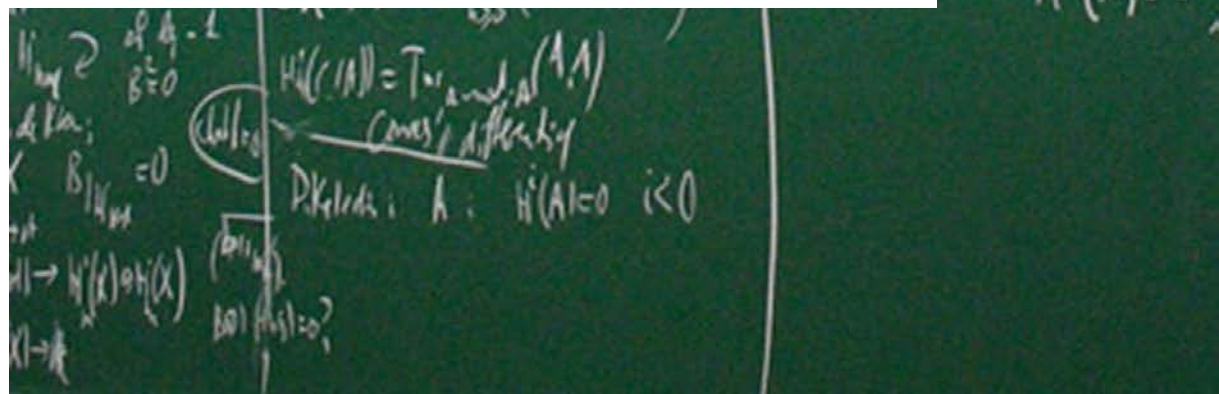
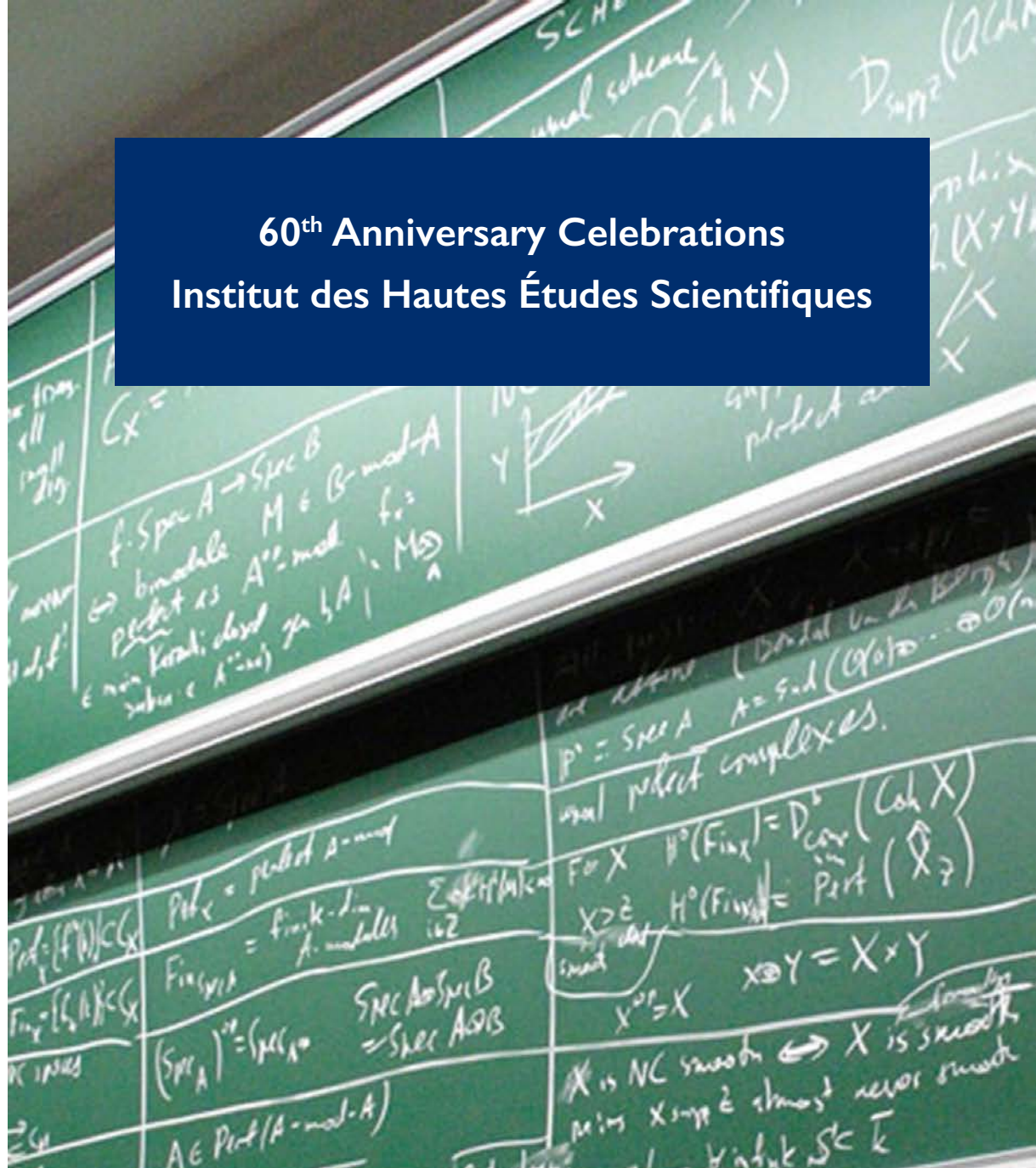
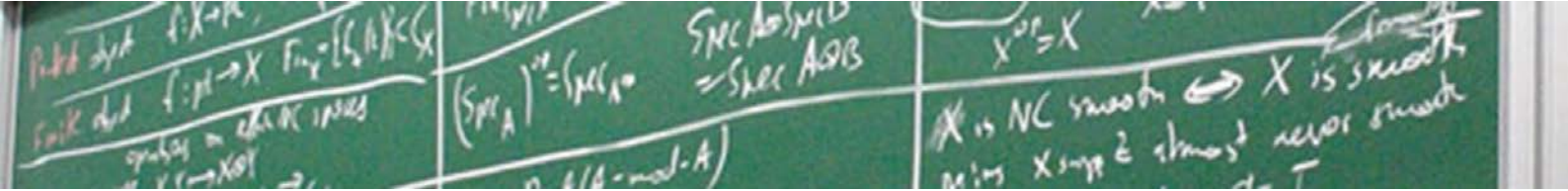


60<sup>th</sup> Anniversary Celebrations  
Institut des Hautes Études Scientifiques





## IHES

The Institut des Hautes Études Scientifiques (IHES) is an advanced research centre in mathematics and theoretical physics, founded in 1958 by an industrialist. About 200 scientists come to the Institute every year (85 % of them from abroad) for their research visits, gathering around a small group of 6 permanent professors.

The Institute's foundational idea is to bring together the greatest minds and to give them wide latitude to carry on their work. It is by following this simple model that IHES has welcomed some of the personalities that have changed the scientific landscape with an unprecedented success. The permanent professors at the Institute have been honored with the greatest distinctions (7 Fields Medals, 2 Abel Prizes, 1 Einstein Prize, 2 CNRS Gold medals, 2 Breakthrough Prizes...)

Since its creation...

In 2017...



**7**  
FIELDS MEDALISTS  
OUT OF THE 10 PERMANENT  
PROFESSORS RECRUITED IN  
MATHEMATICS



**223**  
INVITED  
RESEARCHERS



**15**  
PROFESSORS  
6 PERMANENT PROFESSORS,  
5 EMERITI PROFESSORS,  
4 CNRS RESEARCHERS



**84**  
NATIONALITIES  
HOSTED

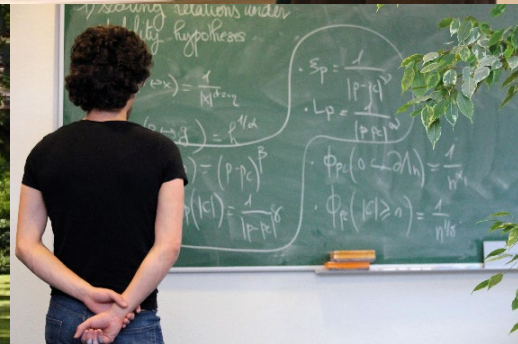
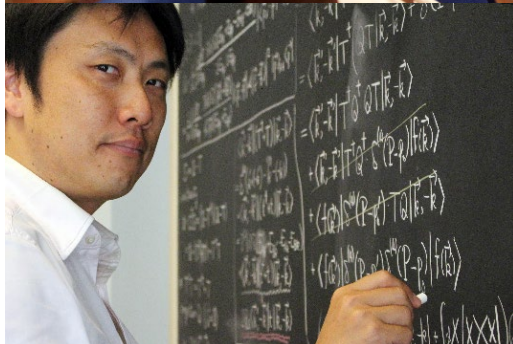


**233**  
SEMINARS



**4**  
INTERNATIONAL  
PRIZES

*In 2018, IHES will celebrate its 60<sup>th</sup> Anniversary. If the Institute's scientific and institutional network will be mobilized, the objective is also to take this opportunity to reach out to a larger audience and share our enthusiasm for research.*





ALEXANDER GROTHENDIECK

1958

Leon Motchane creates IHES.

1959

The Founder recruits **Jean Dieudonné** who works until 1964 on several domains, including group theory and functional analysis.

**Alexander Grothendieck** also joins the Institute. Awarded the Fields medal in 1966, he remains at IHES until 1971. He completely reshapes the foundation of algebraic geometry and its methods.

1962

**Louis Michel**, joins IHES, where he spends 30 years. He is the first permanent professor in theoretical physics and promotes the use of group theory in physics and in the study of symmetry.

1963

**René Thom** (1958 Fields medalist) is recruited by Léon Motchane and stays at IHES until the end of his career. He makes significant contributions to differential geometry and topology, then focuses his research on the role of singularities in morphogenesis and later on theoretical biology, linguistics and philosophy.



RENÉ THOM

1974

**Dennis Sullivan** remains until 1997. He creates algebraic models for topological spaces and contributes to the study of dynamical systems and of a topological approach to hydrodynamics.

1970

**Pierre Deligne** continues the work started by Alexander Grothendieck, to transform arithmetic geometry. He is awarded the Fields medal in 1978 and leaves IHES in 1984.



PIERRE DELIGNE

1964

**David Ruelle\*** makes many lasting and important contributions to quantum field theory, statistical mechanics and the theory of the dynamical systems.

1978

**Jürg Fröhlich** is mostly interested in quantum field theory. He remains at the Institute for four years.

## short history of IHES

*The permanent professors at IHES, all first rate scientists, are the Institute's DNA. Many international prizes have rewarded their remarkable contributions to scientific knowledge.*

1979

**Alain Connes\***, Léon Motchane chair holder, after pioneering contributions on operator algebras, founds a «noncommutative geometry». He is awarded the Fields medal in 1982 and the CNRS Gold medal in 2004.



MIKHAIL GROMOV

1982

**Mikhail Gromov\***, a permanent member at the Institute for over 30 years, completely reshapes geometry. He is awarded the Kyoto Prize in 2002 and the Abel Prize in 2009, just to mention two of his many honors.



JEAN BOURGAIN

1985

**Jean Bourgain** works on Banach spaces, harmonic analysis and ergodic theory. He is awarded the Fields medal in 1994 before joining IAS the same year.

1982

**Oscar Lanford III** stays for seven years to work on the theory of dynamical systems, applying concepts arising from renormalisation group theory. He also turns his attention to computer-assisted demonstrations and is responsible for IHES acquiring computer equipment for the first time.



LAURENT LAFFORGUE

2000

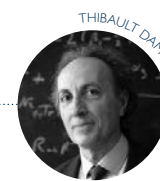
**Laurent Lafforgue\*** is awarded the Fields medal in 2002. His work represents a major advance in the Langlands program. Also in 2000, **Nikita Nekrasov** becomes a permanent professor in physics. A specialist in string theory, he works at the Institute for 12 years.



MAXIM KONTEVICH

1995

**Maxim Kontsevich\***. He belongs to a new generation of mathematicians who have been able to incorporate aspects of quantum theory into their work, opening up radically new perspectives. He is awarded the Fields medal in 1998 and many subsequent prizes: the Crafoord Prize (2008), the Shaw Prize (2012) and two Breakthrough Prizes in fundamental physics (2012) and mathematics (2014).



THIBAUT DAMOUR

1989

**Thibault Damour\*** works on relativistic gravitation, cosmology and new concepts of gravitation. An Einstein specialist, he has received many awards, including the CNRS Gold medal in 2017.



VASILY PESTUN

2014

**Vasily Pestun\*** works on quantum field theory and string theory. He is awarded the Hermann Weyl prize in 2016.



HUGO DUMINIL-COPIN

2016

**Hugo Duminil-Copin\*** is a probabilist whose research has an impact on mathematical physics, complex analysis and combinatorics.



SLAVA RYCHKOV

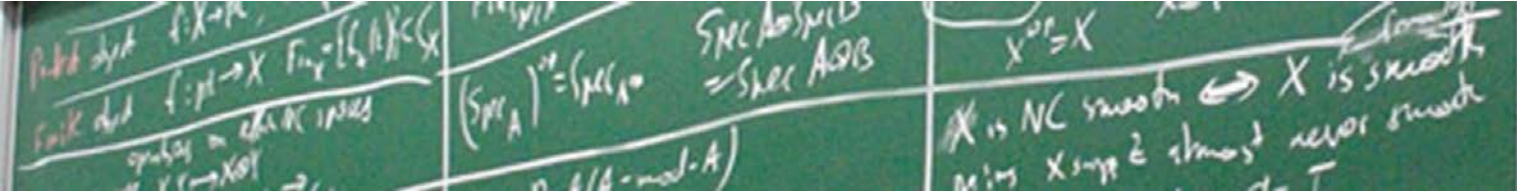
2017

**Slava Rychkov\*** has developed analytical and numerical techniques and obtained unexpected results, particularly in conformal field theory.

● Mathematician

● Theoretical physicist

\* Professor currently at IHES



## PROGRAM

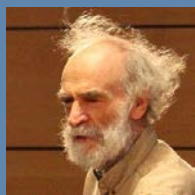
### Scientific events at IHES

A series of events, labelled '60<sup>th</sup> Anniversary' will take place at the Institute in 2018. They will be addressed to a specialist audience but might include a time for informal discussions with the organisers that will help put the subject into perspective and highlight its general importance as well as the history of its development at IHES.

**Maths – biology interface : 5 – 9 March 2018. “From molecules and cells to human health”.** Conference organised by N. Segev (University of Illinois at Chicago), A. Harel-Bellan (IHES), M. Gromov\* (IHES) and N. Morozova (CEA).

One of the currently most rapidly evolving research fields is found at the interface between biology, physics and mathematics. IHES actively takes part in this movement through regular seminars and bigger events. The purpose of this conference is to bring together leading researchers from different areas of biology with scientists from other disciplines to discuss on how breakthrough ideas and experiments in molecular biology have influenced their current work.

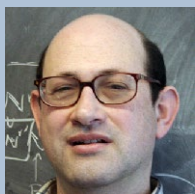
\* Misha Gromov, permanent professor at IHES since 1982, emeritus since 2016



Misha Gromov completely reshaped geometry during the 1980's. His huge achievements have been recognized through many international prizes and continue inspiring generations of mathematicians. At the end of the 1990's he started working at the interface between mathematics and biology. This fascinating research field gives biologists the opportunity to apply mathematical models to their experiments, to help point out the emergence of new concepts or new important parameters.

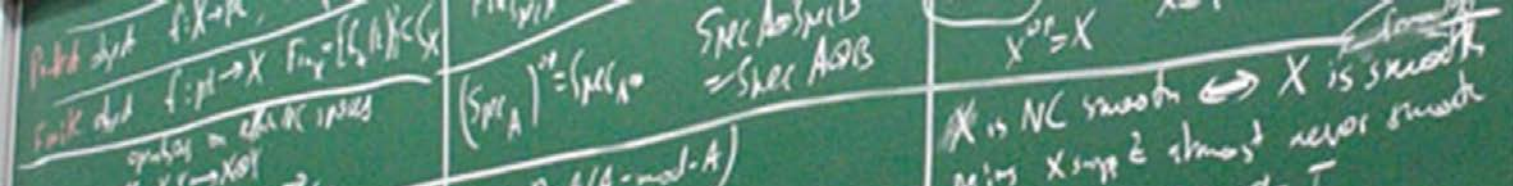
**Mathematics : 11 – 15 June 2018. “Arithmetic algebraic geometry - conference in the honor of Ofer Gabber on the occasion of his 60th birthday.”** organized by A. Abbes (IHES, CNRS), S. Bloch (University of Chicago), L. Illusie (université Paris-Sud) and B. Mazur (Harvard).

Arithmetic algebraic geometry is a broad and central area of mathematics. This conference will focus on a number of areas of important progress over the last three or four years and it will be dedicated to Ofer Gabber\*. It aims at attracting a wide audience where the presence of more experienced mathematicians will be balanced by the one of young talented researchers.



\*Ofer Gabber, CNRS Research Director since 1984

Ofer Gabber was a child prodigy who proved complex conjectures in the early 1980's. He has continued to do profound work, touching upon practically every area of arithmetic geometry. Ofer's work is broadly applied today. He is also known for his extreme rigor and reliability, and his capacity to detect any minimal inconsistency. Very generous with his ideas, for thirty years he has been an inspiration for other mathematicians, including some of the very best.



**Physics : Summer school, 16 – 27 July 2018. “Supersymmetric localization and exact results”**. Scientific committee : V. Pestun\*, S. Pufu (Princeton University), J. Teschner (Deutsches Elektronen-Synchrotron-DESY)

Since 2006, summer schools have been one of the priority of the Institute’s scientific policy and a visible event in the scientific community. Every year a group of researchers, leaders in their field, organize two weeks of courses addressed to a selected audience of young researchers and covering current research topics. Traditionally mainly focused on mathematics, the IHES Summer School will for the first time be dedicated to physics, particularly to the significant progress that has been made during the last decade in gauge theories. The 2018 Summer School will focus on the development of new techniques and on supersymmetric localization.

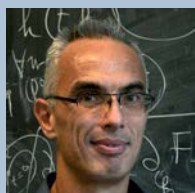


*\*Vasily Pestun, permanent professor at IHES since 2014*

*Vasily Pestun’s recent arrival continues the IHES tradition of research in quantum field theory and string theory, a highly abstract subject in theoretical physics which requires remarkable mathematical knowledge. He importantly contributed to his research field and his articles are among the most cited by his peers. Since his arrival at IHES, he has actively participated to the Institute’s scientific activity and contributed to its attractiveness, especially among a group of post-doctoral researchers who gather around him.*

**Mathematics - informatics interface: on 15 - 19 October 2018 “20 years of Google matrix: fundamental aspects, applications and beyond”** . Scientific committee: A. Benczur (Hungarian Academy of Sciences), D. Shepelyansky (université Paul Sabatier, CNRS), Emmanuel Ullmo\* (IHES)

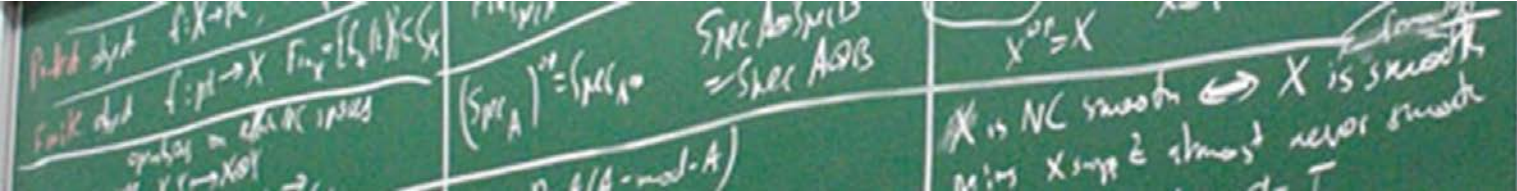
The volume of available numerical data grows significantly, as well as research on subjects related to Big Data. For the first time IHES will host a conference touching upon such subjects. This workshop will aim to present the fundamental characteristics that determine the efficacy and the control of the information flux on directed networks, including the fundamental properties of the Google matrix, 20 years after the seminal paper by Sargey Brin and Larry Page.



*\*Emmanuel Ullmo, mathematician, Director of IHES*

*Specialist in arithmetic geometry, he alternated between posts in France and abroad (IMPA in Brazil, Princeton University in the United States and Tsing-Hua University in the People’s Republic of China) before becoming Director of the Department of Mathematics of Orsay, then the directorship of IHES in 2013. Under his impetus, the scientific activity of the Institute intensified, especially with the reception of many postdoctoral and the creation of two permanent faculty positions.*





## Savant Mélange, the scientific research evening



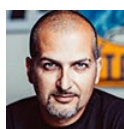
Meeting some among the most renowned researchers, the science enthusiasts, and sharing their passion, that is the purpose of Savant Mélange.

Fundamental research aims at understanding the structures of the universe and it often makes use of very abstract ideas. However, words like algorithm, relativity and quantum computing have become part of our daily vocabulary. Such is the contribution of theoreticians to everyday technologies. The mixture of intuition, experimentation, elegance and creativity that is the core of fundamental research confirms every day the irreplaceable, even though at times invisible, role of fundamental sciences.

The Institute will invite some of these visionary minds to share their discoveries and their passion for research at this unique event.

The evening will be hosted and animated by Mathieu Vidard, on 16 October, at Grand Amphithéâtre of the Sorbonne.

### ... Confirmed speakers...



#### **Bruce Benamran, filmmaker**

Bruce Benamran has a background in computer science and is mostly known for his French speaking popular science YouTube channel e-penser, which presents outreach programs on mainly scientific topics. He created his channel in August 2013 and has reached, nowadays, near one million subscribers .



#### **Malek Boukerchi, philosophe et conteur**

Malek Boukerchi obtained degrees in sociology of organizations, social philosophy, intercultural management, political and trading theology. In 2006, he created his own structure to advise companies looking for managerial and/or commercial performance. He offers interactive and fun conferences, coaching and personalized support. He is also a fan of parables and is ultra-runner.



#### **Thibault Damour, permanent professor since 1989, 2017 CNRS Gold Medal**

Thibault Damour is world-wide appreciated for his work on black holes, pulsars, gravitational waves and quantum cosmology. He has received several international awards, especially following the detection of gravitational waves in 2016, to which he importantly contributed through his theoretical work.. He (co-)wrote various popular science books on physics.



#### **Hugo Duminil-Copin, permanent professor since 2016**

Recruited at 31 as permanent professor at IHES, Hugo Duminil-Copin is a very talented mathematician ; he received numerous international awards thanks to his work on probabilities.



#### **Olivier Peyon, director and screenwriter**

A director and a fiction screenwriter, in 2013 Olivier Peyon realized a documentary feature, "How I Came to Hate Maths", nominated for the 2014 Best Documentary Feature César Award. The documentary investigates the role of mathematicians in our society through interviews to a range of international figures.



#### **Laure Saint-Raymond, mathematician**

Laure Saint-Raymond is a professor at École Normale Supérieure in Lyon, and a member of the French Academy of Sciences. since 2013. She is interested in describing physical phenomena through mathematical models.



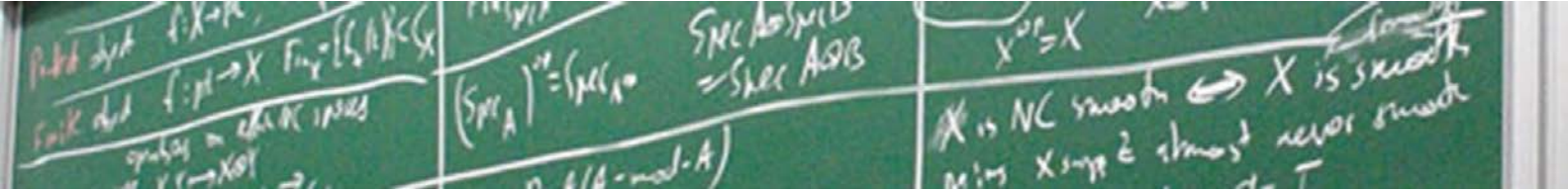
#### **Cédric Villani, médaille Fields 2010**

Cédric Villani is a close friend of IHES, which he attended as a scientist for many years. A strong defender of science to the general public, he is now a Congressman of the Essonne region and has recently been in charge of a mission on artificial intelligence..



#### **Claire Voisin, mathematician, CNRS Gold Medal 2016**

Claire Voisin is a CNRS research director at the Jussieu Mathematics Institute in Paris and a member of the French Academy of Sciences. Recently she has become the holder of the new chair in algebraic geometry at Collège de France.. Pure mathematics is what fascinates her the most.



## New building opening ceremony at IHES (16 November 2018)

Under the chairmanship of the Minister of Higher Education, Research and Innovation, *Frédérique Vidal*

The construction of a new building that will host more research offices will start in 2018 as a natural consequence of an intensified scientific activity. Among the ambitious projects of Emmanuel Ullmo, the Institute's Director, there is the creation of two new professorships, an intensified post-doctoral programme, regular series of lectures given by IHES professors, "Les Cours de l'IHES".

This ceremony will constitute an occasion for him to present his project, but also to officially launch the Institute's third fundraising campaign which aims at supporting his strategy. The Institute's institutional partners, especially within the Paris-Saclay community, as well as its private partners, will be invited to this event, which will be followed by a closing cocktail party.



## PUBLICATIONS

The Institute's 60<sup>th</sup> Anniversary will be highlighted in all of its institutional publications. In particular, the communication service is planning to release a special edition of the annual newsletter in November 2018.

A more ambitious project involving Anne-Sandrine Paumier\*, an historian of science, and Stéphane Deligeorges\*\*, a scientific journalist, is in preparation. The book will retrace the big scientific landmarks of the Institute's sixty years of existence. It will be published during the third trimester of 2018. This publication has obtained the UNESCO patronage.



\*Anne Sandrine Paumier

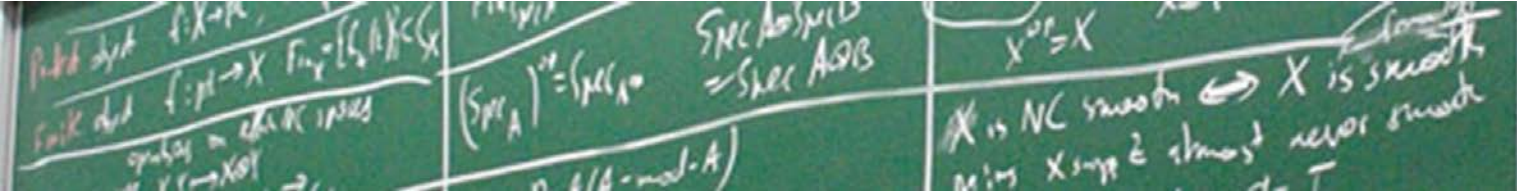
With a background in mathematics (ENS Lyon and PhD from UPMC, Paris), Anne-Sandrine Paumier is an historian of science interested in the "geography of mathematics" after World War II. Her focus is on the different places where mathematics was studied at this specific time in history, and on their impact on the way in which mathematics was done as well as on the scientific results. She did a post-doc at IHES, where she studied the history of the Institute starting from its archives and the memories of those who were there.



\*\*Stéphane Deligeorges

Stéphane Deligeorges is a scientific journalist with a degree in philosophy. He worked for different newspapers (Nouvelles littéraires, Libération) and he was editor in chief of the scientific magazine Sciences et Avenir.

He hosted the weekly program "Continent sciences" by France Culture and he produced news reports everywhere in the world. At the same time he is director of scientific collections by éditions Carré and editor Christian Bourgeois. He published several books and was awarded the Grand prix de l'Académie des Sciences for scientific communication and the Prix du Sénat for his program Continent Sciences.



## PUBLIC RELATIONS AND MEDIA



Organisation  
des Nations Unies  
pour l'éducation,  
la science et la culture



### Partners

The Institute obtained the UNESCO patronage for the general audience event. It will also rely on its institutional partners, such as CNRS and the French Ministry of Higher Education, Research and Innovation.

The Institute has also benefited from the network of both its sponsors and its institutional partners for the organisation of its 60<sup>th</sup> anniversary.

#### 60<sup>th</sup> Anniversary supporters

**Schlumberger**  
**Dr. Raymond and Beverly Sackler**  
**UNESCO**  
**Génopole**  
**BNP Paribas**  
**Fondation mathématiques Jacques Hadamard**  
**Institut Clay**  
**CNRS**  
**Institut Curie**  
**Société Générale**  
**Ville de Paris**  
**Google**

### Communication

Facebook and the IHES web site will be a showcase for all events. E-mails will be sent out to a selected target audience as a reminder of the important dates as well as of the Institute's activity. A mini web site and a campaign on social media will advertize the general audience conference.

All events will be video recorded and published on the IHES YouTube channel, which got more than a million views and 10,000 followers. The Institute will internally produce short video interviews with the organizers of the scientific events.

Depending on the media partnerships that will be formed, interviews with the conferences organizers and with the speakers will possibly be organized all the year long. It is important to keep in mind that mathematics will be particularly put forward as a topic during the international congress of mathematics, when the Fields medals will be awarded, in August 2018.



Algebras  
 $A$  Alg. algebra  $\rightarrow X = \text{Spec } A$   
 $C_X = A$ -mod (in  $A$ -mod)

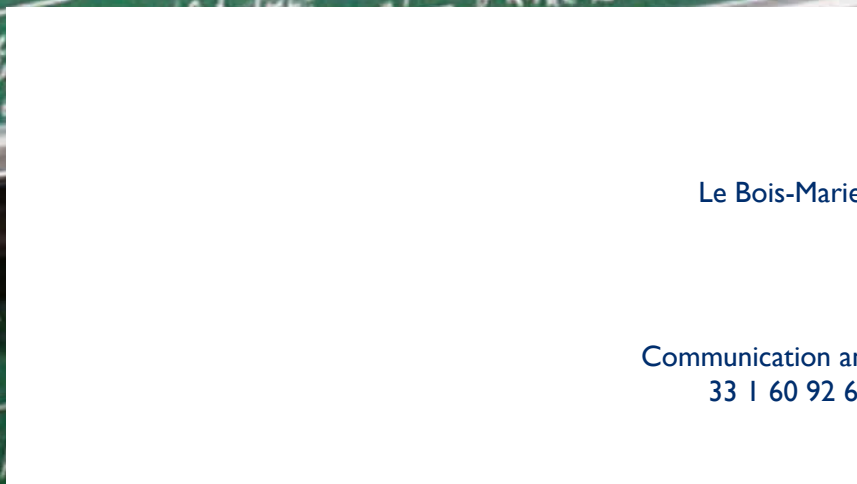
$X$  usual scheme  
 $\rightarrow H^0(C_X) = \mathcal{D}(\mathcal{O}_X)$   
 usual:  $\mathbb{Z} \subset X \rightarrow X_{\text{supp}}$

NC morphisms  $\rightarrow$  usual morphisms  
 graph  $f \in \mathcal{D}(\mathcal{O}_X \times Y)$   
 supp proper  $X$   
 perfect over  $X$

$f: \text{Spec } A \rightarrow \text{Spec } B$   
 $M \in B$ -mod  $A$   
 $\Leftrightarrow$  bimodule  
 perfect as  $A$ -mod  $f_*$   
 $\in$  non Karan; closed  $f_*$   
 subset  $\in A$ -mod  $M \otimes_A A$

$P^1 = \text{Spec } A$   $A = \text{S.d.}(\mathcal{O}_1 \otimes \dots \otimes \mathcal{O}_n)$   
 usual perfect complexes.  
 For  $X$   $H^0(\text{Fin}_X) = \mathcal{D}_{\text{conv}}^b(\text{Coh } X)$   
 $X \geq \mathbb{Z}$   $H^0(\text{Fin}_X) = \text{Perf}(X)$   
 $X^{\text{op}} = X$   $X \otimes Y = X \times Y$

$(\text{Spec } A)^{\text{op}} = \text{Spec } A$   $\text{Spec } A \otimes \text{Spec } B = \text{Spec } A \otimes B$   
 $A \in \text{Perf}(A\text{-mod-}A)$   
 $X$  is NC smooth  $\Leftrightarrow X$  is smooth  
 Min  $X_{\text{supp}}$  is almost never smooth



$C(A)$   
 $H^i(C(A)) = \text{Tor}_{i, \text{mod } A}^1(A, A)$   
 comes from differential  
 $\mathcal{D}(\text{Ker } d_i: A \rightarrow H^i(A) = 0 \quad i < 0$

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