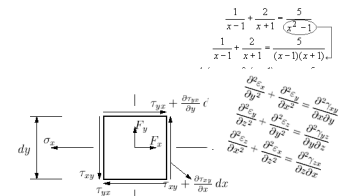


ICM 2006

Daily News



Madrid, August 29th 2006

Carlson: "Perelman fulfills all the requirements of the Millennium Prize" Cao: "Hamilton and Perelman are the giants and our heroes!"

If there was any doubt about who did what when it came to proving the Poincaré Conjecture, Huai-Dong Cao makes it clear in this short interview he gave to the ICM2006 Daily News. Once this point has been clarified, the next question is: will as many people have predicted Grisha Perelman receive one of the "Millennium Prizes"? The man with the answer to this question could be Jim Carlson, president of the Clay Mathematical Institute. A question nobody can answer, however, is whether Perelman will agree to accept the prize if he is awarded it.

INTERVIEW WITH JIM CARLSON

For Perelman to be declared the winner of one of the Millennium Prizes he has to fulfill several conditions: his work must be published and reviewed by a referee; and he must then wait two years, during which the Clay Institute, which drew up the list of problems to be solved, verifies that these conditions have been fulfilled. Jim Carlson, president of the Clay Mathematics Institute (CMI) and one of the members of the CMI's Scientific Advisory Board, speaks about the million-dollar prize.

Does the Clay Institute consider that Poincaré's Conjecture has been proven?

In his talk, John Morgan said that the conjecture had been proven by Grisha Perelman. Let me just say that Perelman's stunning breakthrough is an event for great celebration. Perelman stood on the shoulders of giants – Richard Hamilton, in particular – but he saw further ahead than did any of us.

Does this mean that Perelman will be officially declared as a winner of one of the Millennium Prizes, offered by the Clay Institute to those who can solve the so-called "Millennium Problems"?

The rules of the Institute stipulate a two-year wait after the work receives refereed publication and general acceptance by the mathematical community. The two-year period during which the entire mathematical community can scrutinize these articles, now publicly available, is crucial. Only then does the Scientific Advisory Board take up the matter and make a recommendation to the Directors of the Institute.

Does the fact that Perelman's work has only been posted on Internet posed any problem for the Institute?

Detailed expositions of Perelman's work have now appeared in the work of Cao-Zhu, Kleiner-Lott, and Morgan-Tian, and the work by Gérard Besson will soon appear as well. These works, all refereed or in the process of being refereed, are enough.

So Perelman gets the prize?

He is the one who announced a proof of the conjecture. The decision to award the prize will be made in roughly two year's time. There is a procedure in place for the decision: appointment of a panel of experts made up mainly of persons not connected with the Clay Institute, consideration of their report by the Scientific Advisory Board, and, finally, decision by the directors of the Institute.

Do you think he'll accept it?

I couldn't say; I have no idea. We will do what the ICM did when it conferred a Fields Medal on Perelman. I think John Ball and the Fields Medal Committee did exactly the right thing. They offered the medal based on

Perelman's achievements, and did not condition that decision on his possible reaction. If the Clay Institute decides to offer the Millennium Prize to Perelman, it will follow the same philosophy.

The Clay Institute (Massachusetts, USA) was founded in 1999 by Boston businessman Landon T. Clay. In 2000, CMI announced the creation of a series of prizes for seven problems, known as the "Millennium Problems," each one worth one million dollars. The problems were selected by the Scientific Advisory Board of CMI (Alain Connes, Arthur Jaffe, Andrew Wiles, and Edward Witten) in consultation with other leading mathematicians. The seven are important classic problems which have long resisted solution. The current Scientific Advisory Board consists of James Carlson, Simon Donaldson, Gregory Margulis, Richard Melrose, Yung-Tong Siu, and Andrew Wiles. Arthur Jaffe was the first president of CMI. Simon Donaldson, Gregory Margulis, and Edward Witten are Fields Medalists.



INTERVIEW WITH HUAI-DONG CAO

In the latest issue of the Asian Journal of Mathematics, published in the U.S.A, the Chinese mathematicians Xi-Ping Zhu (University of Zhongshan, Canton, China), and Huai-Dong Cao (Lehigh University, Pennsylvania,(USA), announced that they had arrived at “a complete proof of the Poincaré and Geometrization Conjectures”. They appeared in many media as the true authors of the solution to a legendary problem.

You have been at the heart of a media-storm. It was even announced you have finally proved the Poincaré Conjecture. How have you lived through all this?

I like mathematics and love working on geometric flows, in particular Ricci flow. Unfortunately some of the media’s attention seems to be much more interested in something else other than discussing mathematics. I simply focus on the mathematics part.

The controversy has focused on ‘who did what’. Prof. Shing-Tung Yau, for instance, has been quoted saying that Perelman contributed no more that 25%



to the solution of the problem, while you contributed 30%. What is your view?

In my joint paper with Zhu, we have given a detailed account. Hamilton and Perelman have done the most important fundamental works. They are the giants and our heroes! In my mind, there is no question at all that Perelman deserves the Fields Medal. We just follow the footsteps of Hamilton and Perelman and explain the details. I hope everyone who read our paper would agree that we have given a rather fair account.

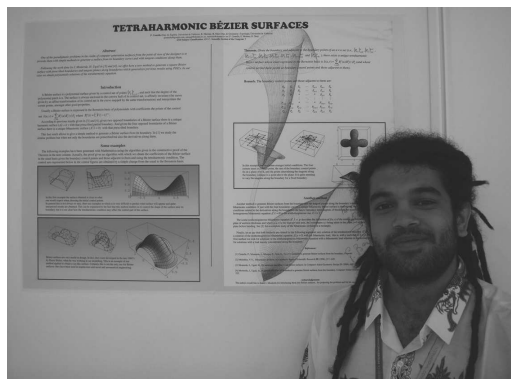
Most unfortunately, Prof. Yau’s view point has been distorted by the media. As far as I know, Prof. Yau never assigned any percentage distribution and he doesn’t agree with any such distributions. In fact, he has shown me several emails (...) he wrote to various reporters which stated explicitly that he doesn’t agree with that kind of distribution. I also like to add that Prof. Yau respected Perelman’s contribution a great deal. In more than one occasion, including when talking to the reporters of the New Yorker (...) he said that Perelman deserves the Fields Medal.

POSTER COMPETITION

“Just seeing our poster up and people looking at it, I feel satisfied and rewarded”.

It’s a great honour for me to present a poster at the International Congress of Mathematicians. I’d like to take this opportunity to thank the Organizing Committee, and in particular the committee responsible for the volunteers for giving us this opportunity. It all began during a doctorate course when my colleagues Pablo Centella Barrio and Elena Gálvez

Moreno and I solved a problem and decided to submit the paper for publication. Almost immediately we received an e-mail from Emilio Bujalance informing all the congress volunteers that we could present a short communication or a poster. None of us had ever done a poster before (I don’t think we even knew what one was!), but we asked around and decided to go for it. A poster is simply a means of presenting your most important results in an attractive and entertaining way without going into too much detail. It’s also good for those who are not comfortable speaking in public. In our case, the poster’s quite noticeable because of some computer-generated images of surfaces, and also because fortunately the artistic taste of my colleagues is better than mine. I also have to say that it wasn’t too hard to make the poster. Basically, we



did the classic cut and paste. As far as composition and presentation of the poster is concerned, we spent quite a lot of time deciding on colours, backgrounds, framing, etc..

Several months later, here I am, about to present a poster for the first time, and nothing more and nothing less than at the ICM! With of course the added emotion of taking part in a competition. The poster will be on display from August 25th to 29th, but we all have a certain time (from 5.00pm to 6.00pm; Saturday 26th in my case) when we have to be present in person to answer questions from interested parties – or maybe listening to criticism (I hope not!). That’s okay by me, at least until somebody asks me a question I can’t answer, but that’s all part of the game.

Seriously though, I’m pretty excited about all this, but not nervous. It’s always gratifying to see something you’ve spent some time working on displayed like this where everyone can view it. I invite you to come and see our poster “Tetraharmonic Bézier surfaces”, as well as the others on display with it. I’m sure the standard of this ICM won’t disappoint anybody. Lastly, I’d like to congratulate the winners of the competition. That’s all!

Raúl Oset Sinha, Doctorate student at the University of València, ICM Volunteer

Mandelbrot: “Fractals are very important to understand the evolution of the stock markets”

Benoit Mandelbrot coined the term ‘fractal’ in 1975 from the latin word fractus (‘broken’ or ‘fractured’), and opened up a new field of mathematics devoted to the study of these structures. Today, fractals are used in such diverse applications as medicine –i.e. to detect certain types of tumors— and cinema –to generate artificial landscapes—, as well as art. Mandelbrot is currently the Sterling Professor Emeritus of Mathematical Sciences at Yale University, and IBM Fellow Emeritus (Physics) at the IBM Research Center. He answered some of our questions via e-mail.

Fractals have become one of the most beautiful faces of modern mathematics, and a useful one to popularise mathematics among the general public. How do you feel about this?

I’m thoroughly delighted to see that fractals help bridge the abyss that separates difficult open questions of mathematics from lay persons’ interests -young and old. Some mathematicians have always liked their field to be left alone but I always thought that isolation is unwise, in fact, very harmful.

What did your colleagues first say when you showed them your results with fractals?

Fractal geometry did not involve any Eureka! moment. It was not a serendipitous discovery but the end of a very long process which repeated itself for diverse forms of roughness that occur in pure mathematics and in many areas of science. Pure mathematicians had come to believe that it was no longer possible for pictures to affect their field. To the contrary, my discovery of the Mandelbrot set consisted in a number of visual observations phrased into conjectures demanding rigorous mathematical treatment. Naturally, the very possibility of deriving conjectures from pictures was originally received with scepticism and the extreme difficulty of my conjectures came as a very big surprise. Today the situation is completely different. For example, my $4/3$ conjecture about Brownian motion has inspired a large amount of highly admired purely mathematical work. And the MLC conjecture about the Mandelbrot set -that it is locally connected- has so far resisted all attempts to proof or disproof. All those conjectures can be rephrased in ways everybody can understand and provide the layperson with glimpses of active portions of the frontier.

On top of these questions, Mandelbrot gave a press conference a few days ago in the ICM2006. During the conference he spoke of the relation between art and mathematics “via” fractals. “It’s wonderful to see how both worlds combine, art and mathematics. In a certain sense, it harks back to the nature of human beings, to the forms that human beings have always perceived in nature. Because save for a few exceptions, such as the eye or the moon, forms in nature are rough, not homogeneous or simple. Art has always noticed this. Mathematics on the other hand have always remained isolated and have concentrated on simple figures. I’ve been very lucky to work with the mathematics of roughness. In a certain sense, the circle has been completed; in many cultures the rough



has always been considered art. Then this concept arrived to mathematics and afterwards to other sciences, then back to mathematics again, and finally to art once more through fractal art”.

What is also very significant for Mandelbrot is that the multiple applications of fractals will arrive after their “artistic” uses in fractal geometry. In fact, engineers were a rather late in discovering the uses of fractals, but as soon as they realized it the applications soon followed as an almost natural outcome. “Take antennas, for instance; in many modern devices the antennas are fractal. They are much more efficient. Or take the noise in houses; the walls are very bad, because they reflect noise. So why not make the walls fractal? Now the patents of fractal walls are being used by a very big company. They have a rough texture and the noise is not reflected, it is absorbed. Or take electronics. You can make microcapacitors by folding following a fractal structure. Or take concrete. It is a very important material of course, but most of the concrete in old buildings is very bad. The water goes into it and rusts metallic bars... Concrete is a porous material that you don’t want to be porous. But the thinking for the new concrete is based entirely on the theory of fractal porous materials. It is much stronger and durable. Once the tradition was to think only of smooth shapes, and [by breaking that tradition] fractals are becoming increasingly useful”.

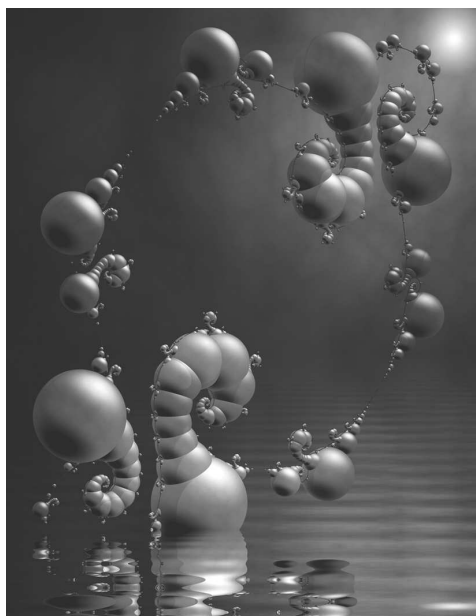
When Mandelbrot turned 80 his friends organised in his honour a conference on practical application of fractals. “It was a beautiful conference, because in almost every field of engineering, if you accept the rough shapes you simply have a greater choice”. Mandelbrot has currently returned to the field where fractal geometry started, financial markets. One of his latest projects has been to apply fractals to models for predicting price behaviour. “The usual theory in price variation, taught in every business school, is that prices follow a random motion; they go up a little bit, then down... but never much, and this process is continuous. But prices are not continuous; prices jump. And price jumps are absolutely essential. My theory takes account of them, and the theory that used to be taught in every business school did not. So I think fractals are very important to understand the evolution of stock markets. Fractal geometry has the tools to represent prize variations realistically, and this is a first.

Fractal Art: Painting with numbers

Equations are a way of describing reality, but some equations can be used the other way round; that is, to generate artificial worlds. Equations describing fractal sets, for example, can give rise to landscapes as fascinating as those depicted in famous canvases. To see it you only have to take a look at the works on display at the Exhibition of Fractal Art, at the ICM2006 International Congress of Mathematicians and at the Centro Cultural Conde Duque in Madrid.

It is not necessary to enter into a complicated mathematical description to get an intuitive grasp of what they are: structures which, “when a small portion is observed, preserve a similar, although not necessarily identical appearance to what they look like when observed in their entirety”, explains Javier Barrallo, fractal artist. Some examples of fractals are: a tree and its branches; a cauliflower, apparently made up of endless cauliflowers joined together; the coastline of a country...

The point of departure to make a fractal artwork is indeed a mathematical formula. The first fractal formulae were described more than a century ago. Today there are hundreds. And, as Barrallo explains, the computer is vital:



“A small image, one of 640 x 480 pixels, for example, contains 307,200 dots that must be calculated. It may be necessary to calculate each one of these dots about 1,000 times by the formula determining the fractal. This means that the formula must be calculated more than 300 million times. And this is just for a small-size image!”. So, armed with both formula and computer, we must now proceed to iteration. This involves “calculating a formula over and over again, starting from its initial value”, says Barrallo. “After calculating the formula for the first time, we take the resulting value and introduce it into the formula. The new result is calculated again, and so on successively”.

In the case of fractals, the initial value has to do with the position of the dot in the frame (the pixel on the screen). Then colours are assigned according to the value of each dot. The fact that the behaviour of two dots situated very close together can be radically different – one diverging toward the infinite and the other converging toward a given value - is “what makes fractal exploration so fascinating”, says Barrallo, and also what leads to the explosion of shapes and colours in the image.

Personal Stories Behind One Hundred Years of the ICM

Two years ago, it occurred to the ICM2006 Organizing Committee to set up an exhibition based on the history of the IMU. Right away, however, I realized that this would be more or less the same as explaining the background of the Social Security Office in Soria; i.e. pretty boring (for people who aren't Spanish). So I decided to tell the story of the ICM instead, but from a graphic and above all human point of view. That's why the exhibition “The ICM through History” is meant to be an account of the ICM as a human endeavour. In fact we use the activities of mathematicians in ICMs as a mirror in which history, culture, technology, fashion and attitudes are reflected.

The background to the exhibition consisted of a quest for the personal stories behind the ICM over the years: Gaston Julia wearing the mask he wore to conceal the wound he sustained in World War I, giving one of the closing addresses of the 1936 ICM in Oslo and telling how his life was saved by a Norwegian nurse in a field hospital; or the 1912 congress visiting Cayley's grave in Mill Road cemetery, Cambridge. How could we tell these stories? We needed pictures for our imagination to feed on, but where could we find these pictures?

This was no easy task. It took more than a year to track some of these images down. We had to unearth them one by one from math departments, libraries, archives, and personal records: all together, more than thirty institutions from between 30 to 40 different countries have made contributions. The result - more than 400 images help the visitor to visualize the journey of ICMs through the turbulent waters of the last one hundred years.

The outer part of the exhibition reviews the ICMs in chronological order from the first congress held in 1897 to the current one in 2006. It consists of a selection of images and texts. On the inside we have a cross-section of the ICM from the point of view of social life in ICMs (excursions, banquets, parties, concerts), graphic design in ICMs, the buildings that have provided the venue for the congress, the history of the International Mathematical Union, and of course the awards: the Fields Medals, and the Nevanlinna and Gauss Prizes. At the end of the ICM2006, the exhibition will travel to Spanish universities and different institutions in Europe.

*Guillermo Curbera,
Curator of the exhibition “The ICM through History”*

The Spanish Face of the Congress

Who's Who on the Executive Committee

The history of the ICMs will not be forgotten; it has its own chronicler, **Guillermo Curbera** (Madrid, 1961). Formerly a student delegate (Madrid 1979 and Sevilla 1985), he is now an associate professor of mathematical analysis at the University of Seville. The objects of his study are function spaces, vectorial measures, operators with kernel and Sobolev spaces. His remarks on the Congress leave no room for doubt: "What I'm most proud about is that it exists". This pride extends to the exhibition he set up after two years of hard work and which has become one of the star events of the Congress: "The ICM Through History". As far as reactions to the Congress are concerned, he says he's happy that for at least once a year mathematicians are in the limelight, "because it's good for the profession and because it can encourage students to take up this science".



The separation between science and letters is just a myth. They are not in the least incompatible. **Antonio Durán** (Córdoba, 1962) provides a proof for this and makes it a theorem. Novelist (among other books, "La luna de nísán", published by Editorial Debate) and professor of mathematical analysis at the University of Seville, is particularly interested in approximation theory and special functions. He has derived many good things from this Congress, but as the Committee member responsible for cultural activities he is especially proud of the results achieved by teamwork. "I feel particularly satisfied by the media coverage given to the Congress, and the general level of public interest about what we're doing here".

Marta Sanz-Solé (Barcelona, 1952) has the whole ICM2006 scientific programme in her head. She is professor of mathematics at the University of Barcelona, a specialist in stochastic analysis and chair of the Local Programme Committee. From the very beginning, her dealings with the invited speakers have been one of the most exciting aspects of her work, because as she says, "you appreciate different characters and their ways of working, and of course it's an honour to deal with so many outstanding mathematicians". She also emphasizes the enthusiasm shown by the participants: "the excellent attendance at the sessions and the positive comments about the programme and the organization are a source of great satisfaction", says Sanz-Solé.



Alberto Ibort (Huesca, 1958) is probably the most versatile member of this group. Not only does he provide the Daily News cartoon, he also stands in as interpreter in the Congress press conferences. And from the mathematical point of view, he is a man for all seasons. Professor of applied mathematics at the Carlos III University of Madrid, he has always tried to adopt a broad view of science, combining theoretical physics with pure and applied mathematics. He is also interested in the relation between computation and pure mathematics, as well as the role that geometry and topology could play in computation. What he likes most about the Congress is the vitality of the mathematical community, something that is reflected in all the events, from sessions "sold out" to the steady stream of exhibition visitors. He is also eager to point out "the interaction with the media, which is both constructive and creative. In this way we can learn from each other and improve".

Highlights of Wendelin Werner's work

The work of Wendelin Werner and his collaborators represents one of the most exciting and fruitful interactions between mathematics and physics in recent times. Werner's research has developed a new conceptual framework for understanding critical phenomena arising in physical systems and has brought new geometric insights that were missing before. The theoretical ideas arising in this work, which combines probability theory and ideas from classical complex analysis, have had an important impact in both mathematics and physics and have potential connections to a wide variety of applications.

A motivation for Wendelin Werner's work is found in statistical physics, where probability theory is used to analyze the large-scale behavior of complex, many-particle systems. A standard example of such a system is that of a gas: Although it would be impossible to know the position of every molecule of air in the room you are sitting in, statistical physics tells you it is extremely unlikely that all the air molecules will end up in one corner of the room. Such systems can exhibit phase transitions that mark a sudden change in their macroscopic behavior. For example, when water is boiled, it undergoes a phase transition from being a liquid to being a gas. Another classical example of a phase transition is the spontaneous magnetization of iron, which depends on temperature. At such phase transition points, the systems can exhibit so-called critical phenomena. They can appear to be random at any scale (and in particular at the macroscopic level) and become "scale-invariant", meaning that their general behavior appears statistically the same at all scales. Such critical phenomena are remarkably complicated and are far from completely understood.

In 1982 physicist Kenneth G. Wilson received the Nobel Prize for his study of critical phenomena, which helped explain "universality": Many different physical systems behave in the same way as they get near critical points. This behavior is described by functions in which a quantity (for instance the difference between the actual temperature and the critical one) is raised to an exponent, called a "critical exponent" of the system. Physicists have conjectured that these exponents are universal in the sense that they depend only on some qualitative features of the system and not on its microscopic details. Although the systems that Wilson was interested in were mainly three- and four-dimensional, the same phenomena also arise in two-dimensional systems.

During the 1980s and 1990s, physicists made big strides in developing conformal field theory, which provides an approach to studying two-dimensional critical phenomena. However, this approach was difficult to understand in a rigorous mathematical way, and it provided no geometric picture of how the systems behaved. One great accomplishment of Wendelin Werner, together with his collaborators Gregory Lawler and Oded Schramm, has been to develop a new approach to critical phenomena in two dimensions that is mathematically rigorous and that provides a direct geometric picture of systems at and near their critical points.

Percolation is a model that captures the basic behaviour of, for example, a gas percolating through a random medium. This medium could be a horizontal network of pipes where, with a certain probability, each pipe is open or blocked. Another example is the behaviour of pollutants in an aquifer. One would like to answer questions such as, What does the set of polluted sites look like? Physicists and mathematicians study schematic models of percolation such as the following. First, imagine a plane tiled with hexagons. A toss of a (possibly biased) coin decides whether a hexagon is colored white or black, so that for any given hexagon the probability that it gets colored black is p and the probability that it gets colored white is then $1 - p$. If we designate one point in the plane as the origin, we can ask, Which parts of the plane are connected to the origin via monochromatic black paths? This set is called the "cluster" containing the origin. If p is smaller than $1/2$, there will be fewer black hexagons than white ones, and the cluster containing the origin will be finite. Conversely, if p is larger than $1/2$, there is a positive chance that the cluster containing the origin is infinite. The system undergoes a phase transition at the critical value $p = 1/2$.

This critical value corresponds to the case where one tosses a fair coin to choose the color for each hexagon. In this case, one can prove that all clusters are finite and that whatever large portion of the lattice one chooses to look at, one will find (with high probability) clusters of size comparable to that portion. The accompanying picture represents a sample of a fairly large cluster.

The percolation model has drawn the interest of theoretical physicists, who used various non-rigorous techniques to predict aspects of its critical behavior. In particular, about fifteen years ago, the physicist John Cardy used conformal field theory to predict some large-scale properties of percolation at its critical point. Werner and his collaborators Lawler and Schramm studied the continuous object that appears when one takes the large-scale limit—that is, when one allows the hexagon size to get smaller and smaller. They derived many of the properties of this object, such as, for instance, the fractal dimension of the boundaries of the clusters. Combined with Stanislav Smirnov's 2001 results on the percolation model and earlier results by Harry Kesten, this work led to a complete derivation of the critical exponents for this particular model.

Another two-dimensional model is planar Brownian motion, which can be viewed as the large-scale limit of the discrete random walk. The discrete random walk describes the trajectory of a particle that chooses at random a new direction at every unit of time. The geometry of planar Brownian paths is quite complicated. In 1982, Benoit Mandelbrot conjectured that the fractal dimension of the outer boundary of the trajectory of a Brownian path (the outer boundary of the blue set in the accompanying picture) is $4/3$. Resolving this conjecture seemed out of reach of classical probabilistic techniques. Lawler, Schramm, and Werner proved this conjecture first by showing that

the outer frontier of Brownian paths and the outer boundaries of the continuous percolation clusters are similar, and then by computing their common dimension using a dynamical construction of the continuous percolation clusters. Using the same strategy, they also derived the values of the closely related “intersection exponents” for Brownian motion and simple random walks that had been conjectured by physicists B. Duplantier and K.-H. Kwon (one of these intersection exponents describes the probability that the paths of two long walkers remain disjoint up to some very large time). Further work of Werner exhibited additional symmetries of these outer boundaries of Brownian loops.

Another result of Wendelin Werner and his co-workers is the proof of the “conformal invariance” of some two-dimensional models. Conformal invariance is a property similar to, but more subtle and more general than, scale invariance and lies at the roots of the definition of the continuous objects that Werner has been studying.

Roughly speaking, one says that a random two-dimensional object is conformally invariant if its distortion by angle-preserving transformations (these are called conformal maps and are basic objects in complex analysis) have the same law as the object itself. The assumption that many critical two-dimensional systems are conformally invariant is one of the starting points of conformal field theory. Smirnov’s above-mentioned result proved conformal invariance for percolation. Werner and his collabora-

tors proved conformal invariance for two classical two-dimensional models, the loop-erased random walk and the closely related uniform spanning tree, and described their scaling limits. A big challenge in this area now is to prove conformal invariance results for other two-dimensional systems.

Mathematicians and physicists had developed very different approaches to understanding two-dimensional critical phenomena. The work of Wendelin Werner has helped to bridge the chasm between these approaches, enriching both fields and opening up fruitful new areas of inquiry. His spectacular work will continue to influence both mathematics and physics in the decades to come.

BIOGRAPHICAL SKETCH

Born in 1968 in Germany, Wendelin Werner is of French nationality. He received his PhD at the University of Paris VI in 1993. He has been professor of mathematics at the University of Paris-Sud in Orsay since 1997. From 2001 to 2006, he was also a member of the Institut Universitaire de France, and since 2005 he has been seconded part-time to the Ecole Normale Supérieure in Paris. Among his distinctions are the Rollo Davidson Prize (1998), the European Mathematical Society Prize (2000), the Fermat Prize (2001), the Jacques Herbrand Prize (2003), the Loève Prize (2005) and the Pólya Prize (2006).

by Allyn Jackson



Daily News (versión en español)

CARLSON: "PERELMAN CUMPLE LOS REQUISITOS PARA EL PREMIO DEL MILENIO"

CAO: "HAMILTON Y PERELMAN SON GRANDES. Y SON NUESTROS HÉROES"

Si quedaba alguna duda sobre quién hizo qué a la hora de demostrar la Conjetura de Poincaré, Huai-Dong Cao la resuelve en esta breve entrevista concedida al Daily News del ICM2006. La siguiente cuestión es: ¿recibirá Grisha Perelman, como muchos han pronosticado, uno de los 'premios del Milenio'? La respuesta podría tenerla Jim Carlson, presidente del Instituto Clay de Matemáticas. Algo que nadie podría responder, sin embargo, es si Perelman aceptará el premio si efectivamente le es concedido.

Entrevista con Jim Carlson

Para que Perelman sea el ganador de uno de los Problemas del Milenio se deben cumplir varios requisitos: que su trabajo se publique y sea revisado por un referee, que pasen dos años desde ese momento y que el Instituto Clay, la institución que elaboró la lista de los problemas dé por válidos esos condicionantes. Jim Carlson, presidente del Instituto Clay de Matemáticas (CMI, en sus siglas en inglés) y uno de los miembros del Comité Científico Asesor de la institución, habla sobre el premio, dotado con un millón de dólares.

¿El Instituto Clay considera que la conjetura de Poincaré está probada?

John Morgan en su conferencia dijo que la conjetura está probada por Grisha Perelman. Déjeme decir que el impresionante avance de Perelman es un evento para una gran celebración. Perelman basa su trabajo en el gigante -Richard Hamilton, en particular- pero él ha ido mucho más allá que cualquiera de nosotros.

¿Quiere decir eso que Perelman será el próximo Premio del Milenio, el galardón otorgado por el Instituto Clay para quien resolviese alguno de los denominados "Problemas del Milenio"?

Las reglas del Instituto dicen que hay que esperar dos años desde que se publique el trabajo y haya una aceptación general por parte de la comunidad matemática. El período durante el cual la totalidad de la comunidad matemática puede examinar estos artículos, ahora disponibles públicamente, es crucial. Solo entonces el Comité Científico tomará una decisión y hará una recomendación a los directores del Instituto.

Que el trabajo de Perelman se haya publicado sólo en Internet, ¿constituye un problema para el Instituto?

La exposición detallada del trabajo de Perelman aparece en los trabajos de Cao-Zhu, Kleiner-Lott y Morgan-Tian y el trabajo de Gérard Besson también se publicará pronto. Estos trabajos, todos revisados por referees o en proceso de ser refutado, son suficientes.

¿Entonces el premio es para Perelman?

Él es el único que ha anunciado la prueba de la conjetura. La decisión de a quién otorgar el premio será tomada en dos años. Hay un procedimiento que seguir para la toma de la decisión: la cita de un grupo de expertos de personas no relacionadas con el Instituto Clay (en su mayoría), la consideración de su informe por parte del Comité Científico y, finalmente, la decisión de los directores del instituto.

¿Cree usted que lo aceptará?

Eso no lo puedo decir: no tengo ni idea. Nosotros procederemos exactamente igual que el ICM cuando le ha premiado con la Medalla Fields. Creo que John Ball y el comité de las medallas Fields lo han hecho perfectamente. Ellos le otorgaron la medalla basándose en sus logros, sin pensar en la posible reacción de Perelman. Si el Instituto Clay decide ofrecerle el Premio del Milenio a Perelman, seguirá la misma filosofía.

El Instituto Clay (Massachusetts, EE.UU.) fue fundado en 1999 por el empresario bostoniano Landon T. Clay. En el año 2000 el CMI anunció la creación de una serie de premios: un millón de dólares para quien resolviese alguno de los siete problemas que el grupo de expertos convocado al efecto proclamó como los "Problemas del milenio", considerados los más importantes y elusivos del inicio del siglo. La lista de los "Problemas del milenio" fue elaborada por el Comité Científico Asesor del CMI, tras consultar a algunos de los más prestigiosos matemáticos de todo el mundo.

Entrevista con Huai-Dong Cao

Usted ha estado en medio de la tormenta mediática que llegó incluso a anunciar que usted había probado finalmente la conjetura de Poincaré. ¿Cómo ha vivido este proceso?

A mí me gustan las matemáticas y me encanta trabajar en fluidos geométricos, en particular el flujo de Ricci. Desafortunadamente la atención de ciertos medios parece haber estado mucho más interesada en hablar de asuntos ajenos a las matemáticas. A mí sólo me preocupa la parte matemática.

La controversia ha estado centrada en 'quién hizo qué'. Por ejemplo, se ha citado al professor Shing-Tung diciendo que Perelman contribuyó a la resolución en menos de un 25%, mientras que usted lo hizo en un 30%. ¿Qué opina al respecto?

En mi trabajo con Zhu detallamos qué ha hecho cada uno. Hamilton y Perelman han realizado los trabajos fundamentales más importantes. ¡Ellos son los gigantes y nuestros heroes! Para mí no hay ninguna duda de que Perelman se merece la Medalla Fields. Nosotros sólo hemos seguido el camino abierto por Hamilton y Perelman y explicamos los detalles. Espero que cualquiera que lea nuestro trabajo esté de acuerdo en que lo hemos planteado de una forma justa.

Desafortunadamente, la prensa ha distorsionado el punto de vista del professor Yau. Por lo que sé, él nunca se asignó ningún porcentaje y no está de acuerdo con ese tipo de distribuciones. Es más; me ha enseñado varios correos electrónicos que envió a periodistas, en

los que dejaba claro su desacuerdo con esas distribuciones. Quisiera también añadir que el profesor Yau siente un enorme respeto por la aportación de Perelman. En más de una ocasión, incluida su conversación con los periodistas del *New Yorker*, dijo que Perelman se merecía la Medalla Fields.

CON VER EL PÓSTER COLGADO Y A GENTE MIRÁNDOLO YA ME SIENTO PREMIADO

Es para mí un gran honor presentar un póster en el International Congress of Mathematicians. Quiero aprovechar esta oportunidad para agradecer al Comité Organizador, y en particular al comité encargado del voluntariado, el habernos brindado esta posibilidad.

Todo empezó cuando, en un curso de doctorado, mis compañeros Pablo Centella Barrio y Elena Gálvez Moreno y yo resolvimos un problema que decidimos enviar a publicar. Acto seguido, nos llegó el e-mail de Emilio Bujalance informándonos a todos los voluntarios de que podíamos dar un short communication o presentar un póster. Ninguno de nosotros había hecho un póster antes (¡creo que ni siquiera sabíamos lo que era!) pero, tras informarnos un poco, decidimos intentarlo. Un póster es simplemente una forma de dar a conocer tus resultados más importantes, sin entrar en detalle, de una manera divertida y vistosa, evitando el mal trago de tener que dar una charla a quienes les suponga un problema hablar en público. En nuestro caso, el resultado es bastante llamativo por algunos dibujos de superficies generadas por ordenador, y porque, por suerte, el gusto artístico de mis compañeros es mejor que el mío. Debo decir que tampoco supuso un trabajo excesivo darle forma al póster. Básicamente (y todos los que hayan hecho pósters lo sabrán) hicimos el clásico copiar y pegar. Pero, en cuanto a maquetación y presentación, sí que estuvimos bastante tiempo decidiendo colores, fondos, cuadros, etc.

Varios meses después, aquí me encuentro, a punto de presentar por primera vez un póster. ¡Y nada más y nada menos que en el ICM! Por supuesto, con la emoción añadida de entrar en concurso. El póster estará colgado desde el día 25 hasta el 29, pero todos tenemos una hora concreta (de 17:00 a 18:00 del sábado 26 en mi caso) en la que tenemos que estar ahí, atendiendo a los interesados y respondiendo preguntas. O recibiendo críticas (espero que no). En principio, no me supone ningún problema. Al menos no hasta que alguien me pregunte algo que no sepa contestar; pero bueno, eso es parte del juego. Sinceramente estoy bastante ilusionado, que no nervioso, con todo esto. Siempre es gratificante ver algo en lo que has invertido bastante trabajo colgado de esa manera y al alcance de todos. Os invito a todos a pasaros a ver nuestro póster "Tetraharmonic Bézier surfaces" y, por supuesto, los de todos los demás participantes. Estoy convencido de que el nivel de los pósters en ICM no nos defraudará a ninguno. Por último, quiero dar mi más sincera enhorabuena a los ganadores del concurso. Y nada más, a seguir disfrutando del congreso.

*Raúl Oset Sinha, Alumno de doctorado en la
Universitat de València, Voluntario del ICM*

ARTE FRACTAL

Las ecuaciones son una manera de describir la realidad, pero algunas ecuaciones pueden usarse como generadoras de mundos artificiales. De las ecuaciones que describen conjuntos fractales, por ejemplo, pueden emanar paisajes tan sugerentes como los creados por el mejor de los pinceles. La mejor prueba: la Exposición de Arte Fractal del Congreso Internacional del Matemáticos ICM2006, que se puede ver la sede del ICM2006 y en el Centro Cultural Conde Duque (Madrid). Muchas de las obras expuestas proceden del Concurso Internacional de Arte Fractal ICM2006 Benoit Mandelbrot, considerado el padre del arte fractal.

No hace falta recurrir a una descripción matemática - bastante compleja- de lo que son los fractales. Para tener una idea intuitiva bastaría decir que son estructuras que "al ser observadas en una pequeña porción mantienen un aspecto similar, aunque no necesariamente idéntico, al que presentan al ser observadas de forma completa", explica Javier Barrallo, artista fractal. Algunos ejemplos: un árbol, con sus ramas; una coliflor, aparentemente formada por un sinfín de minicoliflores unidas; el litoral de un país... El ejemplo de la línea de costa sirve para explicar otra de las propiedades de los fractales, el hecho de que por mucho que disminuya la escala a la que son observados -por mucho que se haga 'zoom' en ellos-- siempre mantendrán el mismo aspecto, hasta el infinito. Aunque el litoral de un país no es, obviamente, infinito -los fractales 'auténticos' son una idealización matemática--, el efecto del fenómeno fractal se puede apreciar en la 'paradoja de la costa', que sí es del todo real. Al medir una costa, o cualquier superficie rugosa, el resultado variará en función de la precisión a que se aspire: si se tiene en cuenta el contorno de las bahías, de las rocas, de los granos de arena... la costa será teóricamente más y más larga, y en un fractal ideal llegaría a hacerse infinita.

Cada fractal parte de una fórmula matemática -las primeras fórmulas fractales fueron descritas hace más de un siglo; hoy hay centenares-. Y el ordenador es indispensable, como explica Barrallo: "Una pequeña imagen, por ejemplo de 640x480 píxeles, contiene 307.200 puntos que deben ser calculados. Cada uno de estos puntos puede requerir ser calculado por la fórmula que determina el fractal unas 1.000 veces. Es decir, cada fórmula ha de ser calculada más de 300 millones de veces. Una vez armados de fórmula y computadora, hay que recurrir a la iteración. Se trata de "calcular una fórmula repetidas veces a partir de un valor inicial. Una vez calculada la fórmula por primera vez, tomamos el valor resultante y volvemos a introducirlo en la fórmula. El nuevo resultado se vuelve a calcular y así sucesivamente", dice Barrallo. En el caso de los fractales el valor inicial tiene que ver con la posición del punto en el plano (el píxel en la pantalla). Luego se asignan colores en función del valor de cada punto. El hecho de que el comportamiento de dos puntos muy próximos pueda ser radicalmente opuesto -uno divergiendo hacia el infinito y otro convergiendo hacia un valor dado- es "lo que hace fascinante la exploración fractal", dice Barrallo. Y también lo que permite la espléndida explosión de formas y colores en la imagen.

QUIÉN ES QUIÉN EN EL COMITÉ EJECUTIVO ESPAÑOL

- La separación de ciencias y letras es puro mito. No son incompatibles. **Antonio Durán** (Córdoba, 1962) lo demuestra y lo hace teorema. Escritor (La luna de nisán, Editorial Debate, entre otras novelas) y catedrático de análisis matemático de la Universidad de Sevilla, tiene como intereses de estudio la teoría de aproximación y funciones especiales. De este Congreso extrae muchas cosas buenas, pero se enorgullece en particular, desde su cargo como vocal de actividades culturales del Comité, del resultado obtenido, fruto del trabajo del equipo. "Me siento especialmente satisfecho de la acogida que los medios han dado al Congreso y el interés del público en general por lo que hacíamos en él".

- Tiene en la cabeza el programa científico del ICM2006. **Marta Sanz-Solé** (Barcelona, 1952) es catedrática de matemáticas en la Universidad de Barcelona. Especialista en análisis estocástico y presidenta del comité local de Programa. Desde que comenzó, lo más emocionante ha sido el trato con los conferenciantes e invitados porque, dice, "se aprecian las diferentes maneras de trabajar, los caracteres y, además, es un honor tratar con tantos matemáticos de prestigio", comenta. También subraya el entusiasmo por parte de los participantes, "la alta asistencia a las sesiones y los comentarios positivos sobre el programa y la organización me llenan de satisfacción".

- La historia de los ICM no caerá en el olvido: tiene un cronista, **Guillermo Curbera** (Madrid, 1961). Fue delegado estudiantil (Madrid 1979 y Sevilla 1985) y actualmente es profesor titular de análisis matemático en la Universidad de Sevilla. Su objeto de estudio son los espacios de funciones, medidas vectoriales, operadores con núcleo y espacios de Sobolev. Cuando habla del Congreso es rotundo: "Lo que más me enorgullece es que exista". El orgullo se extiende a la exposición que ha montado tras dos años de intenso trabajo y que es una de las estrellas del Congreso, El ICM a través de la Historia. Respecto a la repercusión del evento, señala que está contento de que, por una vez al año, los matemáticos sean los protagonistas, "porque es bueno para la profesión y porque puede animar a los estudiantes a acercarse a esta ciencia".

- Es, probablemente, el más polifacético del grupo. No sólo aporta su toque de humor gráfico al Daily News; también, si es preciso, hace traductor en las ruedas de prensa del Congreso. Y, desde el punto de vista matemático, **Alberto Ibort** (Huesca, 1958) es, simplemente, un todoterreno. Catedrático de matemática aplicada de la Universidad Carlos III de Madrid, siempre ha intentado tener una visión amplia de la ciencia y por ello ha combinado la física teórica con la matemática pura y aplicada. Entre sus intereses se cuentan la relación entre la computación y la matemática pura, además del papel que juega o puede jugar la geometría y la topología en la computación. Lo que más le gusta del Congreso es la vitalidad de la comunidad matemática,

que se refleja en todos los eventos, sesiones repletas, visitantes continuos a las exposiciones... Resalta también "la interacción que se está produciendo con los medios, que es constructiva y creativa. Así, aprendemos unos de otros y mejoramos".

ASPECTOS DESTACADOS DEL TRABAJO DE WERNER

El trabajo de Wendelin Werner y sus colaboradores representa una de las interacciones más emocionantes y fructíferas entre las matemáticas y la física de los últimos tiempos. La investigación de Werner ha desarrollado un nuevo marco conceptual para entender fenómenos críticos de sistemas físicos, y ha puesto en evidencia nuevos aspectos geométricos antes desconocidos. Las ideas teóricas que emergen en este trabajo, que combina teoría de la probabilidad e ideas de análisis complejo clásico, han tenido un gran impacto tanto en matemáticas como en física, y tienen conexiones potenciales con una amplia variedad de aplicaciones.

Una de las motivaciones del trabajo de Wendelin Werner es la física estadística, área en que la teoría de probabilidad es usada para analizar el comportamiento a gran escala de sistemas complejos, integrados por muchas partículas. Un ejemplo tipo de un sistema complejo es el de un gas: aunque sería imposible conocer la posición de cada molécula de aire en una habitación, la física estadística dice que es muy improbable que todas las moléculas acaben en un rincón de la habitación. Estos sistemas pueden mostrar transiciones de fase que marcan un cambio repentino en su comportamiento microscópico. Por ejemplo, cuando el agua hierve se produce una transición de fase de líquido a gas. Otro ejemplo clásico de transición de fase es la magnetización espontánea del hierro, que depende de la temperatura. En estos puntos de transición de fase el sistema puede exhibir los llamados 'fenómenos críticos'. Pueden parecer aleatorios a cualquier escala (y en particular a nivel microscópico), y se convierten en "invariantes de escala", lo que significa que su comportamiento general aparenta ser estadísticamente el mismo a cualquier escala. Estos fenómenos críticos son muy complejos, y aún se está lejos de entenderlos completamente.

En 1982 el físico Kenneth G. Wilson recibió el premio Nobel por sus estudios sobre los fenómenos críticos, que contribuyeron a comprender la 'universalidad'. Muchos sistemas físicos diferentes se comportan de la misma manera a medida que se acercan a los puntos críticos. Este comportamiento está descrito por funciones en las que una cantidad (por ejemplo la diferencia entre la temperatura real y la crítica) es elevada a un exponente, llamado un "exponente crítico" del sistema. Los físicos han conjeturado que estos exponentes son universales en el sentido de que dependen sólo de determinadas características cualitativas del sistema, y no de sus detalles microscópicos. Aunque los sistemas en que Wilson estaba interesado eran sobre todo de tres y cuatro dimensiones, en dos dimensiones se da el mismo fenómeno. Durante los años ochenta y noventa los físicos hicieron grandes esfuerzos por desarrollar la teoría conforme de campos, que proporciona una aproximación al estudio de los fenómenos críticos de dos dimensiones. Pero esta

aproximación era difícil de entender de una manera matemática rigurosa, y no proporcionaba una imagen geométrica de cómo se comportaban los sistemas. Un gran logro de Werner y sus colaboradores Gregory Lawler y Oded Schramm ha sido el desarrollo de una nueva aproximación a los fenómenos críticos de dos dimensiones matemáticamente riguroso y que proporciona una imagen geométrica directa de sistemas cerca de, y en, sus puntos críticos.

La percolación es un modelo que capta el comportamiento básico de, por ejemplo, un gas filtrándose a través de un medio aleatorio. Este medio podría ser una red horizontal de tuberías en las que, con una cierta probabilidad, cada tubería está abierta o bloqueada. Otro ejemplo es el comportamiento de contaminantes en un acuífero. Uno quisiera responder a cuestiones como ¿qué aspecto tiene el conjunto de sitios contaminados? Los físicos y los matemáticos estudian modelos esquemáticos de percolación como el siguiente. Primero, imagine un plano cubierto de losetas hexagonales. Con una moneda (posiblemente trucada) lanzada al aire se decide si un hexágono es blanco o negro, de forma que para cualquier hexágono dado, la probabilidad de ser de color negro es 'p' y la probabilidad de ser de color blanco es '1 - p'. Si designamos un punto en el plano como el origen, podemos preguntar, ¿Qué partes del plano están conectadas al origen por una franja de hexágonos negra? Este conjunto se denomina 'cluster' que contiene el origen. Si p es menor que $\frac{1}{2}$, habrá menos hexágonos negros que blancos, y el cluster que contiene el origen será finito. Por el contrario, si p es mayor que $\frac{1}{2}$ hay una probabilidad positiva de que el cluster que contiene el origen sea infinito.

El sistema presenta una transición de fase en el valor crítico $p = 1/2$. Este valor crítico corresponde a la situación en la que uno lanza una moneda no trucada para escoger el color de cada hexágono. En este caso se puede probar que todos los clusters son finitos y que en cualquier porción de la superficie que uno escoja mirar encontrará, con gran probabilidad, clusters de tamaño comparable a dicha porción. La imagen adjunta representa una muestra de un cluster bastante grande.

El modelo de percolación ha atraído el interés de los físicos teóricos, que han usado varias técnicas no rigurosas para predecir aspectos de su comportamiento crítico. En particular, hace unos quince años, el físico John Cardy usó la teoría conforme de campos para predecir algunas propiedades a gran escala de percolación en su punto crítico. Werner y sus colaboradores Lawler y Schramm estudiaron los objetos continuos que aparecen cuando se toma el límite de gran escala -esto es, cuando se permite que el tamaño de los hexágonos sea más y más pequeño-. Obtuvieron muchas de las propiedades de estos objetos, como por ejemplo la dimensión fractal de los bordes de los clusters. Este trabajo, combinado con los resultados de Stanislav Smirnov en 2001 sobre el modelo de percolación y con trabajos anteriores de Harry Kesten, condujo a la obtención completa de los exponentes críticos de este modelo particular.

Otro modelo de dos dimensiones es el movimiento browniano en el plano, que puede ser visto como el límite a gran escala del paseo aleatorio discreto. El paseo

aleatorio discreto describe la trayectoria de una partícula que escoge aleatoriamente una nueva dirección en cada unidad de tiempo. La geometría de las trayectorias del movimiento browniano en el plano es bastante complicada. En 1982 Benoit Mandelbrot conjeturó que la dimensión fractal de la frontera exterior de la trayectoria de un movimiento browniano en el plano (la frontera exterior del conjunto azul en la imagen adjunta) es $4/3$. Resolver esta conjetura parecía fuera del alcance de las técnicas probabilísticas clásicas. Lawler, Schramm, y Werner la demostraron probando en primer lugar que la frontera exterior de las trayectorias brownianas y las fronteras exteriores de los clusters de percolación continuos son similares; después calcularon su dimensión común usando una construcción dinámica de los clusters de percolación continuos. Con la misma estrategia también obtuvieron los valores de los muy relacionados 'exponentes de intersección' para el movimiento browniano y el paseo aleatorio discreto, que habían sido conjeturados por los físicos B. Duplantier y K.-H. Kwon (uno de estos exponentes de intersección describe la probabilidad de que las trayectorias de dos caminantes no se crucen durante un largo periodo de tiempo). Otro trabajo posterior de Werner mostró simetrías adicionales de estas fronteras exteriores de los bucles brownianos.

Otro resultado de Wendelin Werner y de sus colaboradores es la demostración de la "invariancia conforme" de algunos modelos de dos dimensiones. La invariancia conforme es una propiedad parecida a la invariancia de escala, aunque más sutil y general. Está en la raíz de la definición de los objetos continuos que Werner ha estado estudiando. Sin precisar demasiado, se dice que un objeto aleatorio bi-dimensional es un invariante conforme si su distorsión por transformaciones que preservan el ángulo, es decir, por las transformaciones que en el análisis complejo se denominan aplicaciones conformes, tiene la misma ley de probabilidad que el objeto inicial.

Suponer que muchos sistemas críticos de dos dimensiones son invariantes conformes es uno de los puntos de partida de la teoría conforme de campos. El resultado de Smirnov mencionado anteriormente demostró la invariancia conforme para la percolación. Werner y sus colaboradores demostraron la invariancia conforme para dos modelos clásicos de dos dimensiones, el paseo aleatorio con bucles suprimidos (en inglés, loop-erased random walk) y el modelo relacionado con el mismo denominado árbol de expansión uniforme (en inglés uniform spanning tree), y describieron su comportamiento límite normalizado. Uno de los grandes desafíos actuales en esta área es demostrar la invariancia conforme para otros sistemas de dos dimensiones.

Los matemáticos y los físicos han desarrollado abordajes muy distintos para entender los fenómenos críticos de dos dimensiones. El trabajo de Wendelin Werner ha contribuido a reducir la brecha entre estas estrategias, enriqueciendo ambos campos y abriendo nuevas y fructíferas áreas de investigación. Su espectacular trabajo seguirá influenciando tanto las matemáticas como la física en las décadas venideras.

Allyn Jackson

ICM 2006

Daily News

Madrid, August 29th 2006

PROGRAMME CHANGES AND NOTES OF INTEREST

NOTES OF INTEREST

The lectures by A. Okounkov and W. Werner (Section 13) and J. Kleinberg (Section 15) have been rescheduled as Prize Winner lectures and therefore cancelled as invited section.

TUE 29, 14:00-14:45 IL A,

Lecture by a Fields Medalist

Andrei Okounkov, Princeton Univ., Princeton, USA

Enumerative geometry of curves in threefolds

Chair: Percy Deift

TUE 29, 15:00-15:45 Andrei Okounkov, (Cancelled)

TUE 29, 15:00-15:45 Jon M. Kleinberg, (Cancelled)

TUE 29, 16:00-16:45 Wendelin Werner, (Cancelled)

SHORT COMMUNICATIONS (new)

TUE 29, 15:35-15:55 SC 08 L401

Mikhail Korobkov, Sobolev Institute of Mathematics, Novosibirsk, Russia Federation

On a Sard type theorem for C^1 -smooth functions of two variables

Chair: Hélène Airault

TUE 29, 16:55-17:15 SC 08 L401

Mingzhe Gao, Normal College of Jishou University, Jishou, China

A new Hardy-Hilbert's type inequality for double series and its application

TUE 29, 17:35-17:55 SC 16 R403

Emil Catinas, "T. Popoviciu" Institute of Numerical Analysis, Cluj-Napoca, Romania

New results in local convergence of iterative methods for nonlinear systems and fixed point problems

Chair: Sergio Amat

SHORT COMMUNICATIONS (cancelled)

TUE 29, 16:05-16:25 SC 08 L401

Andrei Pokrovskii, Institute of Mathematics of the National Academy of Sciences of Ukraine, Kiev, Ukraine

Strong unicity in uniform approximations with a sign-sensitive weight

Chair: Dragan Vukotic

TUE 29, 16:05-16:25 SC 16 R403

Mauricio Andrés Barrientos Barría, University of Antofagasta, Antofagasta, Chile

Convergence of adaptive FEM-BEM for linear exterior problems via DtN mappings

Chair: Juan M. Viaño

SHORT COMMUNICATIONS (changes respect to the printed program)

TUE 29 15:35-15:55 SC 06 R204, Agostino Prastaro à rescheduled WED 30, 17:35-17:55 R204

TUE 29 16:05-16:25 SC 04 R103, Brend Kreussler (already done)

TUE 29 16:05-16:25 SC 06 R203, Takashi Tsuboi (already done)

TUE 29 16:55-17:15 SC 08 L402, Manav Das (already done)

ANNOUNCEMENTS

Tuesday, August 29, 13:00-13:45, Auditorium B

Prize Winners of the Poster Competition at the ICM 2006

In an informal ceremony, the jury of the competition will make public its decision on the names of the prize winners in each scientific section. Awardees will receive their diplomas and monetary prize.

INFORMAL SEMINARS 29TH AUGUST

16:00 – 16:40 *Computation of connection coefficients*, Room L205

Mijiddorj. R., Departement of Programming, Mongolian State University of Education, r_mjddrj@yahoo.com

SUMMARY: based on some properties of connection coefficients we propose an algorithm for calculation one, two and three-factor connection coefficients.

Asymptotical formulas for one and two factor connection coefficients were also presented. These are illustrated with numerical examples.

18:00 – 18:40 *Solving Logic Problems using some Symbolic Dynamics*, Room L205

Paseman Gerhard, Sunwave Communications (USA), grpadmin@sunwave.com

SUMMARY: Certain second-order statements (hyperidentities) can be represented as first order theories T. Sometimes T is equivalent to a finite theory U. We show how Symbolic Dynamics answers when there is a logical equivalence, and ask if Symbolic Dynamics can help settle some conjectures related to computability of these equivalences.

OPENING OF KEIZO USHIO'S SCULPTURE

Tuesday 29th at 16:00 at the main entrance of the Palacio Municipal de Congressos.