bois-marie

INSTITUT DES HAUTES ÉTUDES SCIENTIFIQUES

editorial

What is the point of basic research? This question is often asked of those who have a curiosity-driven rather than a utilitarian approach to their work.

One way to answer this is to show the continuum that exists from basic to applied research. As we celebrate this November the centenary of Einstein describing General Relativity, we recall that without this breakthrough, our GPS systems would operate with the required degree of precision for about two minutes only, once activated. Many technological innovations in the aerospace industry, telecommunications or medical research involve extremely complex theoretical models. Basic research is more than ever a strategic issue for companies.

The socio-economic impact of a reputedly abstract discipline such as mathematics has recently been measured in France: the study (published in May 2015) gives proof positive that mathematics contributes to the creation of added value up to 15% of GDP. A similar result was found in studies in the UK in 2012 and in the Netherlands in 2013 (16% and 13% respectively). A report published by the American Academy of Arts and Sciences in the United States in 2014 has no hesitation in stating that the country's entire economy has greatly benefited from massive investment in science and engineering in the 20th century.

China is also emerging as a leader in R&D funding ($600bn by 2020), with very significant support for basic research. This is a key political issue.

As well as its decisive role in most technological innovations and its impact on economic players, basic research contributes to deep thinking. Whether solving the mysteries of black holes or of morphogenesis, theoretical sciences are some of the most powerful tools to understand the world better. The scientific method is driven by a desire to push the boundaries of knowledge, which is also a desire for independence and freedom - two of IHÉS' core values.

The Institute is a place of knowledge and sharing, led by its faculty and visiting professors. IHÉS is more than ever determined to fully play its part within the scientific ecosystem, by offering exceptional scientists a place where their research can flourish. This Bois-Marie will give you an idea of their intellectual curiosity and of the thriving scientific activity at the Institute. Supporting the IHÉS model for the benefit of the entire scientific community is essential.

Marwan Lahoud
Chairman of the IHÉS Board of Directors

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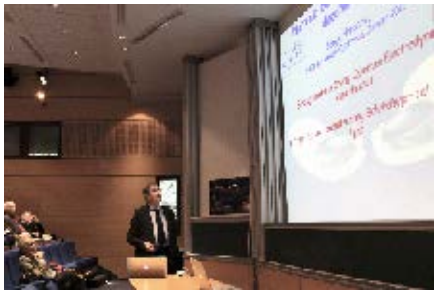
quantum mechanics trimester

For the first time at IHÉS, Thibault Damour, Jürg Fröhlich and David Ruelle organised a trimester on Quantum Mechanics.

Many of the most important experiments that test fundamental predictions or puzzling aspects of Quantum Mechanics have been carried out by research groups in France, in particular ones working in the Paris area. Furthermore, theoretical work on the foundations of Quantum Mechanics has a long-standing tradition in France, which has continued to this day. Finally, problems concerning the unification of quantum theory with a theory of gravitation are actively pursued by people in the Paris area and, in particular, at IHÉS.
The program brought together experimental and theoretical physicists with an expertise in quantum sciences. It was held over 11 weeks with an opening colloquium on 29 January, then a weekly seminar from 4 February to 1 April with talks and discussions around a specific topic. It ended with a closing colloquium on 9 April.

Pierre Cartier, Thibault Damour, Claude Cohen-Tannoudji

There were 37 speakers during this trimester, including Alain Connes, Alain Aspect, Serge Haroche, Claude Cohen-Tannoudji, Jean Dalibard.



Serge Haroche

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You can also keep up with IHÉS news on our Facebook page :

summer school

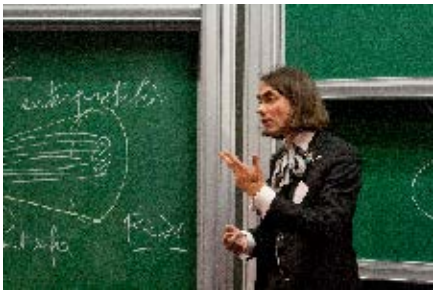
The summer school was organised by Joanna Nelson, Daniel Cristofaro-Gardiner and Joël Fish and was held from 6 to 17 July.

This Summer School, on *Moduli Problems in Symplectic Geometry,* aims to provide PhD students, post-docs, and young researchers with an overview of recent developments in the theory of moduli spaces of pseudoholomorphic curves in symplectic and contact geometry. This year, 7 mini lectures with moderated discussions and related talks by a senior researcher on current and future directions in the field were added to the programme.

Dusa McDuff with Summer School participants

Huawei conference

Stéphane Mallat



Cédric Villani

As part of the partnership with Huawei, IHÉS and Huawei Technologies France's Mathematical and Algorithmic Sciences Lab organised their first joint conference on 15 May, in the Marilyn and James Simons Conference Centre.

Francis Bach, Cédric Villani, Mérouane Debbah and Stéphane Mallat were invited to speak during this day of meetings and exchanges among researchers from both institutions.

Alexander Grothendieck

Alexander Grothendieck, who passed away on 13 November 2014 in Ariège (South-West of France), left a profound mark on the history of mathematics. Hailed as one of the most influential mathematicians of the 20th century, his ambitious programme of bringing together arithmetic, algebraic geometry and topology continues to structure contemporary mathematics.

Alexander Grothendieck was one of the first permanent professors at IHÉS at its creation in 1958 and remained there for 11 years. He set up the extraordinary *"Séminaire de Géométrie Algébrique"*.
Grothendieck was demanding, original and generous and those qualities shaped the spirit of the Institute. The name of the Institut des Hautes Études Scientifiques is inextricably linked to Grothendieck's.
IHÉS wanted to pay tribute to him and inaugurated on 21 January, in partnership with CNRS, the *"Laboratoire Alexander Grothendieck"* where all mathematical and theoretical physics fields will be covered.
The laboratory was established as a Certified Research Team (ERL) and enables the fruitful historical relations between IHÉS and CNRS to perpetuate.

Ahmed Abbes and Emmanuel Ullmo organised an inaugural conference day, broadcasted simultaneously at the Morningside Center of Mathematics, the Chinese Academy of Sciences and the Department of Mathematical Sciences, Tokyo University.

Emmanuel Ullmo

quantum gravity in Paris

The *Quantum Gravity in Paris* workshop meets once a year for four days, including a special day at IHÉS. Over the years, the workshop has led to new collaborations between researchers and strengthened ties among the research institutions involved in its organisation.

2015 freshers' welcome for FMJH Masters' students

Located since 1962 in the Chevreuse valley at the heart of the world's largest pool of mathematicians, the Institute has always maintained close relations with the French mathematical community and is delighted to be organising collaborative events such as welcoming Masters' students. On 2,3 and 4 September 2015, IHÉS welcomed nearly 90 students for a joint start to the academic year, organised by the Jacques Hadamard Mathematics Foundation, for Université Paris-Sud, Université Versailles St Quentin, ENS Cachan, ENSTA and École Centrale Paris.

a day to explore Maxim Kontsevich's contributions

Friends of IHES took advantage of Maxim Kontsevich's visit to the United States to receive his Breakthrough Prize in Mathematics to organise a conference on his work. This event took place at the Simons Foundation on 18 November.
Two of Maxim's close colleagues, Tony Pantev and Anton Kapustin, explored some of his contributions to mathematics and their interactions with physics.

random maps day

Since the early 2000's, there has been increased interest in the study of random maps in theoretical physics, combinatorics and probabilities. In order to bring together scientists working in this field and to facilitate interactions between maths and physics, special *"random maps days"* have been held on a regular basis since 2006 and almost bi-monthly since 2012.
The two last days were held at IHÉS.

Emmanuel Ullmo, elected Member of Academia Europaea

In July 2014, Emmanuel Ullmo was invited to become one of the 278 new members of the Academia Europaea, including 13 in the mathematics section. The mathematicians Jean Bourgain, Jean-Pierre Bourguignon, Mikhail Gromov, Maxim Kontsevich and Cédric Villani, all connected with IHÉS, are among the existing members of the Academia Europaea's mathematics section.

Maxim Kontsevich

Professor Maxim Kontsevich was elected as foreign associate of the National Academy of Sciences in April in recognition of his contributions to fundamental research. He also received an Honorary Doctorate from the University of Vienna on 11 June, with 5 other laureates.

Celebration in the Great Hall of the University of Vienna

the new Université Paris-Saclay

Université Paris-Saclay was officially created on 29 December 2014 and brings together 19 Institutions of higher education and research, among which IHÉS.

As a world famous centre of scientific research and a driving force for innovation and economic development, Université Paris-Saclay is a major scientific, economic and territorial project for France and Europe. Since 2008, 19 research organisations (two universities, École Normale Supérieure, six research institutes and 10 engineering and business grandes écoles) have decided to join forces within the Paris-Saclay Campus Foundation to create the Université Paris-Saclay.
These 19 founding institutions are of a diverse nature yet complementary. Together, they offer a very high standard of training and, through interdisciplinary activities, they combine a scientific potential that is recognised in France and internationally as being first rate. The ambition of this project is to create a major research university based on the development of a continuum from basic to applied sciences using the skills, diversity and wealth of experience of the various players.
IHÉS has naturally chosen to be one of its founding members and is proud to have taken part in this project from its creation.

high school students visit IHÉS

Regional educational mathematics inspectors from the Versailles Academy organised a morning session at the Institute on 11 April for high school students, so that they could learn more about research in mathematics and theoretical physics.
100 students from 33 high schools from the entire Academy visited the IHÉS' facilities. They then attended two conferences. Pierre Vanhove, physicist and CEA senior researcher at IHÉS, presented a conference on *Gravitation Attractiveness* during which he explained the history of gravitation conception, from Aristotle to string theory. Pierre Pansu, mathematician and professor at Université Paris-Sud showed several "*Histoires courtes*" in which researchers explain their activities, and then commented these on the basis of his own experience. The many questions asked by the students were a mark of their interest in these topics and IHÉS is delighted to provide this type of interaction between researchers and the general public.

arrival of Francis Bach

Schlumberger

The sources of inspiration for theoretical sciences are many: from questions lying at the very foundation of sciences to issues arising from developments in industry.
It is on this particular point that Schlumberger, a long-time partner with whom a relationship of trust and mutual respect has been built since 1994, wished to support IHÉS. The largest French donor of the Fiftieth Anniversary Campaign therefore created the Schlumberger Chair for mathematical sciences at IHÉS in 2006. Chair holders are invited to the Institute for research visits, in order to undertake research relating to topics at the interface with high technology.
Francis Bach is the holder of the Schlumberger Chair for mathematical sciences at IHÉS, starting from 1 September for a period of 6 months.

Francis Bach

Francis Bach is currently a researcher at INRIA and has been leading since 2011 the SIERRA project team, which is part of the IT Department at École Normale Supérieure.
After studying at École Polytechnique, he joined the Corps National des Mines (Paris). He then obtained an MSc in Applied Mathematics at École Normale Supérieure (Cachan). In 2005, he completed his PhD in Computer Science at University of California Berkeley (where he was awarded the Eli Jury Award for the best thesis in signal processing) under the supervision of Professor Michael Jordan. In 2007, he spent two years in the Mathematical Morphology group at École des Mines de Paris, and then joined the WILLOW project-team at INRIA/École Normale Supérieure until 2010.
His area of research is statistical machine learning, especially in graphical models, artificial vision, image and signal processing, bioinformatics and brain. He develops tools for processing massive and complex data sets.
Among many other prizes and scientific awards, he received the Microsoft Research Fellowship in 2002 (awarded to 12 students in the US each year) and the INRIA Prize for young researchers in 2012.

other IHÉS Chair holders

Schlumberger Chair for mathematical sciences at IHÉS
Felix Otto, mathematician, Max-Planck-Institut in den Naturwissenschaften, Leipzig (Deutschland).

Israel Gelfand Chair
Spencer Bloch, mathematician, University of Chicago (USA).
Francis Brown, mathematician, All Souls College, Oxford University (UK).
Samson Shatashvili, physicist, Hamilton Mathematical Institut, Trinity, Dublin (Ireland).

Louis Michel Chair
Ali H. Chamseddine, physicist, American University of Beirut (Lebanon).
Eliezer Rabinovici, physicist, Hebrew University of Jerusalem (Israel).

René Thom Chair
Robert C. Penner, mathematician, California Institute of Technology (USA), Aarhus University (Denmark), University of Tokyo (Japan) and MPIM, Bonn (Deutschland).

Les Amis de l'IHÉS

Les Amis de l'IHÉS, an association aiming to raise awareness of IHÉS within a wider audience, once again held two public conferences this year.

IHÉS welcomed for the first time on Thursday 6 November Jean-Louis Etienne, a one-of-a-kind scientist who shared his experience as passionate polar explorer with the public. His talk, *"The antarctic circumpolar current, a major factor in the climate?"* was illustrated by a slideshow of pictures taken during his expedition. The conference was followed by a debate with a large audience.
On 25 June, Yves Barral from ETH Zurich gave a lecture: *"Living theories, theories of the living"*, followed by a musical interlude by pianist Paloma Kouider. He addressed the questions emerging from the huge progress made in genome sequencing and functional analysis over the years. He also mentioned the ubiquity of cognitive systems in the living world and their possible links with as yet poorly understood phenomena such as aging. About 60 people attended this fascinating lecture.

Jean-Louis Étienne

Yves Barral

cours de l'IHÉS

The Cours de l'IHÉS*, a scientific activity initiated in 2013 by the new director, were created with the aim of teaching current research in total freedom to anyone interested, and helping with the dissemination of scientific knowledge.*

The *Cours de l'IHÉS* are given by permanent professors, senior researchers holding positions at IHÉS, chair holders, or invited professors from other institutions. They generally focus on speakers' recent work but are also the opportunity to present the latest developments in a major research topic.
Lectures are free of charge and open to everyone, within space constraints.
Videos of the lectures are all available online on the Institute's YouTube channel.

Dennis Gaitsgory

Mathieu Lewin

The 2014-2015 programme offered many lectures straddling both mathematics and theoretical physics, in the tradition of this specific feature at IHÉS, which gives rise to fruitful exchanges between mathematicians and theoretical physicists.

Vasily Pestun (permanent professor, IHÉS): *Quantum Gauge Theories and Integrable Systems*

Mikhail Gromov (permanent professor, IHÉS): *Probability, Symmetry, Linearity*

Maxim Kontsevitch (permanent professor, IHÉS): *Exponential Integral*

Samson Shatashvili (Trinity College Dublin & IHÉS): *Supersymmetric Vacua and Integrability*

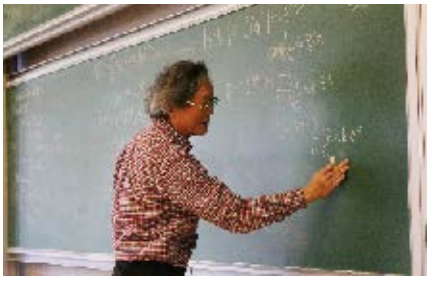
Francis Brown (CNRS-IHÉS): *Périodes motiviques et groupe de Galois cosmique*

Masaki Kashiwara (RIMS, Kyoto) - **Pierre Schapira** (Université Paris 6): *Indsheaves, Temperate Holomorphic Functions and Irregular Riemann-Hilbert Correspondence*

Dennis Gaitsgory (Harvard Univ.): *Singular Support of Coherent Sheaves*

Mathieu Lewin (Université Paris-Dauphine): *Mesures de Gibbs non linéaires et leur dérivation à partir de la mécanique quantique*

Ofer Gabber, Vasily Pestun



Masaki Kashiwara

Samson Shatashvili

Francis Brown studied at the University of Cambridge, then at ENS in Paris. After his doctorate, he went on short visits to the Max-Planck Institute for Mathematics in Bonn and to the Mittag-Leffler Institute in Stockholm, as part of the Post-Doctoral European Institute programme. He joined the CNRS in 2007 and obtained the CNRS bronze medal in 2012. He also received in the same year the Élie Cartan Prize from the Académie des Sciences de Paris for his "proof of two conjectures relating to multiple zeta values".
Francis Brown's work lies at the intersection of algebraic geometry and arithmetic. He has worked in particular on motivic periods, especially multizeta functions. His contributions include: the resolution of the Goncharov-Manin conjecture on moduli spaces of curves, Hoffman's conjecture on multizeta functions and the Deligne-Ihara conjecture on mixed Tate motives over Z.
Part of Francis Brown's research revolves around questions arising from quantum field theory, especially the "cosmic Galois group" programme, which was started by many people connected with IHÉS, in particular Pierre Cartier, Alain Connes, Maxim Kontsevich and Dirk Kreimer.
This is a programme that seeks to reinterpret the theory of renormalisation in physics with Grothendieck's motivic Galois theory. It enables perturbative quantum field theory to be studied from an algebraic geometry point of view.

Christophe Soulé, Francis Brown, Don Zagier

Having been a visiting professor, conference speaker, CNRS senior researcher at IHÉS, and Chair holder, Francis Brown talks of his experience as a researcher at IHÉS.

I initially came to IHÉS to talk with Pierre Cartier because I wanted to present a mathematical result to him. *"It's a conjecture due to Goncharov and Manin. It's an open problem. You can't write a one-page note without any proof"*, was his comment. That was in 2005. I started coming to IHÉS every week: I would fine-tune my proof, Pierre Cartier would challenge it and I would come back the following week. That was how I ended up writing my thesis on the moduli spaces of curves.
I owe the Institute my encounter with physics. Dirk Kreimer was at IHÉS at the time; he organised a conference on *"Field theory, periods and polylogarithms"* in 2009 and invited me to present my results. Dirk was decisive in my developing a taste for physics, he has real talent for getting mathematicians interested in what he is doing. He had highlighted the structure of Hopf algebras on Feynman diagrams and had used it in his joint work with Alain Connes. There were striking similarities with geometry. Together with Spencer Bloch, they had started to work on the question of motives in the context of Feynman integrals. It was a very important time for me: I had just finished my thesis, so I joined the bandwagon. It's exhilarating to be riding the crest of the wave rather than to be swimming against the tide.
The idea to linking Grothendieck's motives with Feynman's theory is an idea that was born at IHÉS: Alain Connes has written something on this, as have Pierre Cartier and Maxim Kontsevich. This idea of wanting to combine Grothendieckian ideas with quantum theory in physics had been around for a long time. It was only later that I understood how to do it. The key point is an operad structure on hypersurfaces associated with Feynman diagrams. The latter were defined by Bloch, Esnault and Kreimer using the Kirchhoff polynomial, discovered in the 19th century to study electrical circuits. This operad structure is similar to a structure on moduli spaces of curves that I used in my thesis. However, this coincidence appeared to be superficial and at that time, we didn't quite know what to do with it. To unblock the situation required the concept of motivic periods – which came out of my work on multizetas – and which, in certain situations, allows a rigorous construction of a Galois theory of periods. This applies perfectly in the physics situation and it's by putting all these ideas together that Cartier's dream can be made to come true: defining a "cosmic Galois group" and drawing practical consequences for particle physics from it. That is what I chose to present in my Cours de l'IHÉS this year.
Both visiting and permanent professors come to listen to the lectures, which bring together all the people who are at the Institute at the same time, as well as people from outside – who can change as the sessions progress, since the videos are now freely accessible. The lectures have a very special atmosphere: participants ask many very precise questions. You can sense their interest in the subject. For the speakers, giving these lectures are helpful to focus their thoughts. Having held a post at IHÉS, I am coming back to IHÉS! I will be a holder of a Gelfand Chair, which represents a fantastic opportunity to come back to the Institute for three months every year over the next three years. IHÉS offers wonderful conditions. This year was the first time that I stayed at the Ormaille residence, it's an aspect of life at the IHÉS that I hadn't yet experienced. There is a community spirit and comradeship which is not always obviously apparent to a permanent professor. But what I prefer the most is the Bois-Marie. When I am stuck on a calculation I put my pen down and take a walk in the woods to clear my mind. It is wonderful to be in this intensely beautiful natural environment and 20 minutes in the woods can sometimes save hours of calculation.

Francis Brown

"séminaire de géométrie algébrique"

Luc Illusie was a student of Alexander Grothendieck and he attended the *Séminaire de Géométrie Algébrique* (SGA). He spoke from Tokyo on 21 January during the IHÉS Paris-Beijing-Tokyo Arithmetic Geometry Seminar. That day, the CNRS and IHÉS were inaugurating the *"Laboratoire Alexander Grothendieck"*. A perfect opportunity to remember the man Luc Illusie calls the Master and to share his memories of the SGA.

I would first like to thank the organisers for the honour of being invited to say a few words to start the day, today being the inauguration of the *"Laboratoire Alexander Grothendieck"*.

The international reputation achieved by IHÉS right from the start is clearly due to Grothendieck and in particular, to the seminars he conducted during the sixties, the "SGAs". They took place every week, on Tuesday afternoons. They were held in the former music room, converted to a library and then to a foyer which is now adjacent to the Marilyn and James Simons auditorium. They were long seminars, in the tradition of those given by Hadamard and Cartan. They were spread over a year, sometimes two. They enabled an entire theory to be developped from its inception. They also played the usual social role of enabling mathematicians from different backgrounds, who shared here the same interests and motivations, to meet and interact. This type of seminar no longer exists. Its spirit can however still be found in certain intensive work groups devoted to a single topic.

I started attending the Grothendieck seminar in the autumn of 1964. It was SGA 5. I had not, alas, been there for SGA 1, 2, 3 or 4 and would also have missed SGA 5 if Grothendieck hadn't pressed me to come and listen to it and, making me very anxious, asked me to write notes for his presentations. At the time, my understanding of algebraic geometry was rudimentary to say the least and I believed that I would never be able to understand a seminar of that level. To my surprise, however, I did. It was because of Grothendieck's style. Those who have had the privilege of listening to him remember it. At the board, he was impressively dynamic but always methodical, clear and rigorous. He would first carefully go through the equipment that was required, explain the seminar's goal and outline and then he would begin: a well-oiled mechanism would produce definitions, examples, statements and (complete) demonstrations, following one another almost seamlessly. In discussing corollaries and applications, he would not hesitate to launch into long digressions, if he felt that these shed an interesting light on the topic. He liked to see mathematical objects in all their facets. When I say "complete demonstrations" he did occasionally assert that such and such verification was "pure routine" and left it to the members of the audience. That was the case especially for diagram commutations: any diagram, if sufficiently natural, would commute (or in the worst case scenario, anti-commute).

> "Of course, he used the language of derived categories and functors from the start, which I discovered with delight. Fifty years on, arithmetic geometers still use this language daily."

It was therefore easy to take notes. And yet the content was incredibly innovative, rich and profound. It dealt with local duality in étale cohomology for torsion coefficients: Grothendieck formulated his famous conjectures at the beginning of the seminar on absolute purity and the existence of dualising complexes[1]. From there, Grothendieck would move on to the theory of cycle classes and to homology[2] and then to the Lefschetz-Verdier formula, the Grothendieck-Ogg-Shafarevitch formula, his own Lefschetz formula on curves using the Nielsen-Wecken method and finally, during the second year (1965-66), to ℓ-adic sheaf theory and the rationality of L functions. Of course, he used the language of derived categories and functors from the start, which I discovered with delight. Fifty years on, arithmetic geometers still use this language daily. Although progress has been made, conjectures have been demonstrated, new tools have appeared, the language itself, "the six operations", is essentially not a day older.

In the SGA 5 audience, I remember of course Grothendieck's students: Berthelot[3], Demazure, Giraud, Jouanolou, Raynaud (Michèle et Michel), Verdier, and also the more "senior" ones: Dieudonné, Samuel, Serre (who came occasionally), Tate (who spent the 65-66 academic year in Paris). A young student of Tits called Pierre Deligne had arrived in January 65. He attended the seminar but his presence was barely noticed, such was his discretion. Soon, however, the Master spoke to me about him. Topos theory, étale cohomology presented basic issues which neither he or Artin or Verdier could solve (existence of non-empty topos with no points, coincidence of "base change" arrows defined in two obvious possible ways). Child's play for Deligne. There was nothing he could not tackle.

The bulk of the presentations were given by Grothendieck, at least in the first part of SGA 5. In the second part, he had invited young colleagues to take over: Jouanolou, Bucur, Houzel. He liked to ask his students to write his talks. They learned their trade that way. His was a tough school. The Master was dauntingly demanding. I have told elsewhere[4] of the long afternoons I spent in his home examining one by one

the criticisms and suggestions with which he had covered the drafts I had submitted to him. Results had to be presented in their natural form which usually meant in the most general form. Everything had to be demonstrated. Any *"It is clear that"* or *"It can easily be seen that"* was banned. Mathematical content wad discussed item by item and so was the order of the words in a sentence and punctuation. Length mattered little. If a complement seemed interesting, it was welcome. We often didn't finish before eight in the evening. He would then invite me to a simple dinner with his wife Mireille and their children. After the meal, as a treat, he would tell me of pieces of mathematics he had been thinking about lately. He would improvise on a blank piece of paper, using his fat pen, his writing narrow and fast, sometimes stopping on a symbol, to go over it again with his pen lovingly. I can still hear his soft, melodious voice, punctuated every now and then by a sudden *"Ahft !"* when an objection came to him. Then he would drive me back to the station, where I would take the last train for Paris.

Seminar sessions started at 2.30 pm and lasted an hour and a half. After the presentation, participants were invited to take tea in the salon in the administrative building. It was a time for discussing a particular issue raised during the seminar and exchanging ideas. Before the presentation, I would often go to the cafeteria. There I witnessed lively debates – of which I understood practically nothing – between Grothendieck, Serre and Tate. Actually, the discussions weren't about the current seminar, they were about topics for future seminars and ideas they had enlarged on in their correspondence: abelian variety reduction, Tate curves, rigid geometry, patterns, etc. After lunch, the Master would sometimes take his pupils for a walk around the park, to share his latest thinking. He had in that way explained to Berthelot and me his reading of Manin's article on formal groups, leading to his conjectures on crystals and the specialisations of their Newton polygons.

But I am ahead of myself. This conversation was to take place in the year 1966-67, the year of SGA 6, the seminar on Riemann-Roch and intersection theory. That year was, I think, a sabbatical one for Grothendieck. In his eyes, Riemann-Roch was ancient history, and he wasn't sorry to let us, Berthelot and me, deal with the topic, in line with the notes he had given us, which we hastened to generalise as much as possible. One day, he admitted to me that Berthelot was more "functorised" than he was. Nevertheless, even if the Riemann-Roch theorem in itself no longer really interested him, he was keen to develop intersection theory *"in its natural context"* i.e. on fairly general Noetherian patterns, using *K*-theory group filtration *"without moving the cycles"* (no moving lemma). A method that was somewhat eclipsed by Fulton's work in the seventies but one that I believe to be more flexible and powerful in the end. For this topic, he had recruited other speakers, who made important contributions to it: Jussila, Kleiman, Raynaud.

The autumn of 1967 saw the start of SGA 7, which, like SGA 5, was to last for two years. It was then that Grothendieck defined the nearby cycle and the evanescent cycle functors ($R\Psi$ et $R\Phi$) [5], and used them in particular to establish his semi-stable reduction theorem of abelian varieties, together with his general theory of biextension, a concept introduced by Mumford shortly before.

In this study, he had needed for a technical point, a variant in étale cohomology of a specific case of the classical Picard-Lefschetz formula in topology. He admitted to not understanding a word of Lefschetz's demonstration and had therefore let Deligne explain it to him and transcribe it in étale cohomology. He had also asked Katz to make the geometric preliminaries on Lefschetz's pencils. That is how in 1968-69, the keys to the seminar found themselves being handed Deligne and Katz, rather like, in 1960-61, Cartan had handed them to him for his seminar on analytic spaces.

It should also be mentioned that, from 1967 onwards, Grothendieck had been thinking about other matters. In a letter to Tate in May 1966, he had sketched a theory of crystals and of crystalline cohomology. He had developed it in presentations given during the autumn of that year, which were drafted by Coates and Jussila. He then suggested to Berthelot that the latter write up the details for his thesis, "details" which we now know to be considerable. During the same period, he worked on the interactions between this new theory, Serre and Tate's work on *p*-divisible groups and Dieudonné's theory, issues which were to take up a good chunk of his time up right to the end of the sixties. At the same time, he had given a series of talks on standard conjectures (written by Kleiman) and on patterns. He was clearly not short of work. Nonetheless, he dreamt of an SGA 8 seminar. He had thought of doing it on abelian schemes. It is a real cause for regret that it did not materialise, the literature on this topic now being scattered in many different texts, sometimes not very satisfactorily.

Despite all these beautiful problems which occupied his thoughts - and I also have in mind the "mysterious functor" problem he set in 1970 and which was to be the starting point for Fontaine's and many others' work on *p*-adic Hodge theory - from 1969 onwards, mathematics had ceased to be his sole focus. He had developed a new interest in physics (he told me that he wanted to study Feynman's lectures) and then turned to biology and finally, to radical environmentalism, the consequences of which are well-known.

When I think again of the sixties, those SGA years, I see them as golden age of algebraic geometry. A wind of freedom and innovation was blowing. Both the young and the not so young laboured enthusiastically in the new fields that Grothendieck uncovered for us. The

memory I want to keep of him is not that of the irascible hermit of later years. Rather, I remember the brilliance of this exceptional mathematical who gave us fifty years ago, with such generosity, so much.
Thank you.

Luc Illusie

1. In their most general form proposed by Grothendieck, these conjectures were only solved much later, by Gabber, the first one in 1994 and the second in 2005.
2. he was the first to define this as cohomology with coefficients in the dualising complex – a brand new construction and generalisation of the "Borel-Moore homology".
3. from January 1966.
4. *Reminiscences of Grothendieck and His School*, Luc Illusie with Alexander Beilinson, Spencer Bloch, Vladimir Drinfeld et al., Notices of the AMS, vol. 57, no.9, Oct. 2010, 1106–1115, and *Grothendieck, magicien des foncteurs*, INSMI, 22.12.2014, http ://www.cnrs.fr/insmi/spip.php ?article1097.
5. However, the term "nearby cycles" only appeared in the seventies.

Luc Illusie is a French mathematician, specialised in algebraic geometry. He was a student of the mathematician Henri Cartan and from 1964, he also studied under Alexander Grothendieck.
He was a research fellow, then a senior research fellow at the mathematics laboratory of Université Paris-Sud, and became a professor there. From 1984 to 1995, he led the arithmetic and algebraic geometry team amongst others. He has been professor emeritus since 2005.
In 2012, Luc Illusie was awarded the Émile Picard medal *"for his fundamental work on the cotangent complex, the Picard-Lefschetz formula, Hodge theory and logarithmic geometry"*..

Oppenheimer and IHÉS (1958-1967)

Robert Oppenheimer, Léon Motchane, 1963

Much has been written about Robert S. Oppenheimer (1904-1967), the famous American physicist and scientific director of the Manhattan project; his charisma and career have inspired a good dozen biographers. One aspect remains little known however: his role in establishing the Institut des Hautes Études Scientifiques.

IHÉS explicitly draws inspiration from the model of the Institute for Advanced Study in Princeton (IAS). This research institute was founded in 1933, Oppenheimer becoming its director in 1947. IHÉS adopted its basic characteristics - the intellectual ones - as a high level institute dedicated to basic research - and certain practical ones - such as the tradition of tea being served daily, conducive to exchanges of views. Of equal importance was the relationship between Oppenheimer and Léon Motchane (1900-1990), the founder and first director of IHÉS. As life member of the scientific committee, advisor to the director, frequent visitor and regular correspondent, Oppenheimer played a major role in the crucial early years at IHÉS.

Beginnings and inspiration

The first meeting between Oppenheimer and Motchane probably goes back to 1948. It is mentioned by Freeman Dyson and commented on by Cécile DeWitt-Morette, who was at the time at IAS. Oppenheimer was its new director and Motchane a business man, often staying during his frequent business trips with his brother Alexandre Motchane, who lived in Monclair in New Jersey. It was probably through Alexandre, a chemical engineer, that he was able to meet Oppenheimer.

But the true beginning for IHÉS and Oppenheimer's contribution started in 1958. In the spring of 1958 Oppenheimer was in fact in Paris. He was giving a series of conferences at the Sorbonne which aroused much interest. Motchane met him and organised a meeting with Joseh Pérès. With Maurice Ponte (CSF), Pierre Dreyfus and Fernand Picard (Régie Renault), Motchane was looking for the seed funding required to create his Institute. These very supportive initial contacts enabled him to quickly bring other industry leaders on board (especially in the oil industry). It was however not quite quickly enough for Oppenheimer - who was leaving on 17 May - to attend the founding meeting as Motchane had wished. The notice of invitation to the General Meeting on 27 June 1958 formally establishing the Institut des Hautes Études Scientifiques association nevertheless bore his signature, as well as those of Joseph Pérès, Dean of the Faculté des Sciences de Paris and Paul Montel, the President of Paris Académie des Sciences de Paris.

In Pérès' office, Motchane, a man with a passion for mathematics who obtained his doctorate at the age of 54 and who was responsible for the bulk of the preliminary work, declared that he wanted to *"stem the French haemorrhage to the United States"*. The Institute was born and he became its first director.

He was delighted to announce the fact to Oppenheimer by telegram. Notices soon appeared in the French and American press in the summer of 1958. In the autumn, Motchane visited IAS to see Oppenheimer and also Chicago, to settle the details of mathematicians Jean Dieudonné and Alexander Grothendieck's recruitment. He had probably approached them beforehand, in any case no later than the International Congress of Mathematicians which took place in Edinburgh.

It was the start of a long relationship between Oppenheimer and Motchane, who exchanged long letters and short telegrams on all aspects of life at IHÉS. During his annual visit to Oppenheimer in 1962, this is how Motchane described its importance: *"There is no doubt that I come mainly to see you and to have two or three good conversations with you, as we do every year. By discussing the problems we both encounter, speaking in friendship of things and of men - because the Institute is a human affair - by listening to you, I am able to outline a way forward which seems to take us in the right direction."*

Hopeful for theoretical physics

Was Oppenheimer truly convinced by Motchane's project, in which he had agreed to take part? Whilst defending it in public, he expressed a few concerns in private in 1959. He said that he was hopeful for the possibilities that such an institute could offer to the development of scientific research in France and beyond in Europe and praised the excellence of the mathematics section. As regards theoretical physics, however, he believed that Motchane needed to bring proof of stable funding and to move the Institute - located at that time in two offices of the Fondation Thiers to proper premises. This was needed to establish *"the theorem of existence on which everything else depends"*, meaning the ability to attract physicists permanently. He declared himself ready to help the Institute in any way he reasonably could. As things evolved and IHÉS having bought Bois-Marie in Bures-sur-Yvette, in 1961 he seemed more confident and *"hopeful for theoretical physics in Europe and in the world"*, with IHÉS finally recruiting its first theoretical physicist, Louis Michel (1923-1999).

Oppenheimer's visits

Visits by Oppenheimer were cleverly orchestrated by Léon Motchane and reported in the press. Oppenheimer's presence was an event in itself and his coming to lHÉS gave the Institute important official recognition. Oppenheimer was to come to IHÉS three times: from 16 to 19 September 1959, on 17 and 18 October 1961 (in Bures, although the Institute had not moved there yet), and from 14 to 17 May 1963. His last visit, planned for 1965, was cancelled for health reasons.

The programme of a visit was planned very carefully to allow for official scientific discussions (meeting of the scientific committee) and for private ones with company directors (French industry leaders, members of EURATOM) as well as meeting with the key players in higher education and research in France. For example, in 1959, he had lunch with Gaston Berger, director of higher education and Pierre Massé, Planning Commissionier. He dined with Pierre Piganiol who was the general delegate for scientific research. He also had time to visit the future Bois-Marie site and to talk with physicists. Each of these meetings was an opportunity for Oppenheimer to speak favourably of IHÉS and to place it in the broader scope of scientific research development.

The Directors of the Board were enthusiastic about their meetings with Oppenheimer. In fact, some of them visited him in Princeton, their status as IHÉS Board member serving as introduction, when they travelled to the United States (as René Grandgeorge, Managing Director of Saint Gobain, did in 1960, Fernand Picard of Régie Renault in 1961, Léon Kaplan of Société Shell France in 1962).

Setting up the theoretical physics section

Oppenheimer was a life member of the IHÉS scientific committee. He was also a theoretical physicist and, as IAS director, came into contact with many other theoretical physicists staying there. He played a key role in setting up the theoretical physics section at IHÉS. Whereas the mathematics section established itself quickly around Dieudonné and Grothendieck, it was not the case for theoretical physics, even though it quickly welcomed very brilliant and enthusiastic physicists – but none permanently. Gell-Mann, for instance, hesitated for a long time over whether to accept but refused in the end, despite discussions with Oppenheimer and the fact that the terms he had asked for had been met by Motchane.

Oppenheimer's input was decisive in at least three instances including the recruitment of two permanent professors.

Relations between IHÉS and academics had not always been smooth and Oppenheimer was sometimes taken to task. From 1959, Motchane had sought Michel's advice on invitations to physicists and in 1961 offered him, with the support of the scientific committee, the post of permanent professor. Maurice Lévy, then holder of the Chair of theoretical and high energy physics considered this initiative to be *"shocking and immoral"* as the offer competed with academia, depriving the university of a good professor and a *"research-leader"* it lacked. He shared his concerns with Oppenheimer, asking him to use his influence with Motchane to change the latter's mind. He ended his letter by promising *"a bitter battle should that not be the case"*. In response, Oppenheimer chose to favour developing IHÉS. He justified Michel's recruitment to Lévy, pointing out the entire scientific committee's endorsement and adding that the decision would on the contrary benefit academia, physics and its consolidation in the Paris region. Nonetheless, Lévy persisted in believing that Motchane's offer was fundamentally a bad thing and added that Cartan and Schwarz shared his opinion; they leant on Michel to refuse, arguing it would create a precedent. Oppenheimer having passed on Lévy's letter to him, Michel would explain to Lévy in a thoughtful letter that he saw this post he had just accepted at IHÉS as another way of organising theoretical physics in France and of paving the way for future cooperation between IHÉS and universities.

Oppenheimer intervened again at the time of David Ruelle's recruitment. In June 1963, Louis Michel and Harry Lehmann, then both permanent professors of theoretical physics, put forward the name of David Ruelle, who was recommended by Jost and Wightman.

Oppenheimer to Assist New French Institute

PARIS, Sept. 19 (Reuters) —Dr. J. Robert Oppenheimer, director of the Institute for Advanced Study at Princeton, N. J., arrived here today to help organize the French Institute for Advanced Study.

Dr. Oppenheimer, a member of the French Institute's directing committee, told reporters that the French school should play the same role in Europe as the Princeton institute plays in the United States.

He said it was necessary that science continue to prosper in Western Europe, adding he hoped scientific cooperation between nations would increase.

New York Times, Sunday, September 24, 1959

However, Ruelle was being sounded out for a post at IAS. Motchane wanted *"to avoid at any cost anything resembling competition between the two Institutes"* and shared his views with Oppenheimer, who told him on no account to limit his freedom of action and that this did not preclude IAS from making an offer itself. This high level of trust between the two directors endured. Ruelle accepted the post at IHÉS in September 1963.

Finally, Oppenheimer had a very clear vision of developing theoretical physics and of the way it should be implemented at IHÉS, which Motchane shared: *"physics should not be forgotten in theoretical physics"*. When the possibility of replacing Harry Lehmann in 1965 arose, Oppenheimer was in favour of recruiting a physicist *"concerned with the actualities of present experimental explorations of fundamental physical problems"*. He recommended Léon Van Hove - who hesitated for a long time before refusing because of the administrative work he foresaw - rather than Vladimir Glaser, for whom he had great esteem, but who did not fit into the desired development of the theoretical physics section.

The American Committee for the Institute for Advanced Study – Europe, Inc. (1964 -1971)

In the summer of 1958, when the creation of IHÉS was being announced in the American press, Oppenheimer received a letter from Brakeley, a fundraising agency, asking whether it would be opportune to develop a support group for the Institute. It was only a few years later, in 1963, that the IHÉS Chairman, André Grandpierre - the Chairman of Pont-à-Mousson, he took over from Joseph Pérès on the latter's death in 1961 - put this idea to the Board members. This followed the suggestion from an American academic, Irving Michelson, in Nancy for the year. By then, IHÉS had in fact started to become very well known in the United States and the proportion of American visits had always been very important (around 30%). Before taking a decision, Motchane asked Oppenheimer for his view on the idea, as well as information on the Sam Swerdloff agency they had selected to launch a fundraising campaign: "in Europe, we are not used to this way of doing things" he writes. Having received a telegram from Oppenheimer and favourable reports of Swerdloff, Grandpierre convened a meeting of the Board members on 18 September 1963 at the Fondation Thiers, when they decided to set up this support committee.

Swerdloff, having met Oppenheimer, would start by coordinating the production of a brochure, with statements from French industry leaders as well as from American scientists like Wightman, explaining what IHÉS meant to them. Oppenheimer himself validated the name used for the campaign: Institute for Advanced Study-Europe, which is the English translation of Institut des Hautes Études Scientifiques, but beyond that, recognition of what IHÉS had become: the European counterpart to the IAS in Princeton. Motchane thanked him: *"I am very touched by this analogy, which is a promotion"*.

Motchane went to the United States in December 1963 and in a few days, enlisted the support of American industry leaders (such as International Nickel, United States Steel, John Manville, Union Carbide, IBM), to whom he was introduced by IHÉS Board members. He was delighted to report to Oppenheimer: *"I find it quite extraordinary that our vague project of an American support group should have come into being so quickly in such excellent conditions – let all our friends be praised and thanked!"*

The founding luncheon of the American Committee for the Institute for Advanced Study – Europe, Inc., which took place on 11 March

1964, was an opportunity for Oppenheimer, who had agreed to make up its scientific committee together with Richard Courant, to express his views about IHÉS. This is how Motchane reported what he said: *"Finally, Oppie spoke like a philosopher, saying that he had always wanted to see a competitor emerging, how three-quarters of those who come to us have already been to Princeton, that this was not the result of any agreement between Mr Motchane and himself but was in the nature of things. He said that our Institute had achieved infinitely more in the first five years of its existence than Princeton in the corresponding period. He explained why better work is done in this type of institute."*

The decision of the Inland Revenue Service in the United States on 29 December 1964 allowed tax deductions which had initially been seen as difficult to obtain. Subscriptions, some already acquired from the start, followed. For six years, the American committee contributed up to 10% of the budget, contributions decreasing gradually.

The main players of the American committee were Henry S. Wingate (International Nickel Cy of Canada), together with Albert P. Gagnebin (International Nickel Co., New-York), then Harold W. Fisher (Standard Oil Company) and Emanuel Piore (IBM corp.). The two presidents, Wingate and Fisher, took part in the IHÉS Board (1964, 1969).

The existence, the successes of the American committee and its warm welcome enabled Motchane and Grandpierre to approach American foundations, as they did by contacting Warren Weaver, of the Sloan Foundation, for instance, following a suggestion and an introduction from Oppenheimer.

In 1967, the support committee considered a campaign to reach the level of funding asked for by Motchane, or 30% of IHÉS' income, matching the percentage of American visitors in the year 1966-67. To that end, the American committee recommended that Motchane launch a similar campaign in Europe, to increase non-French European funding and to boost American investors' confidence. Unfortunately, the committee struggled. Faced with his failure to find new members, Harold Fisher decided to call an end to the venture. The reasons he put forward to explain the difficulty in renewing membership were the recession, the fact that this was an institute for advanced study, therefore far removed from industry and most importantly, the impression that it was up to Europe to fund IHÉS, as American industry leaders were preferring American institutions. The dissolution of the committee was decided

Robert and Kitty Oppenheimer at IHÉS, 1963

in the autumn of 1970 and the last cheque received on 8 February 1971.

In no way did this mark any downturn in IHÉS' relations with the United States, quite the opposite. The following years saw as many American visitors as ever and discussions began with the National Science Foundation, as well as with the National Academy of Science. And surely the creation of Friends of IHES, Inc. in 1999 can be seen as a rebirth of this first American committee!

Oppenheimer and European science

On a broader level, in Oppenheimer's mind (as we have seen in the description of his hopes for theoretical physics in Europe), IHÉS truly had to play the part of a European institute. His commitment to IHÉS was part of his wider activities in the interest of the *"European scientific renewal"*. His speech during the inauguration of the Synchrotron Proton at CERN in 1960, reported by Motchane, bears witness to this long-standing attachment to European science: *"I am among those who owe almost everything of their formal education to Europe, as do many of my generation in our country. We are glad that we can be confident that our children, and our children's children, will be coming back to Europe for a renewal of the great tradition which binds us together."* But his work was in no way limited to perpetuating an existing European scientific tradition. Paying tribute to Oppenheimer, Jules Guéron, chemist and EURATOM scientific director, wanted to follow *"the modern European side of Oppenheimer"*, who was interested in all European scientific projects. Indeed, Oppenheimer, like Motchane, took part in the discussions concerning the creation of the European University that European States wanted to see. This project resulted in curbing European contributions to IHÉS, which would no longer be deemed necessary. Oppenheimer's opinion was frequently sought and in discussion or letters, he never ceased to make the case for IHÉS' existence and the need to fund it. In this way was his input largely instrumental in EURATOM supporting IHÉS from 1960.

Let Léon Motchane conclude with these last words to Kitty Oppenheimer, soon after her husband's passing: *"The image of your husband lives on in everyone's memory, rich and varied, with everyone finding something of their own aspirations.*

During our meetings on Institute business for the past nine years, I was able to appreciate his profound humanity, his discernment of young people's character, his idealism that made him take on a cause wholeheartedly if he felt it to be a worthy one. When our Institute was founded, he agreed enthusiastically to be part of it and lent the entire support of his authority to our young theoretical physics section which sorely needed it. We have lost a faithful and attentive friend."

Anne-Sandrine Paumier

Mathematical historian, Anne-Sandrine Paumier is currently a postdoc at IHÉS, where she works on the history of the Institute, drawing on its archives and the memories of the people connected with it.
A mathematician by training (École Normale Supérieure de Lyon), she obtained her PhD from the Institut de Mathématiques de Jussieu with a thesis on *"Laurent Schwartz (1915-2002) and the collective mathematical life"*. Her field of research is "mathematical geography" after the second world war, that is, the various "places" for mathematics specific to the period and their impact on mathematicians' work and on the mathematics produced.

Charles Simonyi

friends of IHES gala dinner in New York

The third Friends of IHES Gala was held on 18 November at the Intrepid Sea, Air & Space Museum in New York.

The evening was chaired by Marwan Lahoud and its theme was *Math & Physics Exploring Space*. The dinner was a dynamic mingling of legends in science, space and business, who share a passion for exploring the universe.
Professor Thibault Damour was the speaker of honour and provided historical insights into the concept of Space. Doctor Charles Simonyi shared his extraordinary experience of spaceflight missions.

The fundraising objective was more than doubled with $662 308 collected that evening thanks especially to the Simons Foundation matching system, enabling research visits in Bures of scientists from all over the world to be funded. The Institute thanks its American friends for their support and generosity.
The next Friends of IHES gala dinner will take place on 4 November 2015 at the Pierre Hotel in New York and the theme will be *Math and Games of Chance*.

Friends of IHES' Directors of the Board

conference

Friends of IHES held a mathematical finance conference, *An Analysis of 180 Years of Market Drawdowns* on 30 June 2015 in the New York offices of AXA, a major IHÉS Fiftieth Anniversary Campaign donor.
The presentation was made by Dr Robert J. Frey, Director, Program in Quantitative Finance, Stony Brook University and former hedge fund managing director. Around fifty scientists and financiers participated in this fascinating conference which generated many questions.

Watch the video of the event directly:

setting up a Support Committee

Philippe Camus

André Lévy-Lang

The IHÉS Support Committee met on 7 July 2015 to set the international fundraising strategy for IHÉS and the conditions for launching the third fundraising campaign. This new strategic phase will enable clear goals to be defined and to meet the Institute's ambitions for the coming years.
A private institution, IHÉS has benefitted since its creation from the generosity of sponsoring companies and philanthropists. The arrival of new partners and the renewal of historical support during the two previous campaigns are clear indications of the merits of IHÉS' efforts.
A Campaign Committee is being set up, to monitor the projects undertaken in the various strands of IHÉS' development strategy. IHÉS is proud to announce that Philippe Camus and André Lévy-Lang have agreed to co-chair it.

conference cycle with Société Générale Private Banking

Since the autumn of 2013, Société Générale Private Banking has been co-organising with IHÉS a series of scientific conferences in France and in the rest of Europe.

Thibault Damour, Permanent Professor at IHÉS since 1989 held a conference in Monaco and in Geneva. In his talk, *"Troublants trous noirs"* he described this phenomenon, a most fascinating prediction of Einstein's theory of General Relativity. He also showed their crucial role not only in Astrophysics but also in Particle Physics.

Pierre Vanhove, CEA senior researcher at IHÉS, also contributed to the series by giving a conference on gravitation in Luxemburg. This proved to be a scientific epic, covering Aristotle, Newton and the Copernican revolution. The link was made between the nature of gravity and our vision of the cosmos, leading us to rethink gravitation and answer fundamental questions on the nature of the Universe.
IHÉS is delighted to partner with one of its major Fiftieth Anniversary Campaign donors. These lectures are real opportunities to reach a wider audience and they show the public's interest in highly theoretical topics.

Pierre Vanhove

a one-million-euro gift from Huawei

At the end of 2014, Huawei, a leading global provider of information and communications technology solutions, announced a one-million-euro gift to IHÉS.

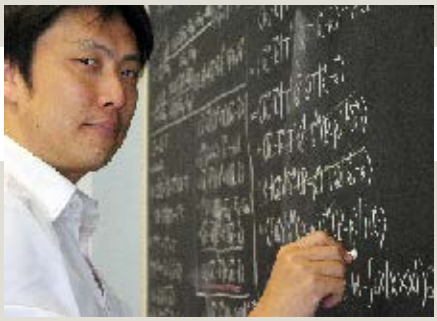
This gift comes as part of the R&D plan carried out by Huawei in Europe and in France in particular, in the field of mathematics. Huawei wishes to support excellence in research locally, giving it international visibility downstream. For this reason, Huawei decided to renew its support to IHÉS. *"The Huawei research programme in France is a particularly ambitious one, and this new gift illustrates Huawei's commitment to the most fundamental of sciences."* commented Emmanuel Ullmo.
The "Huawei fund", created in 2010 with 250 000 euros, will now enable support to be provided in perpetuity for the visits of mathematicians. *"We are proud to bring our support to IHÉS whose dynamism and expertise produce many initiatives designed to support fundamental research."* said Mr Karl Song, Managing Director of Huawei France.
For its part, IHÉS is delighted with this new partnership and wishes to convey its deepest thanks to Huawei.

Mérouane Debbah, Emmanuel Ullmo

IHÉS in UK

On 9 June 2015, Emmanuel Ullmo was invited by Sylvie Bermann, French Ambassador in the United Kingdom to present the Institute's development activities. A dozen participants attended the lunch, organised to raise awareness of IHÉS and build new partnerships.
After two conferences already organised in 2013 and 2014 by Rémi Bourrette and Rama Cont, members of the IHÉS Support Committee, this invitation marks a decisive step forward for the development strategy in the UK.
IHÉS would like to thank Ambassador Bermann and Cyrille Van Effenterre, Science and Technology Counsellor, for their support.

point of view of...



Shigenori Seki is a Japanese researcher in theoretical physics. He obtained his PhD in 2002 in Kyoto University (Japan). Since then, he has been travelling extensively in Japan, Israel, South Korea and regularly in France, at IHÉS.

My first visit at IHÉS was in November 2009. I moved from Tel Aviv and had a wonderful time at IHÉS for two years as a postdoc. The residence in Ormaille is well equipped and the IHÉS staff supported me to install myself (e.g. to obtain a carte de séjour). Therefore I could start my research without any trouble. Fortunately, I have visited IHÉS again for one or two months every year since 2011. IHÉS provides us with complete freedom, so that I have had many opportunities for scientific activities (e.g. seminars, workshops, collaboration, etc.) in France.

My day at IHÉS begins with a calm morning. I buy a pain au chocolat at the bakery on my way to the Institute, and then concentrate on research. IHÉS is located in Le Bois-Marie, which is a quiet forest. I sometimes walk there for relaxation and meditation. This environment, which is different from the office, helps me to organise my thoughts. Near Kyoto University in Japan, which I graduated from, there is a pedestrian path along a narrow canal which is called "Philosopher's Walk". In the 20th century, Kitaro Nishida, professor of philosophy at Kyoto University, walked on this path for meditation. An appropriate place to go for a walk is important for the research of fundamental science and philosophy! From one o'clock we have lunch together at the IHÉS cafeteria. The lunch is table service and takes about one hour. From four o'clock we gather in the salon for a tea break. So lunch and tea are suitable times to chat with researchers in various subjects. I have been studying string theory, which is at the interface between physics and mathematics. Even if I do not completely understand my colleagues' researches, they stimulate my consideration and attract my interest. I think unexpected creativity is sometimes born of such communications with different research worlds.

Paris is one of the most active centres of research in string theory. There are many institutes and universities in the region of the Grand Paris. IHÉS is in Bures-sur-Yvette, which is a quiet village and is not far from Paris. So I can easily access seminars and conferences, and contact researchers in the Paris region. Actually I attended the series of seminars, *"Rencontres théoretiennes"*, at Institut Henri Poincaré twice a month. I also often visited IPhT/CEA-Saclay. It takes thirty minutes on foot from IHÉS to Saclay. Since Saclay is on the plateau, it is good exercise for me to climb to IPhT. My collaborator, Prof. Robi Peschanski, is at IPhT. Our collaboration was initiated in 2009 during my first stay at IHÉS. At that time, we were interested in the scattering of particles in the context of the AdS/CFT correspondence, and succeeded in publishing a paper. My collaboration with Robi is still continuing. Recently one of my research topics has been quantum entanglement. During my last stay, we had fruitful discussions about the entanglement of interacting particles in a scattering process.

The atmosphere in IHÉS always refreshes my brain. What atmosphere is it? Calm and stimulating. Life at IHÉS is calm, and I can meditate on problems deeply in the quiet environment. At the same time, IHÉS provides interactions between the researchers coming from all over the world, so that the unentangled researchers become entangled. Such interactions stimulate my mind.

agenda 2015/2016

22 September to 6 October 2015, every Tuesday, IHÉS
Cours de l'IHÉS: L. Lafforgue, *Catégories syntactiques pour les motifs de Nori*.

23 to 25 September 2015
Algebraic Geometry - A conference in honour of Arthur Ogus on the occasion of his 70th birthday, organised by A. Abbes and L. Illusie.

13 to 15 October 2015, Université Paris-Sud/ IHÉS
Journées Mathrice d'automne 2015, meeting for mathematics laboratories' Systems and Network Administrators

October 2015
Cours de l'IHÉS: J. Pardon, *Contact Homology and Virtual Fundamental Cycles*.

12 October 2015
Start of the Université Paris-Saclay Doctoral Schools of Mathematics.

October - November 2015
Cours de l'IHÉS: C. Villani, *La théorie synthétique de la courbure de Ricci*.

4 November 2015, Pierre Hotel, New York
Gala dinner organised by Friends of IHES.

23 - 27 November 2015
Topos à l'IHÉS, organised by O. Caramello, P. Cartier, A. Connes, S. Dugowson et A. Khelif.

November 2015
Conference by T. Damour organised by *Les Amis de l'IHÉS*

14 - 18 December 2015
Cellular and Molecular Biotechnology, entretiens interdisciplinaires de Bures organised by F. Képès, M. Gromov et N. Morozova.

January to February 2016
Cours de l'IHÉS: T. Damour, *Ondes gravitationnelles et systèmes binaires*.

January to February 2016
Cours de l'IHÉS: H. Duminil-Copin, *Le modèle d'Ising en dimension d*.

March - April 2016
Cours de l'IHÉS: E. Ullmo, *La conjecture d'André-Oort*.

May - June 2016
Cours de l'IHÉS: E. Rabinovici, *Topics in Quantum Field Theory and String Theory*.

2 May - 29 July 2016
Trimester Program (seminars, workshop and colloquium) on *Nonlinear Waves*, organised by Y. Martel, F. Merle, F. Planchon, P. Raphaël and J. Szeftel.

23 - 27 May 2016
Colloquium as part of the Trimester Program on *Nonlinear Waves*.

20 - 24 June 2016
Colloquium as part of the Trimester Program on *Nonlinear Waves*.

18 - 29 July 2016
Summer School as part of the Trimester Program on *Nonlinear Waves*.

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Photos: J.-F. Dars, M.-C. Vergne - *Text and layout:* C. Brisson, M. Caillat, V. Touchant-Landais - *Translation:* I. Peeters, H. Wilkinson