bois-marie

INSTITUT DES HAUTES ÉTUDES SCIENTIFIQUES

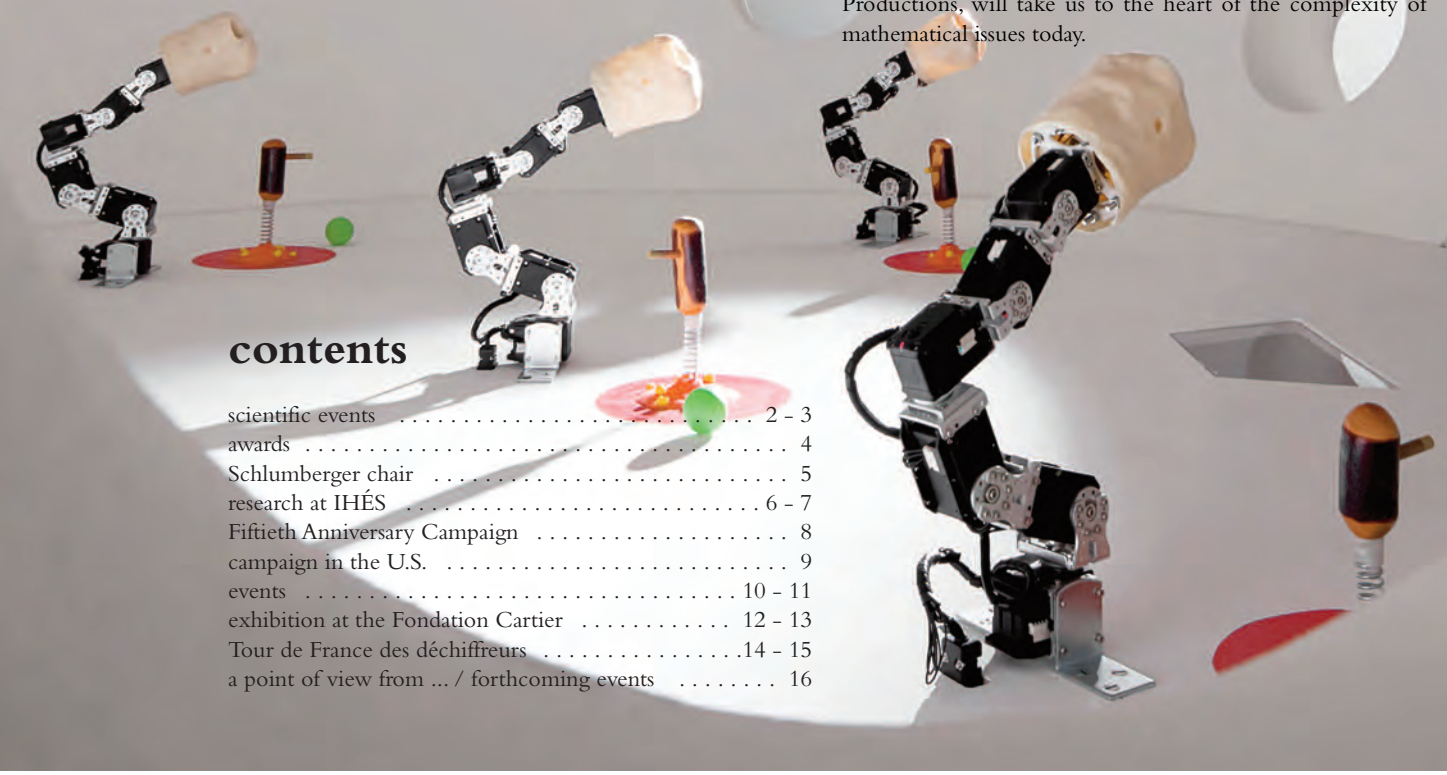
editorial

Not so long ago, opening mathematics to everyone was a challenge that felt very daunting. This science fascinates us as much as it scares us, sitting as it does at the intersection of so many paths we walk down every day: technological progress, philosophical enquiry, educational strategies. This fascination and fright can be explained by the fact that mathematics challenges us, throwing back to us our lack of understanding of the world around us. However, mathematics is very much with us, very real and present everywhere, so closely woven in the fabric of our daily life that we don't notice it. Lying in wait in its abstraction, its very first rampart of defence, it does not reveal itself easily and its beauty is only known by mathematicians.

And yet, it was the wish of the mathematical community to gain increased exposure and esteem. The *Mathematics, A Beautiful Elsewhere* exhibition, at the Fondation Cartier pour l'art contemporain offered a wonderful showcase and timeframe for this. IHÉS very much hopes that this unprecedented venture in the history of mathematics, which attracted over 80 000 visitors, will prompt other initiatives with a similar scope, to help the general public dare look at mathematics without fear and with pleasure.

IHÉS has been carrying out a complementary project since September 2011, aimed at high school and university students. The *Tour de France des déchiffreurs* has travelled in approximately twenty French towns; thousands of people have been able to discover fundamental research in mathematics and theoretical physicists from a fresh perspective. A more modest undertaking in terms of resources, it was also a great success. Because the general public is obviously curious about mathematics, IHÉS will continue its efforts to try and inspire young people and to firmly establish the presence of fundamental research in the public sphere.

Two projects in this vein are underway. The celebrations marking the centenary of Henri Poincaré's passing, coordinated by the Institut Henri Poincaré, will take place this autumn. A documentary film for general release in 2013, directed by Olivier Peyon and produced by Haut et Court and Zadig Productions, will take us to the heart of the complexity of mathematical issues today.



© Ergo-Robots: artificial curiosity and language - View of the exhibition Mathematics, A Beautiful Elsewhere, from 21 October 2011 to 18 March 2012 at the Fondation Cartier pour l'art contemporain, Paris. - Photo Pierre-Yves Dinasquet

contents

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scientific events

gravitation

From 6 October 2011 to 15 March 2012, Thibault Damour (IHÉS), Cedric Deffayet (APC) and Pierre Vanhove (CEA-Saclay IPhT & IHÉS) organised eight seminar sessions on the theoretical and experimental aspects of gravitation.

Évariste Galois

A conference on *Differential Equations and Galois Theory* was organised from 17 to 21 October 2011 at IHÉS to present the significant results of the past few years in this field.

wall crossing

From 10 to 12 November 2011, Maxim Kontsevich (IHÉS) and Andrew Neitzke (UT Austin) made a series of presentations on wall crossing, a relatively recent phenomenon that appears in several areas, such as homological algebra, combinatorics, differential geometry and complex analysis.

Publications mathématiques de l'IHÉS

A new *Rencontre autour des Publications Mathématiques de l'IHÉS* was organised on 20 January 2012, after a first such event in 2011, by Claire Voisin, managing editor of Les Publications Mathématiques de l'IHÉS.

Laurent Schwartz seminar

For the second year running, F. Merle (Univ. of Cergy-Pontoise & IHÉS) and F. Golse (École polytechnique) jointly organised the Laurent Schwartz Seminar on the subject of *Partial Differential Equations and Applications*. The seminar took place over a day, comprising 3 or 4 presentations, and generally saw specialists on the subject meeting together once a month, at the École polytechnique or at IHÉS.

physics seminar

From 6 February to 26 March 26, 2012, David Ruelle (IHÉS) and Hans Henrik Rugh (Univ. Paris-Sud) organised a seminar, with seven presentations on *Dynamical Systems and Nonequilibrium Statistical Mechanics*.

$7^{1/2}$ symposium in honour of **Yuri Manin**

$7^{1/2}$, a symposium organised by Ivan Penkov (Jacobs University, Bremen) took place at IHÉS on 5, 6 and 7 March 2012. The event was in honour of mathematician Yuri I. Manin, Professor at the Max Planck Institute in Bonn and former member of the IHÉS Scientific Council, and the symposium was held on the occasion of his 75th birthday.

With the idea of recreating the atmosphere of the Manin seminar in Moscow (1984-1986), the four speakers were each invited to give a lecture, consisting of two 75 minute sessions. The lectures were given by Alexander Beilinson (University of Chicago), Vladimir Drinfeld (University of Chicago), Mikhail Kapranov (Yale University) and Maxim Kontsevich (IHÉS).

"The meeting in honour of Yuri Manin was a tribute by Russian mathematicians to a Russian mathematician. The range of different ways to practice and share mathematics was dazzling. Vladimir Drinfeld showed the importance of exchanging ideas to make successive simplifications and improve a demonstration. Mikhail Kapranov highlighted the need for a geometric vision in formulating and solving problems of a very algebraic nature, a vision that enables the manipulation of complicated combinatorics. Finally, Maxim Kontsevich shared his brilliant insights and the amazing way he always has of reading certain mathematical formulas."

Claude Sabbah,
professor, École polytechnique

Yuri Manin, Jean-Pierre Serre

courses in **Arithmetics and Algebraic Geometry** at IHÉS

Interview with Ahmed Abbes, research director at CNRS, long term CNRS visitor at IHÉS since 1 May 2011. Ahmed Abbes is a mathematician, specialised in arithmetic geometry.

You are the person who already has several conferences to his credit and is also behind a particular initiative: Courses in Arithmetics and Algebraic Geometry. Why did you choose this approach?

During the 1960s, IHÉS witnessed a revolution in algebraic geometry, led by Alexander Grothendieck, who did much to establish the Institute's international reputation. The foundations of this new theory were developed by Grothendieck and his students over ten years or so in his famous *Séminaire de Géométrie Algébrique du Bois-Marie*. These presentations were then published in a collection of papers (known by the acronym SGA) which remains to this day the « bible » for this topic. This foundational period was extended with Pierre Deligne continuing the tradition of the seminar, by presenting some of the most elegant and profound results in arithmetic and algebraic geometry (Weil conjecture, Hodge theory, Galois representations and modular forms ...). The new series of courses in arithmetics and algebraic geometry, which I am currently co-organising with Christophe Breuil and Laurent Lafforgue, aims to revive the tradition of an in-depth seminar on important topics. The courses are likely to enhance the attractiveness and influence of IHÉS.

There is an abundant supply of generalist or thematic seminars in the Paris area at the moment. Because of their format, these seminars only give a brief presentation of new results, without exploring the new ideas and theories that gave rise to them. We did not think it useful to create another seminar, preferring a longer format (8 to 12 hours). This allows listeners to discover recent or ongoing work in arithmetic geometry, which provides them with significant advances in their subjects or new insight into established results. The success of the first two courses taught by Peter Scholze (*Perfectoid Spaces and the Weight-Monodromy Conjecture*, October and November 2011) and Kim Minhyong (*Fundamental Groups, Non-Abelian Cohomology and Diophantine Geometry*, February 2012) shows that this format meets a real need. The courses are filmed and videos and notes are made available on the IHÉS website, in order to benefit the greatest number possible.

Peter Scholze

You love Japan and you run the Paris-Tokyo Arithmetic Geometry Seminar. How did this come about? Do you have any other projects involving Japan?

The idea came to me during an extended stay at the University of Tokyo (Todai) in 2008. Over the past ten years, I have been working extensively with Takeshi Saito at Todai on arithmetic geometry ramification. This has given me the opportunity to discover this wonderful country and has, more importantly, enabled me to establish relationships of trust and friendship with my Japanese colleagues, primarily with Takeshi Saito. The pleasure of a scientific collaboration is so much greater with friends. We had the opportunity to jointly organise three conferences, two in France and one in Japan. But we thought it helpful to maintain more regular contact. Todai accepted the idea straight away. In 2008, the university already had the necessary equipment for conducting video-seminars.

I then spoke of the project to IHÉS, where it was welcomed with enthusiasm. IHÉS equipped itself with a videoconferencing system in 2010. Since then, the seminar has usually been held once a month. Speakers are alternately from IHÉS and Todai, and their presentation is transmitted simultaneously by video to the other institute. The audience is able to interact directly with the speaker, which is the whole point of this new technology.

The French school of arithmetic geometry has kept close links with the Japanese school since the 1970s. These were initially developed by Michel Raynaud and Tetsuji Shioda, then by Luc Illusie and Kazuya Kato. With Takeshi Saito, we hope to carry on this tradition for the benefit of both schools. Our next project is the joint *Arithmetic Geometry Week* in Tokyo to be held from 4 to 8 June 2012.

Toby Gee

⋆ Courses in arithmetic and algebraic geometry are jointly organised by the Fondation mathématique Jacques Hadamard and IHÉS. For more information, visit www.ihes.fr/ abbes ~ / CAGA / caga.html

⋆ Paris-Tokyo Arithmetic Geometry Seminar www.ihes.fr/ abbes ~ / SGA / suron-kika.html

⋆ Arithmetic Geometry Week in Tokyo www.ms.u-tokyo.ac.jp/ tsaito ~ / conf / agwtodai / agwtodai.html

Jean-Pierre Bourguignon, Doctor Honoris Causa of Nankai University

Jean-Pierre Bourguignon, CNRS research director, and IHÉS director since 1994, was made Doctor Honoris Causa of Nankai University in recognition of the key role he played in bringing the French and Chinese scientific communities closer together. The award ceremony took place on 24 October 2011, during the celebrations marking the centenary of Shiing Shen Chern's birth. Nankai University is the second Asian university, after Keio University, to award Jean-Pierre Bourguignon an honorary doctorate, a mark of his strong commitment to promoting scientific exchanges with Asia.

Jean-Pierre Bourguignon, Zihe Rao, President of Nankai University

George Papanicolaou, Doctor Honoris Causa of Université Paris Diderot

George Papanicolaou, professor at Stanford University, was one of the first two holders of the Schlumberger Chair for mathematical sciences at IHÉS and, in that capacity, was a visiting researcher at the Institute from September to December 2010. In December 2011, he was awarded an honorary doctorate from Université Paris Diderot. To mark the occasion, the Laboratoire de Probabilités et Modèles Aléatoires and the Laboratoire Jacques-Louis Lions organised two half-days of scientific presentations in his honour.

Maxim Kontsevich, 2012 Shaw Prize

Maxim Kontsevich, permanent professor at IHÉS, holder of the AXA-IHÉS Mathematics Chair, has been awarded the 2012 Shaw Prize.

This prize, created by Mr Run Run Shaw in November 2002, rewards scientists who have made significant breakthroughs in academic and scientific research or application, and whose work has resulted in a positive and profound impact on mankind.

The Shaw Prize consists of three annual prizes: Astronomy, Life Sciences and Mathematical Sciences. Maxim Kontsevich is the first French mathematician to have received this prestigious award.

Maxim Kontsevich

Cécile DeWitt-Morette, officer of the Legion of honor

It was standing room only in the lecture theatre of the Marilyn and James Simons Conference Centre on 18 November 2011: Yvonne Choquet-Bruhat bestowed the insignia of Officer of the Legion of Honour on Cécile DeWitt-Morette, and a large number of people had come to congratulate her personally.

Cécile DeWitt-Morette

They included family members, colleagues and friends, as well as the entire IHÉS staff. Yvonne Choquet Bruhat's speech was a testimony to the longstanding friendship between these two outstanding physicists. Cécile DeWitt-Morette's very warm speech was also highly appreciated.

Ofer Gabber, Thérèse Gautier Prize

Ofer Gabber, Centre national de la recherche scientifique (CNRS) research director was the winner of the 2011 Thérèse Gautier Prize, which is awarded by the Académie des Sciences de Paris. Ofer Gabber has been a CNRS visitor at IHÉS for many years. He contributes to various aspects of algebraic geometry. The 2011 Thérèse Gautier Prize recognises especially *"his fundamental research in algebraic geometry"* and also his contribution *"to the work of many mathematicians around the world, a contribution which is discreet and often not recognised."*

Source : Académie des Sciences de Paris

Ofer Gabber

Schlumberger chair

Joakim Andén, Stéphane Mallat

Stéphane Mallat, professor, École polytechnique, is the holder of the Schlumberger Chair for Mathematical Sciences at IHÉS since September 2011. He succeeds Josselin Garnier, Université Paris VII and George Papanicolaou, Stanford University, who held the Chair from September 2010 to February 2011.

The amount of digital information acquired each year will soon reach the astronomical figure of one zettabyte, or 10 to the power of 21. Analysing the information contained in these sounds, images and videos requires the development of automatic classification algorithms. Applications are extensive, and include speech, music and image recognition, multimedia search engines, oil exploration, medical diagnostics, robotics... A major difficulty is to establish distances between signals – which reflect the similarity of the information they contain – in order to classify them. To achieve this, we need to construct invariant representations, especially in relation to the action of groups that leave these classes invariant. A simple example is the recognition of handwritten numerals, like those shown in Figure 1. The numeral 2 is recognised as such, even if its position changes or if it is not too deformed. Because translation does not affect the class of an image, its representation should be translation invariant. In addition, this representation must be continuous with respect to deformations and thus to the action of diffeomorphism. Finally, the representation must keep sufficient information to discriminate between different numerals. These properties are not satisfied by classical invariants, such as the Fourier transform modulus or canonical invariants. At IHÉS, Stéphane Mallat is studying class groups of invariants, which are stable under the action of diffeomorphism [3]. These invariants are calculated by wavelet transforms iterated over multiple paths, as in a nonlinear scattering process. In collaboration with doctoral students, he is developing applications for the classification of images and sounds. Joan Bruna has introduced state of the art algorithms for the classification of handwritten numerals and visual texture discrimination [3]. In the case of textures, the idea is to build representations of stationary processes. Geophysical applications are studied in collaboration with Michael Glinsky, a visitor at IHÉS. Joakim Andén [1] is working on auditory perception, which involves translation invariants, and also frequency transposition invariants. When signal classes are very complex, however, it is necessary to step outside the structured framework of groups, to build invariant manifolds, an issue that Laurent Sifre is addressing. Reconstructing a function from the modulus of its Fourier transform is a classic problem of harmonic analysis, which is unstable. The generalisation of the inverse problem is being studied by Irene Waldspurger for transforms other than Fourier, particularly those related to the wavelet transform.

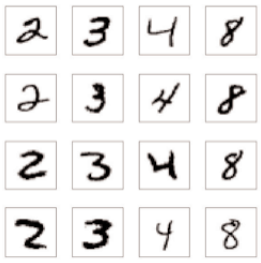


Figure 1: A handwritten number remains recognisable regardless of its position, even if it is slightly deformed. These properties are captured by representations which are translation invariant and stable to deformations.

Representation problems for classification are directly related to the modelling of neural processes for visual and auditory perception. Researchers in the neurophysiology of hearing, signal processing, mathematics and resarchers from industry will come to IHÉS for a Schlumberger conference to take place on 14 and June 15. The aim is to explore the interfaces between the neurophysiological models of auditory perception and the mathematical tools and algorithms developed for processing sounds.

Stéphane Mallat

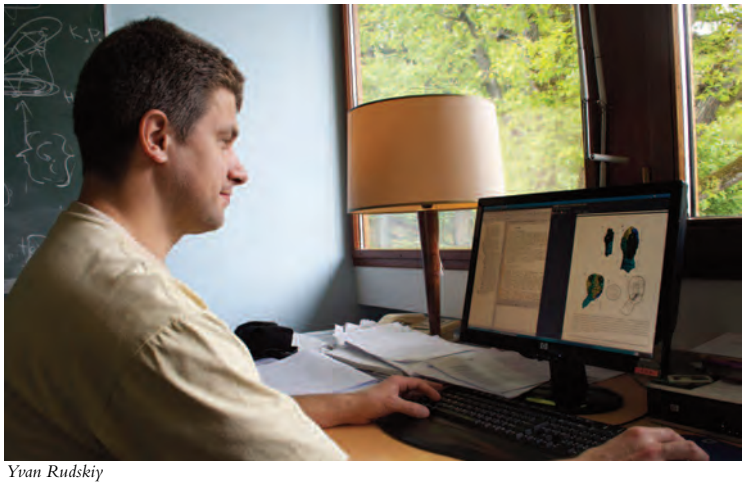
[1] J. Anden, S. Mallat, *Multiscale Scattering for Audio Classification*, ISMIR 2011.

[2] J. Bruna, S. Mallat, *Classification with Scattering Operators*, CVPR 2011.

[3] S. Mallat, *Group Invariant Scattering*, Commun. in Pure Applied Math., 2012.

formalisation of **developmental processes**

The developmental program of living organisms is enigmatically written in their genome. Fortunately, for multicellular organisms we can read it using basic mathematical notions.



Yvan Rudskiy

Decoding the program responsible for the spatial organisation of multicellular organisms is one of the frontiers of modern biology. My work at IHÉS is focused on the elaboration of precise and complete description of a species-specific rules of the cellular architecture development using plants as a basic model. The spatial arrangement of cells has the uniqueness of the individual organism and at the same time the regularity peculiar to the species. Of course, everything in biology should conform to the molecular-genetic mechanisms, since it is the most basic level of organisation. However, at the cellular level, there is a natural universal structural unit - a cell, and every plant or animal, even a giant, begins its regular and individual development from a single cell. The mathematical language provides a rather rich and multiform spectrum of object relations in addition to hierarchical ones commonly used in structural biology.

Plants and animals have a regular structure due to their iterative way of development expressed in the life cycle and metameric organisation. Plant tissues are characterised by two stable spatiotemporal properties, which are easy to formalise: genealogy of cells in the form of genealogical tree and the spatial arrangement of cells as a graph of spatial adjacency, both of them are taken from the microscopic observation of real objects, such as Calla palustris L. embryo, for example (Fig. 1). These two types of data were used to construct a regular space with species-specific properties, such that any real data taken from the same species are embeddable into this space and any developmental event like cell division or death is interpreted as a proper translation of some subtree in this space. We regard this space as a Cayley graph of a free group on two generators (Fig. 2). The species-specificity of such regular space is expressed in the subgroup topology constructed upon it.

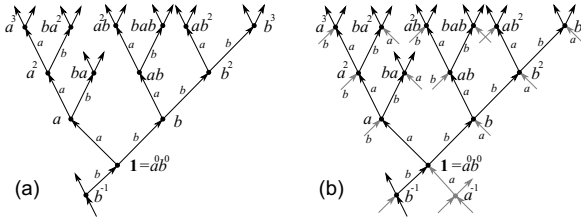


Figure 2: Embedding of a genealogical tree with induced labelling **(a)** into the Cayley graph of a free group < a, b > **(b)**.

Representation of the developmental program as a group action is natural, since a group describes not just a set of elements, but a set of all possible transformations between them. The developmental program is "closed" with respect to a set of all possible developmental events leading to a species-specific structure of organism. Hence the subgroup structure is a natural classification of developmental processes according to their degree and mode of iteration. For example, the activity of the potentially immortal cell lineages corresponds to some combinations of group elements, and an identity is such a combination that gives a morphogenetic result indistinguishable from the initial state. Decoding the species-specific developmental programs is undoubtedly a resolvable and very promising question at the cellular level of organisation.

Yvan Rudskiy

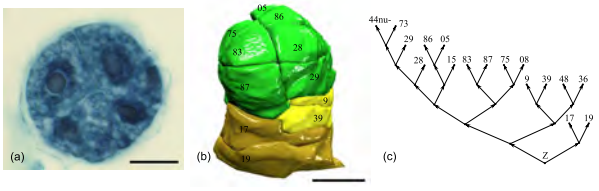


Figure 1: Formalistic representation of *Calla palustris* embryo development. Scale bar 10 μm. **(a)** – a section from a stack of transversal sections. **(b)** – 3D reconstruction of the whole embryo. **(c)** – genealogical tree as a result of cell shape analysis.

Yvan V. Rudskiy

Born on 16 February 1976 in Saint Petersburg, Yvan Rusdkiy is a specialist in developmental biology. He was a researcher at the Komarov Botanic Institute of the Russian Academy of Sciences (RAS). A visiting researcher at IHÉS since 2010, he has been invited to work with Mikhail Gromov's team, as part of IHÉS opening up its research activities to biology.

gravitational waves

"Energy versus Angular Momentum in Black Hole Binaries", an article written by Thibault Damour (IHÉS permanent professor), Alessandro Nagar (IHÉS visiting researcher), Denis Pollney and Christian Reisswig, has recently been published in Physical Review Letters (Vol.108, No.13), a leading peer-reviewed scientific journal. The background to the research described in this article, together with its main findings, are presented briefly below.

Studying the dynamics of binary systems (here, black hole binaries) is a key component in the program of detecting gravitational waves (GW). This momentous program, which physicists have been working on for more than 50 years, is entering an exciting new stage. Let us recall that the successful comparison between binary pulsar observations (due, notably to Joseph Taylor, Princeton University) and the relativistic theory of GW back-reaction effects in binary systems (as developed, notably, by T. Damour in the 1980s) has confirmed the reality of gravitational radiation. A direct detection of GWs on Earth is likely to come within the next few years from ground-based kilometric-size interferometers.

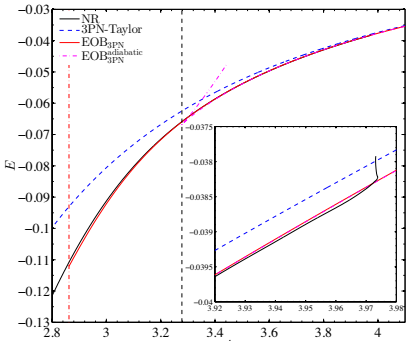
Alessandro Nagar, Thibault Damour

Such interferometric GW detectors are located in the United States (LIGO project) and in Europe (notably the French-Italian Virgo project). Their sensitivity is currently being significantly enhanced.

GWs are emitted by astronomical bodies in motion. A major challenge for physicists has always been that observing them is extremely difficult, given their very low amplitude when they reach the Earth. For this reason, very massive bodies moving at velocities comparable to the velocity of light, such as black hole binaries near coalescence, are among the best candidate sources of GWs. Even for such sources, a key obstacle to the observation of GW waves lies in the fact that their signal in an interferometer is extremely weak and obscured by a considerable amount of "noise".

The ability to accurately compute GW emission is the key to overcoming these problems. To achieve this, physicists have been recently using a combination of analytic methods and the results of numerical relativity (NR) simulations. Among the analytic methods, either traditional methods (based on the time-honored "post Newtonian" expansions) can be used, or the more recent effective-one-body formalism introduced by Thibault Damour and Alessandra Buonanno.

The effective-one-body method is based both on a new approach to the dynamics of relativistic binary systems and on the law of conservation of energy and angular momentum between the back hole binary and the radiation emitted. The recent work of Damour, Nagar, Pollney and Reisswig has allowed, for the first time, to directly test some of the key features of the effective-one-body method against high-accuracy numerical simulations. Using the numerical simulations of emitted GWs, they accurately computed, all along the quasi-circular "inspiralling" motion of two black holes, the losses of energy and angular momentum in the form of GW fluxes at infinity. This gave a NR estimate of the relation between the energy (E in the figure below) and angular momentum (j in the figure below) of black hole binaries along a sequence of quasi-circular orbits. They could then compare this NR-deduced functional relation E(j) to the predictions of the two main analytic methods: post-Newtonian and effective-one-body (EOB). The result of this comparison is shown in the figure below. The main result is that the EOB prediction is much closer to the NR result than the (canonically defined) post-Newtonian one. It is interesting to note (in the inset) the importance, for the NR-EOB agreement, of the initial loss of (physically spurious) "junk radiation" before the binary settles into an inspiral. However, NR simulations, requiring extensive computations, represent very time-costly analyses of the dynamics and GW emission of black hole binaries. By contrast, the EOB formalism, being an analytic tool, offers a robust and time effective alternative.



Comparison between four E(j) curves. The canonical prediction from post-Newtonian methods shows the largest deviation from NR results, while the EOB curves agree remarkably well with the NR one. (Figure by Alessandro Nagar, published in the article cited above.)

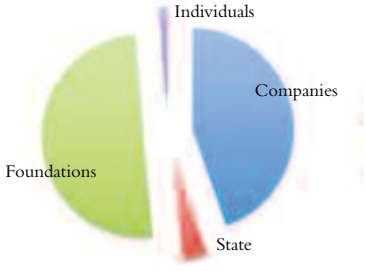
27 million euros raised and **a new five-million euro challenge-gift**

"This second IHÉS campaign has, once again, used the full range of contacts developed over time, which have enabled resources to be secured across several continents and from very varied sources: individuals, foundations, companies. Engaging with this highly composite network remains the Institute's preferred approach."

Jean-Pierre Bourguignon

The IHÉS 50th Anniversary Campaign has been a great success from start to finish, overreaching its target by over 7 million euros.

The 50th Anniversary Campaign has a large number of donors who, with their support, have enabled IHÉS to consolidate its endowment funds substantially. The campaign, conducted primarily in France, the United States and Japan, is a real victory for the Institute, which engaged wholeheartedly in this six-year project and required the strong commitment of its teams.



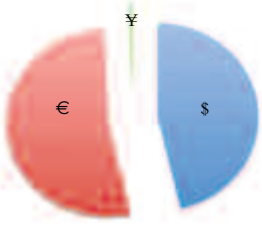
It ends with a new challenge-gift from the Simons Foundation, a US foundation created by Jim and Marilyn Simons, longstanding friends of the Institute. For one euro collected between December 2011 and December 2016, one euro will be matched by the Foundation. IHÉS will, now more than ever, continue with its fundraising activities in France and abroad to raise all the funds pledged. In total, 10 million euros will be collected as part of this challenge, a much needed amount for IHÉS to maintain the highest level possible globally. At a time when public support is under threat, especially the funding from the many foreign countries that have supported the Institute for decades, the Institute has to be mindful of its future and needs to treat fundraising as an urgent necessity.

IHÉS has five years to meet the challenge-gift set by the Simons Foundation. On 30 September 2016, it will come to an end and so will the chance of matching any funds not raised as part of the five million euro challenge. This represents a wonderful opportunity for IHÉS, and a real incentive to maintain its development activities at the same high level as in the past ten years. The Institute would like to give its heartfelt thanks to Marilyn and Jim Simons for this new mark of trust in IHÉS and its staff.

To date, 27 million euros have been raised in total by IHÉS during the 50th Anniversary Campaign. That is an impressive result for an institute that remains little known by the French public, but is fortunately appreciated by an international circle of supporters, convinced of the leading role played by IHÉS both nationally and worldwide.

In this second campaign, the Institute has once again measured the strength of its international status, with at least half the gifts made by foreign donors (individuals, corporations and foundations) on several continents.

The Institute is extremely grateful to all its 50th Anniversary Campaign donors and to all those who helped it in this venture. To thank them for their trust, IHÉS is more than ever committed to improving its visibility within France, and also to promote mathematics to the general public and scientific research to young people.



François Quentin, Chairman of Huawei France, Huawei Fund official launch at IHÉS, on 17 November 2011 on the occasion of the Celebration at the Institute of S.S. Chern's centennial

A donor's testimony

"The Access Club was created in the 1980s by Pierre Grouvel, who was a pioneer in the development of optical disc playback. Members of the Club are executives who have played a decisive part in the development of Information Technology in France and abroad.

The purpose of the Club is to discuss topics relating to science, the economy and art, in a friendly and relaxed atmosphere. The Club therefore regularly invites people who have made important contributions to each of these areas. On 28 October 2010, Jean-Pierre Bourguignon was the Club's guest; he presented IHÉS on this occasion, together with the research which is undertaken there.

It was natural for the Club to support IHÉS, firstly because mathematics is one of the tools used in each of the Access Club's areas of interest and secondly because its members have all followed a mathematical curriculum. The Club supported the Institute via the Pierre Bonelli Chair, Pierre Bonelli having been a highly regarded colleague."

François Dufaux

campaign in the U.S.

2011 – 2012 campaign

The target for this campaign is to raise three million dollars, mainly to help IHÉS fund the visits of American researchers invited by the Institute.

Friends of IHES, Inc.'s campaign has been given a fantastic boost by the launch in 2011 of a new challenge-gift to IHÉS by the Simons Foundation, amounting to five million euros. As part of this challenge, until December 2016, all gifts and pledges made both to Friends of IHES and IHÉS will be matched by the Foundation on a one for one basis.
Friends of IHES warmly thanks Marilyn and Jim Simons for their incomparable and faithful support.

SIMONS FOUNDATION

This new challenge will help Friend of IHES to convince new contributors across the American continent to join it in its commitment to international scientific research.

Jim Simons attending the conference by Michael R. Douglas in New York on November 2011

"Within the last twelve months, out of the 179 mathematicians, physicists, biologists and computer scientists who visited IHÉS, 49 were US residents. The continuous development of links and collaboration between the American scientific community and the Institute is key to Friends of IHES. This exceptional relationship induces mutual benefits to IHÉS and to scientists and institutions in the US. Following their stay at IHÉS, American scientists return to their home institutions with a broader and enriched knowledge of their field that they can share with their fellow scientists and students to extend their research.
In this context, Friends of IHES continues to increase the visibility of IHÉS in the United States by setting up events where American scientists, foundations, corporations and individual supporters can meet and share their passion for theoretical science.

Véronique Carpentier

Friends of IHES organized a reception on November 10, 2011 in New York in the office of law firm DLA Piper. The theme of the evening was a debate on the announcements questioning the light speed theory. How physical theory and experiment relate: Neutrinos faster than light? *was the then highly topical question raised, leading to lively and spirited interactions. Guests from the scientific and business communities had the opportunity to exchange with Professor Michael R. Douglas, leading theoretical physicist and professor at the Simons Center for Geometry and Physics at SUNY Stony Brook, Louis Michel Professor at IHÉS, who led the discussions."*

Véronique Carpentier
Friends of IHES, Inc.
Executive Director

Friends of IHES, Inc., a charitable 501 (c) (3) organization since 1999

Friends of IHES, Inc.'s mission is to increase the visibility of IHÉS in the United States, to coordinate the network of current and former American visiting scholars to the Institute, to organize scientific and cultural events, and to raise funds for IHÉS.
All gifts made to Friends of IHES are tax deductible. Further information can be found on the website: www.friendsofihes.org.
Because the Internal Revenue Service recognizes Friends of IHES as a 501(c)(3) charitable organization, bequests are fully deductible for estate-tax purposes.

the forthcoming event of Friends of IHES

Coming up on July 11, 2012, from 8.30 to 9.30 am, Friends of IHES will have the great pleasure of hosting Cédric Villani, professor at the University of Lyon 1, director of the Institut Henri Poincaré (IHP), Paris, 2010 Fields medallist, part-time visiting professor at IHÉS, for a breakfast at the French Cultural Services in New York. On this occasion, he will give a conference: *Of Triangles, Gas and Men*. He will explain how non Euclidian geometries can provide pertinent models to understand the movement of gases. It will also speak of how mathematical research cannot do without meetings, both planned and fortuitious, between scientists with different areas of interest, so cannot do without places that make these meetings possible, such as IHÉS or IHP.
To register, please contact Véronique Carpentier: vcarpentier@friendsofihes.org

On 12 November 2012, the first Friends of IHES Annual Gala Dinner will take place in New York with the theme *Beauty & Mathematics*. This outstanding event will gather scientists and artists with a passion for the creativity inherent to scientific research.
For further information, please refer to www.friendsofihes.org

Taking the Long View

George Csicsery, born in 1948 in Germany, has been a writer and film director since 1968. He has directed many films, including short films and documentaries. For the past ten years or so, his work has focused on mathematical topics. He has been awarded many prizes, especially the JPBM Communications Award for communicating mathematics to a broad public. The film on Shiing-Shen Chern, which he directed, was funded by the Simons Foundation and was shown for the first time during the Shiing-Shen Chern centenary celebrations at IHÉS on 17 November 2011, in the presence of professor Chern's daughter, May Chu.

"The very first scene I ever filmed at MSRI was on September 11, 2000, and it was a discussion between S. S. Chern and mathematicians Robert Osserman, the institute's then-director David Eisenbud, and deputy director, Joe Buhler. Chern's colleagues knew that he was moving back to China for the remainder of his life, and that this was a last chance to capture something on video with him in Berkeley for posterity. We taped the discussion and everyone forgot it. It was the only time I ever met Chern in person. The footage remained unused in a box until 2010. The happy result is that there are now several sequences in Taking the Long View: The Life of Shing-shen Chern, of Chern telling his own story in English. Having him speak in the film brings him to life, as if he were interviewed especially for this film. Although I knew very little about Chern's mathematical work when I started working on the film in 2010, there were other areas of his life and thought that opened up a very exciting tale spanning most of the 20th century and great swathes of history. Behind the mathematical achievements, I saw an epic story combining elements of Chinese, European, and American history with ancient Chinese philosophy - all embodied in the life of one man.

As I got to know Chern through the many interviews we filmed in the United States, China, and Germany, I gradually discovered that I was better prepared for this project than I had first imagined. I had studied Comparative Religions at university, specializing in Chinese philosophy and religions, with a particular emphasis on the writings of Lao-Tzu. I soon saw Chern's life as a near perfect rendition of Lao-Tzu's admonitions to accomplish great things by taking a low-key steady approach. His strategy to ride out adversity in order to create something lasting and worthwhile soon emerged for me as a great theme for the film. To me Chern was very close to the iconic classical taoist scholar; a man who could command without giving orders, who could sway decisions with his mere presence, and who could produce fantastic creations by conveying his approval and encouragement. But in Taoism there is always an enigma. I will never know if my film has contributed to the creation of a myth, or if the man everyone described to me really existed in such exemplary form. Myth or reality, mathematicians and countless others will remain grateful to Chern for a long time to come."

George Csicsery
Oakland, California

does time exist?

Thibault Damour

On 14 September 2011, the Caisse des dépôts hosted in its offices, located on quai Anatole France in Paris, a public conference given by Thibault Damour, theoretical physicist and permanent professor at IHÉS: *Physics and Reality: Does Time Exist?*

This conference attracted a large number of people, who had come to listen to Thibault Damour, one of the world's leading experts in general relativity.

The conference dealt with the conceptual upheavals brought about by 20th Century physics, making the audience think about its philosophical impact. The key question was the following: how should Time be thought of, after Einstein's relativity theory, which removes any meaning from "now"?

We would like to thank the Caisse des dépôts for having kindly hosted this event.

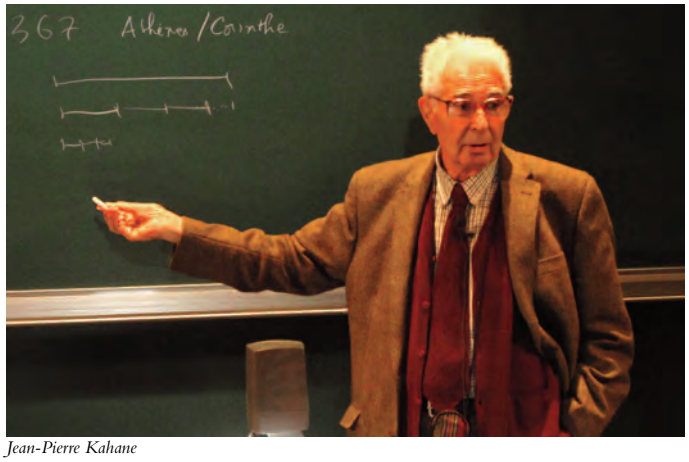
les Amis de l'IHÉS's evening events

Les Amis de l'IHÉS is an association which was created in 1998 to make the cutting edge research carried out at IHÉS known to as many people as possible.

In order to this, they regularly organise conferences for the general public, usually followed by high quality musical performances. Accredited for receiving donations, the association reaches out to all these who wish to support IHÉS and at the same time nourish their intellect and their soul with science and music. If you wish to join the association, please contact Les Amis on amisihes@ihes.fr.

The Music of Forms, a conference by Alain Connes (Collège de France and IHÉS) on Thursday 26 April 2012:

During this very popular conference, Alain Connes explained, with many concrete examples, the duality that exists between a geometric form and its spectrum.
A musical interlude was provided by Audrey Michael (soprano) and Thibault Damour (piano), during which they played Lieder by Robert Schumann and Richard Strauss.



Jean-Pierre Kahane

Theaetetus, the Greek Galois, a conference by Jean-Pierre Kahane (Université Paris-Sud), on Tuesday 29 November 2011, followed by a musical interlude with Paloma Kouider, pianist:

"Theaetetus, the young man who appears in Plato's dialogues, was the author of great discoveries in mathematics, and died at the age of 20. Comparison with Galois ends there: Galois was neglected in his time, and he is famous today; Theaetetus was famous in his time and he is forgotten today. Most official biographies, basing themselves on his reputation, have Theaetetus die at the age of 46. But Theaetetus left no writings and had no students. Where did his reputation come from? Is it compatible with the hypothesis that he died at the age of 20? My only reference point will be Plato, but it will go beyond "Theaetetus". I will credit Theaetetus with the best of Plato's fascination for mathematics, and I will even venture to formulate the hypothesis that he is the author of the fundamental theorem of arithmetics, the existence and uniqueness of the decomposition of an integer into prime factors. Other hypotheses may be of interest to hellenists: the dates of the writing of Plato's dialogues. The character of Thaetetus seems interesting to me, his time dazzling, and Plato's reading is a real treat for the anti-Platonician that I am."

Jean-Pierre Kahane

high school students visit IHÉS

IHÉS regularly opens its doors to students, so that they can get to know the world of fundamental research better.

On Wednesday 25 May 2011, the Institute welcomed around 20 high school students from the Sofia Kowalewskaia Club at the Lycée Blaise Pascal in Orsay. This mathematics club, open to girls only, was created in 2010 on Principal Bernadette Skowron's initiative, to encourage young women to choose scientific courses in their studies.
First year high school students from the Lycée de la Vallée de Chevreuse in Gif-sur-Yvette, follow the "Mathematics and Scientific Practices" option in their curriculum. In this context, around 150 people (students and teachers) came to visit IHÉS on 26 May 2011.
These two groups were offered a tour of the Institute, which was followed by an informal meeting with several IHÉS professors. The professors first explained briefly what had brought them to fundamental research and students then asked questions. IHÉS is open to educational institutions that would like to have their students meet IHÉS scientists.


Christophe Soulé


Jean-Pierre Bourguignon, Cécile DeWitt-Morette

Mathematics, a Beautiful Elsewhere exhibition at

From 21 October 2011 to 18 March 2012, the Fondation Cartier pour l'art contemporain presented the exhibition *Mathematics, A Beautiful Elsewhere*, an original creation designed in collaboration with IHÉS, under the patronage of UNESCO.

An installation rather than an exhibition, not didactic in its approach, *Mathematics, A Beautiful Elsewhere* was an unprecedented union of creative thought from great mathematicians (Sir Michael Atiyah, Alain Connes, Nicole El Karoui, Misha Gromov, Cédric Villani and Don Zagier) with that of famous artists with widely varying approaches in different art forms (Jean-Michel Alberola, Raymond Depardon and Claudine Nougaret, Takeshi Kitano, David Lynch, Beatriz Milhazes, Patti Smith and Hiroshi Sugimoto). It also represented an opportunity to show the public the experiments on matter conducted by CERN at the heart of the Large Hadron Collider, the mapping of the primeval universe recorded by ESA's Planck satellite and the work of the developmental and social robotics team led by Pierre-Yves Oudeyer, INRIA Bordeaux-Sud-Ouest (see front cover).

We owe this exhibition to the audacity and generosity of Hervé Chandès, Director General of the Fondation Cartier, a new convert to mathematics, who dared to venture into a land of numbers, together with Michel Cassé, his travelling companion, who enlivened the years required to bring this difficult project to light with his graceful turn of phrase.

Having enjoyed great success in France, the exhibition will soon travel abroad (dates and places to be confirmed).

Poster by Tadanori Yokoo

Karol Beffa, Stéphane Paoli, Harmonies, night of uncertainty on 13 February 2012

Nights of uncertainty

A series of meetings initiated by the Foundation Cartier to coincide with the exhibition. Everyone was welcome to join these events, which represented a continuation of the "Beautiful Elswhere" experience. Three meetings around the theme of uncertainty were organised in February and March 2012, during which mathematics were explored across the themes of music, finance and cosmology.

Mathematics for Everyone?, an international conference co-organised by the French delegation at UNESCO, the Fondation Cartier and IHÉS was held alongside the exhibition, at the UNESCO headquarters on 30 and 31 January 2012.

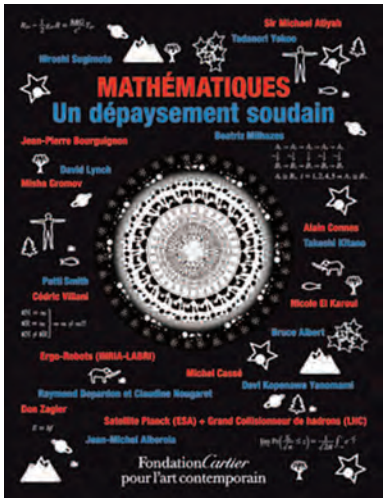
This event was a thought provoking one, with insights provided by experts from all over the world on recent developments in mathematics, in terms of their interactions with other sciences and with society, as well as their accessibility to the general public and their educational import globally. The interactions with areas such as medicine and the economy, in which mathematics feature in the news, sometimes surrounded by controversy, were tackled by means of four round tables.

Annick Harel-Bellan

The day and a half long symposium was held in the presence of Jean Audouze, Chairman of the French National Commission for UNESCO and of Jean-Pierre Bourguignon, Hervé Chandès and Michel Cassé, joint exhibition commissioners of the *Mathematics, a Beautiful Elsewhere* exhibition.

The topics explored during the four round tables reviewed mathematics today in France and elsewhere, focusing on their impact on people's current and future lives. The spotlight was also trained on the accessibility of mathematics to the general public and its teaching, put into context by the description of various situations in different countries (PR China, South Africa, Russia and Uruguay)

the Fondation Cartier pour l'art contemporain



The exhibition catalog is a wonderful document, which provides continuity to the exhibition experience.

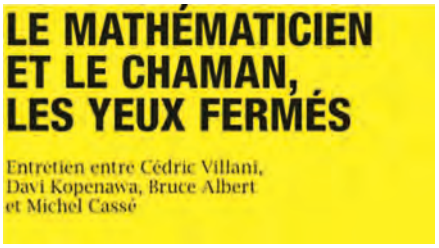
It contains texts by: Bruce Albert (anthropologist), Jean-Pierre Bourguignon (mathematician), Michel Cassé (astrophysicist), Misha Gromov (mathematician), Takeshi Kitano (artist), Pierre-Yves Oudeyer (robotics researcher), Hiroshi Sugimoto (artist), Cédric Villani (mathematician), Don Zagier (mathematician), Silke Wimmer-Zagier (mathematics historian), interviews and notes, a collection of ideas and mathematical concepts that are an extension of the themes covered by the exhibition. Also included is a CD, comprising the original exhibition soundtrack, with texts read by Patti Smith, and the score specially created by David Lynch.

Au Bonheur des Maths, by Raymond Depardon and Claudine Nougaret. In this 32-minute film, the floor was given to nine mathematicians who participated actively in the creation of the exhibition. They each explain, with their own sensibility and experience, their personal relationship with mathematics: Sir Michael Atiyah, Jean-Pierre Bourguignon, Alain Connes, Carolina Gonzalez Canales and Giancarlo Lucchini, Misha Gromov, Nicole El Karoui, Cédric Villani, Don Zagier.
The DVD can be purchased from the Palmeraie Desert website or the Fondation Cartier pour l'art contemporain bookstore.

Extract from *Living mathematics*, a text by Michel Cassé, astrophysicist, directeur de recherche, Commissariat à l'énergie atomique et aux énergies alternatives, research Fellow, Institut d'astrophysique de Paris:

"Why transfer mathematics onto the walls of an art venue ? For the obvious reason that mathematics is one of the most advanced forms of culture. Endowed with representational power and ability to reveal, equations are indeed manifestations of timeless beauty.
Mathematics elaborates concepts in order to apprehend the world and the world beyond. High culture was in need of high ground, a hanging garden and a hi-fi (in low tones).
Mathematics has been transplanted into the Fondation Cartier like an exotic flower into a cultural garden. What we wish to emphasize is the boundless curiosity, the research, the creativity that mathematics requires. Most of all, we want to show how the problematic nature of knowledge can be a source of pleasure and delight-without minimizing the athletic or ascetic efforts that are needed in order to acquire this knowledge. The ideas involved are of interest to us only insofar as they fuel the passion of mathematicians.
Where humankind is rendered speechless, allow mathematics to stir the blood of the race ; and before its tongue dries up, may it take us to the bubbling wellspring of equations! The aim of this mathematical detour is to make algorithms and equations tangible, turn them into things that one can see, taste, hear, or maybe just do. Mathematics encounters the real world through images and sounds in a Library-Land recomposed by David Lynch."

Michel Cassé, astrophysicist



Extract from *The mathematician and the shaman, with eyes closed*, an interview featuring Michel Cassé, Cédric Villani, Davi Kopenawa, chaman, and Bruce Albert, anthropologist:

"To start off our mathematical-shamanic discussion, I could relay the intense curiosity Davi Kopenawa showed with regard to Cédric Villani's spirited, virtuoso ability to "bring down" the images of equations onto the screen of his computer. He remained silent and thoughtful for a long time, and then suddenly asked him point-blank: "Do you dream a lot? What are your dreams made of?" An unsettling question, to which Cédric Villani responded right away by reading from the "dream notes" that he immediately retrieved from the memory of his laptop like a series of belated subtitles to the mathematical images he had just showed us. I was struck by that moment of such improbable transcultural syntony."

Bruce Albert, anthropologist

Tour de France des déchiffreurs

Espace Culture, Université Lille 1, Villeneuve d'Ascq

The idea for the *Tour de France des déchiffreurs* (The Unravelers' Tour de France) came from the observation that fewer and fewer young people are interested in science and fundamental research especially; numbers enrolling in sciences courses are in fact decreasing year on year.

IHÉS therefore decided to organise a national travelling event to reach out to the general public, and especially to young people, with a photo exhibition, *The Unravelers*, and public conferences given by scientists from IHÉS and/or the host institutions.

The event represents an invitation to students, including high school students, and the public at large, to meet those involved in fundamental research, and to gain some insight into the issues and vibrancy of this field.

The *Tour de France des déchiffreurs* is only stopping in provincial towns, thereby showcasing the mathematical excellence that exists outside the Paris region. It enjoyed a four-month stay in the Nord-Pas de Calais region, with very active cooperation from the Cité des Géométries in Jeumont, and in particular from its Chairman, Francis Trincaretto, and Valerio Vassallo, a mathematician at Université Lille 1.

Since it started on 26 September 2011 at the Ecole Normale Superieure de Lyon, there have been *Tour de France des déchiffreurs* stages in 19 cities, giving rise to 29 conferences. In total, over 4200 people have already visited the exhibition and 1300 people have attended the conferences.

The *Tour de France* is currently at the Collège de Matha in Charente Maritime and at the Université de Clermont Ferrand. It will end on 30 June 2012, at which point the entire French mathematical community will be wearing the yellow jersey...

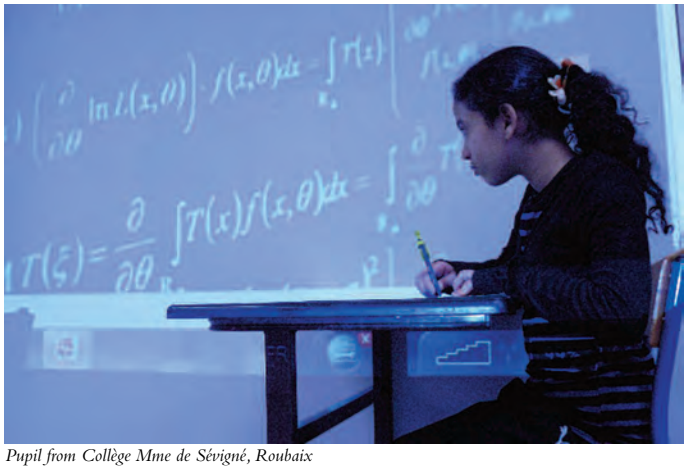
The broad scope of this project was made possible by the financial support from the Caisse des dépôts and the support of Belin and Pour la Science magazine.

We would like to commend all the people from the various host institutions for their very active involvement and also all the scientists, who were kind enough to take part in conferences, for their contribution. Without the commitment of each of them, this event would not have had such an impact.

Full details on www.ihes.fr

"Some 800 to 900 students came to see the exhibition, but what I remember most is the students' silence as they came with their teacher for an hour in groups of 35. They were entranced by those faces, those eyes and the poetry emanating from these wonderful photos. Some students came back, with their parents or by themselves.
One student on his way out from the exhibition said to me:
'Sir, it feels like the mathematicians are speaking to us, showing us the way towards work. They are beautiful.'
And another:
'They look like Jedi Knights of mathematics.'"

José Inacio
professor of mathematics,
lycée Benjamin Franklin, Orléans



Pupil from Collège Mme de Sévigné, Roubaix

Tour de France des déchiffreurs lecturers

LYON

Thibault Damour, permanent professor, IHÉS and Étienne Ghys, directeur de recherche, CNRS, Laboratoire UMPA, ÉNS de Lyon

STRASBOURG

Gaël Collinet, lecturer, IRMA and Pierre Cartier, CNRS – IHÉS

RENNES

Annick Lesne, directrice de recherche, CNRS, LPTMC - UPMC and Antoine Chambert-Loir, professor, Université de Rennes 1, IRMAR

NANCY

Jean-Pierre Bourguignon, directeur de recherche, CNRS, director, IHÉS and Patrick Sargos, Université de Nancy

JEUMONT

Jean-Pierre Bourguignon, directeur de recherche, CNRS, Director, IHÉS

LILLE

Aziz El Kacimi, professor, Université de Valenciennes and mathematician in residence, Cité des Géométries, David Coupier, lecturer, Université Lille 1 and Hervé Vezin, Directeur de recherche, CNRS

CALAIS

Bruno Martin, lecturer, Université du Littoral

ORLÉANS

Annick Lesne, directrice de recherche, CNRS, LPTMC - UPMC

VALENCIENNES

Aziz El Kacimi, professor, Université de Valenciennes and mathematician in residence, Cité des Géométries

DOUAI

Pierre Vanhove, CEA – IHÉS and Claire Voisin, directrice de recherche, CNRS, Institut de Mathématiques de Jussieu

LENS

Étienne Matheron and Martintxo Saralegi-Aranguren, professors, Université d'Artois

NANTES

Vincent Jullien, professor of history and the philosophy of sciences, Université de Nantes

ROUBAIX

Alain Vienne, director, Observatoire de Lille, professor of astronomy, Université Lille 1 and Rossana Tazzioli, professor, Université Lille 1

CASSEL

Claire Voisin, directrice de recherche, CNRS, Institut de Mathématiques de Jussieu and Jimmy Dillies, professor, University of Utah, USA – IHÉS

ARMENTIÈRES

Nicole El Karoui, Professor, UPMC – École polytechnique and Olivier Sernam, lecturer, Université de Lille 1

MANOSQUE

Emmanuel Philippe, professor, Lycée Les Iscles and Pierre Vanhove, CEA – IHÉS

VILLENEUVE D'ASCQ

Maxim Kontsevich, permanent professor, IHÉS, Chaire AXA-IHÉS de Mathématiques

BORDEAUX

Josselin Garnier, Université Paris Diderot and Yiannis Vlassopoulos, IHÉS

PAU

Stéphane Mallat, École polytechnique - IHÉS

CLERMONT-FERRAND

Ariel Provost, professor, Laboratoire Magmas et Volcans, Université Blaise Pascal and Sylvie Paycha, Université Blaise Pascal and Université Potsdam

MATHA

Arndt Benecke, CNRS

"I had the pleasure of welcoming to the Nord-Pas de Calais Region The Unravelers exhibition, featuring photographs by Jean-François Dars. Ten different sites in our region were selected to host The Unravelers: the Salle des Pas Perdus at Jeumont station, the Boardroom at the Collège de Wazemmes in Lille, the Université du Littoral de Calais's library, a classroom at the Université de Valenciennes, the Lycée d'Excellence in Douai's library, the entrance lobby of the library of the Université d'Artois de Lens, the Collège de Sevigné's auditorium in Roubaix, the Collège le Frison de Cassel's exhibition hall, the Lycée d'Excellence d'Armentières's hall and the Espace Culturel in Villeneuve d'Ascq at the Université Lille 1. This meant that the exhibition could reach a wide audience, including from Belgium, thanks to the fact that our region is near the border. This very varied selection attracted visitors with very different interests, aroused a keen interest for research in mathematics and theoretical physics - thanks also to a cycle of conferences organised at each site - and in addition led to other highly laudable activities in the schools and high schools, where the exhibition was hosted."

Valerio Vassallo,
lecturer in Mathematics,
University of Lille 1,
mathematician in residence at the Cité des Géométries, Gare Numérique de Jeumont

Conference by Annick Lesne, lycée Benjamin Franklin, Orléans

a point of view from ...

Mirjana Đorić

Mirjana Doric is a professor in the Faculty of Mathematics at the University of Belgrade, Serbia. Her area of research is differential geometry, more specifically, Riemannian geometry. She was invited to IHÉS for two months in 2010 and 2012 to carry out her research.

During my stay at IHÉS in January 2012, besides listening to lectures given by leading scientists on seminars and sharing some of their current work, I also had the opportunity of taking part in several activities aimed at promoting mathematical research for the general public. As an example, I visited the exhibition *Mathematics, A Beautiful Elsewhere*, presented at the Foundation Cartier pour l'art contemporain and attended the symposium *Mathematics for Everyone*, held at the UNESCO headquarters in Paris, focusing on the role of mathematics in our everyday environment. Besides the fact that scientific research contributes to the economic development of society, it also benefits teaching and education. Hopefully, these activities will encourage young people to get involved in scientific and research professions.

Considerable attention has been lately devoted to such popularisation efforts of mathematics in Serbia as well. Several journals for primary and secondary school pupils have been published, and their contents are not limited to school curricula. These journals also include various articles dealing with topics other than the obligatory syllabus, chess and prize problems. Not only tournaments and competitions, but also preparatory classes, have been organised for gifted and interested pupils. In the course of the past few years, the Science Fair and various workshops have been organised, largely focusing on mathematics. These events cover lectures and playing activities aimed at explaining certain mathematical notions and increasing the creativity, too. There are several associations gathering those who are interested in enriching their knowledge in the field of mathematics. Prizes won by Serbian participants at different competitions are only one of the results of working with young people.

Although that is not always the case, Serbian participants are most often pupils of the Mathematical High School in Belgrade, a secondary school dedicated to teaching gifted and talented children with an interest in mathematics, physics and informatics, which was founded in 1966. Its students have won more than 400 medals at International Olympiads. Besides this school, there is also one specialised class in most of the larger towns in Serbia, working along a similar syllabus and thus more challenging than other secondary schools. Their great advantage is that young people with similar interests are gathered in one place. That kind of environment positively affects their motivation to work, the level of exchange of knowledge and experiences.

Over the past few years the number of students wanting to enrol at the Faculty of Mathematics, University of Belgrade, has increased. Nevertheless, it is important to stress that some of them are interested in informatics and taking teacher positions in schools. Students studying pure mathematics form small groups. This enables them to have closer contacts with their professors, who often work with them beyond obligatory classes, too. The numbers of female and male students are almost the same. Although the conditions for teaching and studying, above all the quality of classrooms and equipment, could be better, the students are very motivated to study and to start doing some research. An educational reform has been implemented during the past few years, which resulted for the Faculty of Mathematics in an increase of the number of exams, now corresponding to one-semester, instead of one-year, courses, and a lot of homework, colloquiums and mid-term exams. Most of the courses have an oral exam as one of their prerequisites, usually very important.

Even though the number of students who spend several months at universities abroad has increased lately, those who attend summer schools, workshops and conferences during their studies are still few. However, upon graduation (or sometimes even when they finish secondary school) many students are granted scholarships to attend foreign universities, so they go abroad to continue their education. Only some of them return after they have finished their studies and obtained the adequate diploma.

The post-graduate programme at the Faculty of Mathematics in Belgrade has been constantly improved, but nonetheless there are still numerous difficulties. The conditions for obtaining a PhD diploma in Mathematics are not at all simple. Besides passing the necessary exams, a PhD student also has to publish a paper in a journal on the SCI list.

The way to obtain various diplomas may differ from one institution to the next, but it is just one step in the ever-going cycle of education.

forthcoming events

The *Tour de France des déchiffreurs*

5 - 29 June: Clermont-Ferrand

11 - 22 June: Collège Marc Jeanjean, Matha

11 - 12 June, IHÉS

Dialogues autour de l'algèbre, la géométrie et les fonctions multizétas, conference in honour of P. Cartier's 80th birthday

14 - 15 June, IHÉS

Mathematical Models of Sound Analysis, Schlumberger workshop organised by A. de Cheveigné, S. Mallat, D. Pressnitzer and S. Shamma

25 - 28 June, IHÉS

Nonlinear Partial Differential Equations: Theory and Applications to Complex Systems, conference in honour of H. Matano, organised by F. Merle and D. Hillhorst.

27 and 29 September, IHÉS

Celebrations of the 50th anniversary of IHÉS moving to Bures-sur-Yvette

Poincaré 100, celebration one hundred years after Henri Poincaré's passing away

- Since 25 April, traveling exhibition on the key stages in the life and work of Henri Poincaré
- Conference cycle at the École polytechnique
- Public day, Grand Amphithéâtre, Sorbonne, Paris, 17 November
- International scientific conference, IHP, 19 - 23 November

IHÉS
Institut des Hautes Études Scientifiques

For more information: www.ihes.fr

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