.

Q: There is no CMI headquarters?

A: Our offices were in Cambridge (Massachusetts) from 1999 to 2012, but our perspective has always been the global mathematical community. We now have a new president, Nicholas Woodhouse from Oxford University, where he has his office, so now we're even more decentralized. We're an American institution with a president in Europe.

Q: How is the CMI president appointed?

A: The president is appointed by the Board of Directors, which consists of members of the Clay family, specifically Landon Clay, Lavinia Clay and Thomas Clay.

Q: What does the future hold for the institution?

A: I'd have to say our wish to stay close to the pulse of mathematical innovation and to respond quickly to change, which is the vital force in any domain of research. CMI has a small administrative base and very few formalities, so we are very agile and able to act quickly to opportunities whenever they arise. In this way we can do things that complement larger institutions and government agencies. That's our guiding principle.

Q: Could you outline any up and coming opportunities?

A: With a new president in Oxford there's certainly a lot of new activity on the horizon in Europe. Young people should pay particular attention to our Clay Research Fellowships, post-doctoral appointments that may be held anywhere in the world.

Q: What do you think is the role of mathematical research as regards global challenges, such as the environment, climate, energy, food resources, and so on?

A: Right now a global initiative called "Mathematics of Planet Earth 2013" (MPE 2013) is being launched, and I'm excited about being a member of its steering committee. We're trying to bring together all the mathematical centers in a joint effort of coordination, because as a community we have much to contribute to the many challenges facing life on our planet; much more than has been done so far. The very complex problems that face both developing and industrialized nations alike can no longer be regarded as "someone else´s problem"; they are our problems, and we are going to have to work together to solve them. MPE 2013 represents the first step towards focusing the world community of mathematicians on tackling the challenges facing humanity.

Q: Can you identify any field in mathematics that may be especially useful in the coming years?

A: Pure research is full of surprises, and breakthroughs often come from new insights and connections between disparate fields of research. Applied research,

such as investigating climate change, may also lead to fundamental advances in other areas and new branches of mathematics. Just think of the pioneering work of the meteorologist Edward Norton Lorenz, whose work on climate modeling laid the foundations of chaos theory. The mathematics of planet earth draws our attention to many such mathematical challenges: designing intelligent cities, predicting natural disasters, epidemiology, and facingthe energy demands of our future… We as mathematicians are finding new perspectives for these challenges. "Mathematics of Planet Earth 2013" is only the start, but we hope one that will entice a much wider group of mathematicians to get involved.

Q: The development of mathematics as a pure science is also important. What's the involvement of the CMI in this area?

A: CMI is fundamentally devoted to pure mathematics, to basic research. One of the challenges with this type of research is that it's not grounded in experiment, and sometimes it's hard for young people to develop an intuition for good problems. With practical problems as a guide, mathematicians must develop the art of knowing where to focus their attention. That's why we chose the Millennium Problems, not specifically as goals for 21st century mathematics, but to celebrate the enduring power of great problems in mathematical research.

Q: Did you want to set some guidelines for research in pure mathematics?

A: These deep problems [the Millennium Problems] are like telescopes through which you can see far into the distance. What's more, we also wanted to show the general public that pure research in mathematics is a vibrant and exciting science, whose challenges reach across centuries and bring the general public into the drama of our research. Moreover, by offering a prize for their solution, we could demonstrate the intrinsic value of pure research in a way everyone can understand (one million dollars).

Q: What do you think about the current state of funding for basic science, particularly in Europe and the USA, and the role of private institutions such as the CMI?

A: The CMI is an innovative model, one that has since been adopted by several other institutes, and we hope by many more in the future. In America it's usual for science to be backed by private funding, but CMI was the first operating foundation in mathematics to be entirely based on private funding from a single donor. We have a very low administrative overhead, and our funds go directly to mathematicians and their activities. By partnering with other institutions, we can bring new activities to the many fine facilities around the world, and respond quickly to trends and ideas at the forefront of mathematical research.

Q: What is your relation with public agencies?

A: Those agencies funded by the state have the leading role, and that is to support science on its grandest scale. But when special opportunities arise, private donors can have a great impact. What makes a community vibrant and a nation successful is the ability to make rapid progress in certain directions.

Q: What will the role of private funding be in the framework of the crisis?

A: In the midst of the financial crisis, private funding is even more important for the continued development of science. We hope the success of the CMI model will inspire other donors to get involved.

Q: What's your relation with the ICMAT?

A: I am not attending this workshop (Workshop Periods and Motives: A Modern Perspective on Renormalization) as a representative of CMI, but rather as a researcher, for my interest in the subject and the high quality of the talks.

Q: What's your impression of the institute?

A: This is the first time that I've been to ICMAT, and my impression is that you've got a marvelous infrastructure here. I think it's wonderful that the Spanish scientific agency (the Consejo Superior de Investigaciones Científicas-CSIC) and the universities have come together to create an initiative like this. It's an exciting time for ICMAT, a time of development and growth.

Q: What are your main interests as a researcher?

A: Non-commutative geometry, operator algebras and mathematical physics; the basic idea of non-commutative geometry is to take concepts from classical geometry and carry them over to the study of non-commutative spaces. In addition, the close relation with quantum physics, which has always fascinated me, is very intriguing. I've always been attracted to mysterious things, and non-commutative geometry sheds new light into the virtual spaces of quantum theory and its philosophical interpretation.

Q: So from all these mysteries, why did you choose mathematics?

A: On the one hand, because it suits my personality, and on the other because it's a very interesting pursuit as aprofessional career. Apart from providing you with great challenges and the chance to meet manypeople, mathematics can also be of great benefit to our society.

Q: How did you move from research to the directorship of the CMI?

A: I was working at Harvard and the first president of the CMI invited me to work with him and help set up the functioning of the institute. I was lucky to be with CMI from the very beginning, and could help shape the future of our programs.

Q: Does all this leave you any time for research work?

A: The truth is that at the moment I don't have as much time as I would like for research, but working together with so many brilliant mathematicians to organize programs in many different branches of research has been very fulfilling. As a visiting scholar at Harvard next year, I hope to get back to some of the research programs that I love.

New trends in Harmonic Analysis

José María Martell/Javier Parcet, ICMAT researchers.

From late 2012 to the middle of 2013, the ICMAT is celebrating a year devoted to Harmonic Analysis with an ambitious program called ''New Trends in Harmonic Analysis at ICMAT, 2012-2013''. This will include many encounters aimed at showing the latest research advances in this field to encourage collaboration among scientists working in different areas. Furthermore, these activities will attract outstanding researchers to the centre, which will undoubtedly be of benefit to the entire Spanish mathematical community.

Harmonic Analysis is a highly active research field holding a pivotal position within mathematics. Its many branches make it indispensible for the understanding of diverse problems in the fields of Partial Differential Equations, Functional Analysis, Operator Algebras, Differential Geometry and Probability, among others.

The program includes two thematic trimesters of particular importance: the "Thematic Trimester on Real Harmonic Analysis and Applications to Partial Differential Equations", from April to June 2013, and the "Thematic Trimester on Operator Algebra Methods in Harmonic Analysis and quantum Information", from May to July 2013.

In addition, other activities will be held, such as workshops, talks, schools and courses, designed to cover a broad range of topics associated with modern Harmonic Analysis. All these activities will enable the current state of research in this field to be explored in depth, as well as addressing the latest ideas and techniques in this area.

According to ICMAT's director, Manuel de León, Harmonic Analysis is already one of the centre's strongest research lines, and this program is aimed at strengthening it even further, both in basic research and in its applications.

The main goal of this research program is to bring together researchers in all these fields in order to encourage their mutual interaction; they will include the most prestigious experts and new doctoral researchers, as well as doctoral students who have yet to defend their theses. The intention is to stimulate further ICMAT's international connections with leading research centers throughout the world.

Activities

Special attention will be given in the Harmonic Year program to subjects such as connections with Partial Differential Equations, Geometric Measure Theory, Non-commutative Harmonic Analysis, Classical and Abstract Calderón-Zygmund Theory, Quantum Probability and Operator Space Theory, among others. The scheduled activities are as follows:

— School on Elliptic Partial Differential Equations. From October 15th to 25th, 2012. Organizer: J.M. Martell.

This was the first activity in the thematic year and was organized jointly with the Department of Mathematics of the Universidad Autónoma de Madrid (UAM). The school consisted of two courses in which it was shown how the techniques of analysis can be very useful tools for working on problems involving partial differential equations and geometry. The first course, "A brief introduction to the method of boundary layer potentials", was given by Marius Mitrea (University of Missouri-Columbia, USA). The second course, "Topics in Geometric Analysis and Applications to PDEs", was given by Dorina Mitrea (University of Missouri-Columbia, USA). Both researchers were on a stay in Madrid during the month of October that was funded by the UAM "Postgraduate of International Excellence in Mathematics" and by the ICMAT "Severo Ochoa Program".

— Workshop: New Trends in Non-commutative Harmonic Analysis. From December 17th to 21st, 2012. Organizers: J. Parcet, M. Perrin and M. Junge.

Our aim is to identify problems and research avenues in Non-commutative Harmonic Analysis. Special attention will be given to interaction among personnel with a small number of talks, which will be informal and interactive. Much is still to be learned about some of our favorite topics: Fourier multipliers in classical and non-commutative Lp spaces, convergence of Fourier series for matrix functions and on discrete groups, diffusion semi-groups related to the Calderón-Zygmund algebraic theory and non-commutative probability. The participants include Mikael de la Salle, Marius Junge, Tao Mei, Éric Ricard and Quanhua Xu.

—Introductory Courses on Analysis and Applications. March 2013. Organizers: J.M. Martell and J. Parcet.

This program consists of four introductory courses to several crucial topics, which we trust will help young researchers to follow the events in the ICMAT Harmonic Year. Each course will be comprised of four or five talks and the main theme will address modern analysis and quantum analysis. This includes the Calderón-Zygmund theory, elliptic partial differential equations, non-commutative martingale inequalities and quantum information theory.

—Thematic Trimester on Real Harmonic Analysis and Applications to Partial Differential Equations.

From June to April, 2013. Organizers: P. Auscher, J.M. Martell and C. Pérez.

Modern Harmonic Analysis is a very active field of theoretical research whose development has accorded it a fundamental position in the mathematical sciences. During this trimester we concentrate on the real part of harmonic analysis as well as its applications to the partial differential equations to which it gives rise. Some of the topics that will be covered in this trimester are as follows: classical and modern Calderón-Zygmund theory; inequalities with weights and the A2 conjecture; elliptic and parabolic boundary problems; Kato's conjecture; Geometric Measure Theory, etc. This trimester will consist of four courses on Modern Harmonic Analysis given by prestigious researchers among whom there will be T. Hytönen, A. Volberg, S. Hofmann and A. McIntosh. Each course will include introductory talks in which the general context of the topic will be explained, and will conclude with the latest developments and challenges in each field. Furthermore, throughout the trimester long-, medium- and short-term visitors will attend ICMAT to give talks and seminars. Among the visitors who have already confirmed their attendance are: N. Badr, T. Coulhon, X. Duong, S. Mayboroda, I. Mitrea, M. Mitrea, C. Pereyra, S. Monniaux, A. Morris, J. Pipher, M.C. Reguera, C. Rios, K. Rogers, A. Rosen, Y. Sire, C. Thiele, T. Toro, R. Torres, A. Vargas, etc. Grants are available to partially cover expenses for doctoral students who wish to participate in the semester.

— Harmonic Analysis, Partial Differential Equations and Geometry: a joint workshop between the "ANR-Harmonic Analysis at its boundaries" project and the ICMAT-Severo Ochoa Program. From May 27th to 31st, 2013. Organizers: P. Auscher, J.M. Martell and C. Pérez

This workshop forms part of the thematic trimester outlined above. It consists of a joint activity between the ANR "Harmonic Analysis at its Boundaries" project, coordinated by P. Auscher, and the ICMAT Severo Ochoa program. The list of speakers is as follows: J. Bennett, F. Bernicot, D. Cruz-Uribe, G. David, D. Dos Santos Ferreira, O. Dragicevic, I. Gallagher, F. Gancedo, L. Grafakos, C. Guillarmou, H. Koch, A. Lerner, D. Mitrea, E. Ouhabaz, J. Parcet, S. Petermichl, V. Pierfelice, F. Ricci, A. Sikora, J. Szeftel, X. Tolsa , S. Treil, J. Verdera, L. Weitz.

— Thematic Trimester on Operator Algebra Methods in Harmonic Analysis and Quantum Information. From May to July, 2013. Organizers: J. Parcet, C. Palazuelos, M. Perrin, D. Pérez-García and M. Junge.

Quantum Mechanics has radically changed the laws of physics. The attempt to provide a rigorous mathematical foundation to Heisenberg matrix mechanics immediately caught the attention of leading mathematicians in the field. John von Neumann was the first to realize that the classical and relativist notions of measure and geometry no longer reflected our knowledge of the physical world. This led him to propose the 'quantification of mathematics', which brought about a transformation in the discipline. We are now able to find non-commutative forms of classical theories that enable non-classical commutation relations. This is illustrated, for example, by non-commutative geometry and topology, quantum probability and non-commutative Lp spaces. Other more recent cases are quantum groups and operator spaces. This thematic trimester will concentrate on implementing this perspective in the context of harmonic analysis and information theory. The first half of the program will be devoted to the interaction between non-commutative harmonic analysis, operator algebras and quantum probability. We start with three weeks during which specialized courses and selected talks will be given by F. Cipriani, P. Fima, C. Houdayer, M. Junge, T. Mei, J. Peterson, G. Pisier, É. Ricard, F. Ricci, M. de la Salle and S. Vaes. In the fourth week we will organize an international workshop on operator spaces, harmonic analysis and quantum probability, which is detailed below. The second part of the trimester will be devoted to the connections between operator algebra methods and quantum information theory. At this time we will be visited by numerous international experts, among whom we may mention A. Acín, H. Buhrman, A. Defant, A. Montanaro, O. Regev, P. Shor, T. Vidick, A. Winter and R. de Wolf.

—Workshop: Operator Spaces, Harmonic Analysis and Quantum Probability. From June 10th to14th, 2013. Organizers: J. Parcet, M. Perrin and M. Junge.

This conference is the continuation of a series of meetings organized over the last ten years by U. Haagerup, M. Junge, G. Pisier, Q. Xu and other researchers in Marseille (CIRM), Paris (Henri Poincaré Institute), Banff (BIRS), Toronto (Fields Institute), Universidad Texas A&M, Besançon, etc. The main subject will be the interaction between harmonic analysis, operator spaces (Banach quantum spaces) and quantum probability. The provisional list of speakers includes C. Arhancet, S. Avsec, M. Bozejko, B. Collins, M. Cowling, K. Dykema, S. Dirksen, U. Franz, U. Haagerup, G. Hong, M. Junge, H.H. Lee, M. Lindsay, C. Le Merdy, M. Musat, N. Ozawa, V. Paulsen, G. Pisier, Y. Qiu, Y. Raynaud, J. Roydor, Z.J. Ruan, M. De la Salle, D. Shlyaktenko, F. Sukochev and Q. Xu.

Further information

at the Harmonic Analysis website:

www.icmat.es/NTHA

Contact: ntha@icmat.es.

ICMAT strengthens its international presence with Indian, French and British institutions

From left to right, Oscar García-Prada, G. Misra, Manuel de León, Sinnou David, M. S. Narasimhan, R. Ramadas, and Tomás Gómez de Quiroga.

The celebration of the forthcoming Indo-Spanish Congress to be held on the Indian subcontinent in two years time, the increase in researcher exchange between both countries, and the application for a joint European Project together with French and British institutions were some of the results to come out of the meeting held by representatives from the ICMAT, the CSIC and the UAM, all from Spain, and the Indian Institute of Science, the National Board for Higher Mathematics, the Tata Institute in Mumbai and the Chennai Mathematical Institute, all from India. They all met in Madrid last September 16th, 2012, where they were joined by representatives from Oxford University (UK) and the CNRS (France).

According to ICMAT director, Manuel de León, "the aim of this meeting was to extend and develop the co-operation agreement signed in 2009. Together we will conduct training activities and increase researcher exchange, as well as setting in motion future doctoral programs".

A further notable outcome of this meeting is the application for a joint European project through the Marie Curie Network between the ICMAT and the Indian Institute of Science, a scheme to which the French Centre National de la Recherche Scientifique and Oxford University have also signed up. The European Marie Curie Program is aimed at the training, professional development and attraction of promising young researchers in the European Union. The collaboration agreement with this Indian research center will form part of the UAM-CSIC Campus of International Excellence framework.

Researchers' Night: Mathematics for understanding the brain

The Instituto de Ciencias Matemáticas (ICMAT) took part for the first time in Researchers' Night within the Universidad Autónoma de Madrid's 2012 program "Open Your Mind with the UAM". In the context of the International Year of Neuroscience, ICMAT researchers Juanjo Rué, Ana Zumalacárregui and Carlos Vinuesa spoke about the work of mathematicians on the study of neural networks by modeling with graphs. The researchers introduced some concepts in Graph Theory and their applications in multidisciplinary research; in particular, in the so-called "small- world networks". The "Being simple is complicated: graphs and complex networks" workshop was held on September 28th at the UAM Cultural Center.

The main aim of Researchers' Night, a dissemination activity that has been held throughout Europe since 2005, is to "bring researchers closer to the general public for a better understanding of their work and its benefits for society and influence on daily life, within a festive and playful atmosphere in which both researchers and members of the public can participate".

Agenda

New trends in harmonic analysis atthe ICMAT

Madrid, October 2012 to July 2013
www.icmat.es/NTHA

March 2013
Introductory Courses on Analysis and Applications.

April-June 2013
Research Term on Real Harmonic Analysis and Applications to Partial Differential Equations.

May 27-31, 2013
Harmonic Analysis, PDEs and Geometry: A joint Workshop of the ANR-Harmonic Analysis at its boundaries and the ICMAT-Severo Ochoa.

May-July 2013
Research Term on Operator Algebra Methods in Harmonic Analysis and Quantum Information.

June 10-14, 2013
Workshop on Operator Spaces, Harmonic Analysis and Quantum Probability.

The fifth such grant awarded to researchers from the Instituto de Ciencias Matemáticas

ICMAT researcher Daniel Faraco awarded a prestigious Starting Grant

Daniel Faraco.

Daniel Faraco, a researcher belonging to the Instituto de Ciencias Matemáticas (ICMAT) and professor at the Universidad Autónoma de Madrid (UAM) Department of Mathematics, has been awarded a Starting Grant for conducting work that will open the way to great progress in the fields of fluid mechanics, inverse problems (with applications to tumor detection and oil deposits) and the construction of invisible materials, as well as in more theoretical fields such as the so-called 'quasi-conformal functions'.

"Our goal is to develop mathematical tools to enable us to construct solutions different to the classical ones in the modeling of invisible materials and problems relating to fluid mechanics," says Faraco. To that end, one of the methods employed is known as "differential inclusions", a generalization of the differential equations that have enabled highly complex physical problems to be modeled. The ICMAT has obtained all the Starting Grants awarded so far in Spain in the field of mathematics.

International News

A year for exploring the 'Mathematics of Planet Earth'

More than one hundred scientific institutions have this year joined the global scheme "Mathematics of Planet Earth 2013" (MPE 2013). The contributions made by this discipline to the study of issues ranging from natural catastrophes to climate change will be highlighted throughout the year, including questions concerning sustainability and pandemics. The MPE 2013 will promote workshops and conferences as well as dissemination events aimed at a complete cross-section of the public.

ICMAT, present at MPE 2013

The Instituto de Ciencias Matemáticas (ICMAT) will take part in this event with the organization of several activities, the most important of which will be the congress that the ICMAT is holding on the mathematics underlying research into Earth Sciences. The aim is to stimulate multidisciplinary research and to bring scientists from different fields into contact with each other, both in mathematics and in geosciences. Furthermore, in collaboration with FECYT, ICMAT will draw up an instructional guide for the dissemination of the most up-to-date topics concerning the mathematics involved in these disciplines.

Fields Medal winner Lars Hörmander dies

Lars Hörmander, the Swedish mathematician who was awarded the Fields Medal at the 1962 International Congress of Mathematicians in Stockholm, died in Lund (Sweden) on November 25th, 2012, at the age of 81.

Lars Hörmander made fundamental contributions in the fields of partial differential equations and mathematical analysis. In the citation at the Fields Medal award ceremony, mathematician Lars Garding described Hörmander's work as follows: "In a talk given in 1945, Petrovsky asked about a general theory of linear differential operators, including those that did not even appear in mathematical models in physics... in his book on distributions, Laurent Schwartz had posed numerous problems on differential operators. A lot of work has been carried out on the topic since then, and many people have made contributions, but we owe the deepest and most significant results to Hörmander".

Lars Hörmander was also awarded further prizes in recognition of his research work: the Wolf Prize in 1988 and the Steele Prize in 2006. His work led to a greater understanding of solutions to a broad and important class of differential equations that had remained difficult to crack until that time. This research work constituted a revolution in the field of linear partial differential equations, applications of which have been found in many fields, among them being oil exploration and seismology.

2013, International Year of Statistics

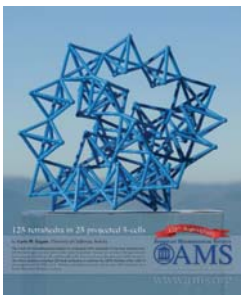
The invisible power of statistics pervades practically all the fields of human activity. Nevertheless, its immense capacity for making the world that surrounds us more understandable often passes unnoticed. It is for this reason that 2013 has been designated as the International Year of Statistics. (Statistics2013).

More than 700 organizations belonging to almost 100 countries are participating in this celebration, which seeks to raise public awareness about the power of statistics, to promote the profession devoted to statistics and to stimulate its development.

Basic information on this event can be found at the website www.statistics2013.org. In Spain, the Sociedad de Estadística e Investigación Operativa (SEIO) will organize a series of events as well as the XXXIV National Congress on Statistics and Operational Research (www.seio2013.com).

The institutions organizing this International Year are as follows: the American Statistical Association, the Institute of Mathematical Statistics, the International Biometric Society, the International Statistical Institute (and the Bernoulli Society), and the Royal Statistical Society.

The American Mathematical Society (AMS) celebrates its 125th anniversary



AMS

125 aniversary of the AMS poster.

2013 will be a special year for the American Statistical Society (AMS): it celebrates the 125th anniversary of its foundation and will commemorate the occasion with meetings, publications and special events to be held throughout the year.

Ever since it was founded in 1888, the AMS has grown enormously to become a leading international institution. It is currently a giant comprising 30,000 members scattered all over the world, with an annual budget running to millions of dollars and a publishing empire that is greatly appreciated by the whole mathematical community.

The biggest mathematical congress

The events to celebrate the 125th anniversary got under way with the Joint Mathematics Meetings held in San Diego from the 9th to the 12th of January. With more than 6,000 participants, it is the biggest mathematical congress in the world. Researchers presented almost 3,000 scientific articles on all the branches of mathematics.

The CIRM launches its own Youtube channel

The knowledge generated at the Centre International de Rencontres Matématiques (CIRM) is now more accessible thanks to the window open on Youtube. It already has more than a dozen videos, most of which are short interviews with leading mathematicians who have visited the center. They can be found at: www.youtube.com/cirmchannel.

ICMAT

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Editing:
ICMAT
C/ Nicolás Cabrera, nº 13-15
Campus de Cantoblanco, UAM
28049 Madrid SPAIN

Editorial commitee:
Manuel de León
Ágata A. Timón

Production:
Divulga S. L.
C/ Diana 16 - 1º C
28022 Madrid

Coordination:
Ignacio F. Bayo
Lorena Cabeza
Ágata Timón

Design: Lorena Cabeza

Collaborators:
Mónica Salomone
José María Martell
Javier Parcet

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Madrid (España)

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