18TH JULY 2024 | #4

9TH EUROPEAN CONGRESS OF MATHEMATICS

ECM Sevilla2024

July 15th to 19th

# 9ECM Daily News

**Information and current events from the Congress**

**Mathematician women: inequality but strength.** Girls are worse at mathematics than boys. This is one of the false myths about the relationship between women and numbers. And no, they are not worse at it, neither they like it less conclude data and studies. For example, the paper *Gender similarities in the brain during mathematics development*, published in the Nature partner journal Science of Learning in 2019, is conclusive: women's and men's brains process mathematical information in the same way.

Beyond hoaxes, in the current situation of mathematics there is positive data on the gender gap, but situations of inequality and differences between women and men continue to be found in the mathematical community. “According to the latest report of the Consejo Superior de Investigaciones Científicas (CSIC) on women researchers, it shows an unequal evolution of the scientific career of women and men. In Spain, in the research stage prior to the PhD, men account for 48.6% and women for 51.4%. Approximately 50% of doctorates are obtained by women, although the percentage of grants obtained by women is lower than that of men”, explain the Women and Mathematics Commission of the Spanish Royal Mathematical Society (RSME).

Except for the difference in scholarships, this is not bad news for the training part, but later, in the academic career, the differences begin to show. “According to the report *Scientists in figures*, prepared by the Spanish Ministry of Science and Innovation, only 43% of research staff in universities are women and only 22.5% of chairs are held by women. In mathematics, this percentage is worse, 12%, although it seems that the percentage is growing”, the Commission points out.

**Obstacles for women & mathematician mothers**

Why is this happening, and where are the women professors and academic researchers? “In Spain, the probability of a full professor being promoted to tenured professor is 2.5 times higher than that of a woman professor with a similar personal, family and professional situation. In the case of having a family, the situation gets worse, because **a man with children is four times more likely to be promoted to tenured professor than a woman with children** and a similar curriculum”, emphasize the mentioned Commission.

Behind these differences there are challenges that women have to face. These issues were discussed during the 9ECM, particularly in the panel discussion held yesterday organized by the International Association European Women in Mathematics (EWM).

On one hand, "women are still under-represented in the highest positions in academic and research careers", says Isabel Fernández, mathematician at the University of Seville and member of the 9ECM scientific committee. On the other hand, "women decline (to a greater extent than men) invitations for family and work-life balance reasons: **it is undeniable that family burdens continue to affect women more than men in research careers**," she adds.

"Women, on average, take on more responsibilities for their children also later in life, although this is something which varies between families", agrees Nina

Holden, Associate Professor at the Courant Institute of Mathematical Sciences at New York University, and one of the awarded mathematician of the European Mathematical Society (EMS) Prizes of this year, who has recently become mother of her third children. In general, "women face several challenges which men do not. For example it is physically demanding to go through pregnancy and childbirth, and one is set back by the career disruption that comes from maternity leave", says the mathematician. What she highlights is that "it's important not to forget that **women are able to produce very good research, also after becoming mothers**".

It seems obvious, but in real daily life it can be not so simple. "We have to make it easy for people to do their jobs. We are an international community in mathematics and what's happening in one part of the world affects all of us. Things are changing, but there is a long way to go", considers Tara Brendle, from the University of Glasgow, who participated in one of the activities of the EWM at 9ECM. She knows this well: back at her early career in the US, she wasn't eligible for maternity leave when she had her first child. "I took a semester of unpaid leave and found a different temporary position at a research institute instead".

Sometimes, we can even not notice, as it happened to Annalisa Buffa, professor of Mathematics at Ecole Polytechnique Fédérale de Lausanne and plenary lecturer of the 9ECM: "Being a woman had never been a problem to me until I realized that indeed there is a difference. I got to talk with female colleagues who live in a more masculine environment and they told me, 'hey, did you realize that you have to shout to be heard, that you raise your hand and no one gives you the floor?'. I hadn't realized, but it is true. There is bias, sometimes an unconscious bias, but we have to fight it because it affects a lot of women and that's a shame".

**Women mathematicians at the 9ECM**

All this data is also reflected in the usual situations in the lives of mathematicians, such as congresses. If we look at the numbers of women at the 9ECM, "**in the plenary lectures we are at a ratio of 30-70**, which is similar to the two previous editions. We try to ensure that this criterion is taken into account, which is why there are nine women and nine men on the Organising Committee and two women and two men in the public lectures," explains Juan González-Meneses, president of the 9ECM Organising Committee. As for the number of participants, they don't know precisely because there is a section in the registration form to indicate gender, but it is not obligatory. "In figures of the people that have include this information, there are 265 women and 467 men" explains González-Meneses. From previous congresses they don't have this data.

In the 9ECM programme it is positive to see the presence of many women, but

sometimes it is still difficult to achieve a gender balance when designing the programme for an event like this, acknowledges Isabel Fernández: "It is true that the scientific community (and mathematics in particular) is increasingly aware of the importance of having a gender balance when designing the scientific programme of a congress (in the same way that we try to have a thematic or territorial balance). But it is also true that **we are still far from parity**".

***"Women are still under-represented in the highest positions in academic and research careers. They also decline (more than men) invitations because of family and work-life balance reasons"***

"It is still difficult. Selection committees are of course influenced by the more experienced members. When one of them declares that a specific woman is 'not really good enough' or 'too young' and moves onto the next name, **it is very hard to fight**", reveals Barbara Fantechi, mathematician and professor at the International School for Advanced Studies, and part of the scientific committee of the 9ECM.

**What still needs to be done**

Then, what is still necessary to change so that mathematician women have an easier way to pursue their careers? "This is a difficult question since there are already a number of good initiatives directed towards women, and the situation varies between different countries and institutions", says Nina Holden. But, regarding maternity and children, she finds "it's important to have access to good childcare, equal expectations to both parents and the possibility to get tenure-track or tenured position at an early stage of the career". More generally, she considers **it is essential "recruitment and visibility of women**, and it's also important with awareness around unconscious biases".

"At European level there has been a **marked improvement**, achieved by the effort of many dedicated mathematicians, not just women. I would say we should open up, since women aren't the only discriminated group, only the more numerous. We should do this by listening attentively. There's so much to hear, if we choose to do so", claims Fantechi. "It is easy to be tempted to think that we have already achieved equality, but the truth is that **it is only a theoretical equality**, we are still far from real equality", says Fernández, and activities such as those organised by the International EWM at the 9ECM "provide an opportunity to confirm this fact".

"Moreover, I think it is especially important for young women starting their research careers, because it helps them to create a 'network' of female mathematicians, many of whom have similar experiences in terms of what it means to be a woman in a traditionally male world", emphasises Fernández. "**It is necessary for young women to have female role models**. Otherwise, it can be tempting to think that research, and above all research of excellence, is for men", adds.

In this sense, the ECM offers the EWM Exhibition *Celebrating and Supporting Women in Mathematics*. Also, one of the activities organised by the EWM consisted of five talks by five women mathematicians: Elena Gaburro, from the University of Bordeaux; about symmetries of surfaces. Jessica Fintzen, from the University of Bonn; Maria Yakerson, from the University of Oxford; Chiara Saffirio, from the University of Basel; and Tara Brendle. Afterwards all of them participated in a panel discussion where they told their personal experiences on how to build a career and to overcome obstacles, such as dealing with pressure and stress, organizing time and how not to feel frustrated. "I think that events like these are great. **There is not a solution that fits all**, what works for somebody else may or may not work for you, but the more people you talk to the more likely you find an idea that works", considers Brendle.

As Isabel Fernández concludes, "**combating this inequality is everyone's job**, not just women's, which is why I think it is important to make it visible in these forums, where the entire mathematical community comes together".

EWM panel discussion: celebrating and supporting women in mathematics, hold yesterday.

# "My approach is always to try to take applications, extract the easiest problem I cannot solve and at least solve that one"

**Annalisa Buffa, professor of Mathematics at Ecole Polytechnique Fédérale de Lausanne**

*"She is one of the more relevant applied mathematicians, one of our references in partial differential equations". That's how Annalisa Buffa was presented before her plenary lecture about the impact of geometric simplification in the numerical simulation of partial differential equations (PDEs), yesterday at 9ECM.*
*Buffa, professor of Mathematics at Ecole Polytechnique Fédérale de Lausanne (EPFL) since 2016, is an expert in the numerical analysis of partial differential equations, geometric design, computational mechanics, and computational electromagnetics. But all her work has a strong approach to industrial applications. The objective is helping prototypes to be tested on the computer before they are manufactured, and, at the end, save time, money and resources. She builds simplified geometric models, runs simulations and provides tools in the hands of practitioners to control accuracy. Before EPFL, she was the research director and director of the Instituto di Matematica Applicata e Tecnologie Informatiche of the Italian National Research Council (CNR). Buffa is also a corresponding member of the Accademia dei Lincei, associé etranger of the French Academy of Sciences and member of the European Academy of Sciences, amongst others. She has received an ERC Starting grant and an ERC Advanced grant, she is a recipient of the Collatz prize from the ICIAM and, alongside speaking at several venues, she was the AWM-SIAM Sonya Kovalevskaya lecturer at ICIAM 2023.*

**You work in algorithms for computer simulations of the behavior of machines with complicated geometries, what is your approach?**

I am a computer scientist with a PhD in Mathematics, so I learnt mathematics on the way. I really believe my role is always to try to use mathematical tools at the service or this or that application. Mathematical reasoning brings a point of view that is helpful and brings novel sound approaches.

For example, I work a lot with mechanical engineers. Out of need, geometric modes are drastically simplified to run simulations. But then what? What happens to your solution? How can we know if the solution is good enough? The question comes from real applications, but then can be reformulated and understood in mathematical ways. So my approach is always to try to take applications, extract the easiest problem I cannot solve and at least solve that one with the rigor of mathematics.

**That is a one-way road, but you look for a win-win.**

Yes, then there is the way back: bring my knowledge back to the practitioners or to the applications, and in this path one may also encounter problems that are not well formulated in mathematical terms or too complex, and then my role is also to translate the mathematical understanding and contribute to get the best out of it, in some sense.

**Then, we can sum up that you try to build a bridge between applications and theoretical mathematics, and back, by translating and adapting mathematical results to applications.**

***"The idea is that via mathematics we can have a point of view that is helpful and brings novel, sound approaches to real life problems"***

Yes, and also to get mathematical problems that I solve come from the applications, and then I try to bring the solutions back to practitioners. This is an effort, it's not for free. Because if you don't do that mathematical results may remain just unused. My effort is often to do the path back and try to make the results that I obtain useful. I'm an applied mathematician and, in the spectrum of applied mathematicians, I'm one of the closest to applications. But of course this is just my approach, and there are many others.

**Once you analyse the errors and run the test… how do you adjust the mathematics?**

So, the steps are: I simplify the model, I compute the solution on the simplified model and also an estimate of how far it is from the solution on the real model (with all my integrals and so), and with those, I can tell for each complex model if it was important or not to add that feature that was simplified for the simulation - it will depend on the size of the error and on the needs of the applications. This is where the features come in, once I do the estimation. So the feature is removed in the geometric

model, but I can now measure the impact of removing it on the simulation we are interested in.

**Is it possible to go fully adaptive, what do you mean?**

This is a numerical analysis mathematical jargon. Being fully adaptive means that I have the capability to run several simulations. It's about the simplification of the model, but it means that at some point the adaptive will tell me that I have to make my model more complex. I run a simulation, compute an estimate of the error, decide where I need to refine my mesh, then I do another simulation, simplify, then another one, over and over…. It's a mathematical strategy. On real life problems, it's often intractable. Often there is only one mesh, one simulation, one attempt. In real life full adaptivity is not feasible. On the other hand, it's good to know if what has been computed is right or wrong!

**When doing all this, what mathematical tools do you use in your research?**

Basically, the interface between geometric modeling and partial differential equations. And then there is all the part of how we study partial differential equations, and that's with functional analysis and theory of Sobolev spaces.

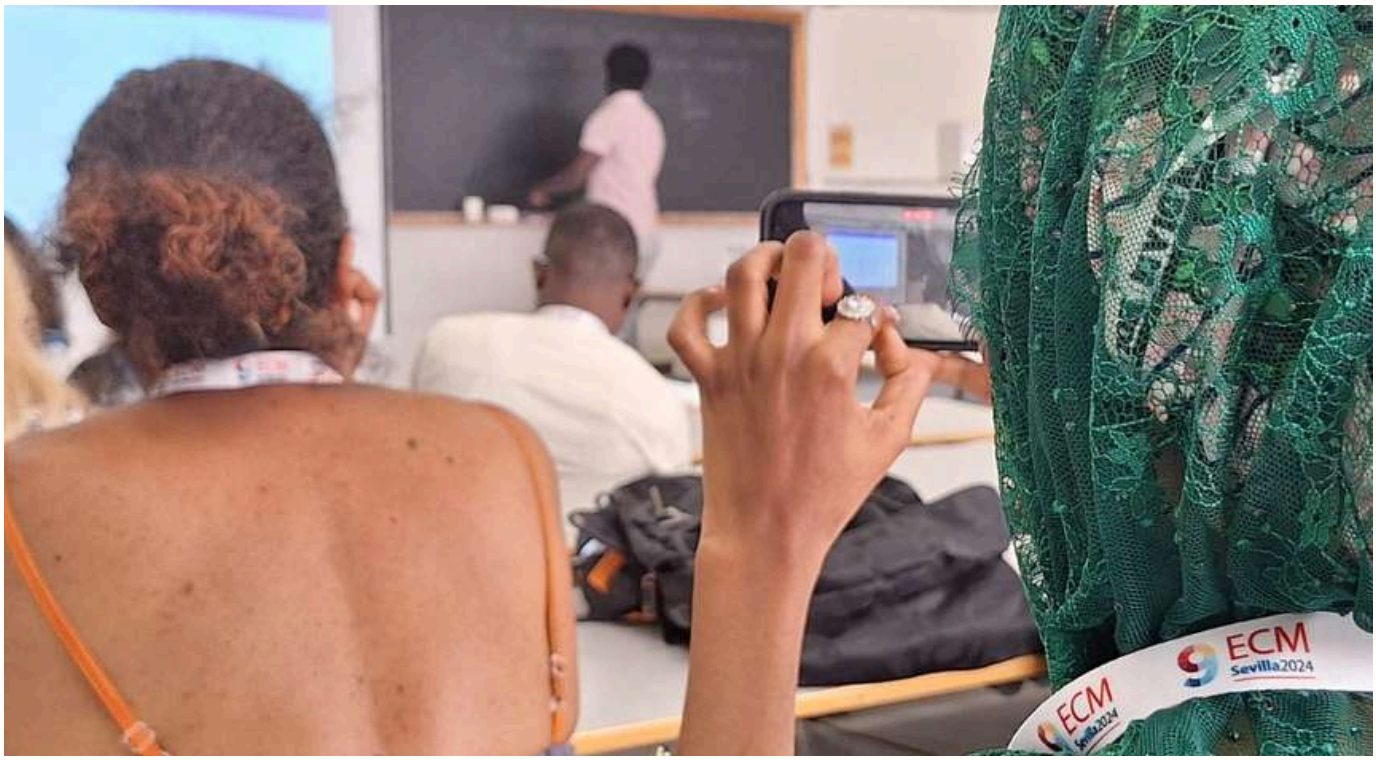
All this reminds me of digital twins, digital models that can emulate the behavior of a physical system.

Yes, these geometrical representations, their simplification and the simulation of PDEs are 'components' of digital twins.

**This technology is related to algorithms based on artificial intelligence. Do you think AI can be used to improve these processes?**

There are several ways to use tools from machine learning in our developments. It's delicate in the sense that machine learning requires access to huge amounts of data. Now, if we look for example at engineering applications, we don't have data organized in a way that is usable. We really have an issue on how we get the data and train machine learning networks for this purpose - it's not entirely clear how to use AI in this kind of application. Moreover, if we speak of digital twins in energy or in mechanical engineering applications, often the accuracy of the solutions needs to be 'certified' with stringent constraints. Machine learning results miss this 'certification' for the time being. The future will probably be a mixture.

# In math, we also collaborate: Europe and the Global South




A key theme of the 9ECM is undoubtedly academic cooperation. This is exemplified by the 120 scholarships awarded by the conference organizers to young mathematicians and those from developing countries who lack the resources to attend.

The scholarship selection committee, coordinated by Mirta M. Castro Smirnova from the University of Seville, also includes Martina Magliocca, a Ramón y Cajal researcher at the University of Seville; Christophe Ritzenthaler, a professor at the University of Rennes 1 and director of the International Center for Pure and Applied Mathematics (CIMPA); Lidia Fernández, a professor at the University of Granada; and María de los Ángeles García Ferrero, a researcher at the Institute of Mathematical Sciences in Madrid, affiliated with the CSIC (ICMAT).

Among the developing countries that have been awarded these scholarships, as listed by the International Mathematical Union (IMU) which aims to foster international cooperation in mathematics, notable ones include Ukraine, Serbia, Montenegro, and Romania, as well as other countries such as Turkey. Beyond Europe, scholarships have also been granted to individuals from Uzbekistan, India, Pakistan, Iran, Morocco, Tunisia, Algeria, Nigeria, Ethiopia, Uganda, and within Latin America, Mexico, Honduras, Colombia, and Brazil.

Yesterday, Wednesday, a Mini-symposium on collaboration between countries titled "Shared Horizons: Collaborations Between Europe and the Global South" took place. In its organization, among others, participated the Director of CIMPA

(Centre International de Mathématiques Pures et Appliquées), and it included the participation of some of the scholarship recipients who have significantly contributed to the development of mathematical research in their respective countries at the 9ECM. The symposium emphasized, as its name indicates, topics related to scientific collaboration between Europe and the "Global South."

The accomplished objective of this Mini-Symposium was to give voice to researchers from developing countries, allowing them to present their projects and establish contacts among themselves and with other developed countries. As Cristophe Ritzenthaler from CIMPA mentioned, "Today, real strides are being made in mathematical cooperation. Through my organization, funded by France, Switzerland, Norway, Germany, and Spain, we are training about a thousand students each year, and we provide dozens of scholarships for young mathematicians to undertake research stays at European institutes."During the session, sponsored activities available to developing countries and those just beginning to cultivate their mathematical culture were discussed, focusing on establishing connections with mathematicians worldwide. Within the realm of cooperation, Christophe stated that there are different priority levels: "Brazil, Mexico, China, or India, which are somewhat more advanced, are not in the same situation as Africa in general." In this context, attendees at the meeting emphasized that one of the main challenges is supporting research in Africa. "They are isolated; for us, the 9ECM is just another conference, but for them, being here is like a dream come true," concluded the director of CIMPA.

Definitely, the 9th European Congress of Mathematics has underscored that this issue is non-negotiable, and that now more than ever, there is a need to strengthen collaboration, cooperation, and support for third countries in research to advance mathematics worldwide. Quoting mathematician Adolf Hurwitz,"The great ideas of our science often arise and mature in solitude; no other branch of science, except perhaps philosophy, has such an introverted character as mathematics. And yet, a mathematician feels the need to communicate, to participate in discussions with other mathematicians."

# ON TODAY'S MENU

## HIRZEBRUCH SPEAKERS

### Étienne Ghys

**10:00. BARCELÓ CONVENTION CENTER**

Étienne Ghys is currently Permanent Secretary of the French Académie des Sciences and emeritus senior CNRS researcher in UMPA, École Normale Supérieure de Lyon. His research focuses mainly on geometry and dynamical systems, though his mathematical interests are broad. He has enabled us to better understand the topology of the Lorenz butterfly, a paradigm of chaos theory. In recent years, he has been involved in several dissemination initiatives, like the production of mathematical films and the founding of an online journal aimed at the general public. This earned him the 2015 Clay Prize for the Dissemination of Mathematics and the 2022 CNRS Scientific Mediation Medal.
He was an invited speaker at the ICM 1990, in Kyoto, in Seoul 2014, and a plenary speaker in Madrid 2006. He also was a plenary speaker in 2012 at the International Congress on Mathematical Education in Seoul. He received honorary doctorates from Geneva and Neufchâtel. He is a member of the Académie des sciences, Académie des sciences et lettres de Lyon, Academia Mexicana de Ciencias, Academia Brasileira de Ciências and Academia Europaea.

## PLENARY LECTURES

### André Neves: Recent progress in the theory of minimal surfaces

**09:00. BARCELÓ CONVENTION CENTER**

André Neves is a Professor of Mathematics at University of Chicago. He received his PhD from Stanford University in 2005. His field of research is geometric analysis and for his research he has been invited to speak at the ECM 2024, received the AMS Veblen Prize in Geometry in 2016, the New Horizons in Mathematics Prize in 2015, and a Simons Investigator Award in 2018. He is a member of the American Academy of Arts and Sciences since 2020.

## Benny Sudakov: Restricted subgraphs of edge-colored graphs and applications

**11:30. BARCELÓ CONVENTION CENTER**

Benny Sudakov received his PhD from Tel Aviv University in 1999 and has held appointments at Princeton University, the Institute for Advanced Studies, and the University of California at Los Angeles. He is currently a professor of mathematics at ETH Zurich. Sudakov is the recipient of a Sloan Fellowship, an NSF CAREER Award, and a Humboldt Research Award. He is a Member of the Academia Europaea, a Fellow of the American Mathematical Society, and was an invited speaker at the 2010 International Congress of Mathematicians. Sudakov has authored more than 300 scientific publications and serves on the editorial boards of dozens of research journals. His main scientific interests include combinatorics and its applications to other areas of mathematics and computer science.

**PUBLIC LECTURE**

## Monserrat Vilá: Biotic Globalization by Invasive Species

**16:00. SCHOOL OF ENGINEERING ROOM A**

Specialized in the ecology of invasive plants, Montserrat Vilà is a research professor at the Doñana Biological Station (EBD-CSIC) in Seville (Spain). She previously completed a postdoctoral fellowship at the University of California, Berkeley. Currently, her research focuses on the impacts of biological invasions and the development of invasion risk assessments. She is a member of the Scientific Forum of the European Regulation on Invasive Alien Species, of the IUCN SSC Invasive Species Group and Chair of the European Working Group on Biological Invasions (NEOBIOTA). She is the lead author of the IPBES Invasive Alien Species Assessment. In 2021 she received the Alejandro Malaspina National Research Award in Environmental Science and Technology, and the Mercer Award from the Ecological Society of America.

Her talk will deal with the introduction of exotic species promoted by human action, accelerated in the last century with the global increase in trade, the movement of people and the development of large infrastructures. Many alien species are able to establish, expand and invade the region of introduction, thereby altering biodiversity and the ecosystem. They can also affect all socioeconomic sectors, from agriculture to tourism to public health. As with epidemics, strategies to deal with biological invasions require better prevention and early detection policies and management.

## SPECIAL LECTURE

### Saul Schleimer: Puzzling the 12-Cell

**17:30. SCHOOL OF ENGINEERING ROOM 7**

Saul Schleimer is a geometric topologist and currently an Associate Professor at the University of Warwick. His other interests include combinatorial group theory and computation. He is especially interested in the visualisation of ideas from these fields. To promote such work, and outreach more generally, he co-founded the Illustrating Mathematics illustratingmath.org Steering Committee in 2022.

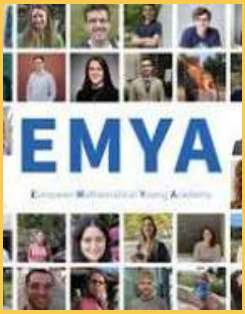
Interlocking puzzles (also called burr puzzles) are a great way to challenge your eyes, hands, and brain. You have to use both logic and spatial senses to figure out how the pieces fit together. In this talk, you'll use our understanding of four-dimensional space to build "Quintessence", a new family of 3D-printed interlocking puzzles. These are based on the geometry and combinatorics of the 120-cell. After giving some mathematical background, Schleimer will explain the construction of the puzzles. There will be many, many pictures. At the end of the talk the audience will be invited to solve some of the puzzles.

## PANEL DISCUSSIONS

### The Role of Institutes of Mathematics in the Advancement of Mathematical Research

**17:30. SCHOOL OF ENGINEERING ROOM 301**

The Institute of Mathematics of the University of Seville (IMUS), organizes this panel discussion with the participation of Justo Puerto, Director of the IMUS; Anna Wienhard, Director of the Max Planck Institute for Mathematics in the Sciences (MPIM); Martin Bridson, President of the Clay Mathematics Institute (CMI); Miguel Sánchez, director of the Institute of Mathematics of the University of Granada (IMAG); Rosa Crujeiras, director of the Center for Mathematical Research and Technology of Galicia (CITMAGA); Lluís Alsedà, director of Centre de Recerca Matematica (CRM); José Antonio Lozano, director of the Basque Centre for Applied Mathematics (BCAM); and Javier Aramayona, director of the Institute of Mathematical Sciences of Madrid (ICMAT). This event will address, among other topics: Attracting talent through mathematics institutes; Doctoral Programme in Mathematics. Agreements with companies; Knowledge transfer; Recognition in international rankings, Self financing and Organization of conferences and congresses to promote mathematical research at European level.




**Sustainability panel & group discussion (EMYA Panel)**

**17:30. SCHOOL OF ENGINEERING ROOM 5**
***ATTENTION: THE ROOM HAS CHANGED AND IS NOT THE ONE SHOWN IN THE PAPER PROGRAM**

Concerns about environmental sustainability and mental health have risen in recent years, especially among young people. In the field of scientific research, these issues come together. On the one hand, it is a profession where traveling in order to interact with colleagues and attend conferences is essential. How do we deal with its environmental impact? On the other hand, academic careers can lead to a weakening of researchers' short-term and long-term well-being due to a lack of stability options and work-life balance problems. What can be done, individually and collectively, to alleviate this problem? Organised by the EMS Young Academy (EMYA), the idea of the session is to discuss in small groups about sustainability (environmental and mental) in the academic career.

## PRIZE LECTURES

**Nina Holden: Random surfaces**

**14:05. SCHOOL OF ENGINEERING ROOM 207**

**Adam M. Kanigowski: Ergodic and spectral properties of smooth flows on surfaces**

**14:05. SCHOOL OF ENGINEERING ROOM 7**

**Danylo Radchenko: Fourier uniqueness pairs and interpolation formulas**

**14:05. SCHOOL OF ENGINEERING ROOM 301**

## EMS/ECMI LACZOS PRIZE LECTURE

**Patrick Amestoy. MUMPS: Multifrontal Massively Parallel Solver for the direct solution of sparse linear equations**

**14:05. SCHOOL OF ENGINEERING ROOM A**

# YESTERDAY AT A GLANCE

**Hyperbolic geometry is good for you!**

That is one of the most remarkable quotes of this morning. Just going through the congress' equator, Martin Bridson, the Whitehead Professor of Pure Mathematics at Oxford and President of the Clay Mathematics Institute, delivered a brilliant plenary lecture. He is renowned for his work in Geometric Group Theory. More precisely, he is interested in groups of symmetry of low dimensional objects, particularly hyperbolic spaces. The opening question of this talk, "To what extent are groups determined by their finite images?", caught everyone's attention from the first minute. "Like many good questions", he added, "it leads you to think about all sort of mathematics".

After showing a few examples of groups, and their finite presentations in terms of generators and relations amongst them, he stated that it is very difficult to answer even basic questions, such as if a group is trivial, from these presentations. Then, he went into developing some strategies that allow us to get answers, for instance by looking at how the groups act on spaces. He pointed out Max Dehn's pioneering work in decision problems. The rest of the session was focussed on explaining to what extent is a finitely presented group determined by its finite quotients. Finally, he concluded by presenting a few conjectures whose veracity is still being worked on.

## The Möbius Function: Where dynamical systems and number theory meet

There's nothing like a quick mention of the ever-relevant Riemann Hypothesis to get a room full of mathematicians excited, which explains why Tamar Ziegler (Einstein Institute of Mathematics at the Hebrew University of Jerusalem) used this Millennium Prize Problem to start her talk. The session began with a quick run-through of some of the properties of the function that titled the talk, the Möbius function, particularly its multiplicative nature and the relation of its asymptotic behavior to the Riemann Hypothesis.

She introduced the Liouville function, which is closely related to the Möbius function, and followed with a discussion of some very relevant conjectures in this field, particularly Chowla's and Sarnak's Conjectures. She again insisted on the relation between these conjectures and some number theory results, such as the prime number theorem and the twin primes conjecture. A key part of this talk was the interdisciplinary aspect of this research, which used various branches of mathematics, such as number theory, combinatorics, dynamical systems, and ergodic theory.

She closed the talk with a discussion of some very recent advances, like the superpolynomial growth, which brings researchers closer to the exponential growth needed to show the conjecture. The audience chimed in with some questions that initiated a nice exchange of ideas to finish off Wednesday's plenary lectures.

## Science must be open for mathematics to advance

“Knowledge must be available, open to everyone, and no one should be excluded”. With these words as an approach, the panel discussion on open science was held yesterday. Organized by the Centre de Recerca Matemàtica in the framework of the 9ECM, the speakers were Miguel Benítez, from the Basque Center for Applied Mathematics (BCAM), Pilar Rico, from the Spanish Foundation for Science and Technology (FECYT), Ignasi Labastida i Juan, from the University of Barcelona, and André Gaul, representative of the European Mathematical Society Publishing House (EMS).

Titled “New scenarios in open science”, they addressed current issues such as the inaccessibility even today of many researchers to scientific publications, the reluctance of some publishers to change to a model of greater openness and the current situation in the discipline of mathematics. “Open Access means that information is accessible, which is the only way for science in general, and mathematics in particular, to grow,” stated André Gaul of the EMS.

During the interventions, the participants concluded that it is necessary for academic institutions and publishing companies to coexist, and that the future lies in the implementation of different models of open science -commercial or not-, but that in no case should mathematical research be harmed in its progress.

## Surfing to escape the magnetic cage

"Commercial fusion reactors could be a reality within the next decade", emphasized Eleonora Viezzer in her public lecture today, Wave-particle interactions in Tokamak fusion plasmas. Viezzer is leading the Plasma Edge Physics research line and is co-IP of the SMART Tokamak of the University of Seville. Introduced by Federico Perea, professor of Applied Mathematics at the University of Seville, she started explaining how the environmental and geopolitical problems posed by the increasing energy demand can be addressed by nuclear fusion.
For fusion reactions to happen, a plasma must be confined and heated to enormous energies that no material cage would be able to resist. But since it is electrically charged, it can be put on a magnetic cage. This is the principle of reactors like the famous Tokamaks. However, magnetic fields and plasma interact in complex ways that lead to the analog of solar flares, allowing the plasma to escape its cage, like a surfer riding a wave. In the remaining of the talk, Viezzer explained how she and her colleagues at the University of Seville are making important advances both in understanding and in taming such waves, with the construction of SMART Tokamak, "the first and worldwide unique spherical tokamak with large negative triangularity". The lecture ended with a lively Q&A session, where Viezzer further explained the reasons why she thinks fusion energy will be a reality rather soon.

## In memoriam Rolf Jeltsch

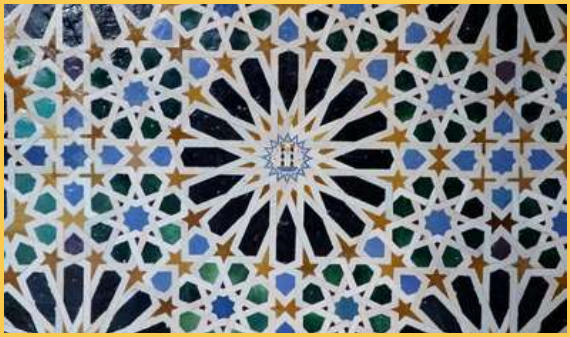
Today's plenary lectures started with an emotive remembrance, by president of the EMS Jan Philip Solovej, of the recently deceased Rolf Jeltsch. He was former president of the EMS from 1999 to 2002, did a lot of work for European mathematics and was instrumental in publishing the efforts of the EMS. To honour Rolf, the audience stood up and joined Solovej in a minute of silence.

## 900 congress participants visited El Real Alcázar de Sevilla

As part of the program for this 9ECM, over 900 of the congress attendees were able to visit El Real Alcázar de Sevilla. This visit to the 14th-century palace - Europe's oldest still in use building and a UNESCO World Heritage Site- was possible thanks to the collaboration of Seville's City Council and the fantastic guides of "Todo Sobre Sevilla" (todosobresevilla.com).

# Exhibitions

## The geometric treasure of the Alhambra



The exhibition A Geometric Walk Through the Alhambra will be exhibited at the headquarters of the 9ECM (School of Engineering of the University of Seville), during the celebration of the Congress (July 14 to 19, 2024). The curator of the exhibition is Miguel Ortega, professor of the Department of Geometry and Topology at the University of Granada. The exhibition consists of the fusion of texts with images, in which part of the mathematical secrets present in the Alhambra in Granada are explained. In this monument, the Nasrid artists and craftsmen brimmed with imagination when it came to applying Euclidean geometry to the decoration of floors, doors, windows, walls and ceilings, the great beauty of the patterns obtained being well known. It is worth paying attention to typical decorative elements, such as the Nasrid bow tie, symbol of the Alhambra, indicating how they can be drawn with a ruler and compass, even though computers are used today. As the exhibition will be part of a mathematics congress, the technical part is important. The concept of plane crystallographic groups, Conway's notation for their description, and their classification theorem are reviewed, which states that there are essentially 17 different ways to fill the plane from a basic drawing by jumping in two different directions, without overlaps or gaps (as happens in bathrooms and kitchens of any house covered by tiles). How many of these shapes are present in the Alhambra? To answer the question, examples of the crystallographic groups it contains will be shown, spread over various rooms and the Museum.

# Enjoying Seville

## Setas de Sevilla

Another architectural example full of mathematical interpretations is the Setas de Sevilla. Its real name is actually Metropol Parasol, though it's most commonly known as Setas because its structure is reminiscent of these mushrooms. It is a work completed in 2011 in the form of a wooden and concrete pergola that is located in the Plaza de la Encarnación, located in a central location in the city, very close to bars where you can have a drink, and stores and bookstores where you can make interesting purchases. Its structure is formed by a large grid in the form of a parasol supported by six pillars; in its distribution each rib offers its own curvature, so the whole gives a sense of undulating movement, especially colorful to observe when you look at the sky and is combined with the movement of the clouds. Below the Setas are the Plaza Mayor and the Antiquarium museum, which houses archaeological remains. You can also climb to the top, from where you can enjoy a spectacular panoramic view of Seville; to access the viewpoint it is necessary to go down to the subway floor, next to the access to Antiquarium and purchase a ticket.

## Erratum

The version of the 9ECM Daily News sent out on Monday, July 15, stated that Victoria Gould is from the University of Kent but she's from University of York. Also, Beatrice Pelloni is not from the University of Edinburgh, but from Heriot-Watt University and Mª Ángeles García Ferrero is not from the Autonomous University of Madrid.

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***The content of this magazine does not necessarily reflect the opinion of the organisation.***