

Math & Presso

Daily News of the Congress

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THE FIELDS MEDALISTS



FIELDS MEDALS: The Fields Medals are awarded every four years on the occasion of the International Congress of Mathematicians to recognize outstanding mathematical achievement for existing work and for the promise of future achievement.

Artur Avila

Citation: "His profound contributions to dynamical systems theory have changed the face of the field, using the powerful idea of renormalization as a unifying principle."

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, at billiards and partially hyperbolic dynamics.

Avila's work on real one-dimensional dynamics brought completion to the subject, with full understanding of the probabilistic point of view, accompanied by a complete renormalization theory. His work in complex dynamics led to a thorough understanding of the fractal geometry of Feigenbaum Julia sets.

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.

In the theory of billiards, Avila proved several long-standing conjectures on the ergodic behavior of interval-exchange maps. He made deep advances in our understanding of the stable ergodicity of typical partially hyperbolic systems.

Avila's collaborative approach is an inspiration for a new generation of mathematicians.

Born in Brazil in 1979, Avila is a French citizen. He received his Ph.D. in 2001 from the Instituto Nacional de Matemática Pura e Aplicada in Rio de Janeiro; his advisor was Wellington de Melo. Since 2003 Avila has been a researcher at the Centre National de la Recherche Scientifique and became a research director in 2008; he is also attached to the Institut de Mathématiques de Jussieu-Paris Rive Gauche.



Manjul Bhargava

Citation: "He has developed powerful new methods in the geometry of numbers and applied them to count rings of small rank and to bound the average rank of elliptic curves."

Bhargava's thesis provided a reformulation of Gauss's law for the composition of two binary quadratic forms.

He showed that the orbits of the group $SL(2, \mathbb{Z})^3$ on the tensor product of three copies of the standard integral representation correspond to quadratic rings (rings of rank 2 over \mathbb{Z}) together with three ideal classes whose product is trivial. This recovers Gauss's composition law in an original and computationally effective manner. He then studied orbits in more complicated integral representations, which correspond to cubic, quartic, and quintic rings, and counted the number of such rings with bounded discriminant.

Bhargava next turned to the study of representations with a polynomial ring of invariants. The simplest such representation is given by the action of $PGL(2, \mathbb{Z})$ on the space of binary quartic forms. This has two independent invariants, which are related to the moduli of elliptic curves. Together with his student Arul Shankar, Bhargava used delicate estimates on the number of integral orbits of bounded height to bound the average rank of elliptic curves. Generalizing these methods to curves of higher genus, he recently showed that most hyperelliptic curves of genus at least two have no rational points.

Born in 1974 in Canada, Bhargava grew up in the United States and in India. He received his Ph.D. in 2001 from Princeton University under Andrew Wiles. Bhargava became a professor at Princeton in 2003. His honors include the Fermat Prize (2011), and the Infosys Prize (2012). He was elected to the U.S. National Academy of Sciences in 2013.



Martin Hairer

Citation: "He has made outstanding contributions to the theory of stochastic partial differential equations, and in particular created a theory of regularity structures for such equations."

A mathematical problem that is important throughout science is to understand the influence of noise on differential equations, and on the long time behavior of the solutions. This problem was solved for ordinary differential equations by Itô in the 1940s. For partial differential equations, a comprehensive theory has proved to be more elusive, and only particular cases (linear equations, tame nonlinearities, etc.) had been treated satisfactorily.

Hairer's work addresses two central aspects of the theory. Together with Mattingly he employed the Malliavin calculus along with new methods to establish the ergodicity of the two-dimensional stochastic Navier-Stokes equation.

Building on the rough-path approach of Lyons for stochastic ordinary differential equations, Hairer then created an abstract theory of regularity structures for stochastic partial differential equations (SPDEs). This allows Taylor-like expansions around any point in space and time. The new theory allowed him to construct systematically solutions to singular nonlinear SPDEs as fixed points of a renormalization procedure. Hairer was thus able to give, for the first time, a rigorous intrinsic meaning to many SPDEs arising in physics.

Born in 1975, Hairer is an Austrian citizen. In 2001, he received his Ph.D. in physics from the University of Geneva, under the direction of Jean-Pierre Eckmann. He is now Regius Professor of Mathematics at the University of Warwick. His honors include the Fermat Prize (2013), and the Fröhlich Prize of the London Mathematical Society (2014). He was elected a Fellow of the Royal Society in 2014.



Maryam Mirzakhani

Citation: "She has made outstanding contributions to the dynamics and geometry of Riemann surfaces and their moduli spaces."

Mirzakhani has led the way to new frontiers in this area. Her insights have integrated methods from diverse fields such as algebraic geometry, topology and probability theory.

In hyperbolic geometry, Mirzakhani established asymptotic formulas and statistics for the number of simple closed geodesics on a Riemann surface of genus g . She next used these results to give a new and completely unexpected proof of Witten's conjecture, a formula for characteristic classes for the moduli spaces of Riemann surfaces with marked points.

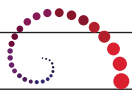
In dynamics, she found a remarkable new construction that bridges the holomorphic and symplectic aspects of moduli space, and used it to show that Thurston's earthquake flow is ergodic and mixing.

Most recently, in the complex realm, Mirzakhani and her coworkers produced the long sought-after proof of the conjecture that while the closure of a real geodesic in moduli space can be a fractal cobweb, defying classification, the closure of a complex geodesic is always an algebraic subvariety.

Her work has revealed that the rigidity theory of homogeneous spaces (developed by Margulis, Ratner and others) has a definite resonance in the highly inhomogeneous but equally fundamental realm of moduli spaces, where many developments are still unfolding.

Born in 1977 in Tehran, Iran, Mirzakhani received her Ph.D. in 2004 from Harvard University, advised by Curtis McMullen. She is currently a professor at Stanford University; her honors include the 2013 Satter Prize of the American Mathematical Society.





Welcome Message from the President of the IMU

It is a great pleasure for me to welcome you all to the International Congress of Mathematicians and to this newspaper, Math&Presso, issued as is now traditional to greet all participants in the International Congress of Mathematicians.

Organizing an ICM is a monumental task; preparation of this ICM started 4 years ago, right after the end of the 2010 ICM. The IMU Executive Committee Members and Officers, elected at the IMU General Assembly in 2010, got to work immediately once their term started. One of their first jobs was to select and appoint the committee members for the IMU Prizes – although the committees wouldn't start their work until later, it was important to ensure that the committee members kept, for the next four years, their independence from other award committees. In the time since, these several prize committees have done their difficult work of selecting the award winners.

The Fields Medals and the Nevanlinna Prize are unusual among top scientific distinctions in that they are reserved for young researchers – we will celebrate with them the new mathematical discoveries and constructions they bring to us. The Gauss Prize, highlighting exceptional mathematical contributions that have impacted fields outside mathematics, and the Chern Prize, awarded at this ICM for the second time, have no such age restrictions, and will give us the opportunity to celebrate the extraordinary lifelong achievements of their recipients. And this ICM marks the establishment of the Leelavati Prize, for popularization of mathematics, as a continuing IMU prize to be awarded at every future ICM. I am glad that we now have the means to recognize the important role played by superb communication of mathematics to the wider public.

The Program Committee, led by its chair Carlos Kenig, also started its work soon after the previous ICM. The committee members first defined how they wanted to structure their task, built up the disciplinary panels, and then proceeded to the arduous selection process, with the goal of giving us an interesting

and varied portrait of what is at the forefront of mathematical research in all our different disciplines. All the selections were thoughtful and considered, but even more special care was taken in selecting the plenary speakers, who face the highly nontrivial task of presenting advanced mathematics at a high level to an audience consisting of mathematicians from many disciplines, including some far removed from their own. I look forward to hearing their presentations and I am sure you will also.

Many of us toiled for almost four years to prepare this ICM, but the Local Organizing Committee, led by its chair Hyungju Park and its many devoted subcommittee chairs, had started work well before the previous ICM – securing funding commitments from governmental and other organizations and defining the wonderful NANUM program that makes ICM 2014 truly special. The Local Organizing Committee set itself the herculean task to raise money to invite 1,000 (one thousand!) mathematicians from developing countries to ICM – and delivered! It required heroic feats in fund-raising, in spreading the word, and in identifying mathematical talent in so many countries; and it is wonderful that it worked and that ICM is welcoming these recipients of NANUM fellowships. NANUM was made possible through the generosity of South Korea, a generosity that was not only financial but also expressed itself through the enthusiasm with which a “spirit of sharing of togetherness” was widely embraced. I am very pleased to have the privilege, representing the IMU, to express my gratitude to the Korean mathematical community, to the Korean people, and to institutional and personal friends of mathematics in Korea and elsewhere, for their generous support of the NANUM program in particular and of the ICM and its outreach programs more generally.

In the name of all of us who have worked so intensely on its preparation, I bid you welcome. We hope you will admire, learn, marvel, meet old friends and make new ones – in a word, that you will enjoy it!



Ingrid Daubechies
President of the IMU
Duke University

Welcome Message from the Chairman of the Organizing Committee

On behalf the local organizers of Seoul ICM, I am truly excited to welcome our colleagues from around the world to this Congress. You have come from more than 120 countries of the world, and many of you are also attending one of our 51 satellite conferences. I sincerely thank the International Mathematical Union for the help and support it provided during the past years, which saved us from many mistakes and pitfalls.

For this Congress to be realized, it took many years of preparations by dedicated members of the Korean math community, and the level of support from the government and corporations of Korea has been phenomenal. The legislative body of Korea, the National Assembly, adopted a resolution in support of Seoul ICM in November 2013 and the Korean government declared the year 2014 as the Korean Mathematical Year in order to maximize the impact of Seoul ICM in Korea. Several prominent corporations made substantial donations to this Congress, underscoring the growing importance of mathematics. We believe that this experience of working together with many faces of our society during the preparations for the Congress will help to open a new era of an expanded role for mathematics in the 21st century.

Starting from the ashes of the Korean War in the 1950s, the Korean economy has displayed exponential growth. Korea's semiconductor industry, in particular, has achieved tremendous development to become the third largest in the world. Names like Samsung, Hyundai and LG have become global brands. At the crossroads of Northeast Asia, Korea has also been called the “Miracle on the Han River”. It goes without question that this economic miracle was made possible largely by the strong emphasis on education in Korean society and culture. The illiteracy rate is close to zero, and the education of children is usually the

highest priority for Korean families. This high regard for education and scholarship, together with the fact that the country's education system emphasizes the importance of rigorous mathematical reasoning, partly explains the stellar performance of young Korean students in International Math Olympiads and the steady influx of gifted students into the mathematics profession.

Our NANUM program to invite 1,000 mathematicians from developing countries to this Congress required the focused and concerted efforts of the Korean math community. I believe that the NANUM grantees will take the ICM excitement back home, further extending the positive impact of the Congress to future generations in their respective countries.

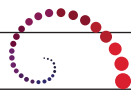
This Congress also put much emphasis on public outreach programs. The public lectures by James Simons and by the Leelavati prize winner, the Baduk (Go) match against renowned masters, and the math movie projection event, to name a few, were made possible by the efforts of our outreach team. We hope that these efforts will contribute to making mathematics a part of the mass culture of our times.

I hope that you enjoy and are rejuvenated by the exciting mathematical lectures and by the company of colleagues from afar. I hope you will also be able to savor some of the fine attractions that our country offers. Korea's five-millennia history has contributed greatly to its illustrious cultural heritage and exotic charm. Often referred to as the “Land of the Morning Calm,” Korea has its own unique cultural heritage, distinct from that of other Asian countries. A visit to the country's numerous historical relics, 10 of which are designated UNESCO World Cultural Heritage Sites, will make ICM participants' journeys all the more special.

Again, welcome to Seoul!



Hyungju Park
Chairman of the SEOUL ICM 2014
Organizing Committee
Pohang University
of Science and Technology



Rolf Nevanlinna Prize Winner

Citation: “Subhash Khot’s prescient definition of the “Unique Games” problem and his leadership in the effort to understand its complexity and its pivotal role in the study of efficient approximation of optimization problems have produced breakthroughs in algorithmic design and approximation hardness, and new exciting interactions between computational complexity, analysis and geometry.”

Subhash Khot defined the “Unique Games” problem in 2002 and subsequently led the effort to understand its complexity and its pivotal role in the study of optimization problems.

Khot and his collaborators demonstrated that the hardness of Unique Games implies a precise characterization of the best approximation factors achievable for a variety of NP-hard optimization problems. This discovery turned the Unique Games problem into a major open problem of the theory of computation.

The continuing quest to study its complexity has had unexpected benefits. First, the reductions used in the above results identified new problems in analysis and geometry,

The Nevanlinna Prize is awarded once every four years at the International Congress of Mathematicians for outstanding contributions in the mathematical aspects of information sciences.

invigorating the analysis of Boolean functions, a field at the interface of mathematics and computer science. This led to new central limit theorems, invariance principles, isoperimetric inequalities, and inverse theorems, affecting research in computational complexity, pseudorandomness, learning and combinatorics.

Second, Khot and his collaborators used intuitions stemming from their study of Unique Games to yield new lower bounds on the distortion incurred when embedding one metric space into another, as well as constructions of hard families of instances for common linear and semidefinite programming algorithms.

This has inspired new work in algorithm design extending these methods, greatly enriching the theory of algorithms and its applications.



Subhash Khot
New York University

Carl Friedrich Gauss Prize Winner

Citation: “Stanley Osher has made influential contributions to several fields in applied mathematics, and his far-ranging inventions have changed our conception of physical, perceptual, and mathematical concepts, giving us new tools to apprehend the world.”

Stanley Osher has made influential contributions in a broad range of fields in applied mathematics. These include high-resolution shock capturing methods for hyperbolic equations, level set methods, methods based on partial differential equations in computer vision and image processing, and optimization.

His numerical analysis contributions, including the Engquist-Osher scheme, TVD schemes, entropy conditions, ENO and WENO schemes and numerical schemes for Hamilton-Jacobi type equations, have revolutionized the field. His level set contributions include new level set calculus, novel numerical techniques, fluids and materials modeling, variational approaches, high codimension motion analysis, geometric optics, and the computation of discontinuous solutions to Hamilton-Jacobi equations; level set methods have been extremely influential in computer vision, image process-

The Gauss Prize is awarded once every four years to honor a scientist whose mathematical research has had an impact outside mathematics – in technology, in business, or simply in people’s everyday lives.

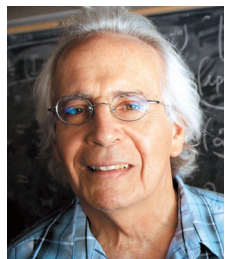
ing, and computer graphics.

In addition, such new methods have motivated some of the most fundamental studies in the theory of PDEs in recent years, completing a picture where applied mathematics inspires pure mathematics.

Stanley Osher has unique mentoring qualities: he has influenced the education of generations of outstanding applied mathematicians, and thanks to his entrepreneurship he has successfully brought his mathematics to industry.

Trained as an applied mathematician and an applied mathematician all his life, Osher continues to surprise the mathematical and numerical community with the invention of simple and clever schemes and formulas.

His far-ranging inventions have changed our conception of physical, perceptual, and mathematical concepts, and have given us new tools to comprehend the world.



Stanley Osher
UCLA

Chern Medal Award Winner

Citation: “The 2014 Chern Medal is awarded to Phillip Griffiths for his groundbreaking and transformative development of transcendental methods in complex geometry, particularly his seminal work in Hodge theory and periods of algebraic varieties.”

Phillip Griffiths’ ongoing work in algebraic geometry, differential geometry, and differential equations has stimulated a wide range of advances in mathematics over the past 50 years and continues to influence and inspire an enormous body of research activity today.

He has brought to bear both classical techniques and strikingly original ideas on a variety of problems in real and complex geometry and laid out a program of applications to period mappings and domains, algebraic cycles, Nevanlinna theory, Brill-Noether theory, and the topology of Kähler manifolds.

A characteristic of Griffiths’ work is that while it often has a specific problem in view, it has served in multiple instances to open up an entire area to research.

The Chern Medal is awarded every four years, on the occasion of the International Congress of Mathematicians, to an individual whose accomplishments warrant the highest level of recognition for outstanding achievements in the field of mathematics.

His wide-ranging investigations have brought many new techniques to bear on these problems and led to insights and progress in many other areas of geometry that at first glance seem far removed from complex geometry.

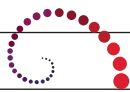
Many others areas in algebraic geometry, including web geometry, integrable systems, and Riemann surfaces, are currently seeing important developments that were stimulated by his work.

His legacy of research and service to both the mathematics community and the wider scientific world continues to be an inspiration to mathematicians world-wide, enriching our subject and advancing the discipline in manifold ways.



Phillip Griffiths
Chair, Science Initiative Group

| The 2014 Leelavati Prize was awarded to Adrián Paenza. His citation and profile will be on Page 3 of the Aug. 20th Math&Presso. |



A Gabonese delegate discusses the development of mathematics in his country during the 17th General Assembly of the International Mathematical Union in Gyeongju, North Gyeongsang Province, Monday, Aug. 11, 2014. Around 170 mathematicians including the members of the IMU Executive Committee, who were sitting on the podium, participated in the two-day meeting held in the capital of the ancient Korean dynasty, Shilla. Brazil was chosen as the host of the next ICM during the Gyeongju assembly. The next members of the IMU Executive Committee were also elected in Gyeongju. The International Congress of Mathematicians will kick off today at COEX in Seoul for a nine-day run.

IMU General Assembly

New leaders named; Brazil to host the next ICM

Brazil, the host of the 2016 summer Olympic Games, will also host the Olympics of mathematics in 2018.

The International Mathematical Union voted unanimously to name Brazil as the next host of the 2018 International Congress of Mathematicians at its 17th General Assembly in Gyeongju, Korea, on Monday, Aug. 11, 2014. Rio de Janeiro will host the ICM 2018 on Aug. 7-15 and Sao Paulo will host the 18th General Assembly of the union on Aug. 4-5.

Brazil was the only contender to host ICM 2018. The quadrennial event is a venue for prominent mathematicians around the world to share new ideas and celebrate the latest academic achievements in mathematics. Prestigious awards such as the Fields Medal are handed out during the event.

Eight representatives from Brazil, who made a final presentation before the voting at the general assembly meeting on Monday, will have a special interest in the running of this congress in preparation for their own work. The ICM 2018 will be the first congress to be held in the southern hemisphere and also the first in Latin America.

Seoul won the bidding for the 2014 ICM at the last general assembly, in India in 2010. The 2014 congress will begin its nine-day run today at COEX in southern Seoul.

Gyeongju, the capital of the ancient Shilla Dynasty in Korea, was the venue for the 2014 general assembly; it ran for two days at the Hotel Hyundai in southern city in North Gyeongsang Province. About

170 people participated in the meeting, including 120 delegates representing 50 national members of the IMU. Others attending were the assembly's organizers, IMU committee members, and observers.

The IMU, the governing body of the ICM, uses the general assembly to review the IMU's activities over the past four years and take positions on important issues affecting mathematicians over the world. In Gyeongju, the delegates elected new members of the executive committee, the IMU's supreme body. Shigefumi Mori, a professor of mathematics at Kyoto University and a recipient of the 1990 Fields Medal, was unanimously elected as president of the IMU. He is the first mathematician based in Asia to be elected as IMU president. K. S. Chandrasekharan, an Indian-born mathematician, served in the position in 1971-4, but had long been based in Zürich, Switzerland.

Helge Holden, a professor of mathematics at the Norwegian University of Science and Technology, was elected as IMU's secretary; Alicia Dickenstein of Argentina and Vaughan Jones of New Zealand were named vice presidents.

Six members at large of the IMU Executive Committee were selected by ballot, including Hyungju Park, the chairman of the SEOUL ICM 2014 Organizing Committee. He is the first Korean to be elected as a member of the executive committee. The new committee members will start their four-year terms in January.

During the meeting, the participants also approved a dozen resolutions, in-



Shigefumi Mori

cluding one directing a study of changing or relaxing age limits for some major awards. The Fields Medal is currently awarded only to mathematicians 40 years old or younger.

The new executive committee will name an ad-hoc group next year to consider the age ranges for IMU prizes and medals. Martin Grötschel, the incumbent secretary general of the IMU, cautioned that it was too early to predict the results. "This is a very cautious and careful move,"

the professor at the Technical University of Berlin said. "I have no idea what it will lead to; maybe changes, maybe not. I would not make any bets on it."

Participants at the assembly got a taste of Korean hospitality at a gala dinner in the hotel's Dynasty Hall on Sunday and a farewell dinner at the East Palace Garden Restaurant on Monday.

During the dinners, assembly participants watched Korean traditional performances such as pansori, a musical storytelling art form, talchum, a traditional mask dance, and namdo minyo, southern provincial folk singing. The governments of the city of Gyeongju and the province of North Gyeongsang sponsored the banquets and were in many other ways crucial to the success of the assembly.

A Korean has been elected for the first time as a member of the top governing body of the International Mathematical Union.

Hyungju Park, the chairman of the organizing committee for the 2014 International Congress of Mathematicians Seoul, was voted to be a member-at-large of the Executive Committee of the International Mathematical Union during the IMU General Assembly in Gyeongju on Monday. The mathematics professor at POSTECH will oversee, along with nine other committee members, the processes of making major decisions affecting

mathematicians from all over the world over the next four years.

His election, coinciding with Korea as host of the ICM, reflects Korea's rise in math prowess. As of 2012, Korea was No. 11 in the world in the number of academic papers on mathematics.

Park said he would continue to encourage young Korean mathematicians, but would also urge them to focus on the quality of their research.



Hyungju Park

MENAO Symposium

For the developing world, mathematics is the key

"I was born in Northern Rhodesia, which is now called Zambia. It was part of the federation of what was called Rhodesia and Nyasaland in those days," said Professor Edward Lungu of the University of Botswana.



"Unfortunately, in those days when I was growing up, society was segregated. You were designated black, Indian colored, or white. Depending on your designation, you went to the corresponding school. Needless to say, I went to a black school."

Lungu, who is now a key leader in promoting teaching and research in applied mathematics in southern Africa, gave a speech yesterday about growing up in the southern African nation of Botswana. The symposium was held at COEX.

"At that time, during the 1950s, there was something going on in South Africa and its government argued that mathematics was actually not good for black people; it would do them no good. So in South Africa, mathematics was banned for blacks for some time."

Because the young Lungu studied at a native school in a neighboring country, his school was also affected by the decision to ban Africans from studying mathematics in South Africa. Math textbooks were taken away from the students and were replaced by a "rather humiliating math book titled 'Native Arithmetic,'" he said.

Although he said it was not his everyday habit, Lungu confessed that he managed to steal a textbook.

"I was a class monitor, and when the original math textbooks were being taken away from the black students, I managed to steal one," he recalled. "I read that book very thoroughly. I believe mathematics was what kept me going at that time."

Fortunately, Lungu went on to study at the University of Bristol, where he got a master's degree and then a Ph.D. in 1980. His research has focused on hydrology (his home country relies on storing rainwater) and ecology (domestic livestock and wildlife are key to its economy). He also focused on epidemiology in an effort to understand the progression of HIV/AIDS and how to help its victims.

Despite growing up in an underdeveloped country and being brought up in a seemingly hopeless situation, Lungu's story exemplifies the numerous achievements and opportunities available in emerging nations if advanced countries take notice and offer a helping hand.

That was the agenda of this one-day Mathematics in Emerging Nations: Achievements and Opportunities (Menao) Symposium yesterday at COEX,



Professor Edward Lungu of the University of Botswana, who has been described as a "fundamental person" in the development of teaching and research in applied mathematics in southern Africa, tells the story of how mathematics shaped his life and career during the MENAO symposium yesterday at COEX in southern Seoul.

the day before the official opening of the SEOUL ICM 2014.

At 9 a.m., about 300 mathematicians from around the globe gathered to listen to the stories of mathematicians and advanced students of mathematics from the developing world.

Since the 1970s, the IMU's Committee for Developing Countries (CDC) has focused on promoting mathematics and advanced mathematical education in the developing world, through programs such as a scholarship program for studies in advanced nations. According to the IMU, that work has its impetus in the "perception that the developing world is potentially home to the greatest untapped resource of mathematical talent."

According to the SEOUL ICM 2014 Organizing Committee, the CDC is giving financial support to about 150 mathematicians from developing countries to participate in the ICM. However, since

the Seoul ICM has launched the NANUM program, which invited 1,000 mathematicians from developing countries to the Seoul congress, CDC decided not to overlap the support program but instead hold the Menao Symposium.

"We are aiming to bring together promising institutions with potential donors interested in supporting and hope to create new partnerships that will benefit the developing world and mathematics in general," said Ingrid Daubechies, IMU president, and Martin Grötschel, IMU secretary, through its official webpage (www.mathunion.org).

"The leadership of the International Mathematical Union wishes to make MENAO a premier event of compelling interest to all organizations, governmental agencies and individuals that have contributed to international mathematical development or are potentially interested in doing so."

Yesterday's MENAO Symposium featured personal stories from a variety of mathematicians, including a presentation on the state of mathematics in Korea and its influence on economic development. Professor Ngo Bao Chau of the University of Chicago, who received the Fields Medal at the Hyderabad ICM in 2010, also talked about the development of mathematics in his home country, Vietnam.

Participants also heard about how mathematics acted as a "fundamental pillar of Korean economic development."

Although he's not a mathematician, the internationally known energy engineer and science policy specialist Dr. Kunmo Chung, who also served twice as the minister of science and technology in Korea, gave a detailed presentation asserting that one of the main reasons behind Korea's rapid development was Koreans' realization that mathematics is the "basis of many fields, not only in mathematical science but also in nation building."

Although Korea started off as a typical agricultural country after the Korean War in the early 1950s, Chung said, Korean parents sold their farmlands and animals to afford the tuition for their children's education.

"You know that to farmers, selling land and cows means giving up everything," said Chung. "It's giving up the major resources for their livelihood. For what? To give an education to their children. They could do so because they believed in education."

After a detailed presentation of Korea's economic development linked to mathematics education as well as education as a whole, Chung said that Korea has reached a level now where it has the ability to develop its "brainpower."

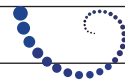
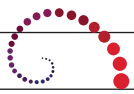
Chung was a major impetus behind the founding of KAIST, Korea's premier science and technology institute. It is vital, he said, for Korea and other countries at a similar level to "work together hand in hand to develop the world together."

That's not just an action for today, he continued. "We will work together with you so the entire global world will have a better living standard and be together. And be one together."

"Just as *nanum* in Korean means 'sharing,' I am also serving as the president of Habitat for Humanity in Korea, which builds houses in underdeveloped countries."

"Through that experience of sharing, I came to realize what it means to be a human being. It gave me much more happiness than I gave to those who are receiving the support," he continued.

"So I ask you participants today. Let's work together to allow every country to have a better living standard."



Tourist Map of the COEX Area



Tourist attractions around the congress site

From temples and tombs to museums, history and culture are near at hand

COEX Aquarium

The COEX Aquarium is located inside the COEX Mall and is home to 40,000 marine creatures of 650 different species. The COEX Aquarium showcases the incredible diversity of aquatic life around the globe in a series of 14 themed discovery zones, from the heights of the Andean mountains to the depths of the Amazonian rainforest, in ecosystems ranging from rivers and swamps to the deep sea. It is open from 10 a.m. to 8 p.m. daily.

First Basement Level of COEX Mall
www.coexaqua.co.kr

(02) 6002-6200

Bongeunsa (temple)

If you want to feel the tranquility of a quiet mountain temple away from the throngs of people inside COEX, you will never regret visiting Bongeunsa, the millennium-old temple in the middle of the city near COEX. It is quite a pleasant surprise that a temple of this size could be located in the busy, fast-paced part of the World Trade Center area. Established in 794 during the Shilla Dynasty, the temple was originally called Gyeonseong-sa, which literally means "seeing true na-

ture." Not to be missed is the Great Statue of Maitreya Buddha, built in 1996, which is the tallest stone statue (23 meters) of the Maitreya Buddha in Korea.

Samseong Station, Line No. 2, Exit 2
www.bongeunsa.org
 (02) 3218-4800

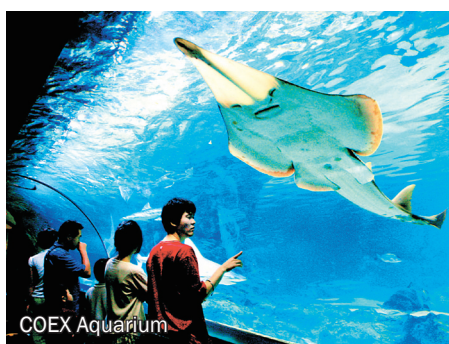
Seonjeongneung (royal tombs)

In southern Seoul, the center of the Korean economy, there is an area where kings of the Joseon Dynasty can be found. Seonjeongneung is a combination of the

names Seolleung and Jeongneung, and refers to the royal tombs of King Seongjong (the ninth king of the Joseon Dynasty), Queen Jeonghyeon (the second wife of King Seongjong) and King Jungjong (a son by the king's second wife). Seonjeongneung was designated as a UNESCO World Heritage site in 2009, enhancing its status as a historical site. It is an ideal place for visitors to enjoy a stroll.

Seolleung, the tomb of King Seongjong (reigned 1469-1494) was built in 1495; subsequently, the tomb of Queen Jeonghyeon (1462-1530) was built on the east side of Seolleung in 1530.

Jeongneung, which is the tomb of



COEX Aquarium



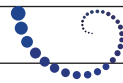
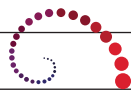
Bongeunsa (temple)



Seonjeongneung (royal tombs)



Museum of Korean Embroidery



King Jungjong (the 11th king of the Joseon Dynasty, reigned 1506-1544), was built in 1544, and was moved from its original site in Wondang, Gyeonggi Province, to this location in 1562 by Queen Munjeong (the second wife of King Jungjong, 1501-1565). Seonjeongneung is designated Historic Site No. 199 and is also a UNESCO World Heritage site. It is open from Tuesday to Sunday from 6 a.m. to 9 p.m.

Seolleung station, Line No. 2, Exit 1

<http://seonjeong.cha.go.kr>

(02) 568-1291

Museum of Korean Embroidery

The first thing that comes into the visitor's sight in this museum is not varied colors but ancestral subtlety. Embroidered patches on the breast and on the back of official uniforms, bridal dresses, dress embroidery with pockets adorned with needlework and gilt, folding screen embroidery with flower and bird paintings, the ten traditional symbols of longevity and Chinese characters signifying long life and happiness are pinnacles of devoted work.

When you look at embroidered products like thimbles, trinkets and boxes, you

feel admiration for the world of beauty created by Korean middle-class women. When you look closely at ancient people's embroidery, interesting stories quickly emerge.

For example, spoon bags are usually red. As diet is closely related to health, the makers used red cloth symbolic of life to drive away bad luck. Among the items, treasured cultural properties such as National Treasure No. 653, Jassugye-bungyeongdo, a four-panel folding screen with embroidered potted plants designating spring, summer, autumn, and winter; and National Treasure No. 654, Jassugasa, an embroidery of Buddhist images, makes visitors stop and take a closer look.

The museum is open from Monday to Friday from 10 a.m. to 4 p.m. It is closed on weekends.

Hakdong Station, Line No. 7, Exit 10

www.bojagii.com

(02) 515-5114-6

Kukkiwon (taekwondo)

If you want to know more about the Korean spirit, you should drop in at Kukkiwon, an association established to promote taekwondo, Korea's national sport. Taekwondo, a traditional martial art unique to Korea that began 2,000 years

ago, is now an internationally recognized sport. It was selected as a regular game at the 27th Sydney Olympics in 2000. Taekwondo's main purpose is to discipline the body and the mind by rigorous training.

The spirit of taekwondo is the product of skills learned through training; humility and politeness become your behavioral philosophy, cultivating one's virtue. Thus, when a person is taught taekwondo for the first time, mind training comes before the acquisition of physical skills.

Opened in 1972, Kukkiwon holds numerous international events such as international taekwondo judges' tests and domestic games. Visitor can enjoy taekwondo demonstrations and watch regular performances, which are organized every Monday and Saturday mornings from 11:30 a.m. to 12 p.m.; admission is free of charge.

Gangnam Station, Line No. 2, Exit 4

www.kukkiwon.or.kr

(02) 567-1058

Dosan Park

Famed as a park in the heart of the city for 30 years, Dosan Park has been visited by tens of thousands of busy urbanites who need a time off from the bus-

ting city life. It was made as a mall park to commemorate Ahn Chang-ho's love for his nation and educational spirit. Ahn was an independence activist in the colonial period, and took part in many independence activities.

In the park are tombs where Ahn and his wife are buried. The burial grounds are near the entrance, and to the east there is a statue and a circular footpath around it. The memorial hall displays 71 photographs, 48 documents, and Ahn's diaries.

Sinsa Station, Line No. 3, Exit 4

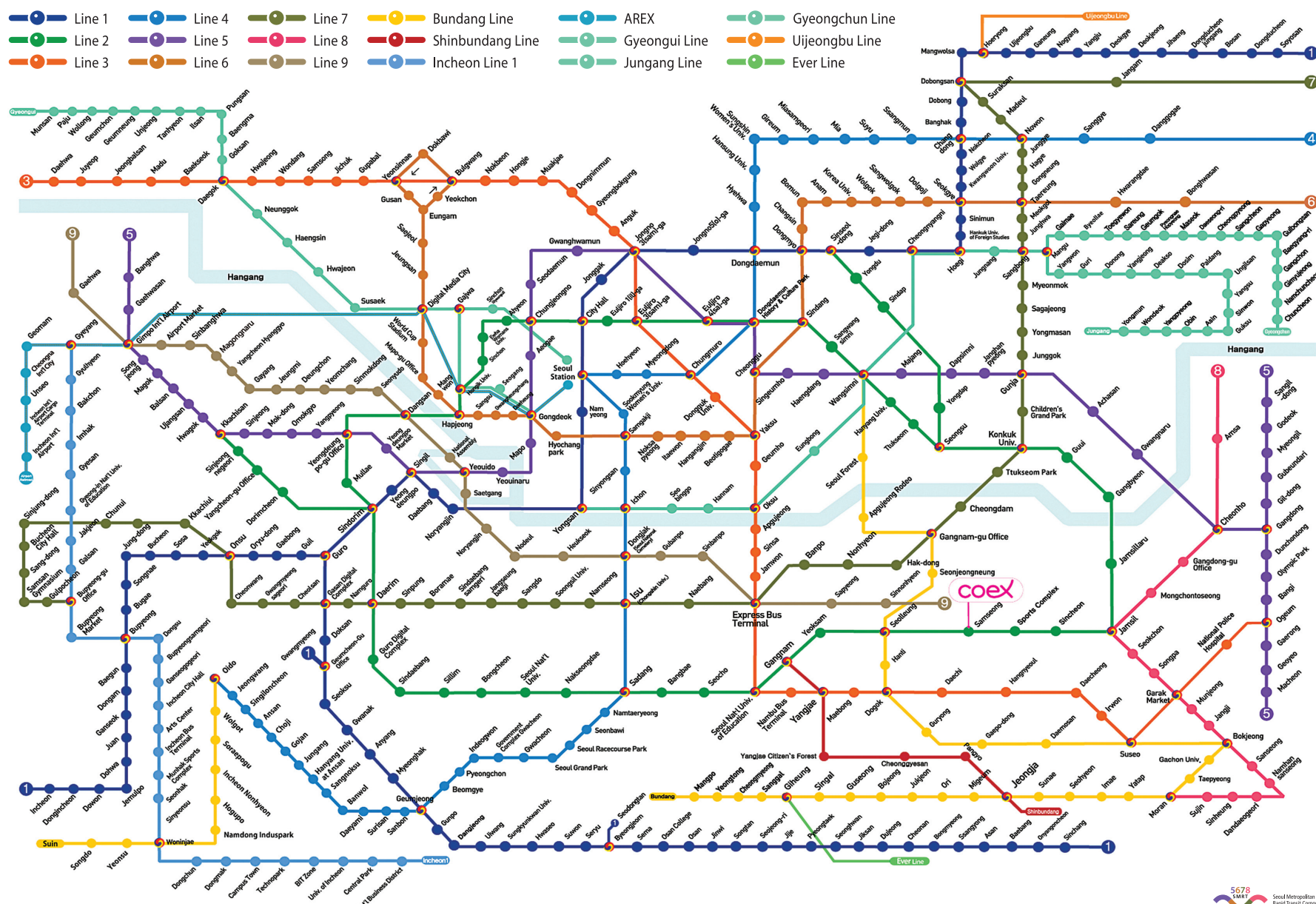
www.ahnchangho.or.kr

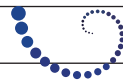
(02) 541-1800

See ATTRACTIONS, Page 8



Subway Route Map





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Wednesday, August 13

09:00 - 11:30	Opening Ceremony Awards Ceremony of the Fields Medals, the Rolf Nevanlinna Prize, the Carl Friedrich Gauss Prize and the Chern Medal Award	Hall D
12:30 - 14:00	Lunch	
14:00 - 16:30	Laudations	Hall D
14:00 - 14:25	Work of Fields Medalist 1	
14:30 - 14:55	Work of Fields Medalist 2	
15:00 - 15:25	Work of Fields Medalist 3	
15:30 - 15:55	Work of Fields Medalist 4	
16:00 - 16:25	Work of Rolf Nevanlinna Prize Winner	
16:30 - 17:30	Special Lecture by the Nevanlinna Prize Winner	Hall D
18:00 - 19:40	Korea Math Night	102-104
20:00 - 21:00	Public Lecture 1 by James Simons Chair: Ki Hyung Lee, CEO of Interpark, Inc., Korea	Hall D

Schedules for plenary lectures on Aug. 14 have been changed. Please check the new schedules below.

09:00 - 12:30	Plenary Lectures	Hall D
09:00 - 10:00	Virtual properties of 3-manifolds Ian Agol , University of California, Berkeley, USA	PL-1
10:15 - 11:15	Mori geometry meets Cartan geometry: Varieties of minimal rational tangents Jun-Muk Hwang , KIAS, Korea	PL-2
11:30 - 12:30	Mathematics of sparsity (and a few other things) Emmanuel J. Candès , Stanford University, USA	PL-3

Announcement of change: NANUM Reimbursement Room has been relocated to Room 204 (2F).

Daily Math Puzzle

Q. Eight people (A, B, C, D, E, F, G, and H) played chess in a round-robin tournament. No match ended in a tie but A and B tied overall for first place. Because C and D were rivals, C beat all players who beat D and D beat all players who beat C. What was the final record of A and B (wins and defeats)?



ATTRACTIONS, from Page 7

Fine Dining

Joseon Choga Hankki

If you wish to experience authentic Korean cuisine, visit Joseon Choga Hankki in Samseong-dong near COEX. When you step into the restaurant, you will feel as if you are visiting a part of history in traditional Korea. Many Korean meals, including boiled pork and *bulgogi* are served. The most popular dish is *bulgogi jeongsik* (grilled beef course, 15,000 won). Several varieties of *makgeoli* (rice wine), are offered to enhance your dining. The restaurant opens at 11:30 a.m. and closes at 11:00 p.m. daily.

555 Samseong-ro, Gangnam-gu
(02-538-0835)

Chef's Note

For the ultimate in luxurious dining,

visit Chef's Note, an Italian restaurant on the first level of Oakwood Premier COEX Center. The restaurant has private rooms, an open kitchen and an outdoor terrace to add to the ambience. The menu includes authentic Italian dishes like pasta, steak and pizza. Try the lunch or dinner set (Lunch 26,000 won, dinner 48,000 won), to taste several of the restaurant's specialties. Along with the food, selections of famous wines are provided for wine lovers. Chef's Note is open from 11:30 a.m. to 10:00 p.m.

First level of Oakwood Premier COEX Center
(02-566-2135)

Wonjo Gwangyang Bulgogi

Would you like to try authentic Korean bulgogi? Head to Wonjo Gwangyang Bulgogi near Seolleung Station. At this restaurant, you can taste authentic Gwangyang bulgogi, said to be the premier style in the nation, along with marinated *kalbi*

(short ribs) and delectable grilled ribeye steaks. Prices range from 30,000 to 40,000 won per person, and other dishes such as *bibimbap* (steamed rice, vegetables and condiments – 7,000 won) are available. The restaurant opens at 11:00 a.m. and closes at 10:00 p.m.

529 Samseong-ro, Gangnam-gu
(02-565-7090)

Shopping Information

Most shops in Seoul are open from 9 a.m. to 9 p.m. on weekdays and until 11 p.m. on weekends.

COEX Mall, the first western-style shopping mall in Seoul, offers movies, restaurants, hair salons and almost all conceivable varieties of consumer goods all under one roof. For more information, please visit the Web site: www.coexmall.com, or see the official smartphone application.

Apgujeong-dong is home to many high-end boutiques, earning it the nickname "Seoul's Rodeo Drive."

In **Cheongdam-dong** you can find many luxury brand stores including Prada, Louis Vuitton, Cartier and Hermes. The art galleries Gallery Hyundai Gangnam and CAIS Gallery are also located here.

Insa-dong is a cobblestone street in downtown Seoul that is a must-visit site for visitors. Insa-dong shops offer souvenirs and all manner of traditional Korean clothing, artwork and handcrafts. Insa-dong also boasts many art galleries, traditional teahouses and restaurants.

Myeong-dong in central Seoul is the hip place for younger Koreans to shop and be seen.

Itaewon is an international district that has outgrown its history as an entertainment area for American GIs, and is now home to a huge variety of restaurants and clubs.



Kukkiwon



Dosan Park



Chef's Note Restaurant



Cheongdam luxury shopping district