

Opening ceremony

Juan González-Meneses, president of the 9ECM

Isabel Fernández, vice-president of the 9ECM

President of the European Mathematical Society,
vice-chancellor of university, research and innovation of the government of Andalusia,
general secretary of research and innovation of the government of Andalusia,
deputy mayor of Seville,
vice rector of research of the University of Seville,
presidents and directors of mathematical societies, faculties and institutes of research,
chairs and members of committees,
dear participants,

The day arrived at last! Welcome to the 9th European Congress of Mathematics! With the collaboration of many people and institutions, we have put together a program for the conference that serves as a showcase for European mathematics. In the mornings, you will enjoy the plenary lectures, together with the Abel and the Hirzebruch lectures. After lunch, prize lectures and invited lectures, plus the minisymposia, contributed sessions and poster sessions. But there is more, each afternoon we will have two panel discussions, and a public lecture about a scientific topic closely related with mathematics. Last, but not least, the outreach lecture, and four exhibitions. Three of them in the main venue of the congress, and one of them, with cartographic gems from the 15th to 18th centuries, in the city center.

We would like to thank the European Mathematical Society for the trust placed in us. Four years ago, the EMS Council decided to bring the European Congress of Mathematics to our city, to Seville. And we are extremely grateful for that. In return, we also want to bring Seville into the congress. You will experience the historic heritage of Seville during the cultural visit to the Real Alcázar. During the congress dinner, you will be immersed in the María Luisa park, a historic garden full of stunning buildings, which is also one of the green lungs of our city. You will see Seville even in the typography of your badges, which mimics the lettering of the street signs in the city.

We would like to thank all the people that collaborated with us to prepare the program for the congress: speakers, members of the committees, organizers of minisymposia and panel discussions, chairs, and of course, our volunteers. Thank you so much to all of them.

All this would not have been possible without the support of many people and institutions. The King of Spain presides the honorary committee. The government of Spain, the government of Andalusia, the council of the province of Seville, and the town hall of Seville, have all contributed to the success of this congress. The univer-

sities of Granada, Cádiz, Málaga and Almería configure the presence in this congress of the Andalusian universities. Let me personally thank the impressive work of Mirta Castro, Guillermo Curbera, María Ángeles Rodríguez Bellido, Antonio Rojas, and each and every member of the organizing committee. The help of sponsors like the Spanish Foundation for Science and Technology (FECYT), the American Mathematical Society, Foundation Compositio Mathematica, Ramón Areces Foundation and Cajasol Foundation, has been invaluable.⁸ And, of course, the support that the organizers have received from our own university, the University of Seville, is worth mentioning.

But we have been overwhelmed by the response of the mathematical community:

- Mathematical societies from Spain, RSME, SeMA, SCM, SEIO, backed our candidacy and support the congress in many ways, as well as institutions like the Spanish National Research Council (CSIC).
- The Institute of Mathematics of the University of Seville, and other Spanish Research Institutes, IMAG, ICMAT, BCAM, CRM are responsible for the organization of really interesting panel discussions. Special thanks go to Magdalena Rodríguez, IMAG and the University of Granada for the stunning organization of the EMS Council in Granada.
- 27 satellite events have been celebrated, all around Spain and Portugal.
- The Spanish Committee for Mathematics, together with faculties from all over Spain, starting by the faculty of mathematics of Seville, made it possible that we can count with 100 volunteers, from many different places in Spain, to help all of you during this week.
- The solidarity of departments, faculties, and individual mathematicians, together with the EMS and CIMPA, allowed us to offer 120 grants for people having difficulties to attend the congress. We are very proud of that.
- And finally, all of you, more than 1,300 participants who are here in Seville attending the congress, with nearly 1,000 talks and posters. Those of you who accepted the invitation to give a lecture, and those who will participate in any other way, you are the reason why this congress exists.

We have no words to express our gratitude to all of you for this support. The best we can do is to say a huge “thank you”, and assure you that we worked really, really hard to make this congress a success.

Right in front of where we are, there is a replica of the Nao Victoria, the ship that in the 16th century set sail from the port of Seville and completed the first circumnavigation of the world, the greatest maritime feat of all time. Just as that ship

⁸All sponsors are listed in section [Sponsors and exhibitors](#)

opened new paths, we hope this congress will forge new connections and significant advancements.

We hope this will not be your last visit to Seville, we hope you come back to our university, to our Institute of Mathematics, the IMUS, to work together, to reinforce the bonds that will be formed during this congress. We welcome you to our city. We hope that, from today, it will become a bit of your own too. Thank you very much.

Jan Philip Solovej, president of the European Mathematical Society

Honored guests,
dear colleagues,

It is my great honor and immense pleasure to welcome you today to the 9th ECM.

This congress offers a fantastic opportunity, as has already been mentioned, to celebrate mathematics in all its beauty, all its depth, and all its diversity. We have a fantastic and fascinating program ahead of us.

Soon, we will learn the names of the prize winners of the ten European Mathematical Society prizes. We will also learn the recipient of the Felix Klein prize for mathematical applications, as well as the winner of the Otto Neugebauer prize in the history of mathematics. In addition, we will announce the prize winners of the EMS/ECMI Lánzos prize in mathematical software and the recipient of the Paul Lévy prize in probability. The last two prizes are new, and we are looking forward to celebrating their winners.

The scientific program offers a rich and diverse mix of plenary lectures, invited lectures, contributed talks, minisymposia, and panel discussions. I would also like to highlight events organized by the association of European Women in Mathematics and by the recently founded European Mathematical Society Young Academy, EMYA.

Of course, we should not forget the social events, which provide valuable opportunities for interaction and exchange. I would like to thank the scientific committee and all the prize committees for their tremendous efforts and hard work. I also wish to thank all the speakers for accepting our invitations. I am equally grateful to all the prize winners for accepting their awards. I would like to thank the University of Seville for hosting us, and I wish to express a very special thanks to the local organizing committee—Juan, Isabel, and their entire team. They have carried out an enormous amount of work, and they truly deserve all the credit. Last but not least, I want to thank all of you for participating in this congress. It is wonderful to see such a large and vibrant audience. Although I regret that I cannot attend all the events myself, I am delighted that you are all here, contributing to what I am confident will be a truly outstanding congress.

Lorena Garrido Serrano, deputy minister of the department of university, research, and innovation of the regional government of Andalusia

It is an honor to take part in the opening ceremony of this 9th European Congress of Mathematics on behalf of the regional government of Andalusia. I would like to take this opportunity to welcome all the participants and organizers of the congress to Andalusia. This land is friendly and welcoming, so I am sure it will leave you with a satisfying memory when your stay comes to an end. Apart from being a welcoming land, it is a community with a deep commitment to science and knowledge, as evidenced daily by the work of our entire university system.

We are proud that this congress returns to Spain and is held for the first time in Andalusia. Our community contributes significantly to the scientific production in Spain, representing over an 11% of the one of the European Union. Andalusia enjoys a reputation for excellence in mathematics research throughout most of its territory, centered around the Andalusian Interuniversity Institute of Mathematics, which is now a reality, as a result of the commitment of our department of university, research, and innovation and the universities of Seville and Granada. Specifically, the mathematics institutes of the universities of Seville and Granada are our two flagships in scientific production in this field.

In the case of Seville, I hope that it will soon be awarded the seal of excellence for which it has been striving for years, accumulating merits in a growing list of achievements. Evidence of this is the position of both institutes, Granada and Seville, in international rankings. From Andalusia, we are already working on the creation of new units of excellence that will serve as stepping stones towards obtaining the national seals of excellence named María de Maeztu or Severo Ochoa. This is our commitment to the well-developed research strength of this land in the field of mathematics.

Our responsibility towards the sciences does not end at the peak of the research career; rather, we are convinced that success is built from the ground up, with an investment of time and dedication that integrates with the future research community. Therefore, we have updated our offering of university degrees after remaining unchanged for 14 years. And we have done this with a deep commitment to sciences, resulting in a variety of degrees where 50% of the undergraduate, master's, and doctoral programs are in STEM fields.

Nevertheless, there is still much to do. We need to work on fostering scientific vocations among our schoolchildren, not just teenagers, but even at earlier stages. We need to work towards increasing the presence of women in science, whose day we celebrate each year with the commitment to continue addressing that gender gap. I'll keep it brief. I just want to emphasize my hope that this congress will be productive

for all, and that you end up convinced that Andalusia is a major laboratory in Southern Europe. Thank you very much.

Álvaro Jesús Pimentel Siles, third deputy mayor of Seville

President of the organizing committee and members of the various committees
of the Congress,
president of the European Mathematical Society,
deputy minister of university, research, and innovation of the regional government
of Andalusia,
vice-chancellors of the University of Seville,
researchers, congress participants, ladies, and gentlemen,

I would like to start by conveying greetings on behalf of the mayor, José Luis Sanz, and extending a warm welcome from the city council of Seville to all participants in this 9th European Congress of Mathematics, hosted by the capital of Andalusia until July 19.

It has already been mentioned in this opening ceremony that this is the second most important congress in the world in this discipline, and that more than 1,300 mathematicians from across Europe will have the opportunity to present and discuss the latest research advances in their respective fields. Therefore, I can only say that from the city council of Seville, we are very proud that our city was chosen for this event which, four years later, follows in the footsteps of Portorož, Slovenia.

Seville aims to be, during this week, the best setting to welcome you and to promote the dissemination of a science that extends beyond the walls of universities and research centers. History, architecture, technology, and craftsmanship are also mathematics.

I am strongly convinced that mathematics is fundamental for the comprehensive development of the individual. It stimulates logic, reasoning, and order. It gives us the capacity to face complex and decisive situations. Therefore, mathematics is more than mere operations with numbers: its presence and impact in everyday life are undeniable.

Discovering the importance of this science for our daily lives is also another goal of this congress. Among the 12 plenary lectures, 64 symposia, or the 270 communications that form the main body of the research, allow me to highlight the lectures, activities for youth, and thematic exhibitions that are part of the congress agenda.

I know that the most important seed you are going to sow during these days goes beyond the impeccable academic dossiers that will be part of the congress records. If even one child participates in a lecture, or a young person takes interest in your exhibitions... this congress will have been a resounding success. The future of society hinges on having well-educated, prepared citizens who contribute to building a

better world through their work. To achieve this, we must not only foster academic understanding but also problem-solving skills, critical thinking, and self-confidence.

In Seville, we know a lot about all I'm talking about. We have two public universities with researchers who are leaders in research and dissemination. We have the most important scientific and technological park in Southern Europe, PCT Cartuja, where all of you will have the opportunity to spend most of these days of the congress. Moreover, you will have the fortune of being in a cutting-edge hub in Europe for technological development, academic training, R&D, and where the society of the future is being shaped.

I want to conclude by congratulating the organizing committee because I know it hasn't been easy to shape such a large-scale event, but they have worked diligently to ensure everything goes perfectly. Also, to the University of Seville and the School of Engineering for being outstanding hosts of this event. And of course, to the awardees in recognition of their excellent contributions in the field of mathematics.

I reiterate that it is a pride to have you in Seville. I hope that your experience in the city during these days will also leave you with the best memories and impressions of a city that, thanks to you, is already considered in the finest history of research and innovation.

Bienvenidos a Sevilla.

Welcome to Seville.

Willkommen in Sevilla.

Vilkamen in Sevilla.

Bienvenue à Séville.

Vianveníú a Sevilla.

Muchas gracias.

Julián Martínez Fernández, vice-rector for research of the University of Sevilla

Good morning to all the researchers gathered here today. Good morning to the authorities and to all colleagues. First of all, on behalf of the rector of the University of Seville, I would like to extend a warm welcome to our university and to our city.

I would also like to express our sincere gratitude to the European Mathematical Society for selecting the University of Seville to host this conference. It is truly an honor to organize the second-largest mathematical event in the world, and we are extremely pleased to have had this opportunity.

This achievement is the result of the outstanding work carried out by the organizing committee, a large and dedicated team composed of many professors from the University of Seville. I see here Juan, Isabel, and many other colleagues and friends who make it possible for Seville, Andalusia, and Spain to play a leading role in mathematical research worldwide. I would like to thank them not only for organizing this

conference, but also for their daily work and tireless commitment to research, which has brought us to our current position.

I would also like to thank the scientific committee, which brings together some of the best researchers in the world. It is a great honor to have you here and to be able to attend your lectures. Scientific meetings such as this one are essential tools for discussion and collaboration, and they are of great importance for institutions like the University of Seville, as they strongly promote research. We all agree that high-quality research is essential for society, and this conference is of outstanding scientific and technological relevance.

The program covers all fields of mathematics, which gives this event particular significance. Moreover, this conference benefits from the strong mathematical structure already established in Andalusia, including the Institute of Mathematics of Seville and the Institute of Mathematics of Granada, which together form the Andalusian Institute of Mathematics, along with the universities of Almería, Cádiz, and Málaga.

This special framework, together with the support of many other institutions – the Royal Spanish Mathematical Society, the Spanish Society of Statistics and Operations Research, the Spanish Society of Applied Mathematics, and many others – has made it possible for more than 1,400 participants to gather here today, along with ten plenary speakers of the highest international standing.

By now, there is no need to emphasize the importance of mathematics. We all recognize that mathematics has accompanied humanity since its origins and has paved the way for understanding the world around us. In recent decades, mathematics has also become a key driver of technological development. We would not have mobile phones, Google Maps, or many of the technologies we use daily without mathematics and algorithms.

Mathematics therefore has an enormous impact on society. A report published a few years ago by IMUS, the Institute of Mathematics of the University of Seville, together with other institutions, showed that every euro invested in mathematical research in Spain generates approximately five euros in societal return.

Mathematics is also becoming increasingly important within our university. Allow me to mention two recent figures. Just a few days ago, the Leiden ranking was published – a ranking I personally value highly, as it is largely based on publications. According to this ranking, the University of Seville increased its share of top publications by 10% over the last year, while citations rose by 9%. More importantly, the university's strongest area continues to be mathematics and computer science, which ranks 127th worldwide.

These figures confirm what we already knew about the importance of mathematics at our university. The University of Seville is a large institution, with 65,000 students, more than 4,000 professors, seven major shared research facilities, and

fifteen research centres. Each year, we produce approximately 5,000 scientific publications and attract around 80 million euros in research funding. Over the last ten years, we have invested 50 million euros in research infrastructure, including the Institute of Mathematics, which I encourage you to visit if you have the opportunity. It offers 1,000 square meters of space to think, reflect, and work on mathematics.

I would like to conclude by encouraging you to make the most of this meeting: to engage in discussion, to exchange ideas, and to produce excellent science. And of course, do not forget to enjoy the city –especially after 9 p.m., as during the day I believe you are better off here.

Once again, congratulations to the entire mathematical community on this remarkable achievement. It is my pleasure to declare the conference officially open. Thank you very much.

Pavel Exner, chair of the EMS prize committee

Dear colleagues, distinguished guests, and dear friends,

I have no intention of competing in dance after that beautiful performance. We now move on to something entirely different. It is my task to announce and present the recipients of the EMS prizes.

In total, ten prize winners are represented here. Two are absent for a reason that may be more important than any modern academic prize: the birth of their newborn children. Before announcing the winners, let me share a few facts about the process.

First, a word about the prize committee. The committee is appointed by the EMS executive committee in accordance with the statutes, and, as you may know, its composition remains confidential until the prize ceremony. The time has now come to reveal its members.

The members of the prize committee were José Antonio Carrillo de la Plata, Heike Fassbender, Elena Fernández Areizaga, Ben Green, Kathryn Hess Bellwald, Juliette Kennedy, Tomasz Łuczak, Volodymir Mazorchuk, Pierre Pansu, Giuseppe Savaré, Teresa Martínez Seara, Kristian Seip, Ofer Zeitouni, and myself as the chair.

Let me now say a few words about the prize itself. The EMS prize was established at the founding of the European Mathematical Society and was first awarded at the inaugural congress in Paris. It quickly gained great prestige, as illustrated by the fact that in almost every group of ten prize winners, one, two, or even three later received the Fields Medal. Out of the 80 laureates to date, 15 have gone on to become Fields medalists.

For the current cycle, we received 55 eligible nominations, significantly more than four years ago. This was a source of both great joy and great frustration: joy, because it reflected the outstanding mathematical work being done by young researchers, and

frustration, because it required us to make many difficult choices. In the end, several excellent candidates could not be selected.

Without further ado, let us now turn to the prize winners, whom I will announce in alphabetical order.

Maria Colombo (EPFL, Switzerland), for her innovative results in fluid dynamics, optimal transport and kinetic theory, and for their impact on analysis in general.

(As mentioned earlier, she is one of the two recipients who could not attend, and her prize will be accepted on her behalf by her colleague, Lucio Galli.)

Cristiana de Filippis (University of Parma, Italy), for her outstanding contributions to elliptic regularity, particularly Schauder estimates for non-uniform elliptic equations and non-differentiable variational integrals, and minima of quasiconvex integrals.

Jessica Fintzen (University of Bonn, Germany), for her transformative work on the representation theory of p -adic groups, particularly for her spectacular demonstration that Yu's construction of supercuspidal representations is exhaustive.

Nina Holden (New York University, USA), for her profound contributions to probability theory and its applications to statistical physics, including results linking Liouville quantum gravity, Schramm–Loewner evolution, and random triangulations.

(She is the second recipient unable to attend, and her prize will be accepted by her uncle, Helge Holden, himself a distinguished mathematician.)

Tom Hutchcroft (California Institute of Technology, USA), for his revolutionary contributions to probability theory and geometric group theory, particularly to percolation theory on general graphs, using tools from geometry, operator theory, group theory, and functional analysis.

Jacek Jendrej (Sorbonne Paris North University, France), for his innovative proofs of the soliton resolution conjecture and the collision problem of two solitons for equivariant wave functions, developing new approaches using ideas from dynamical systems theory to describe the behavior of solutions near a multi-soliton configuration.

Adam M. Kanigowski (University of Maryland, USA), for his outstanding contributions to spectral classification and mixing properties of slowly chaotic dynamical systems.

Frederick Manners (University of California San Diego, USA), for his notable contributions to additive combinatorics and related areas, particularly to the foundations of higher-order Fourier analysis, as well as for other diverse results, such as the solution of the pajama problem.

Richard Montgomery (University of Warwick, United Kingdom), for his solution of the Ringel tree packing conjecture, development of distributive absorption techniques with applications to graph immersion problems, and solution of several classical Erdős conjectures and others on cycle lengths in sparse graphs using the novel machinery of sublinear expanders.

Danylo Radchenko (CNRS, University of Lille, France), for the construction of optimal spherical designs and his seminal contribution to the new field of Fourier interpolation, as well as his fundamental contributions to the theory of polylogarithms.

(All of them went on stage to receive their award from the president of the European Mathematical Society: an accrediting diploma and an Andalusian-themed tile.)

To conclude this part of the ceremony, let us wish these outstanding ten mathematicians every success in their future careers and reward them with a well-deserved round of applause.

Peregrina Quintela, chair of the Felix Klein prize committee

According to the statutes of the Felix Klein prize, the award seeks to honor a scientist under the age of 38 who has used sophisticated methods to provide a solution, meeting the full satisfaction of industry, to a concrete and challenging industrial problem.

At its meeting on April 1, 2024 the committee for the 2024 Felix Klein prize, composed of Professor Krzysztof Burnecki, Dr. Patrice Hauret, Professor Ralph Korn, Professor Karl Kunisch, and chaired by myself, unanimously decided to confer the 2024 Felix Klein prize to

Fabien Casenave (Safran Tech, Digital Sciences & Technologies, France), for his contributions to the integration of simulation-based design in projects related to reduced-order physical modeling in the aeronautical industry.

Thank you very much, and congratulations.

Karine Chemla, chair of the Otto Neugebauer prize committee

As in previous cases, awarding the 2024 Otto Neugebauer prize was a particularly challenging task. The nominations we received were of outstanding quality. The prize

committee, composed of Erika Luciano, Antoni Malet, Roman Murawski, and Peter Ullrich, unanimously decided – after extensive deliberation – to award the prize to

Reinhard Siegmund-Schultze (University of Agder, Kristiansand, Norway), for his outstanding work in the social history of mathematics, which has helped to shape a new and much richer vision of the context of mathematics in the 20th century.

Professor Siegmund-Schultze, thank you very much, and congratulations.

Barbara Kaltenbacher, member of the EMS/ECMI Lánčzos prize committee

A substantial amount of mathematical effort goes not only into proving theorems, lemmas, and propositions, but also into the development of mathematical software. Mathematical thinking is essential for the design and implementation of scientific code, and, conversely, software is an indispensable tool for disseminating mathematical ideas.

To recognize this fact, and on the initiative of CAIR, the EMS Committee for Applied and Interdisciplinary Relations, the European Mathematical Society – jointly with ECMI, the European Consortium for Mathematics in Industry – has established a prize for mathematical software. This prize is named after Cornelius Lánčzos, a European mathematician and pioneer of numerical computation.

The committee received 13 strong nominations. It was composed of members nominated by ECMI and the EMS and was chaired by Patrick Farrell, whom I am honored to represent here today. It is therefore my great pleasure to announce the prize winner. Fortunately, the name is easy to pronounce:

MUMPS. Patrick Amestoy, Jean-Yves L'Excellent and Théo Mary, for its important and widely used contributions to the numerical solution of sparse linear systems.

Thank you very much, and congratulations.

Konstantin Khanin, member of the Paul Lévy prize committee Vincent Biron, grandson of Paul Lévy

It is my great pleasure and privilege to introduce a brand-new prize, integrated this year: the Paul Lévy prize in probability theory. This prize has no age or nationality restrictions. Mathematicians from all over the world are eligible, provided they have made outstanding contributions to probability theory and its applications, broadly understood.

The creation of this prize was a collective effort involving many contributors. The founding organizations include the European Mathematical Society, École Polytechnique – where Paul Lévy worked for nearly forty years – the École Polytechnique Foundation, and the Lévy family. The principal sponsor is BNP Paribas, which not only provided generous financial support but also contributed significantly to making this prize possible.

The selection committee was chaired by Wendelin Werner. While I will not list all five members here, their names will be made public shortly. We are very pleased that the committee was able, within a short time frame, to select an outstanding first laureate.

I would also like to note that the Lévy family has been involved from the very beginning. In particular, Hélène Freysz, a distinguished astrophysicist at the Observatoire de la Côte d’Azur in Nice and granddaughter of Paul Lévy, played an important role in the early stages. Unfortunately, she could not attend today, but we are delighted that Vincent Biron is here to present the award.

The first Paul Lévy prize in probability theory is awarded to

Jeremy Quastel (University of Toronto), for his major advances in the fields of hydrodynamic theory, stochastic partial differential equations, and integrable probability.

Once again, congratulations to all the prize winners.