

The ICMAT Research Centre

The *Instituto de Ciencias Matemáticas* (ICMAT, www.icmat.es) was recently created, as a result of the collaborative efforts of the Consejo Superior de Investigaciones Científicas (CSIC), the Universidad Autónoma de Madrid, the Universidad Complutense de Madrid and the Universidad Carlos III de Madrid. The ICMAT is one of the most important mathematical research infrastructures ever created in Spain.



Main entrance

Historical background

In 1915 the Laboratorio-Seminario Matemático was created within the Junta de Ampliación de Estudios, an institution which had the mission of promoting research and culture in Spain. After the Spanish Civil War, the Junta de Ampliación de Estudios was suppressed and replaced by the CSIC, and the mathematics division became the Instituto de Matemáticas Jorge Juan. Those institutions played an important role in the development of mathematics in Spain until the beginning of the seventies. Unfortunately, the Instituto Jorge Juan was not maintained and was finally dissolved in 1984. Mathematicians in the CSIC were organised in a number of ways from that date until 1992, when the Instituto de Matemáticas y Física Fundamental (IMAFF) was created within the CSIC. Despite the fact that the CSIC is the biggest research institution in Spain, and despite the fact that it covers a very broad spectrum of knowledge (physical sciences, chemistry, life sciences, technology, history, philosophy, etc.), since the disappearance of the Instituto Jorge Juan, mathematicians did not enjoy an independent status in the CSIC.

Fortunately, in recent times the CSIC has realised the relevance of having an independent mathematics institute, and the ICMAT was created on October 29, 2007; as a mixed institute uniting the respective forces of the major mathematics departments in Madrid (the CSIC, the Universidad Autónoma de Madrid, the Universidad Complutense de Madrid, and the Universidad Carlos III de Madrid).

Objectives

The mission statement of the ICMAT contains the following objectives: to undertake high quality mathematical research; to stimulate interdisciplinary research and explore new contexts for its application in basic science and industry; to provide internationally competitive doctoral and postdoctoral training, and to serve as an interlocutor between the scientific community and the technological, industrial, and financial sectors.

Internal structure

The ICMAT faculty currently consists of 14 permanent researchers of the CSIC, and around 25 members of the participating universities. Despite a relatively young average age, the ICMAT faculty enjoys a good scientific reputation; indeed, a number of the members are among the leading experts in their fields. The remainder of the scientific personnel is made up of around 25 postdocs, 10 of them enjoying Ramón y Cajal (close to tenure-track) positions, and around 30 PhD students. Administrative staff constitute approximately 10% of the personnel of the institute. Researchers are divided into pure and applied mathematics divisions; however, such a division is not strict in practice, interaction between researchers of the divisions being commonplace.

The institute is expected to grow in the coming years (slowed slightly by the economic crisis) in accordance with the following percentages: CSIC (36%), UAM (36%), UC3M (7%), UCM (21%). The ICMAT works to attract the best possible young researchers through several kinds of positions using its own funding schemes, seeking to attract the best national and international candidates for PhD and postdoc positions. Strategic high-level permanent positions are also being offered in order to start a new research line or to reinforce an existing one.

Areas of research

Research in the ICMAT is broad; the research lines include:

Algebraic Geometry and Mathematical Physics, Moduli Spaces, Number Theory and Group Theory

In this line we cover topics of algebraic geometry, algebra, and their applications which nowadays include various fields of physics. Within algebraic geometry, some of us work in a systematic study of singularities, from resolution of singularities to the geometric, topological and homological study of singularities of varieties and



Auditorium

mappings, and the deep relations of singularity theory techniques with other areas of mathematics. Researchers in arithmetic geometry were recently appointed to the institute. In pure algebra, we are at the moment focusing on group theory and on homological algebra and simplicial techniques. There is also a strong interest in algebraic geometry in relation to physics, following the thread that in the last three decades has applied ideas of high energy physics to algebraic geometry. Research includes the study of moduli space of vector bundles and related objects (Higgs bundles, holomorphic pairs coming from the vortex equation, etc), and also work in the geometric Langlands program.

Differential Geometry, Symplectic Geometry and Geometric Mechanics

The research of the group is divided into two lines, one corresponding to the differential geometric aspects of symplectic geometry, and the other centering on its applied aspects, with a focus on geometric mechanics and control theory. The first line fits broadly into the study of the global aspects of manifolds, including topological properties of symplectic and contact manifolds, manifolds with special holonomy, rational homotopy theory of differentiable manifolds, and geometric structures of non-Riemannian type (path geometries, etc.). The second line of research focuses on geometric mechanics and control theory. Research themes include geometric field theories, Poisson geometry (groupoids, algebroids, etc.), symplectic integration and numerical linear algebra (algorithms for matrix computations), and nonlinear dynamics (matrix analysis, matrix polynomials, etc.). A common interest in gauge theoretic problems and techniques unites the two lines of research.

Mathematical Analysis, Differential Equations and Applications

The institute has several researchers working in this line, and in a wide spectrum of subjects covering theoretical subjects like harmonic analysis and basic aspects of the theory of partial differential equations, to more applied topics such as fluid mechanics, analysis of singularities, kinetic equations, statistical physics and mathematical biology. A number of the researchers work in the numerical simulation of partial differential equations.



Blue Lecture Room

New research lines are also being created, as for example in number theory and combinatorics.

Scientific life, doctoral and postdoctoral training

There is a colloquium and several seminars being run on a regular basis in several of the topics referred to above. This scientific activity is enriched through the frequent organisation of research schools, conferences and thematic periods. In the last few years, trimesters and semesters have been held on Quantum Control and Quantum Information, Moduli Spaces, Geometric Mechanics and Control Theory, and Contour Dynamics and Incompressible Fluids.

The ICMAT also has a yearly summer programme (the so called JAE intro) addressed to talented undergraduates in the final years of their studies. It is also open to any international student. It consists of two months of training, including a summer school in which researchers from the ICMAT give a course in their research topics, and a period of individual work under the direction of a member of the institute. The best participants of the JAE intro programme often return to undertake their PhD research at the ICMAT.

Members of the ICMAT participate in and often organise activities of popularization and dissemination of mathematics at the national level, and in education programmes at High School level (mathematical olympiads, programmes for detection of mathematical talent, Ciencia en Acción). Indeed, the ICMAT is possibly the most active body in mathematical outreach in Spain, organising a series of public lectures (Matemáticas en la Residencia, in collaboration with the CSIC and the somewhat famous Residencia de Estudiantes), lectures and round tables for secondary students during the Science and Technology Week, mathematical graffiti, publication of books in the CSIC-La Catarata series ¿Qué sabemos de?, the blog Matemáticas y sus Fronteras, and many others.

Location and facilities

The ICMAT is located in a new building with outstanding facilities for mathematical research. It is located on

the campus of the Universidad Autónoma de Madrid, and the proximity with the mathematics department of the Autónoma facilitates interaction between the researchers.

The building boasts six conference theatres (hosting up to 30, 40, 50, 80, or 140 people), and a luxurious auditorium with a capacity for 270 people. They are all equipped with blackboards, screens, overhead projectors, beamer and internet access, and multimedia equipment that allows for the recording of the lectures.

The ICMAT has over a hundred fully equipped offices with capacity for almost 200 people. A number of these offices (more than 15) are reserved for visitors. In addition, the ICMAT has a large communal room equipped with 24 tables and computers, so that the ICMAT can host as many as 50–60 visitors at a time.

The 1100 square metre library houses the historical archives of the old Jorge Juan Institute of Mathematics as well as the materials acquired since its dissolution in 1984. In addition to its library, the ICMAT plans to have a Mathematical Documentation Centre (CDocMath) in which the Instituto de Estudios Documentales sobre Ciencia y Tecnología (IEDCYT-CSIC) and the Coordination Unit of the Network of Libraries of the CSIC will participate. The goal is to make CDocMath a fundamental resource for mathematical documentation in Spain, providing a service to the entire Spanish mathematical community.

Equipment and IT Infrastructure

The Computing Service Centre (CSC) is in the basement of the building and provides general purpose (network access, wifi, web publishing, e-mail, security, software licensing, fax and printing) and scientific computational support to the ICMAT. It has a room for large capacity continuous power supplies (CPS) and related devices, a workshop room to repair computers, and a well equipped room to host PC clusters belonging to either individual researchers or to the institute as a whole. Moreover, it has a large format photocopying service.

The ICMAT has some specialized staff for the maintenance of clusters. The institute already has at its disposal some computing infrastructure, the cluster ODISEA, co-financed by the Madrid regional government, which provides 104 cores for computation. ICMAT researchers also have access to the Supercomputer FINIS TERRAE at CESGA (Santiago de Compostela), which has been co-financed by the CSIC.

Funding

The regular budget issuing from the CSIC and the participating universities covers the existing permanent positions, the regular consolidation of tenure-tracks, the maintenance of the needed infrastructure and a supply of PhD and postdoc positions. The CSIC runs the programme JAE, which offers yearly grants for those partic-

ipating in the JAE intro program, several PhD positions (JAE pre) and postdoc positions (JAE doc). Over and above this, the participating universities also offer PhD positions that can be enjoyed at the ICMAT.

Furthermore, ICMAT researchers are usually very competitive in obtaining research grants both from national and international programmes. This provides support for travel as well as additional PhD, postdoc and invited research positions. Currently, most of our researchers enjoy research grants, which rank in the top ten from the national funding scheme.

As regards the main national programme for appointing senior postdocs (Programa Ramón y Cajal), the ICMAT has attracted more than 30% of the selected researchers from the beginning of the programme. Seven of these Ramón y Cajal researchers have since acquired a permanent position, while three of them are holders of the ERC Starting Grants, the only three mathematicians in the whole of Spain; this represents 25% of the ERC Starting Grants of the CSIC.

Strategic plans

In 2004 the CSIC embarked upon a new way of planning and distributing personnel and economical resources, and an ambitious strategic plan for 2005-2009 was put forward, aiming to be a landmark in the history of Spanish science. The strategic plan for mathematics was evaluated by an international committee and ICMAT was created as a consequence of the panel's recommendations.

In 2009 the ICMAT put forward a second strategic plan for 2010-2013, in which a substantial growth of permanent and temporary positions was envisioned. Again this was evaluated internationally and the highest mark was obtained.

National and international relations

The ICMAT is one of the five nodes of the Spanish project Consolider Ingenio Mathematica i-MATH. ICMAT holds a cooperation agreement with the Centre de Recerca Matemàtica (CRM) in Barcelona and other Spanish and European centres. The ICMAT wishes to be part of ERCOM and we will forward our application in the coming months; our desire is to participate and collaborate with the rest of the mathematical centres in Europe.

In addition, the ICMAT promotes many scientific collaborations with research institutions around the world through the CSIC bilateral agreements.