SEOUL ICM 2014
INTERNATIONAL CONGRESS OF MATHEMATICIANS

# Math&Presso

Daily News of the Congress | Wednesday, August 20, 2014 | No.7

## Artur Avila – Fields Medalist

# Something interesting always goes on in math

Artur Avila, the first Fields Medalist from Latin America, represents a growing presence of southern hemisphere in mathematics. The 35-year-old Rio de Janeiro native will be the face of Brazil when his hometown hosts the International Congress of Mathematicians four years later.

In a joint press interview Monday during the SEOUL ICM 2014, Avila attributed much of his success to the education he received in his two mother countries - Brazil and France. He earned Ph.D. at the age of 21 thanks to math prodigy program at IMPA in Brazil, and furthered his research at CNRS in France, where he was later naturalized.

*Q: You received your Ph.D at 21. How were you able to do it at that age?*

A. Thanks to no age restriction in course enrollments at IMPA, I was invited to study at IMPA at an early age. This early development for mathematical talent was encouraged at IMPA and my case is not unique. I can recall a fellow student, who at the tender age of 13 was enrolled in the linear algebra class for which I was a teaching assistant and subsequently received Ph.D at 19.

*Why did you choose dynamical systems? What drew you to your research?*

During the masters coursework at IMPA, I realized my mathematical strength was in analysis. At IMPA, there are many strong groups of people working in various aspects of dynamics, and I was naturally led to the field. I became happy because the field can be applied to whatever interesting things I like to do. I developed the work around quadratic unimodal maps at IMPA, and later I was exposed to other topics in dynamical systems in France.

Artur Avila, winner of a 2014 Fields Medal, speaks to reporters at the SEOUL ICM 2014 on Monday.

*Could you explain the idea of renormalization, which was repeatedly emphasized in your lecture?*

The word renormalization has different meanings in different parts of mathematics. It is a method to look at a certain kind of dynamical system which is a study of a long term behavior. When you restrict a system to a small part of the space we get a new system similar to the original. This can be repeated. Then you have the sequence of microscopic spaces that allows you to look at smaller and smaller scale. And what happens to the behavior at a smaller scale is that they resemble the same behavior at large scales. The renormalization process involve understanding the nonlinear dynamics in infinite dimension.

*How is your research being applicable?*

Doing research, for some mysterious reason, often turns out to have an application. It is not something you can predict as you do it. You can see how important it is to research mathematics in general just by looking at historical records. I have a lot of respect for applied mathematicians. I find that it's also good that people are concerned with mathematics only because they are attracted to the problems of purest kind. And there are also people who interact with both groups, and they make the transition happen. In my case, I don't get motivated by the possibility of having an application, and I do not have an answer to the question. I am attracted by the beauty of mathematics and by the richness of its theories. Something interesting always goes on in mathematics.

See AVILA, Page 7

## Achievements

Avila leads and shapes the field of dynamical systems. With his collaborators, he has made essential progress in many areas, including real and complex one-dimensional dynamics, spectral theory of the one-frequency Schrödinger operator, flat billiards and partially hyperbolic dynamics.

With his tremendous analytical power, Avila made outstanding contributions to dynamical systems. One of his early significant results closes a chapter on a long story that started in the 1970s, accompanied by a complete renormalization theory At that time, physicists, most notably Mitchell Feigenbaum, began trying to understand how chaos can arise out of very simple systems. The dichotomy of regular vs. stochastic was proved in many special cases, and the hope was that eventually a more-complete understanding would emerge. This hope was realized in a 2003 paper by Avila, Welington de Melo, and Mikhail Lyubich, which brought to a close this long line of research. Avila and his co-authors considered a wide class of dynamical systems-namely,those arising from maps with a parabolic shape, known as unimodal maps and proved that, if one chooses such a map at random, the map will be either regular or stochastic. Their work provides a unified, comprehensive picture of the behavior of these systems.

He has also sometimes done the reverse, applying dynamical systems approaches to questions in analysis. Avila establishes that, unlike the special case of the almost Mathieu operator, general Schrödinger operators do not exhibit critical behavior in the transition between different potential regimes. In the spectral theory of one-frequency difference Schrödinger operators, Avila came up with a global description of the phase transitions between discrete and absolutely continuous spectra, establishing surprising stratified analyticity of the Lyapunov exponent.

His work in complex dynamics led to a thorough understanding of the fractal geometry of Feigenbaum Julia sets.

Avila and Forni proved long-standing conjectures that almost every interval exchange transformation is weakly mixing. This work is connected with the weak mixing property of regular polygonal billiards which was done together with Vincent Delecroix. He made deep advances in our understanding of the stable ergodicity of typical partially hyperbolic systems.

Compiled by
**Kyewon Koh Park**
Ajou University

## 1994 Fields Medalist: Efim Zelmanov

# Believe that what you are doing is important

The Russian mathematician Efim Zelmanov, 58, is known for his work in non-associative algebra and group theory. He was awarded the Fields Medal at the ICM 1994 Zürich for his work in group theory. Currently, he is a professor at the University of California, San Diego, and a distinguished professor at the Korea Institute for Advanced Study.

Math&Presso interviewed Professor Zelmanov by email to learn more about his background, his work, and his connections with Korea.

*Q. When did you first decide to become a mathematician?*

A. At the age of 13, in the 6th grade, I was fortunate to have a very good mathematics teacher. Perhaps she was not so strong in solving problems herself, but she never failed to notice when her students were experiencing difficulty, and she was generous and encouraging.

*You graduated from a foreign language high school. What do you think was the main advantage?*

Speaking decent English made my contacts with foreign colleagues later on. In 1970, it was difficult to predict that English would become so important for a Siberian boy. But I must say that mathematics was taught at our school very well.

*You received the Fields Medal at the ICM 1994 Zürich. What does it mean to you, both mathematically and personally? Also, how did your life change after being awarded the medal?*

Needless to say, the Fields Medal was a huge and unexpected recognition which brought many bonuses to me and my family. There were some humorous side effects as well. Mathematicians are usually a shy crowd. They are not used to giving interviews. For a year after Zurich I felt as though I had moved from mathematics to public relations.

Another problem was that when starting a new project, I subconsciously asked myself, "Is it going to be good enough for a Fields medalist?" That was certainly not a good attitude for doing mathematics, and I had to train myself not to ask that question.

*During an earlier interview, you were asked the secret of being a great mathematician and replied, "Resist trend as much as possible. Believe that what you are doing is important." Can you elaborate on that answer?*

To start with, let me confess that in fact I don't know the secret to becoming a great mathematician. The mathematical community puts special value on originality in work. Some people start trends; usually they get a lot of credit for it compared to those who follow.

*You have been deeply involved with the recent development of the Korean mathematical community. Can you tell us what has been done, what is currently happening, and in which direction it should be heading?*

**Efim Zelmanov**
University of California, San Diego

Yes, I have been fortunate to have been a part of the Korean mathematical community for the last 18 years. Korean mathematics is young. It would be fair to say that 50 years ago it did not exist. Just as the country made her breathtaking ascent into the family of developed countries, so did Korean basic sciences.

Korean mathematics grew as a part of world mathematics. Many top Korean mathematicians received their Ph.D.'s at top U.S. universities. The students whom they taught in Korea are also members of the world mathematical family. This is the strength of Korean mathematics and I think that it will persist for years.

Korean society and the Korean government support mathematics and other basic sciences at an unprecedented level. Along with traditional channels of support such as universities and established institutes like KIAS, this support also goes through the newly established Institute for Basic Sciences.

A knowledge-based economy and a strong emphasis on education, which are parts of the Korean tradition, naturally lead to strong basic sciences.

You asked in which direction the Korean mathematics should be heading. I don't think that anybody should tell Korean mathematicians how to develop. Korean mathematics is now strong and mature. There are mechanisms (including constant international reviews) that will steer it in the right direction while protecting the academic freedom of researchers. In this sense I am an optimist.

*You spent your early years in Novosibirsk, Russia. What was your mathematical life there?*

Mathematical life in Novosibirsk in the 70s and 80s was booming. I miss the atmosphere of seminars where new mathematical results were the most important things in life.

## Invited IMU Panel 3 – 'World Digital Mathematics Library'

# A vision for the future mathematics library

A panel discussion of the topic "World Digital Mathematics Library," covering recent initiatives funded by the Sloan Foundation, will be held from 6 to 7:30 p.m., Aug. 20 in Session Room 402. Five panelists, Ingrid Daubechies from Duke University, Thierry Bouche from Institut Fourier in France, Gert-Martin Greuel from the University of Kaiserslautern in Germany, Rajeeva L. Karandikar from the Chennai Mathematical Institute in India and June Zhang from Peking University in China are expected to participate. Peter Olver from the University of Minnesota will moderate. The following comments are from panelists asked for their thoughts before the meeting.

*Q. What is the World Digital Mathematics Library?*

A. The World DML is a proposed virtual library formed by a distributed network of local DMLs that would comply with interoperability standards for global features such as navigating, searching, mining and computing. This will require unique identifiers (or at least a matching system for different identifiers) for journal articles, books and for authors.

Some visions of a WDML would enforce stricter standards (only open source software and open standards would be considered; only open access repositories would be considered local DMLs; only not-for-profit academic institutions would be considered local DMLs). Even the question of what literature should be included in a WDML is not clear; i.e., what is considered mathematics? Where is the border with neighboring fields such as physics, biology, or computer science? The two global abstracting and reviewing services MathSciNet and zbMATH could serve as guidelines.

*What are your concrete notions on the potential improvements for digital mathematics libraries?*

There are three main challenges. The first is to enlarge the content to the point where a typical literature search would go there by default, just as a mathematician first goes to his local library before trying interlibrary loans. This means convincing all stakeholders in the community that it is better to have an open reliable archive rather than a competitive archipelago of private islands.

The second challenge is to use the mathematical nature of the content as an asset and try to exploit it to create entirely new ways of navigating the literature or querying the library beyond methods already available in existing search engines such as Google. Ideas can be tested on smaller segments of the literature, but the system should be designed to scale well and to handle heterogeneous data sources with the quality necessary to provide usable services.

The final challenge is the long-term maintenance of the library after the basic infrastructure is available.

Moderator
**Peter Olver**
University of Minnesota

## Leelavati Prize Winner – Adrián Paenza

# ‘I want to play with mathematics’

It’s hard to imagine that a mathematician would be content with children’s aversion to his discipline. But Adrián Paenza, who received the Leelavati Prize at SEOUL ICM 2014, goes even further, to say that such a reaction to mathematics means that the children are “healthy.”

“They react that way – and they should react that way – because it’s not something that they should like,” said Paenza, an Argentine mathematician and science journalist who is known for contributions that changed the way in which the public perceives mathematics. “If they liked it, I would be concerned.”

Paenza says this because although he believes mathematics has its own beauty and its utility, it’s not being taught properly in schools. He will deliver a public lecture tonight at 8 p.m., Aug 20, titled “The Wrong Door,” that will touch on mistakes teachers make in presenting mathematics to students” Paenza says the title is self-explanatory, that we are exposed to mathematics with the wrong door is opened.

In life we have problems and then we look for solutions, he continued. “But in school, we get the solutions and then we try to find problems that we didn’t know we had.”

Paenza joined reporters yesterday at COEX to discuss his lecture topic.

Leelavati Prize winner Adrián Paenza, a mathematician and science journalist, at an interview at COEX yesterday. He will deliver the Leelavati Prize Lecture at 8 p.m. this evening.

*Q. You’ve contributed to change the way in which the public perceives mathematics. In your experience, what’s the most effective way to do that?*

A. I wasn’t trained to do this. It’s not that I knew what to do and had a method that I was going to follow. I kind of learned on the fly. I believe I can communicate with the public if I have something that I understand. If I understand it, I have to make sure you understand it too. There’s no way that I should understand something that you don’t. I am going to have to find a way to communicate. Also, it’s not the same to speak in front of college students as it is to talk to elementary school children. Talking to children, you have to play with them and get them to participate. You have to make them ask questions. I also make sure that the kids feel that we are equal. I’m not superior because I know some answers and you are inferior because you don’t. Maybe I know a little about something. That’s when I can share what I know.

*Your books, television programs and newspaper columns explain mathematics to the public. Can you give an example of how you do that?*

I write a weekly column for a newspaper, and I’ll tell a story of what happened the day they hired me. Ten years ago, the owner of a newspaper company asked me to write a column and said I could pick the topics. I told him not to challenge me because if he did, I was going to write something like how to prove the Pythagorean theorem. He repeated that I should write what I wanted to, hired me, and I wrote the article on how to prove the Pythagorean theorem. He published it.

I want to play with mathematics. This way, it’s easier to relate to and it’s a way for me to talk about mathematics. That’s not the way we usually do it in school.

*What was your most rewarding experience in your television experience?*

There are several moments, but I recall now one that made me very happy. When I was taping one of my television shows, “Altered by Pi,” I was in front of 80 children who were 6 or 7 years old. At some point, one of them asked me, “Do you know the multiplication table of 15?” I said, “No, I don’t, but we’ll learn it together here.” Learning the tables is not very important to me, but all those children realized there that the things they didn’t know, I didn’t know either, but we learned together and the impact was huge for them. It was a discovery. They were puzzled not knowing the answers, but together, we found the solution to the puzzle. To me, that’s very rewarding.

*Did you hate math as a young student?*

I don’t know if I hated it, but I remember I was puzzled and bothered by the fact that there were numbers like $\pi$. I couldn’t just get my head around the decimal expansion. I mean, how do I get the next digit, and why do we have those dots even in rational numbers like 1.333333...? That was puzzling; I had my doubts.

When I started college, my idea was to become a chemist. But in the process, I had to study a bit of math and some professors made me realize there was something there I hadn’t seen before. There’s a big connection between the way you are taught and the topics presented to you.

*You said earlier that it’s “healthy” for children to hate math. Why?*

They hate math because what they are shown doesn’t have anything to do with them. They can’t relate to it and then go to their parents to ask why they are supposed to learn it. The parents don’t know either and just say, “Don’t worry, you’ll see it later.” When does “later” arrive?

It’s important to let kids participate and make them relate to the subject by triggering the right code by playing games or making them encode a message. Make them realize there are questions in their mind and bring them out.

## Achievements

The Leelavati Prize recognizes the great appreciation of the IMU and Infosys for outstanding contributions to increasing public awareness of mathematics as an intellectual discipline and the crucial role it plays in many human endeavors.

**Citation:** Adrián Paenza’s contributions have definitively changed the mind of a whole country about the way it perceives mathematics in daily life. He accomplished this through his books, his TV programs, and his unique gift of enthusiasm and passion in communicating the beauty and joy of mathematics.

Paenza has been the host of the long-running weekly TV program “Científicos Industria Argentina” (“Scientists Made in Argentina”), currently in its 12th consecutive season on broadcast television. Within a beautiful and attractive interface, each program consists of interviews with mathematicians and scientists of very different disciplines, and ends with a mathematical problem, the solution to which is given in the next program.

He has also been the host of the TV program “Alterados por Pi” (“Altered by Pi”), a weekly half-hour show exclusively dedicated to the popularization of mathematics; this show is recorded in front of a live audience in several public schools around the country.

Since 2005, he has written a weekly column about general science, but mainly about mathematics, on the back page of Página 12, one of Argentina’s three national newspapers. His articles include historical notes, teasers and even proofs of theorems. He has written eight books dedicated to the popularization of mathematics, five under the name “Matemática. . . ¿estás ahí?” (“Math . . . are you there?”), published by Siglo XXI Editores, which have sold more than a million copies. The first of the series, published in September 2005, headed the list of best sellers for a record 73 consecutive weeks, and is now in its 22nd edition. The enormous impact and influence of these books has extended throughout Latin America and Spain; they have also been published in Portugal, Italy, the Czech Republic, and Germany. An upcoming edition has been recently translated into Chinese.

Extract from an IMU news release

## Popularization of mathematics

# Various math activities attract public interests

During the preparations for the 27th International Congress of Mathematicians held in Seoul, one of the main goals of the organizing committee was to spark the general public interest in mathematics. To that end, the organizing committee commissioned the Cultural Activities Committee in an effort to organize cultural events for the general public.

The Cultural Activities Committee prepared a number of programs to raise awareness of mathematics during the Seoul ICM 2014, but also held many cultural events before the congress.

One of the highlights included production of an episode of a television quiz program. To commemorate the ICM, "Challenge! The Golden Bell," a popular television quiz program in Korea, aired a special episode, a math quiz contest. It aired on July 27th and was sponsored by the organizing committee of Seoul ICM 2014. One hundred talented high school students competed and Hyunsuh Song of Sangsan High School in Jeonju, was the winner, answering all 50 questions.

Special lectures on the connection between civilization and math were also held prior to the opening of Seoul ICM 2014. The lectures highlighted the fact that math is embedded in almost every aspect of culture. The lectures were held throughout Korea, successfully communicating with students and the general public on the subject of mathematics.

A special episode of "Challenge! The Golden Bell," was aired on July 27th to commemorate the 27th ICM held in Seoul..

During the congress, the Cultural Activities Committee's programs have been popular among participants. Hundreds of people gathered to listen to the billionaire mathematician Dr. James Simons on Aug. 13. The founder of the hedge fund company Renaissance Technologies and chairman of the Simons Foundation gave a special public lecture about mathematics, fortune and fate, and his life as a mathematician and a businessman.

On Aug. 19, there was a special program on the close connection between Baduk and mathematics. Students in particular swarmed to watch the games played by Baduk professional players. Some of the lucky ones were able to play players with famous Baduk professional players like Bongsoo Seo, Changhyuk Yoo, Changho Lee, Jieun Park or Hyojung Kim.

On the same day, a French movie featuring several great mathematicians, including Cedric Villani (2010 Fields medalist), was screened. The movie's tongue-in-cheek title is "How I Came to Hate Math?"

On Aug. 20, a special lecture will be given by the 2014 Leelavati Award winner, Dr. Adrián Paenza, under the committee's auspices. The Leelavati Prize recognizes outstanding contributions to increasing the public awareness of mathematics as an intellectual discipline.

## Invited IMU Panel 1 – Mathematical Massive Open Online Courses

# MOOCs versus traditional classroom courses

A panel discussion on mathematical massive open online courses, which allow unlimited participation and open access, was held at 6 p.m. on Monday, Aug. 18 at COEX. The discussion by the four panelists, William Barton of the University of Auckland, New Zealand; Robert Ghrist of the University of Pennsylvania, U.S.A.; Matti Pauna of the University of Helsinki, Finland; and Angel Ruiz of the Universidad de Costa Rica, Costa Rica was moderated by James Davenport of the University of Bath, U.K. An overview of the session follows.

*Q. Please explain the general aspects of the panel's topic.*

A. Our aim is to review the development of MOOCs in the context of mathematics education and to understand the opportunities they provide and the issues that need to be addressed.

*What types of technologies and efforts does it require to operate a MOOC?*

They vary greatly. Almost no technology (but quite a bit of bandwidth) is required to put lecture videos on the Internet, but much more technology is needed to support interaction and assessments. As with most IT developments in their early stages, the answer to this question is "More than you expect, even when you take this answer into account." Generic MOOC systems, even apparently professional ones, may well not support mathematical notation.

*What are the strong and weak points of MOOCs compared to traditional classroom courses?*

It may be a mistake to compare MOOCs to classroom courses. They are fundamentally different modes of education — just as you would not compare community college adult classes with professional university engineering courses. They cater to different constituencies with different needs. It is worth noting that in the U.S. market, many people taking MOOCs already have a qualification at that level and just want more knowledge.

That said, the main strong point of a MOOC is its potential to reach a very wide audience; the main weak point is the lack of a realistic funding mechanism.

Many of us also believe that it is not a question of either/or. Traditional courses will use more and more of the same elements used in online courses to support, for instance, communication, submission of homework and delivery of learning materials.

*What role can MOOCs play in mathematics? What effects do you want MOOCs to bring to mathematics?*

MOOCs are likely to be useful for some basic learning in mathematics and for making universal information available in an enhanced form. We hope these advantages can be mixed with a more traditional education to reduce workload in these areas, to put higher quality "horizon" material within reach of more students, and to show the interesting face of mathematics to a wider audience.

*Do MOOCs have a low completion rate?*

They are "massively open." More dropouts are expected when no investment has been made by students.

*What are the most effective assessments in MOOCs?*

This is a very open question. Pauna's presentation talked about one style; there is currently no one answer.

Moderator
**James Davenport**
University of Bath

## 2014 Bridges Seoul Conference

# The convergence of mathematics, arts and music

Students examining the exhibits at SEOUL 2014 BRIDGES. The Bridges Seoul Conference was held from Aug 14 to Aug 19 at the Gwacheon National Science Museum.

"Explore Math, Crave Art." One might wonder what the relation between math and art is. The answer could be found at the 2014 Bridges Seoul Conference. In an attempt to "bridge" mathematics with diverse fields including arts, music, science and architecture, the Bridges Conference started in Winfield, Kansas, U.S.A., and traveled to cities around the globe. Collaborating with about 300 mathematicians, artists, architects, scientists, designers and engineers from 30 different countries, this annual conference includes seminars, exhibits and performances. Korea was the first Asian country to host this event, in accordance with hosting the SEOUL ICM 2014.

On the opening day of the Bridges Conference on Aug. 14, swarms of mathematicians, artists, teachers, and students crowded the Gwacheon National Science Museum.

"Welcome to the organizing committee of the Bridges Conference and the participants from around the world. 2014 Bridges Seoul aims to connect art and science using mathematics to find new academic values and possibilities for future development," said Sunbin Kim, the director general of the Gwacheon National Science Museum, in his opening speech. "It is a great honor that the conference is held at the Gwacheon National Science Museum, the first time that it has been held in an Asian country."

The 2014 Bridges Seoul Conference began with the first plenary lecture by Minhyong Kim, a professor at Oxford University, on arithmetic symmetry, using his computer software.

"The lecture was somewhat difficult, but at the same time was very amusing. I had the chance to learn new things about mathematics that I couldn't have learned at school. It was a good idea to register for the Bridges Conference since I really feel that mathematics is connected to various fields of life," said Jiyeon Kim, a student of Jamsil Girls' High School.

Art exhibits by participants were displayed outside Eoullim Hall, where the opening ceremony took place. More than 100 artists from around the world sent works to be exhibited at the conference; including paintings, sculptures, clothes and electrical devices related to mathematics.

"It's a challenge to exhibit my work here, but I am flattered that I was invited and I enjoy being here. All the works are so spectacular, and it is great to be part of it," said Hamp Stevens, an artist from the United States who exhibited models of rhombicosidodecahedrons, a geometric solid.

Barbara Pfuetzner, a teacher from Poland, said, "I teach arts and mathematics such as origami and patterned needlework at a gymnasium in Poland. It is fantastic to see all these exhibits of foreign works. This is inspirational for me in terms of teaching."

2014 Bridges Seoul Conference ended its six-day program yesterday. It included a music festival, poetry reading , and experimental theater performances such as math-dance and mime-matics.

# Prominent women are recognized and celebrated

The Seoul International Congress of Mathematicians "shed light on the growing role of female mathematicians, and efforts to promote it should continue," Ingrid Daubechies, the president of the International Mathematical Union said on Aug. 13.

Maryam Mirzakhani, a professor of mathematics at Stanford University, received a Fields Medal during the SEOUL ICM 2014. She is the first female in the 78-year history of the medal to receive one.

"We always believed it could happen one day and now it has happened," said Daubechies, the first woman to take the helm of the IMU, during a press conference at COEX yesterday. "I am very happy that it happened on my watch."

A growing focus on female mathematicians can also be seen in the International Congress of Women Mathematicians, a new ICM event that followed a pilot program in India four years ago. A new website, "Women and Mathematics," went online during the Seoul ICM, open to contributions to promote women's role in mathematics.

"We have to work to make sure that prominent women are celebrated, recognized for their work, and are not forgotten," Daubechies said during another interview in Seoul.

The Belgian professor at Duke University used the example of Hertha Sponer, a German physicist, who became the first female professor in her discipline at Duke. Sponer began teaching at Duke in the 1930s, but few there remembered her 50 years later, Daubechies continued, although she made a large contribution to establishing the physics department at the university.

The IMU president said the notion that women are not good at mathematics is more the result of cultural and social prejudice rather than biological differences. In the United States, about 30 percent of those pursuing doctorates in mathematics are women, but the figure differs from country to country.

Ingrid Daubechies, the president of the International Mathematical Union, speaks to reporters at COEX on Tuesday.

"That also means that it can change," she said. "It certainly changes across borders, and so why couldn't it change over time if you do something?" She declined to predict a date, but said the time will come when there are many women mathematicians and the ICWM is no longer needed.

During the press conference on Aug. 13, Daubechies also praised the projects launched during the SEOUL ICM 2014 to help mathematicians in developing countries. She cited the Korean initiative, NANUM 2014, to invite 1,000 mathematicians from underdeveloped countries to this congress.

The MENAO Symposium, held simultaneously with ICM 2014, capitalized on the importance of mathematics in economic development. "This ICM marks a milestone in that respect," Daubechies said.

She called the Seoul ICM the biggest and most prestigious event during her presidency, and praised Korea for its smooth running. The nine-day event will conclude tomorrow. She also said she was confident the next congress, in Brazil in 2018, would be a successful one.

She praised Shigefumi Mori, who has been elected as her successor, and said she was happy to shed her administrative duties with the ICM and have a chance to do more research.

## The Bridges Conference

# Explore math, crave art in Bridges

Mathematics has periodically been employed not only to interpret and analyze art and architecture, but also to directly integrate with artistic products. There have been periods in the civilizations of numerous cultures around the world in which artists have been fascinated by mathematics, encouraged and even forced to become mathematicians, as happened in antiquity during the golden eras of Baghdad and Isfahan and in the Renaissance.

During the European Renaissance, art, mathematics, architecture, science, and music flourished side by side. This is no longer the case, and although many artists and scientists are calling for ways to regain the lost mutual understanding, appreciation, and exchange, it has been hard to learn how to create an environment in which this can happen in a meaningful way.

Nevertheless, a divide exists between mathematics and the general public. All human beings are fluent in recognizing and appreciating patterns, and are able to deal effortlessly with the abstractions of language, music, visual art, and theatre. Yet most people think that they have a latent aversion to mathematics and are largely unaware of how deeply embedded it is in the world around them. Still, we have seen over and over again how fascinated and excited people become when mathematical connections are presented in ways which relate to their experiences and trigger their natural curiosity and aesthetic sensibilities.

The Bridges Conference, created in 1998 and running annually since, has provided a model of how these divides can be crossed. Here practicing mathematicians, scientists, artists, educators, musicians, writers, computer scientists, sculptors, dancers, weavers, and model builders have come together in a lively and highly charged atmosphere of mutual exchange and encouragement. Important components of Bridges conferences, apart from formal presentations, are gallery displays of visual art, working sessions with practitioners and artists who are crossing the mathematics-arts boundaries, and evening musical or theatrical events. Furthermore, a lasting record of each Bridges Conference is its refereed "Proceedings," a resource book of the papers and the visual presentations of the meeting.

The value of such a conference for mathematics educators in providing new ideas and methods for conveying the beauty, relevance, and ubiquity of mathematical ideas to their students cannot be overstated.

The following is an example of topics that were presented at Bridges, which is the field that I am interested in.

### Persian Mosaic Patterns:

Historical documents evidently show that the designers of patterns on the surfaces of medieval structures in Persia and surrounding regions were well-equipped with significant knowledge of applied geometry. Nevertheless, they never exhibited the same level of effort or interest in providing the pure side of the subject by proving theorems and establishing mathematical facts about such designs.

The main concern of a designer or craftsman was to present visual harmony and balance, not only in deep details but also as a whole. Nevertheless, the steps taken to create such designs include techniques that are only acquired and understood by mathematicians. An individual with the knowledge of such detailed techniques is a mathematician, artist or not.

### Some Methods for creating Mosaic Designs:

**(a) The Radial Grid Method.**

The construction method in Figure 1, which uses a radial grid approach, was a method used in medieval times and is supported by the 13th century treatise "Interlocks of Similar or Complementary Figures." We can use this method to create other interesting patterns. (For details, please visit the Bridges Archive at www.BridgesMathArt.org and search for the article that I authored in 2012, "Polyhedral Modularity in a Special Class of Decagram Based Interlocking Star Polygons."

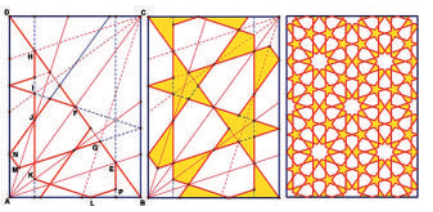


Figure 1

**(b) The Polygons in Contact Method.**

In some literature, another technique, "polygons in contact," has been introduced, and is explained in some recent articles (for references please see the above article on the Bridges Archive). This is another system for which there is evidence of historical use by designers. Figure 2 from left to right exhibits this technique starting from the underlying polygonal network and ending in the final pattern, which is the same pattern as in Figure 1.

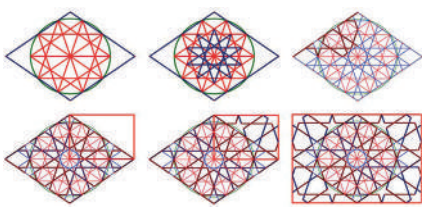


Figure 2

**(c) A Method based on the n/k Star Polygons.**

One may construct the same pattern using the technique introduced in Figure 3, which is based on the use of a 10/3 star polygon and extensions of some of its sides.

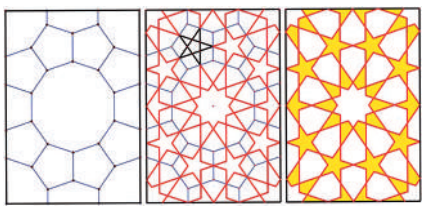


Figure 3

**(d) Modularity Method.**

Modularity offers another interesting approach for creating the layout of a mosaic pattern (that is, for conceptualizing but not necessarily making the individual actual tiles that comprise the final tiling). This method has been suggested as the means used in cultures as old as the Paleolithic period (please see "Modularity in Medieval Persian Mosaics: Textual, Empirical, Analytical, and Theoretical Considerations" by Reza Sarhangi, Slavik Jablan and Radmila Sazdanovic at the Bridges Archive site). In this method we create motifs that are formed by cutting and pasting tiles in different colors or by combining some polygons. We then use these motifs to compose the layout of a mosaic design. The following images are some my artworks that were created based on the modularity method.

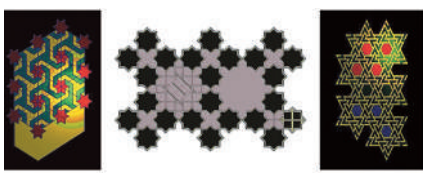


Figure 4

In conclusion, mathematics and art is a two-way street. Many mathematicians and mathematics scientists use mathematics to reach the realm of art. Some may start with art but ends up finding themselves in the world of mathematics.

M. C. Escher, perhaps the most famous visual mathematics artist in today's world, writes, "The ideas that are basic to them [mathematicians] often bear witness to my amazement and wonder at the laws of nature which operate in the world around us. He who wonders discovers that this is in itself a wonder.

"By keenly confronting the enigmas that surround us, and by considering and analyzing the observations that I had made, I ended up in the domain of mathematics. Although I am absolutely without training or knowledge in the exact sciences, I often seem to have more in common with mathematicians than with my fellow artists."

The above statement by Escher perfectly summarizes the privileged relationship that an artist may establish with the scientific community.

**Reza Sarhangi**
(Towson University)

SEOUL ICM 2014
The official newspaper of the 27th
International Congress of Mathematicians
2014 Seoul

**Meaning of "Math&Presso"** A compound word joining "math" and "press" with a slight alteration and pronounced similar to "espresso," this newsletter is distributed to participants every morning and will, we hope, serve our readers like a hot cup of coffee. Math + Press = Math&Presso ≈ Espresso

**Publications Committee Members** **Editor in Chief** – Sun Young Jang **Editors** – Young Rock Kim, Dae-Woong Lee, Ikkwon Yie
**Co-editors** – Poo-Sung Park, Joungmin Song **Assistant Editor** – Yesel Jun **Administrative Staff** – Dohyun Kim
**Korea JoongAng Daily staff** **Production Director** – Moo-young Lee **Reporters** – Gwang-lip Moon, Seung-hye Yim, Eunjee Suh
**Design & Layout** – Mi-Hyun Ryu, Hyo-sun Kim **Photographers** – Sung-soo Lee, Sang-moon Park **Production Coordinator** – Chaewook Lim



The nation's leading English newspaper
KOREA JOONGANG DAILY | 20F DMCC Bldg. 48-6 Sangamsan-ro, Mapo-gu, Seoul, Korea 121-904 **Tel** 82-2-2031-1230 **Fax** 82-2-2031-1277 koreajoongangdaily.com

## Invited ICM Panel 3 – 'Mathematics is everywhere'

# Popularizing math: mathematicians' central role

A panel discussion on the topic 'Mathematics is everywhere' will be held by an invited International Congress of Mathematicians Panel, Panel 3. The discussion will take place from 4:30 to 6 p.m. today in Session Room 402. The panelists are Eduardo Colli, Universidade de São Paulo, Brazil; Fidel Nemenzo, University of the Philippines; and Konrad Polthier, Freie Universität, Berlin, Germany. Christiane Rousseau, Université de Montréal, Canada will moderate the session.

The following is an overview of the panelists' thoughts on the subject that they provided earlier by email.

*Q. What is your approach to this discussion?*

A. The four of us have a passion for communicating mathematics. We were delighted to be given the title "Mathematics is everywhere" because it is one of the important messages that we always wish to convey when we speak to the public. We have many examples and will present several to illustrate our messages. One of us will take you on a guided tour of Seoul as seen through mathematical eyes; the others will show how mathematics provides models for nature.

We will also stress the key ideas that power technological applications are seen in everyday life.

While to many mathematicians it seems obvious that mathematics is everywhere, that it is a living discipline within science and technology, most people are unaware of this and ignore completely the role of mathematics in scientific ventures. The message must be conveyed more effectively to the broadest audience possible. In our panel, we also want to discuss how we can help build a powerful message. An ICM is a great time for such a discussion because we have here some of the best ambassadors of many countries. Can we join forces for greater impact?

The second half of the session will be an open discussion with the people in the room. It is very important for us that this panel be a two-way discussion. In particular, we hope to hear creative suggestions from our fellow ICM participants on how to convey the message and maximize the impact of popularization activities.

*What are your concrete ideas about the potential mathematics popularization?*

There is a great need for many more popularization activities but there are many obstacles for increasing the number of outreach activities. First, some special skills are required to communicate with the public, and not all mathematicians are interested.

Next, it takes time to prepare good material. But the situation is changing; it is now considered a plus for a professional mathematician to participate in outreach activities. Also, we are convinced that one way to improve the present situation is to invite mathematicians to popularization activities; they will learn how to communicate with the public and that stimulates their creativity to find their own themes or ways of explaining things.

Sharing resources is also essential; it minimizes the time required to prepare material and it enlarges the spectrum of topics that can be presented to a local community.

*What do you think are the most important parts of mathematics popularization?*

The main purpose of popularization is to dispel fears of and misconceptions about mathematics and present a positive image of our discipline. There are many different ways to reach this goal.

First of all, it is good to bring the public into contact with mathematicians because that puts a human face on a discipline that too often is considered as cold, dry, and lifeless. If you like the person carrying the message and you realize that the message is fun or interesting, then you may change your opinion of mathematics.

The messages could be very diverse, from mathematical games to mathematical contributions to the arts, to showing the beauty of mathematical reasoning, and to pointing out the numerous applications of mathematics in science and technology.

*What impact do you hope to see on the general public with the popularization of mathematics?*

As the language of science, mathematics is an essential tool for economic development and for addressing the challenges that our planet will be facing in the next decades. Changing the image of mathematics among the public, among children in school and among decision makers is likely to help mathematics play a greater role for the benefit of all.

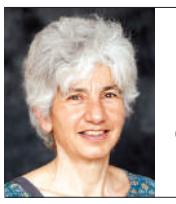
*Can we have a few words from each of you individually?*

Eduardo Colli: I believe that things are moving ahead more consistently than ever before. This year, in September, there will be in Dresden the first MATRIX (Mathematics Awareness, Training, Resource, & Information Exchange) conference. This shows that math popularization is beginning to be not only a hobby of enthusiastic mathematicians but in fact an academic activity in its own right.

Fidel Nemenzo: A growing number of mathematicians is taking part in popularization activities – writing popular mathematics books, columns and blogs. This is a good thing. We need to be able to communicate our passions beyond the borders of our specializations and our discipline. Mathematicians themselves need to join others in the forefront of raising public awareness of mathematics.

Konrad Polthier: Mathematics is an integral part of our society and a key driving force of science and technology. Raising public awareness of this central role of mathematics and its benefits for everyday life is a central aspect of our popularization activities.

Christiane Rousseau: The international year "Mathematics of Planet Earth 2013" was a great success. It had no budget of its own, but its structure, with partners contributing their own resources to the initiative, is a model of how cooperation can increase the impact significantly.



Moderator
**Christiane Rousseau**
Université de Montréal


**At a Japanese reception, socializing and honoring one of their own**

Mathematicians participating in the Seoul International Congress of Mathematicians 2014 at a reception at the conference site yesterday. The social occasion, organized by the Mathematical Society of Japan, was especially festive because Shigefumi Mori, a professor of Kyoto University, had just been elected as the next president of the IMU. Mori, who received the Fields Medal in 1990, is the first mathematician based in Asia to be elected as IMU president.

AVILA, from Page 1

*You have many collaborators. What are the benefits?*

Collaboration plays several different roles in doing a research. For one of them, I like talking to people rather then reading papers to understand what's going on. That's how I've got into several new fields. When I start working on a new field, I usually start collaborating on a project, and this gives me the opportunity to learn about it. I then ask what we should work on, and someone might know a little bit of what to work on, we start talking and he tries to show something that can help. Another positive aspect of collaboration is that when you are developing your ideas, discussing and explaining them make you understand it better. Trying to be comprehensive helps you figure out the relationship between different objects in a clear way. It's very helpful for me.

*Can you say a few words about Jean Bourgain's work (a Belgian mathematician and a 1994 Fields Medalist)?*

His work is very inspiring. Definitely, I was attracted to this particular field by studying his papers. It showed a kind of a map that I had not seen before. I was attracted by his style of mathematics. At the same time, it was very risky to be working on the same field as Jean Bourgain, but somehow I managed to find my place.

**Answer to Aug. 19 Daily Math Puzzle** $992 \times 9 = 93 \times 96$

# Intimate connection between math and Baduk

Baduk, or Go, is a mathematical game, and some mathematicians attending the SEOUL ICM 2014 proved that it really is.

Hundreds of people gathered at COEX, Seoul yesterday to get a glimpse of celebrities in the Baduk world. Five famous professionals, including Bong soo Seo and Changhyuk Yoo, played simultaneous games with some of the participants at a special exhibition during the congress.

The matchups were arranged by the organizers of the Seoul ICM to help promote mathematics to the public using the principles behind Baduk. The Korea Baduk Association helped arrange the events.

Changhyuk Yoo, standing left, a leading professional Baduk player, in a simultaneous game with amateur players at COEX yesterday.

Changho Lee lived up to a tag as a former World No. 1 Baduk player, by beating all five of the professors or researchers he played in simultaneous games. Hiroki Kodama of the University of Tokyo wanted to take on Lee, but had to present an ICM paper yesterday afternoon.

"If you play Go, you know him," said Kodama, 39, as he was watching Lee's game.

But, two other nine-dan professionals, Seo, and Yoo, lost to one of the five opponents for each. Insong Choe, a professor at Konkuk University, beat Seo, Kim Hyo-jung, a female one dan Baduk player, also lost to one.

Jieun Park, a nine dan female player, beat four of her five competitors and tied Taekgyu Hwang, but Hwang, a mathematics researcher at the Korea Institute for Advanced Study (KIAS), said she obviously went easy on him.

Dan are expert rankings of one to nine, the latter the highest.

Andrew Brooke-Taylor of the University of Bristol lost to Park 96-50 despite a nine-stone handicap. The English mathematician agreed that there is a mathematical element to the game.

He said he doubted the game would help teach people mathematics, but added, "It might help them get an appreciation for the fun things the game of Baduk can provide."

Some other female Baduk professionals, such as Hyeyeon Cho (nine dan), and Dongeun Choi (one dan), taught the basics of the game to the general public at the exhibition.

Earlier in the day, the organizers hosted three lectures on Baduk, including one by Byungdoo Lee. The professor of Baduk studies at Sehan University in South Jeolla Province, started by discussing the game's history of more than 2,500 years. He said Baduk enhances brain development in children and prevents dementia in elderly.

On his main theme, the mathematical aspects of Baduk, he stated that many strategies are based on symmetrical patterns and explained how to make use of them to win the game.

So can computers excel because Baduk is a game of patterns? Not entirely, Lee said. He explained the difficulties in designing a computer Baduk program and touched on the work to improve existing algorithms.

Lee is the first in the Korean Baduk community to have earned a Ph.D. in the field. His 2005 doctorate is from Oakland University in New Zealand.

Chanwoo Kim explained the dan ranking system, pointed out some flaws and discussed efforts to fine-tune it.

## Wednesday, August 20

| | | |
|---|---|---|
| **09:00 - 12:30** | Plenary Lectures | **Hall D1** |
| | 09:00 - 10:00 *Random Structures and Algorithms* | PL-16 |
| | **Alan Frieze,** Carnegie Mellon University, USA | |
| | 10:15 - 11:15 *Wild harmonic bundles and twistor D-modules* | PL-17 |
| | **Takuro Mochizuki,** Kyoto University, Japan | |
| | 11:30 - 12:30 *Asymptotics for critical nonlinear dispersive equations* | PL-18 |
| | **Frank Merle,** Université de Cergy-Pontoise et Institut des Hautes Études Scientifiques, France | |
| **12:30 - 14:00** | Lunch | |
| **14:00 - 15:00** | Canceled | **Hall D1** |
| **15:00 - 18:00** | Invited Section Lectures | |
| | 2. Algebra | 318ABC |
| | 3. Number Theory | Hall E1-4 |
| | 5. Geometry | Hall E5-6 |
| | 8. Analysis and its Applications | 327ABC |
| | 10. Partial Differential Equations | 307ABC |
| | 11. Mathematical Physics | 308ABC |
| | 12. Probability and Statistics | 317ABC |
| | 16. Control Theory and Optimization | 301AB |
| | 18. Mathematics Education and the Popularization of Mathematics | 402 |
| | Invited Section Lecture (IL 18.1) by Étienne Ghys will be held in Room 402 at 14:00-14:45 | |
| | Invited Section Lecture (IL 18.2) by Andreas Loos & Günter M. Ziegler will be held in Room 402 at 14:45-15:30 | |
| **15:30 - 16:30** | Invited ICM Panel Discussion: Imaginary Panel | **402** |
| **16:30 - 18:00** | Invited ICM Panel Discussion: Mathematics is Everywhere | **402** |
| **15:00 - 18:00** | Short Communications | |
| | 2. Algebra | 309 |
| | 4. Algebraic and Complex Geometry | 311AB |
| | 5. Geometry | 316 |
| | 6. Topology | 312 |
| | 8. Analysis and its Applications | 320AB |
| | 9. Dynamical Systems and Ordinary Differential Equations | 324AB |
| | 10. Partial Differential Equations | 319 |
| | 12. Probability and Statistics | 322 |
| | 13. Combinatorics | 321AB |
| | 15. Numerical Analysis and Scientific Computing | 325AB |
| | 17. Mathematics in Science and Technology | 313 |
| | 19. History of Mathematics * | 301AB |
| | * ends at 19:00 | |
| **18:00 - 19:30** | IMU Panel Discussion: World Digital Mathematics Library | **402** |
| **20:00 - 21:00** | Public Lecture by Leelavati Prize Winner Adrián Paenza | **Hall D1** |
| | *Chair: Yong-Hoon Lee, President-elect of Korean Mathematical Society, Korea* | |


Yonghoan Kim, a Korean mathematician, lectures on "Combinatorial Game Theory and Baduk" at COEX yesterday. Three lectures on Baduk and simultaneous Baduk games between professional players and amateurs were held during the SEOUL ICM 2014 as part of efforts to promote mathematics and its applications.