



2017

A YEAR AT  
THE **CNRS**

in **Alsace**



# 2017

## A YEAR AT THE CNRS IN ALSACE

is a regional addition to the activity report  
**2017, a year at the CNRS**

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Regional Delegate

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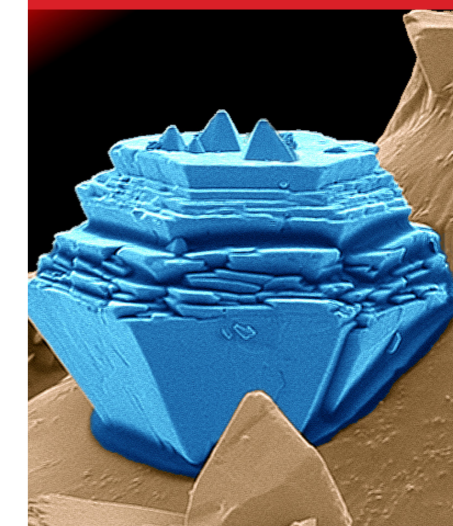
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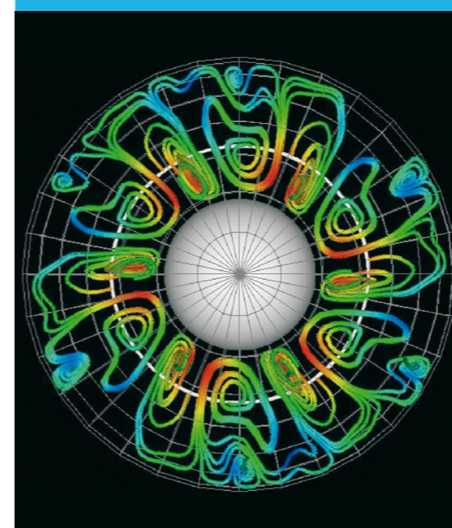
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This pictogram indicates that the CNRS is economically involved.

**glossary\***

Somes words are defined in the glossary, page 21.

A number of facts published in this report, results of scientific equipment\*, came to be thanks to the support of the European Union, the Région Grand Est, the Conseils départementaux du Bas-Rhin et du Haut-Rhin, the Eurométropole de Strasbourg and the Mulhouse Alsace Agglomeration, as well as numerous nonprofit partners. They are hereby thanked for their support to the CNRS unit's research excellence in Alsace.

\* Some projects are laureates of the Unistra IdEx calls for projects (CNRS, Inserm, Université de Strasbourg).

# 2017 IN FIGURES

at 2017 december

**1 647** STAFF MEMBERS

**520**  
researchers

**736**  
engineers and  
technicians

**391**  
contractual  
employees

## RESOURCES

**39**

RESEARCH AND SERVICE UNITS

85 % are in partnership with

The Université de Strasbourg  
The Université de Haute-Alsace  
The Inserm

The Institut franco-allemand de Saint-Louis  
The Institut national des sciences appliquées de Strasbourg

**34**

RESEARCH UNITS

**5**

SERVICE UNITS

## RESEARCH

AN AVERAGE OF  
**2 304**  
SCIENTIFIC  
PUBLICATIONS  
PER YEAR

of wich  
**62,1%**  
ARE CO-SIGNED WITH  
A FOREIGN LABORATORY  
for the period 2015-2016

## FINANCING

A BUDGET OF  
**161**  
MILLION EUROS  
of wich 42 million euros  
come from self-generated income

### Sources des données

Ressources CNRS Alsace/DRH Recherche données SCI Expanded (moyenne 2015-2016) - CPIC-5 (Clarivate Analytics) - Traitement CNRS/SAP25 et INIST  
Financement CNRS Alsace/SFC Implantation CNRS Alsace/STL

## VALORISATION

**523**  
SIGNED CONTRACTS

in 2017 for  
**21,53 M€**

**462**

CONTRACTS  
managed by the CNRS  
**19,15 M€**

source : CNRS Alsace / SPV

**172**

PATENT FAMILIES

as of July 6, 2018,  
among which

**27**

NEW PRIORITY PATENT  
APPLICATIONS

in 2017

**7**

NEW LICENSES

**1** START-UP

founded in 2017

source : CNRS Alsace / SPV

**96 000 M<sup>2</sup>**  
OF REAL ESTATE MANAGED  
BY THE CNRS

on **3** sites



**PATRICE SOULLIE**

REGIONAL DELEGATE  
IN ALSACE

## EDITORIAL

— I am honoured to present to you this new edition of the Alsatian CNRS community's activity report. From an alternative route for cholesterol to a neutrinos telescope installed in the depths of the ocean, the richness and variety of scientific events in 2017 emphasise the importance of the Alsatian integration of research led at the CNRS. This new edition highlights the innovations and scientific advances achieved in our laboratories, and it illustrates the dynamism of the interactions of the ecosystem with the institutional sphere, such as with the European Research Council's 10th anniversary ceremony, as well as with the national and international socio-economic sphere.

The year 2017 has also been shaped by the evaluation of our research structures. Every five years, laboratories are evaluated by the Haut Conseil de l'Évaluation de la Recherche et de l'Enseignement Supérieur. This is an opportunity for the different units to present their results and projects, which are the fruits of their scientific projections. This step allows the CNRS and its partners to maintain dynamic and advanced research in line with the current great scientific questions. I take this occasion to thank each and every researcher, engineer and technician who are working every day to enrich our knowledge and to model efficient research.

This booklet sheds light on many interesting results in the form of small articles, written for the widest audience possible. I also thank the members of the scientific committee, who selected the topics developed in this document. A difficult task when the large number of subjects is considered. It is the excellence of science in Alsace that is highlighted here. I wish you a pleasant reading.

— Science plays an increasingly central role in today's world. At the foundation of the construction of our ever progressing society, in which technological and social advances benefit the greatest number of people, research is also at the origin of most breakthrough innovations, which allow the creation of new jobs and values. In 2017, the CNRS, jewel of the international research, strengthens its role as flagship of French research.—

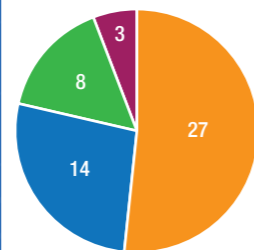
Antoine Petit, Chairman and CEO of the CNRS

# SCIENTIFIC AND INSTITUTIONAL HIGHLIGHTS

- FOCUS -

## THE ERC IS 10 YEARS OLD

The European research council (ERC) aims to promote high quality European research on exploratory themes at the crossroads of disciplines. Every year, thanks to its innovative calls for projects and at the end of a drastic selection, this institution allocates individual research grants – from 1.5 to 3.5 million euros and for 5 years – to talented scientists. Back when the ERC was founded, to goal of the European Union was to develop a more audacious research based on ideas of the researchers themselves. Ten years later, the both scientific and political success of this institution is unquestioned. To celebrate this anniversary, the CNRS, the Inserm and the University of Strasbourg organised an exceptional day in the presence of high personalities\* and of Alsations ERC laureates. This was the occasion to talk about the past, the future but also to discover the diversity of projects supported.



**52 laureates on the Alsatian campus (2007-2017)**  
**27 Starting Grant**  
**14 Advanced Grant**  
**8 Consolidator Grant**  
**3 Proof of Concept**  
**497 CNRS researchers have been laureates of the European Research Council (ERC) since 2007**

\* Carlos Moedas, European Commissioner for Research, Jean-Pierre Bourguignon, President of the European research Council, Thierry Mandon, state secretary in charge of Superior studies and research, Alain Fuchs, President of the CNRS, Christian Boitard, director of the Inserm's Institut "Physiopathologie, métabolisme, nutrition", Michel Deneken, President of the University of Strasbourg, Christine Gangloff-Ziegler, President of the University of Upper Alsace.

### Paolo Samorì Proof of Concept

Paolo Samorì, who has already been the recipient of an ERC Starting Grant, is working on an innovative process for the manufacture of flexible organic light-emitting diodes (OLED). The latter can be used to produce rollable lighting or screens. The financing of this new project, FlexNanoOLED, will enable his team to develop a flexible screen prototype.

Institut de science et d'ingénierie supramoléculaires

### Joseph Schacherer Consolidator Grant

To understand the source of diversity of phenotypes within natural populations, Joseph Schacherer and his team are working on the Phenome'N'al project. It consists in developing a technique at the crossroads of classic genetics methods and of new approaches based on the genomics of populations.

Génétique moléculaire, génomique, microbiologie

### Guillaume Schull Consolidator Grant

The APOGEE project is dedicated to the atomic-scale physical properties of single-photon sources, which are capable of emitting photons one by one. Guillaume Schull and his team are developing a scanning probe microscope in order to be able to simultaneously obtain the chemical, spatial, spectral and temporal resolutions of these sources.

Institut de physique et chimie des matériaux de Strasbourg

### Thomas Hermans Starting Grant

With the Life-Cycle project, Thomas Hermans and his team are aiming to develop a new class of chemically fueled artificial supramolecular materials. These would be more similar to the polymers found only in living tissues, such as the ones the cytoskeleton is comprised of.

Institut de science et d'ingénierie supramoléculaires

## FRENCH GRADUATE SCHOOLS : FOUR LAUREATES

The "École universitaire de recherche" (EUR) initiative is a new structuring plan deployed with regard to the "Programme Investissement d'Avenir 3". Its ambition is to make possible for university campuses to enforce the international attractiveness and impact of their research and training courses. Based on the internationally recognised model of Graduate Schools, the EUR gathers master and PhD courses in which high-level laboratories are involved. In 2017, 191 projects were assessed by an international jury and 29 laureates were chosen for their excellence, without consideration for their discipline. In Alsace, 4 EUR collectively supported by the University of Strasbourg, the CNRS, the Inserm and the SATT Conectus Alsace were retained. They gather 23 research units, 7 training components and 4 doctoral schools for a total amount of 25.7 million euros. These schools touch on several fields: complex systems chemistry [CSC-IGS]; new perspectives in the treatment of pain [EURIDOL]; research in molecular and cellular biology [IMCBio] and quantum physics [QMat]. The University of Strasbourg is also involved in the REDPOP EUR (statistics), supported by the Pantheon-Sorbonne University of Paris.

CSC-IGS : Chemistry of Complex Systems Int Grad School | EURIDOL : Graduate School of Pain | IMCBio : Integrative Molecular and Cellular Biology | QMat : Quantum Science and Nanomaterials | REDPOP : Graduate School Network in Demography and Population sciences.

• BRONZE MEDAL •

The bronze medal awards the first work of a researcher which makes of him or her, a talented specialist in his or her domain. With this award, the CNRS encourages the researcher to pursue his or her already fertile research.

## CAMÉLIA MATEI-GHIMBEU



© Nicolas Busser

Carbon materials are at the foundation of many industrial applications: from aeronautics to the clean-up of waters and including energy storing devices such as batteries. In this domain, Camélia Matei-Ghimbeu is developing next generation, more efficient, hybrid carbon materials with reduced environmental impacts and production costs as well as properties controllable via new synthetic routes. To do so, it is vital to understand their formation mechanisms and the influence of their features (structure, porosity, surface chemistry, etc.) on their efficiency. The development of electrodes for lithium-ion and sodium-ion batteries by using such hybrid carbon materials is one of the most recent achievements in this domain.

Institut de science des matériaux de Mulhouse

## KATIA ZANIER



© Nicolas Busser

Human papillomavirus are small DNA viruses involved in 5% of cancers around the world and responsible for 99% of cervical cancers. In this context, Katia Zanier is studying a protein, called E6, coded by a gene of this virus and involved in the formation of tumors. Using nuclear magnetic resonance and X-ray crystallography techniques, she tries to understand the mechanisms and interactions by which E6 is capable to inactivate another protein, p53, whose role is to protect cells from the process of tumor formation.

Biotechnologie et signalisation cellulaire

## Prices and distinctions

### Prix Fondation Unistra - Ourisson Cercle Gutenberg

- Joseph Moran - ISIS
- Guillaume Schull - IPCMS

### Prix Fondation de l'Institut de France

- Dominique Matt - Institut de chimie de Strasbourg Prix Claude Berthault et médaille Berthelot de l'Académie des sciences
- Danièle Werck-Reichhart - IBMP Prix Foulon de l'Académie des sciences

### Les Espoirs de l'Université de Strasbourg

- Gilles Charvin - IGBMC
- Jean-François Dayen - IPCMS
- Emmanuel Fromager - Institut de chimie de Strasbourg
- Romain Goutany - LNCA
- Michael Heap - IPGS
- Herrade Igersheim - BETA
- Jérôme Petri - Observatoire astronomique de Strasbourg
- Katia Zanier - BSC

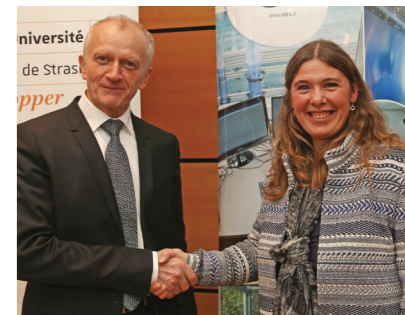
### Nomination au prix de l'inventeur européen de l'Office européen des brevets

- Sylviane Muller - ICT

## A STRENGTHENED PARTNERSHIP BETWEEN THE CNRS AND THE UNISTRA

University of Strasbourg President Michel Deneken and CNRS interim President Anne Peyroche have signed a strengthened partnership to accelerate the development of common initiatives for their laboratories. The goal is to support the dynamism of the Strasbourg campus by enhancing the quality of support to the units and to simplify the everyday life of the scientists when it comes to handling matters such as human resources, health, hygiene, security, and information systems.

Anne Peyroche, CNRS interim President, and University of Strasbourg President Michel Deneken. © Catherine Schröder



## THE CHARLES SADRON INSTITUTE CELEBRATED ITS 70TH ANNIVERSARY



© Olivier Fély

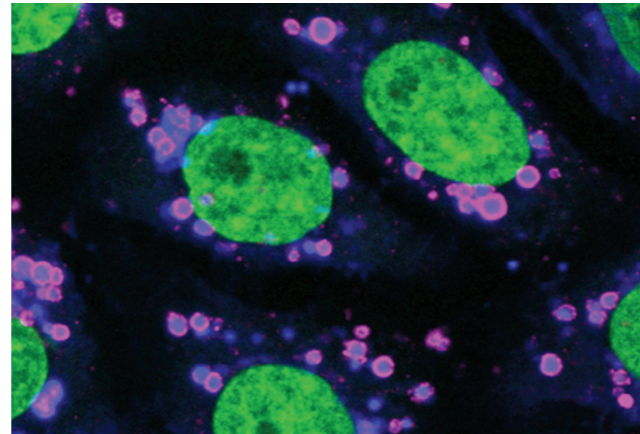
The Charles Sadron Institute (ICS) is a global reference laboratory for polymer materials and self-assembled systems. As soon as 1947, atypical and visionary physicist Charles Sadron took an interest in the emerging domain of the macromolecules that constitute these materials. He brought two new ideas for the time: interdisciplinarity and collaboration with the industry, both inspired by his Rockefeller scholarship supported postdoctoral research, which he led in Professor Van Karmann's laboratory at the California Institute of Technology in Pasadena in the 1930s. Since then, the ICS has kept renewing its research and now works on the polymers of the future. To celebrate this anniversary, a ceremony, a scientific seminar with 180 participants and an exhibition on the instrumental and scientific heritage were organised on the 18th and 19th of May, 2017, in partnership with the University's Jardin des Sciences.

CELLULAR MECHANISMS

## Cholesterol's alternative route

—Cholesterol is an essential constitutive element in a cell's membrane. In order to obtain it, a cell has to either collect it from the blood or directly synthesise it via one of its internal structures, an organelle\* called endoplasmic reticulum. Once captured or produced, the cholesterol is routed towards all the cellular membranes. Scientists have shed light on a previously unknown cholesterol transportation mode. They discovered that the so called STARD3 protein allowed the binding of the endoplasmic reticulum and the endosomes, organelles that ensure communication and transport between the interior of a cell and its environment. Once their membranes are close enough, STARD3 can transfer some of the cholesterol from the endoplasmic reticulum to the endosome. The identification of this new cholesterol fluxes regulation pathway allows to better apprehend neurodegenerative and cardiovascular diseases that alter the distribution of cholesterol throughout the body.

*The EMBO Journal*, avril 2017 —  
Institut de génétique et de biologie moléculaire et cellulaire



On this image, cell nuclei are coloured in green. The cholesterol (in blue) has accumulated in the endosomes which are covered with STARD3 proteins (magenta).  
© Léa Wilhelm

## SAGA, the Swiss army knife of protein factors

—For proteins to be synthesised in a cell, the genes – which contain all the information required for this mechanism – have to be transcribed. Their transcription is controlled by a large number of factors, some of which are proteins. Most of them are specific and only control the transcription of certain groups of genes. Now, researchers have discovered that a particular protein complex, called SAGA, acted as a general factor involved in the transcription of all the genes of a cell. This study contradicts a previous classification according to which SAGA was a specific factor.

*Molecular Cell*, septembre 2017 —  
Institut de génétique et de biologie moléculaire et cellulaire



Artistic interpretation of the SAGA complex emerging from the nucleoplasmic sea while grabbing a chromatin thread.  
© Jonathon Broughton

## Lilly acquires a software suite developed by the LIT

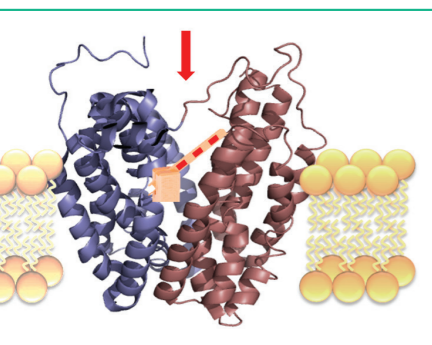
—IChem is a software suite developed by the Laboratoire d'innovation thérapeutique (LIT) and used to represent molecular objects such as proteins, binding sites and protein complexes, in the form of barcodes and graphs. It allows researchers to compare these structures with each other more easily. The source code of this software suite was purchased by the global pharmaceutical group Eli Lilly and Company, which hopes to accelerate the design of active molecules.



## A switch for the transfer of molecules

—In order to cross a cell's membrane, some molecules have to go through membrane pores which are comprised of transport proteins, such as lactose permease. The latter allows the passage of a galactoside – a molecule comprised of a carbohydrate and a non-carbohydrate substance – coupled with a proton. For the transport to be achievable, the galactoside has to bind to the lactose permease. The researchers have developed a spectroscopic method which demonstrates that, to control the passage of the molecules, this binding depends on another interaction: the removal of a proton from a residue called Glu325 in a specific environment.

*Proceedings of the National Academy of Science*, février 2017 —  
Chimie de la matière complexe



Schematic representation of the lactose permease and of Glu325 which function as a switch for the transfer of molecules.  
© Petra Helwig

@maglarecherche

Pierre Kühn's work on new-born's perception of smells was awarded La Recherche magazine's prize : Prix coup de cœur #INCI

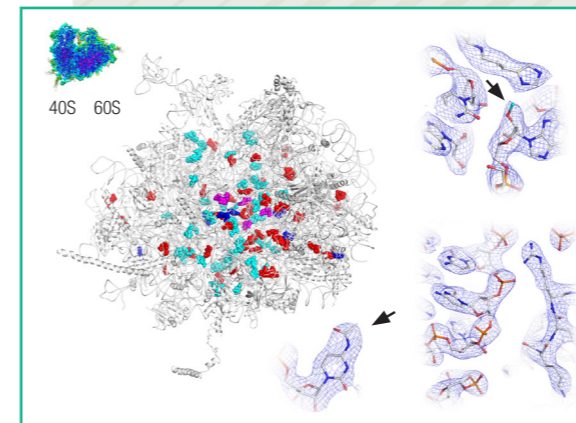
- FOCUS -

## CRYO-ELECTRON MICROSCOPY UNDER THE SPOTLIGHT

In order to be viewed with an electron microscope, biomolecules must be placed in vacuum. By doing so, the sample is dehydrated and therefore rendered unobservable. One solution would be to freeze the sample, but the ice crystals can damage the structure of the biomolecule. In this context, the invention of water vitrification – the fast freezing of water that prevents crystallisation – coupled with adapted data processing methods, gave rise to cryo-electron microscopy. Developed in the 1980's and improved ever since, this technology allows the observation of intact biomolecules at highly precise resolutions and in their native environment. Its inventors, Jacques Dubochet, Joachim Frank and Richard Henderson were awarded the 2017 Nobel Prize in chemistry.

### Ribosomes: better know...

—Ribosomes, the molecular machines in charge of synthesising proteins, are made up of two molecules: proteins and ribosomal RNA\* (rRNA). When ribosomes are formed, rRNA undergoes chemical modifications that, when incorrectly executed, can impair the synthesis of proteins. By pushing cryo-electron microscopy to achieve ever higher resolutions, scientists were able

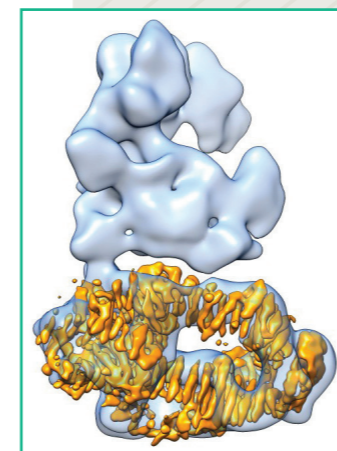


Human ribosome structure, viewed at a resolution that allows to see rRNA's chemical modifications.  
© Bruno Klaholz

to determine the localisation and structure of more than a hundred modifications of the human ribosome, thus showing their major role in the stabilisation of the rRNA structure. This mapping allows to better know the human ribosome as well as to imagine new approaches to counter its malfunctions.

*Nature*, novembre 2017 —  
Institut de génétique et de biologie moléculaire et cellulaire

### Detailing a coactivator via Cryo-EM



Coactivator SAGA structure (blue) and Tra1 structure (yellow).  
© Grigory Sharov

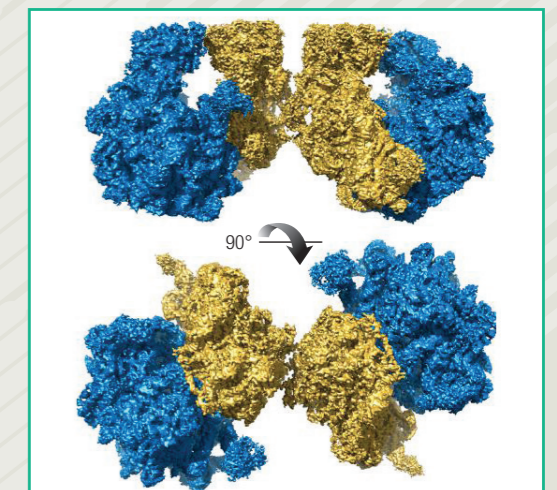
—Chromatin\* is a substance which packs DNA in the cell's nucleus, making it inactive and repressing the genes' expression. The SAGA coactivator helps lifting that repression by modifying the structure of the chromatin. SAGA's spatial conformation, a cluster of 19 proteins, has been brought to light thanks to cryo-electron microscopy and the analysis of 250.000 molecular images. The Tra1 protein plays a major role in activating genes and constitutes the most stable part of SAGA. This stability allowed the researchers to determine the precise conformation of Tra1 at an atomic scale.

*Nature Communications*, novembre 2017 —  
Institut de génétique et de biologie moléculaire et cellulaire

### ... to better target

—Bacteria are resourceful organisms. Thanks to their very short generation time, they can evolve quickly and therefore adapt to the many threats they have to endure, such as antibiotic treatments. *Staphylococcus aureus*, like other bacteria, is able to "hibernate": by associating its ribosomes in dimers, it can stop its protein synthesis machinery and survive extreme conditions. Scientists have observed the three-dimensional configuration of these ribosomes dimers with cryo-electron microscopy to determine their structure at a precise resolution. The conformation, specific to *Staphylococcus aureus*, could partly explain the strong resilience of these organisms to antibiotic treatments. This work paves the way towards the production of therapeutic agents that could target this peculiar structural conformation and help fight these bacteria, responsible for numerous infections contracted in hospitals.

*The EMBO Journal*, juin 2017 —  
Architecture et réactivité de l'ARN - Institut de biologie moléculaire et cellulaire  
Institut de génétique et de biologie moléculaire et cellulaire

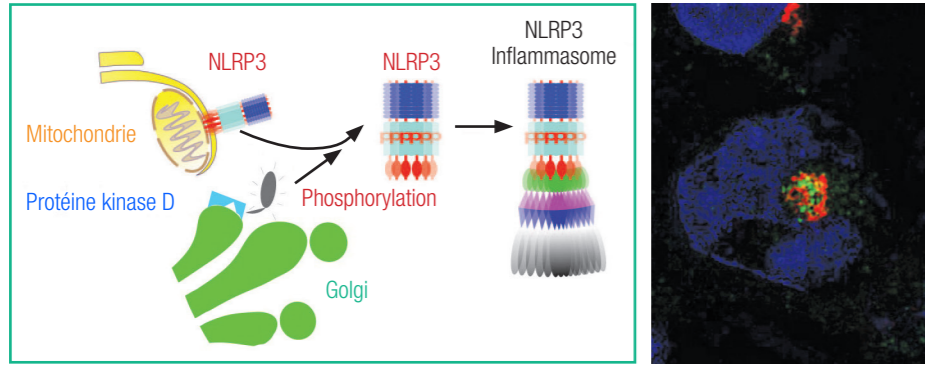


Three-dimensional reconstruction of *Staphylococcus aureus* associated ribosomes, in a state of "hibernation" (resolution : 3.7 Å)  
© Yaser Hashem, Marat Yusupov

## Inflammatory diseases: an unsuspected culprit

\_\_ To fight against external threats, our body must spot danger signals and act adequately, notably through some of its white blood cells, **macrophages\***, which attack pathogens. The alteration of the mechanism which activates those immune cells can generate massive inflammation and associated auto-immune diseases. Scientists have discovered a new signalling pathway which plays a role in the regulation of this mechanism. Surprisingly, it involves the Golgi apparatus, a structure located inside the cell, which interacts with a number of pathogen-sensitive proteins. When they interfered with this mechanism, researchers managed to block the inflammation. Their finding constitutes a major step towards the development of a treatment for a number of inflammatory diseases.

*Journal of Experimental Medicine*, July 2017 \_\_  
Institut de génétique et de biologie moléculaire et cellulaire



On the left: Succession of events leading to the activation of the inflammation process. On the right: In the cell nucleus (blue), protein kinase D located on the Golgi apparatus (green) is inhibited and the NLRP3 protein (red) is blocked at the mitochondrial membrane. The inflammation process cannot be activated.  
© Roméo Ricci

## A neuropeptide to fight obesity-associated diseases

\_\_ Body fat, also called adipose tissue, contains white blood cells and especially **macrophages\***. In people suffering from obesity, macrophages accumulate and can promote inflammation, which is partly responsible for obesity-associated diseases. Scientists have shown that a particular molecule, the so called neuropeptide FF, is involved in this phenomenon. When this neuropeptide binds to its receptor which lies at the surface of macrophages, it generates an anti-inflammatory behaviour from the latter. In people suffering from obesity, however, this molecule is present in smaller quantities in the blood circulation and macrophages therefore become inflammatory. This process can have harmful consequences for the metabolism. This work paves the way to new treatments for obesity-associated diseases such as type 2 diabetes.

*Journal of Clinical Investigation*, June 2017 \_\_  
Biotechnologie et signalisation cellulaire

## A genetic origin for intellectual and cognitive disorders

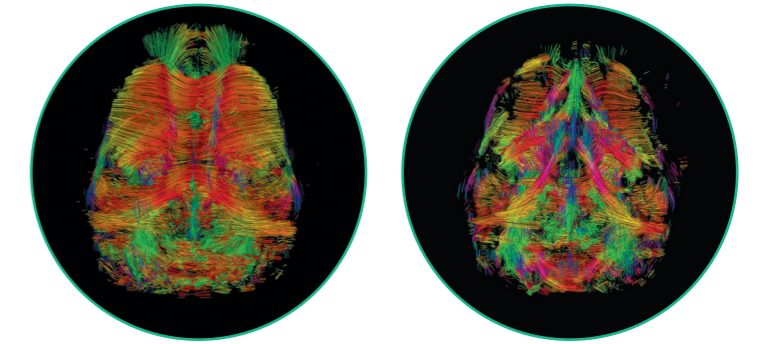
\_\_ Hypoplasie pontocérébelleuse. Derrière ce nom complexe se cache une famille de pathologies sévères caractérisées par un développement insuffisant du cervelet et associées à une déficience intellectuelle. Alors que 25% des cas restent encore inexpliqués, les chercheurs ont découvert un nouveau gène, TBC1D23, impliqué dans cette maladie. Celui-ci code une protéine qui joue un rôle dans le transport intracellulaire. La mutation de ce gène affecte cette fonction ainsi que le positionnement des neurones lors du développement du cortex cérébral.

*The American Journal of Human Genetics*, August 2017 \_\_  
Institut de génétique et de biologie moléculaire et cellulaire



\_\_ Cognitive disorders represent from 5 to 10% of public health costs, but their causes are not well known. Scientists have shed light on the role of the WDR47 gene on the development of the brain, and in particular of the corpus callosum, which is involved in memory and learning processes. This gene is also involved in the regulation of autophagy, the mechanism through which neurons can eliminate their own toxic cellular components. Mutations of WDR47 can thus lead to a malformation of the corpus callosum and cause cognitive disorders.

*Proceedings of the National Academy of Science*, October 2017 \_\_  
Institut de génétique et de biologie moléculaire et cellulaire



Left: normal brain; right : abnormal brain.  
© Chrystelle Po

## Birds of a feather flock together... or do they?

\_\_ The diversity of life relies on genetic modifications and natural selection. For new species to arise there have to be reproductive barriers. A group of researchers have shown a new mechanism of reproductive isolation, that is to say which prevents the **hybridization\*** of two varieties of a same species. Such a mechanism involves two copies of an essential gene. In one of the varieties, a copy of the gene is mutated and inactivated, in the other, the expression of the gene is blocked by **epigenetic modifications\***. Crossbreeding these varieties, and therefore combining their gene's alterations, leads to the death of part of the descendants at the embryonic stage. Because of their reversible nature, epigenetic modifications play a particular role in the differentiation of species.

*Proceedings of the National Academy of Sciences*, March 2017 \_\_  
Institut de biologie moléculaire des plantes

## How long does it take to transmit an epigenetic mark?

\_\_ When a cell divides, it must transmit all the information it contains to its daughter cells, in order to maintain its functions. Some epigenetic marks, namely DNA modifications such as methylation, condition the expression of certain genes and the synthesis of the associated proteins, which are responsible for the cell's identity. When it divides, the mother cell only passes on one methylated DNA strand to its daughter cell; methylation profiles must therefore be duplicated on the newly synthesised strand. To do so, the so called UHRF1 protein binds with the DNA and guides the DNMT1 enzyme which, in turn, ensures methylation of the new strand. Scientists have characterised the dynamic of this mechanism and shown that the protein binds quickly whilst allowing enough time for the enzyme to be recruited at the right spot.

*Journal of the American Chemical Society*, January 2017 \_\_  
Laboratoire de biophotonique et pharmacologie

## A major step towards the understanding of the origins of life

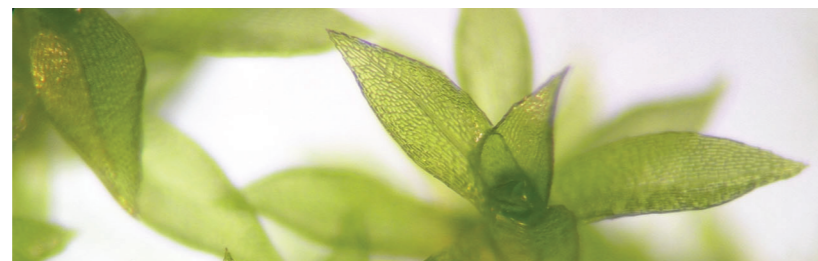
\_\_ The reverse Krebs cycle, which lies at the heart of certain primitive organisms' metabolism, allows the synthesis of precursor elements of sugars, amino acids and other essential molecules of life. Chemists have successfully replicated 6 out of 11 reaction stages of this cycle in a prebiotic environment, that is to say deprived of enzymes, which were thought to be needed for their realisation. In order to do so, they were inspired by the existing environment in the ocean hydrothermal vents, where primitive organisms lived and where life might have appeared... way before the first enzymes. This work is a major step forward in the understanding of the origins of life.

*Nature Ecology and Evolution*, October 2017 \_\_  
Institut de science et d'ingénierie supramoléculaires

## Plants put on their coats to conquer the Earth

\_\_ To emerge courageously from the waters 450 million years ago, plants had to develop mechanisms that would allow them to resist to the dangers of their new hostile environment, such as drought and solar radiations. Among these mechanisms is a vascular system made of biopolymers, such as lignin, that rigidifies the tissues, allowing the transport of water and nutrients in the entire organism. By studying *Physcomitrella patens*, a moss from the most ancient terrestrial plant group – bryophytes – biologists discovered how plants were able to resist desiccation. They showed the importance of the phenolic metabolism, which synthesises a biopolymer associating phenols and lipids. This metabolism is needed to form an impervious cuticle that protects plants against drought and UV radiations.

*Nature Communications*, March 2017 \_\_  
Institut de biologie moléculaire des plantes



*Physcomitrella patens* is a model for the study of plants' adaptation processes to terrestrial environments.  
© Hugues Renault

## Melatonin acts like an endocrine horscope

\_\_ Melatonin is a light sensitive hormone of which the nocturnal production varies all year long, night-time being longer in winter than in summer. This particular dynamic allows the hormone to synchronise biological processes depending on the seasons. Foetuses do not produce melatonin but they are equipped with receptors that are able to recognize it. In the case of Siberian hamsters, scientists discovered that, during pregnancy, the mother's melatonin crosses the placental barrier and acts on the foetus' nervous system. Moreover, baby hamsters born from a winter pregnancy – with less daylight – are more sensitive to the activity of the hormone compared to babies born from a summer pregnancy – with more daylight. Therefore, the former's reproductive system and metabolism develop faster than the latter's, in order to adapt quickly to the upcoming winter conditions.

*Proceedings of the National Academy of Sciences*, July 2017 \_\_  
Institut des neurosciences cellulaires et intégratives



A female Siberian hamster and her pups.  
© Paul Klosen

## New molecules can target both the **infection** and **transmission** of malaria

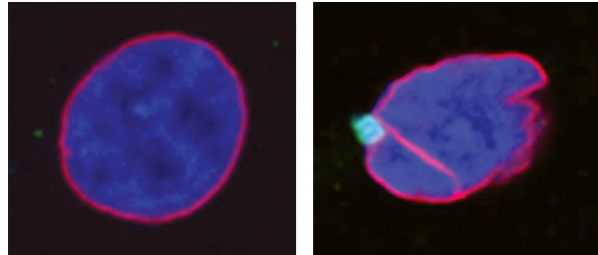
— Malaria is the most common parasitic disease in the world. In the long search for a cure, a number of antimalarial molecules have been discovered. New derivatives of these molecules, bound to steroids, have antiparasitic activities largely superior to that of their non-steroid-bound counterparts. Now, the researchers have shown why. They have discovered that these derivatives can infiltrate the parasite more easily to generate a harmful oxidative stress. Moreover, they are also efficient against the sexual form of the parasite, which resists to classic treatments and is responsible for its transmission to mosquitoes. These combined properties are essential in the fight against malaria.

*Nature Communications*, février 2017 —  
Laboratoire de chimie moléculaire  
Réponse immunitaire et développement chez les insectes

## Discovery of a **new mechanism** responsible for the **FXTAS disease**

— The fragile X-associated Tremor/Ataxia Syndrome (FXTAS) is a rare neurodegenerative disease which affects men over 50 years of age. It is due to abnormal repetitions of 3 nucléotides\* in the so-called FRM1 gene. Scientists have shown that these redundant repetitions were, in fact, translated into proteins, despite the absence of the start codon AUG. The latter is in charge of initiating translation in a healthy cell. In people suffering from FXTAS, another similar codon performs this function, however with reduced efficiency. This reveals that certain regions of the genome that are supposed to be non-coding are notwithstanding translated into proteins. This work allows scientists to better understand the mechanisms responsible for FXTAS disease.

*Neuron*, janvier 2017 —  
Institut de génétique et de biologie moléculaire et cellulaire



Nuclei of neurons derived from healthy (on the left) and sick (on the right) patient cells. The nucleus is coloured in blue and the nuclear envelope in red. On the right, the so called FRMpolyG protein (in green) interacts with the nuclear envelope and destabilises it.  
© IGBMC

## Depression could be caused by the **overexpression** of a protein

— Depression is a condition that can be caused, in part, by chronic pain or intense and prolonged stress. In the brain, the region called anterior cingulate cortex could be involved in the development of this condition. Researchers have analysed molecular alterations of this cortex by combining pharmacological and genomics methods. They have determined that the overexpression of a particular protein, MKP-1 phosphatase, could be one of the main factors responsible for this psychiatric disease.

*Biological Psychiatry*, septembre 2017 —  
Institut des neurosciences cellulaires et intégratives

## Can we **neutralise unwanted side effects** of drugs?

— To be efficient, drugs must be able to reach their target in the organism in sufficient quantity and remain there long enough to act. However, sometimes these substances can stay in the body for weeks, maybe months, and induce unwanted side effects. To overcome this problem, a group of scientists has developed a new type of drug which can be detected and modified by a neutralising agent directly in the organism, so that it can be rapidly eliminated once the treatment is over. This proof of concept leads to potential new treatments combining the efficiency of medication administration and excretion.

*Nature Communications*, mars 2017 —  
Conception et application de molécules bioactives  
Institut de génétique et de biologie moléculaire et cellulaire

## Weakening cancer cells to destroy them more easily

— When a cell undergoes stress, i.e. a dangerous situation compromising its integrity, the DNA it contains can be damaged. In order to repair these lesions, the cell must interrupt transcription, the mechanism which allows genome expression. Only certain genes, such as CSA and CSB, are still expressed to manage DNA repair. In the rare genetic disease called Cockayne Syndrome, however, these genes are mutated and therefore can no longer perform their function. Researchers have discovered that in patients suffering from this disease, the so called ATF3 protein – which is synthesised in response to DNA damage – inhibits the expression of a large number of genes. For transcription to resume, ATF3 must normally be degraded by CSA and CSB. This work paves the way towards a new anticancer treatment. Indeed, many types of chemotherapy are based on the functioning of UVs: they kill tumour cells by damaging their DNA. Preventing ATF3 degradation in the targeted tumour cells could improve the efficiency of those therapies

*Molecular Cell*, décembre 2017 —  
Institut de génétique et de biologie moléculaire et cellulaire



## Man and dog's long-term relationship



— When did dogs become Man's best friends? For a long time this question has been up for debate. By analysing the complete genome of two dogs dated from the Neolithic era and by comparing them with the genomes of modern dogs and wolves, researchers have determined two things. Dogs diverged genetically from wolves around 40 000 years ago and later separated into two distinct populations between the east and the west of the Eurasian continent around 20 000 years ago. The domestication of dogs would therefore have occurred only once in human history, sometime between these two periods. This work contradicts a 2016 study in which the authors argued that dogs had been domesticated twice, in different places and at different times.

*Nature Communications*, august 2017 —  
Archéologie et histoire ancienne : Méditerranée et Europe

Dog mandibles discovered on an ancient Neolithic site (end of 5th millennium before common era).  
© RMA

## Elections: how to **better represent voters'** opinion?

— A group of researchers took advantage of the 2017 French presidential election to test new alternative voting systems in five cities. In Strasbourg, the experiment involved over a thousand volunteers. Two systems were tested: the first is called approval voting – voters approve or disapprove the candidates – and the second is called score voting – voters give each candidate a grade, the winner being the one with the highest score. These one-round voting systems allow voters to give their opinion on each and every candidate, instead of just one. Participation rates in this experiment were particularly satisfying (around 60%) and the results were enlightening. Indeed, five out of the eleven systems tested lead to a different winner, and all of them gave different ranking compared to the official results. In short, these alternative voting systems bring new information that is usually unobtainable via the current two-round system.

Bureau d'économie théorique et appliquée

## Ancient recipes for the **treatments** of tomorrow



— Science involves interdisciplinarity, as shown by a team of biologists, chemists and ancient history specialists that assembled to work on new medical treatments for antibiotic-resistant diseases. Surprisingly, to do so they looked at the past and studied the efficient solutions developed by our ancestors. They translated and analysed the Arabian medieval pharmacopoeia – i.e. the body of collected medical recipes and formulas gathered by medieval scholars. The researchers chose this particular pharmacopoeia because of the large amount of knowledge it contains, due to the convergence of sciences allowed by the 7th century Arabian conquests in the Mediterranean Basin and Asia. Once they will have established the list of functions of these preparations, the scientists will reproduce them to test their efficiency on pathogens. The ultimate goal is to isolate active molecules from the selected preparations in order to synthesis new drugs.

Archéologie et histoire ancienne : Méditerranée - Europe  
Biotechnologie et signalisation cellulaire  
Laboratoire de biophotonique et pharmacologie  
Laboratoire d'innovation thérapeutique

## A World War One underground gallery **virtually recreated**

— As part of the exhibition *Vimy 1917, the underground war of the Canadians*, which commemorates the 100th anniversary of World War One, researchers have virtually recreated a little known gallery that sheltered Canadian soldiers. The team used laser scanning to recreate, in 3 dimensions, these fragile tunnels which are inaccessible to the public. This work gives an insight into the life and talents of the soldiers who lived in this gallery, through the inscriptions and figures that they engraved into the stone walls.

Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie

### - SEMINAR -

## Religion as a foreign policy tool

— In Turkey, the Directorate of Religious Affairs, also called Diyanet, is attached to the President of the Republic. In the last few decades, the Turkish government has turned religion into a political tool. During this seminar, participants debated on the role of this institute in the economy, and on its impact on society and education. They also discussed the international scope of this growing institution – of which the power and means have increased significantly since it was created – as well as its involvement in the management of Turkish communities abroad.

Droit, religion, entreprise et société



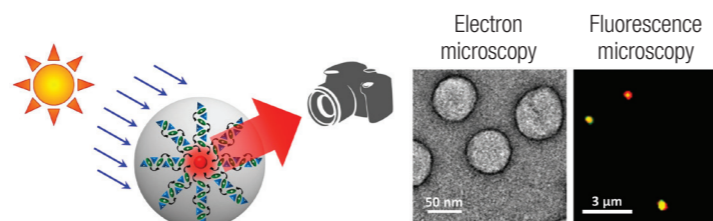


## NANOMATERIALS

### Nanoparticles for molecular photography

...In order to be observable in a living cell or a biomedical sample, a molecule has to stand out. A way to do that is to attach a dye to it. By doing so, the dye – and therefore the molecule it is bound to – can then be seen thanks to fluorescence via a complex device comprised of a special microscope and a powerful source of light. Scientists were inspired by plants' photosynthesis to overcome this constraint. They conceived nanoparticles containing tens of thousands of rhodamine molecules, which can capture the energy of light to transfer it to the dye. They amplified thus a thousand times the target molecule's emission under ambient light, and with a simple camera. This technique paves the way towards new biomedical diagnosis systems relying on the detection of unique molecules, such as cancer biomarkers.

*Nature Photonics*, september 2017 —  
Laboratoire de biophotonique et pharmacologie



On the left: representation of a nanoparticle acting as a fluorescent "antenna" and containing tens of thousands of rhodamine molecules. On the right: the "antennas" as viewed via electron microscopy (left image) and via fluorescence photography (right image).  
© Andrey Klymchenko

### A major step towards the isolation of 2D crystals

...Two-dimensional crystals, which are comprised of a single layer of atoms, are at the centre of researchers' attention because of their fascinating electronic properties and their potential application in the field of quantum computer production. However, these crystals are synthesised on a crystalline substrate, such as aluminium or gold, from which they cannot then be dissociated. While they were working on a particular 2D crystal, the so-called germanene, scientists have discovered a way to bypass this problem. By applying small voltage impulses with the tip of a scanning tunnelling microscope, they changed the atomic structure of the germanene and therefore its interaction with the substrate. This work constitutes a major step towards the isolation of this 2D crystal.

*Journal of Physical Chemistry Letters*, september 2017 —  
Institut de science des matériaux de Mulhouse

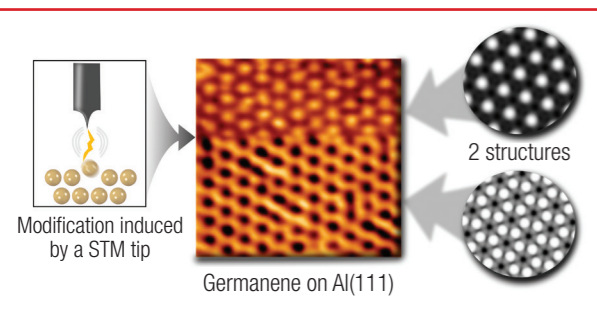


Image obtained via near-field microscopy at atomic resolutions and showing the structural changes.  
© IS2M

### A gearbox to control molecular motor speed and direction

...Molecular motors can produce nanometer scale mechanical movements thanks to energy sources such as light or heat. To orient their movements in a defined direction, they take advantage of the "Brownian ratchet" principle, which, as on a cogwheel, prevents them from turning back. Researchers have now developed a mechanism allowing these motors to work in one direction and then another. Using polymer chains, they attached them to molecular modulators. When irradiated with UVs, the motors rotate and coil the polymer chains which, in turn, transmit the mechanical movement. Under visible light, the modulator rotates in the opposite way, uncoiling the polymer chains. This system enables the control of the speed and direction of the global mechanical process, all the way up to the macroscopic scale.

*Nature Nanotechnology*, march 2017 —  
Institut Charles Sadron



### A new method to produce efficient conductive polymer films

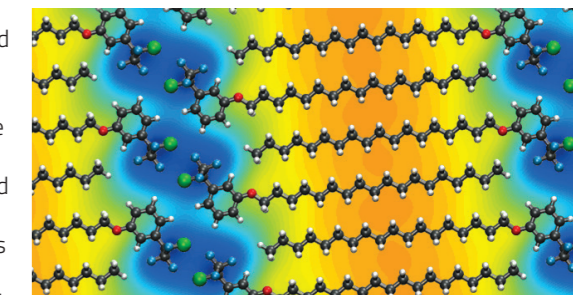
...Unlike most of organic polymers, conductive polymers are able to transport electric charges. Researchers have developed a new and very easy method to produce more efficient conductive polymer films. To do so, they oriented the polymer chains by mechanically brushing them at high temperatures, before doping them chemically to render them perfectly conductive. Transport of the charge is thereby amplified on the newly formed layers. This efficient, quick and cheap method could be applied to numerous semiconductive polymers. The conductivity of the first films obtained via this method is close to that of the copper's.

*Advanced Functional Materials*, april 2017 —  
Institut Charles Sadron

### A hybrid material with programmable electronic properties

...Crystalline-structured inorganic materials, such as graphene, are comprised of only one layer of atoms. When stacked up, these materials can undergo energy modulations at their surface, but these are limited and difficult to control. By adding layers of organic molecules to these materials, researchers have developed a new hybrid material with programmable electronic and optic properties. This work paves the way to numerous applications in the industry of electronics, for example in integrated circuits and transistors.

*Nature Communications*, march 2017 —  
Institut de science et d'ingénierie supramoléculaires



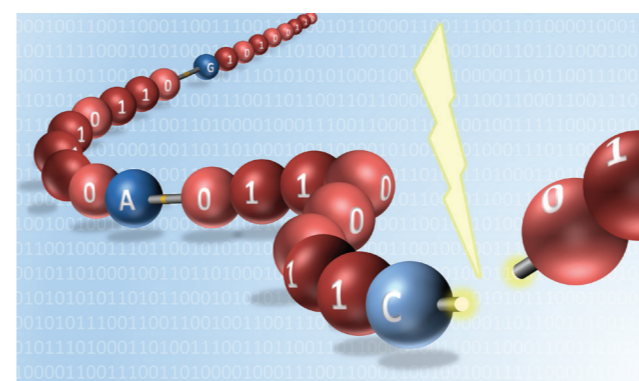
Structure of the molecular network comprised of organic bricks assembled on a graphene surface.  
© Paolo Samorì

## CHEMISTRY

### A new record for molecular scale stored information

...How fast can we read data stored on polymers? A new record has been set by researchers who created artificial polymers that are capable of storing up to 8 bytes of information in a single molecule. These data have then been read with a mass spectrometer, a fast and easy-to-use tool, which constitutes major progress in this domain. With the upcoming development of an adapted reading software and of automated writing methods, this work paves the way towards the storing of larger quantities of data on polymers.

*Nature Communications*, october 2017 —  
Institut Charles Sadron



Schematic representation of a coded polymer chain when read via mass spectrometry.  
© Jean-François Lutz

### 19th century painters' secret revealed

...How did 19th century painters manage to paint quickly whilst applying impressive texture and volume effects to their works? A group of researchers has tackled the question and studied the innovative gels that these painters used to mix with oil paints in order to modify their properties. These substances, which are made of resin and lead acetate, confer better elasticity to the paint and speeds up its drying. They reduced thus the time needed to complete a painting, which could sometimes reach several months.

*Angewandte Chemie International Edition*, january 2017 —  
Institut de sciences des matériaux de Mulhouse

### A new process for olive-oil-production-generated waste upcycling

...Olive oil is largely appreciated in cooking, but its production industry harms the environment. In the production process, the olives are crushed and mixed with water, from which the oil is extracted. Every year, 32 million cubic meters of waste – water and the residues it contains – are produced. When discharged unaltered into the environment, they pollute water bodies and streams, reduce soil fertility and damage ecosystems. Researchers have developed a process which transforms this waste into biofertilizers and clean water usable for irrigation. To do so, they mixed the water and its residues with cypress sawdust. Once dried, the mixture undergoes a few other transformation steps to become the above-mentioned more eco-friendly products.

*ACS Sustainable Chemistry & Engineering*, september 2017 —  
Institut de science des matériaux de Mulhouse



Tests of biofertilizers obtained by the process of olive-oil-production-generated waste upcycling.  
© Mejdil Jeguirim

## ELECTRONIC OF THE FUTURE

### Shedding light on ferroelectric walls

...Ferroelectric materials allow the storage of information in digital memories. They are comprised of microscopic regions where the orientation of electric polarisation is the same. Researchers have discovered that the polarisation of the ferroelectric walls that separate these domains, which was thought to be of zero, is actually non-nil and can have several different orientations. This study opens up new perspectives with regard to the increase of digital memory storage capacity.

*Nature Communications*, june 2017 —  
Institut de physique et chimie des matériaux de Strasbourg

### A new technique allows probing electronic devices' functioning

...A synchrotron's extremely bright light and large spectrum allow physicists to study the electronic properties of matter. To obtain information on the complex operation of an electrical device, the study must focus on the few atoms which govern the transport through it. Physicists have achieved this by measuring the electrical conduction of a functioning magnetic random access memory whilst it underwent a synchrotron's X-ray irradiation. These memories are the elementary bricks of next-generation computers. By allowing the "reading" of the properties of matter in a functioning device, this novel technique should draw the industry's attention to major scientific instruments such as the synchrotron, and speed up both academic and industrial research and development.

*Advanced Materials*, march 2017 —  
Institut de physique et chimie des matériaux de Strasbourg





## Open-heart surgery for the CMS detector

— The Compact Muon Solenoid (CMS) experiment is installed at the CERN Large Hadron Collider (LHC). Designed to detect all types of particles, it allows researchers to deepen their knowledge of the Higgs Boson as well as to search for new particles, such as the ones that dark matter may be comprised of. Since spring 2017, the CMS is equipped with a new internal detector - comprised of 124 million pixels - which precisely measures the trajectory and production point of charged particles. The IPHC engineers have conceived the reading system for this new instrument which records data at a 40 Mhz frequency (40 million times per second).

Institut pluridisciplinaire Hubert Curien

Installation of the new trajectograph at the heart of the CMS detector.  
© 2017 CERN, for the benefit of the CMS Collaboration

## Spectrometry allows rapid detection of pancreatic cancer

— With only 5% of patients' survival at 5 years, pancreatic cancer is one of the cancers with the highest mortality. Its lack of specific symptoms makes it difficult to identify and leads to a late start of the treatment. Researchers have developed a new technique which allows distinguishing cancerous pancreatic cells from healthy ones. In order to compare the tissues, they used HRMAS RMN spectrometry, which allows the detection of metabolites at high resolutions. By doing so, they discovered that a particular metabolite, so called ethanolamine, is present in high quantities within the most malignant pancreatic cancers. The rapidity of this detection technique allows use in the operation room to adapt the surgeon's intervention in real time.

BMC Medicine, march 2017 —  
Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie  
Hôpitaux Universitaires de Strasbourg

## 4D-Pediamenopet: interdisciplinarity in four dimensions



IPGS PhD student Sonia Brahimi performing a geophysical survey in the valley of the Mortuary Temple of Hatshepsut. © Frédéric Colin

— Pediamenopet was an 8th or 7th century BCE intellectual and priest, close to the kings of Egypt. To scan his funerary temple, researchers have developed new particular geophysics methods. Additional to its 22 funerary rooms, this tomb is also comprised of a zone buried under rubble that has accumulated over thousands of years. To overcome these obstacles, geophysicists have scanned the site with captors to draw a magnetic map of the underground, similar

to a medical ultrasound. The detected anomalies confirm the presence of structures - some already known and others new - buried under the rubble, which allows the archeologists to precisely direct their excavations. To this will be added photogrammetry and excavation campaigns which will aim to model the site in three dimensions and its evolution through time. This project will also determine the environment, climate and vegetation of this site at the time of Pediamenopet's burial. In summary, this study is truly an interdisciplinary work which involves several teams collaborating with the Egyptian Ministry of Antiquities and which seeks to renew Egyptology.

Archéologie et histoire ancienne : Méditerranée - Europe  
Institut de physique du globe de Strasbourg  
Laboratoire image, ville, environnement



## Headband protection for cyclists awarded

— To mitigate the risks incurred by cyclists who refuse to wear a helmet, researchers have developed a headband protection. The protection provided is less than that of a helmet, but this strip of barely 13 millimeters can protect against shocks incurred at a speed of up to 16 km/h. It is now marketed under the Okyl brand, a subsidiary of Sport Contrôle, and a new, more comfortable version is on its way to the stores. This invention was awarded the bronze medal of the French Society of Exercise and Sport Medicine and by the Mayor of Strasbourg at the European Lépine competition in Strasbourg.

Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie

© Sport Contrôle

## An atomic switch for quantum dots

— Quantum dots are formed of a single atom. Thanks to scanning tunnelling microscopy, researchers were able to combine four of these dots to form a three-pointed star-shaped structure of which the electronic properties can switch from an ON to an OFF state. Computer models have shown that, initially, charges were homogeneously distributed across the structure, which corresponded to the electronic ON state. Then, when they simulated a charge impulse with the microscope, they observed that the charge was distributed at the tips of the star, which corresponded to the electronic OFF state. This work opens up captivating perspectives in nanoscience related to quantum information and molecular electronics.

Nature Communications, december 2017 —  
Institut de science des matériaux de Mulhouse

## Two new devices enriched the Grand Est's imaging facility

— The rise of analytical and imaging techniques has revolutionised the ability of life sciences to observe the living world with ever improving precision. The Institut de biologie moléculaire des plantes is a centre of excellence when it comes to plant sciences. Two new pieces of equipment have integrated its platforms thereby enriching the imaging facility of the Grand Est region. The first one is the very high resolution mass spectrometer Solarix FTMS. In metabolomics, i.e. the study of chemical processes involving small molecules called metabolites, this device analyses the chemical composition and the mass of a sample's components, directly in the latter, as well as their spatial and temporal distributions. At the heart of this piece of equipment lies the superconducting giant magnet which was built in Wissembourg by Alsatian company Bruker. The second device, a scanning electron microscope, allows researchers to study samples at very high resolutions and in three dimensions thanks to a technology called Serial Block Face Imaging.

Institut de biologie moléculaire des plantes



Weighing approximately two tons, the Solarix FTMS was installed via the roof of the IBMP.  
© Jean-Luc Evrard

## Optimising bone graft via a digital model

— An orofacial cleft is a malformation of the face which affects one new born out of seven hundred. As difficult to live for children as for adults, this issue is at the centre of Caroline Dissaux's research, which aims to correct this malformation by surgery. However, the success of the operation varies from one patient to another. To optimise the bone reconstruction phase of the dental arch, the researcher is working on the development of a biomechanical digital model to simulate the reconstruction of the bone surrounding and maintaining the teeth. Ultimately, this model should help anticipate the graft response with regard to the surgical procedure to minimize consequences at a later age. In 2017, Caroline Dissaux was the recipient of the l'Oréal-Unesco grant for women.



© Fondation L'Oréal  
Carl Diner

Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie

## Using glass marbles for 3D super-resolution

— Interferometric microscopy allows researchers to observe microelectronic components in three-dimensional details. Its axial resolution is of the nanometre scale, but its lateral resolution is less precise. Indeed, in optic microscopy, lateral resolution does not exceed half the wavelength of the used light. Details under 300 nanometres are thus not visible with a perfect microscope. To overcome this problem, researchers have developed a new technique, called "super-resolution". It consists in using glass microspheres which, when placed between the sample and the objective lens, act as "super-lenses" and enlarge details that were invisible until then. By doing so, they can reach resolutions as precise as 100 nanometres. This method enables the measuring of smaller structures, rapidly, via full-field measurement, in a non-invasive way and without the need to previously mark the sample.

Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie

## The SERTIT celebrates its 30th anniversary and integration into ICube

— Created at the launch of first French satellite SPOT-1, the SERTIT produces geographical information based on satellite images. It offers solutions to problems related to the management of crisis, natural resources, the environment, sustainable development and territorial planning. In 2017, the SERTIT celebrated its 30th anniversary as well as its 2015 integration into the Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie (ICube). To mark this occasion, SERTIT partners, the local scientific community and Media were invited to rediscover its successes, its major themes, its ambitions and its privileged link with scientific research.

Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie



## Ostia's adaptations to a changing environment



— Located at the mouth of the river Tiber, the city of Ostia was the seaport of the Roman Empire's capital. In a study, researchers have questioned this city's adaptation capacities when it came to facing river and seaboard variations (floods, erosion, and sedimentary deposits). Thanks to sedimentary coring, they have showed that, between the 4th and 3rd centuries BCE, the Tiber lied under Ostia's current location. The river then moved laterally, as floods went on, while the city developed. Analysis of the streets' orientation and of the archaeological structures showed that, as it grew, the city adapted to the different positions of the seaboard and riverbanks. Ostia's town planning therefore shows adaptation and resilience to environmental variations.

*Earth Science Reviews*, february 2017 —  
Laboratoire image, ville, environnement

3D representation of Ostia, Rome's seaport located at the mouth of the Tiber.  
© Imagerie 3D : Rémi Fabro, Arkod

## Drought adaptation and resilience: historical perspectives in Europe

— Droughts are borderless environmental threats. But how can society adapt to such a hydro-climatic danger? At the crossroads between history of climatology, hydrology, geography, agriculture and archaeology, this interdisciplinary seminar gathered researchers from eleven countries to discuss the historical reconstruction of drought episodes which occurred essentially in France and in Europe after 1500 CE. This has been the first seminar to be exclusively dedicated to this theme, which is of major significance at a time when droughts may, in the near future, disrupt drinkable water supplies, agriculture, fluvial navigation, hydroelectric production and tourism, as well as increase the risk of forest fires.

Laboratoire image, ville, environnement

## Tropical cyclones are deforming the Earth's crust

— Mud flows, landslides and floods are evidence of the destructive power of tropical cyclones. However, researchers have shown that the influence of these hurricanes is not limited to the surface of the Earth: they also deform the terrestrial crust. By analysing data collected for ten years by *extensometers\**, they have demonstrated that the crust's deformation can be divided into two phases: distension when the atmospheric depression occurs, and compression due to the high amount of rain water on the ground, characteristic to the passage of a cyclone.

*Geophysical Research Letter*, november 2017 —  
Institut de physique du globe de Strasbourg

## A new technique to see under our feet

— Leismic tomography allows imaging underground from seismic waves, but the models obtained can be biased in regions where the distribution of those waves is heterogeneous. A group of researchers has developed a new technique of global tomography for the Earth's mantle. Called SOLA, this technique is cheaper than the classic one and brings new unbiased and quantitative insights of the Earth's structure and internal dynamics.

*Geophysical Research Letters*, november 2017 —  
Institut de physique du globe de Strasbourg

## Vitamin deficiency responsible for infanticide in hamsters



— When they studied the impact of corn monoculture on the European hamster, researchers discovered that a diet essentially based on this cereal caused inappropriate maternal behaviour. They have especially observed a high rate of infanticide, as high as 95%, which was attributed to a B3 vitamin deficiency. When the latter was counterbalanced by vitamin supplements, normal maternal behaviour and reproductive success were restored. This work confirms the necessity to develop alternatives to intensive monoculture.

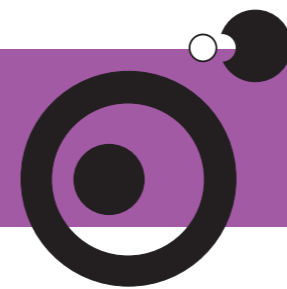
*Proceedings of the Royal Society*, january 2017 —  
Institut pluridisciplinaire Hubert Curien

The 5% of babies who survived the abnormal maternal behaviour suffer growth retardation.  
© Mathilde Tissier

## Past temperatures of the oceans were steadier than we thought

— Les foraminifères sont des organismes marins microscopiques constitués d'une coquille de calcaire dont la teneur en oxygène 18 dépend de la température de l'eau dans laquelle ces organismes ont vécu. L'analyse de ces coquilles fossilisées dans les sédiments permet de définir la température des océans sur des millions d'années. Toutefois, un groupe de chercheurs a remis en question la fiabilité de cette technique en montrant que la teneur en oxygène 18 des coquilles peut changer même après la mort de l'organisme. Ainsi, par le passé, la température des océans a pu être bien plus stable qu'on l'imaginait. Le réchauffement global actuel pourrait donc être un événement sans précédent.

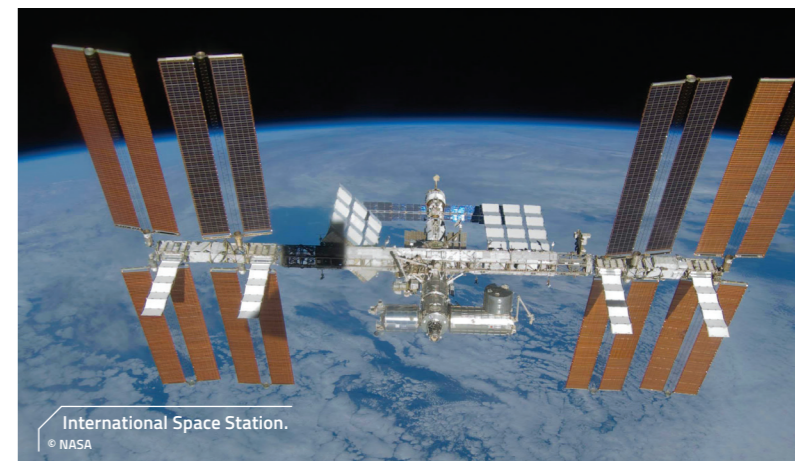
*Nature Communications*, october 2017 —  
Laboratoire d'hydrologie et de géochimie de Strasbourg



## The MMARS project took-off

— Where did the methane detected on Mars by the Curiosity rover come from? Did it originate from the disintegration of the Martian subsoil which occurs when it touches water or was it synthesised by microorganisms? To answer this question, in 2017 researchers sent methanogen microorganisms to the International Space Station via a SpaceX rocket. They aim to determine the survival and methane production capacities of these microorganisms in space conditions similar to that of the Red Planet's subsoil. Analysing these data could contribute to strengthen our knowledge with regards to the possibility of life in the extreme conditions of space and of Mars.

Génétique moléculaire, génomique, microbiologie



International Space Station.  
© NASA

## STELLA started gazing at the stars



Gamma ray detectors (up) above the STELLA dome (down).  
© Marcel Heine

— The lifecycle of massive stars can be significantly informative with regard to the age of our universe, stellar evolution and the formation of chemical elements. These notions are at the heart of the STELLA measuring station, an international facility conceived at the Institut pluridisciplinaire Hubert Curien. In 2017, it started successfully collecting data by measuring the key nuclear reactions of the lifecycle of stars.

Institut pluridisciplinaire Hubert Curien

## Simulating the universe to understand its origin

— To understand how the universe formed, Jenny Sorce studies the layout of galaxies, which is similar to a spider web, with threads and empty spaces. She develops computer models based on fictional data from a "fake universe". By applying variable constraints via an algorithm to the model, she observes whether the universe takes shape the way it is supposed to. If it does, it means the algorithm worked and she therefore applies real data to observe the formation of our local universe. In 2017, she was the recipient of the l'Oréal-Unesco grant for women in science.

Observatoire astronomique de Strasbourg

The night of gravitational waves: conferences and workshops destined to the public were organized by the #IPHC scientists @CNRS @Unistra

## Submarine astronomy



Commissioned in 2017, the ORCA detector of the international KM3NeT collaboration is a second generation neutrinos telescope installed in the depths of the Mediterranean sea. The Institut pluridisciplinaire Hubert Curien is one the production sites of the digital optical modules. This device will be used to study the fundamental properties of neutrinos.  
© CNRS images

## EUROPE AND INTERNATIONAL

### 2017 INTERNATIONAL COLLABORATIONS

- 2 696** Missions abroad registered by the CNRS for Alsatian laboratories staff members.
- 66** Countries covered by these missions, with more than a third in Germany and in Switzerland.
- 16** International associated laboratories (LIA) ongoing.
- 19** international projects for scientific cooperation (PICS), of which 5 were created in 2016.
- 8** International Research Network (IRN, ex GDRI).



### • INTERREG PROJECTS •

- ELENA
- Innov. AR
- Interreligio
- Regiowood
- RMMO
- VITIFUTUR

#MakeOurPlanetGreatAgain

**Giuliano Giambastini** is the laureate for the 2017 call for projects #MakeOurPlanetGreatAgain @Min\_Ecologie for his "Trainer" project, carried out in collaboration with doctor Cuong Pham-Huu ; he integrated the #ICPEES laboratory (@CNRS @unistra)

### Launch of the Hoffmann Infnitus Program

—In September 2017, the « Hoffmann Infnitus Program », established by the Chinese company Infnitus and the CNRS, was officially launched in the presence of Jules Hoffmann, laureate of the 2011 Nobel Prize in Physiology or Medicine. Researchers will test the effects of the traditional Chinese pharmacopoeia's plant extracts on fruit flies affected by viral infections. The goal of this long term collaboration – which will last for 4 years – is to explore the potential roles of phytotherapy in the regulation of the immune system.

Réponse immunitaire et développement chez les insectes

Lam YU, Senior Vice-President of LKK Health Products Group, Managing Director of Infnitus Global, and Michel Mortier, délégué général à la valorisation au CNRS.  
© Nicolas Busser



## PARTNERSHIPS WITH COMPANIES

### Joint research laboratories: a tool for public-private collaboration

The goal of a research joint laboratory is to assemble researchers and engineers from the academic world with those of the private business one in a shared research program. In just a few years, the CNRS and partner universities have more than doubled the number of joint laboratories with companies set up in France and around the world : there were 55 in 2009 and 126 in 2017. The CNRS intends to develop this model which allows the world of economics and the academic research to work together in order to create new knowledge and promote shared innovation.



### Bio-based materials for sustainable buildings

—This new joint research laboratory (LCR), was inaugurated in 2017 between the SOPREMA company, the CNRS and the University of Strasbourg. This laboratory, called Mutaxio, is the result of ten years of collaboration between the scientists of the ICPEES and of the world leader in building waterproofing. It aims to develop materials (foams, membranes) with new properties, from various biomasses (microalgae, lignocellulosic resources, vegetable oils, etc.). The goal is to render available innovative and sustainable materials to replace the fossil ones which are currently used in weather and water proofing. This process is incorporated within the framework of sustainable development and green chemistry, especially with the creation of a value chain which extends from renewable resources to final products.

@Bayer\_FR

Launched in 2014, the joint research laboratory "Organofluorine chemistry" (C2OD) between the @Bayer\_FR company, the @CNRS and the @Unistra was renewed for 4 years. A new contract has been signed by all the partners.

### - FOCUS -

### The evolution of the Fessenhem social ecosystem

—The announcement of the closure of the Fessenhem nuclear power plant raises many questions. To understand the societal and environmental mechanisms that are being put in place and will be amplified during the final shutdown, researchers are mobilizing. Faced with this unprecedented situation, it is now that scientists begin their reflections and research work. A seminar dedicated to the evolution of the Fessenhem social ecosystem was held on the 29th and the 30th of June in Strasbourg. Over 100 experts from many disciplines such as Earth, life, nuclear, environmental and economical sciences gathered to talk about shared projects at the crossroads of these domains but also of territories (such as Germany and Switzerland). Indeed, with such a complex issue, only a multidisciplinary approach will enable the production of new and relevant scientific knowledge, which will be shared with participants involved in the project, politicians and society in general. At the end of the seminar, project Juxta Rhenum was created. Next in line is the creation of a Fessenhem Human-Environment Observatory (HEO). These HEO, created by the CNRS, are research entities dedicated to the understanding of very anthropised and complex ecosystems. This tool is necessary for the organisation and support of interdisciplinarity. It will enable the researchers to follow the progress of the Fessenhem ecosystem in the long term.



Fessenhem.  
© Florival.fr/Rémi Stoskopf

### The Commemoration of the Arette earthquake

—On the 13th of August 1967, an earthquake shook the town of Arette (Pyrénées Atlantiques) and the nearby villages, damaging 80% of the buildings. Although there was only one casualty thanks to the fact that the inhabitants were warned by a preliminary tremor, this earthquake is the strongest to have shaken France since the 1909 Lambesc temblor. Fifty years later, a commemoration was organised. During five days, 2000 visitors discovered records from the inhabitants of Arette and attended sound and light shows as well as cultural and scientific animations. IPGS and BCSF researchers and engineers in seismology raised awareness among the population concerning the dangers of earthquakes. The workshops (seismic simulator, seismometers and models) as well as a series of conferences, gave the opportunity to the public to become familiar with earthquakes, the notion of risk and the vulnerabilities of buildings. The BCSF is an entity of the EOST whose mission is to collect, analyse, and spread information about seismic activities in France. The IPGS is conducting research in geophysics, geology and seismology.

Bureau central sismologie français  
Institut de Physique du Globe de Strasbourg  
École et observatoire des sciences de la Terre de Strasbourg



Arette.  
© Stahl - Collection BCSF

@MT180FR

Regional finals co-organised by the @CNRS ans @unistra\_JDS  
1<sup>st</sup> place (Jury Prize): **Clémentine Bidaud**, IS2M  
2<sup>nd</sup> place (Jury and Public Prize): **Geoffrey Cotin**, IPCMS  
3<sup>rd</sup> place (Jury Prize): **Halima Elazhar**, IPHC



Discovering Earth Sciences: the EOST (@cnrs @unistra) and the @unistra\_JDS organised a thematic week for students and the general public with geological walks, workshops, debates and conferences



The university campaigns against false beliefs – a cycle of itinerant conferences was organised par the researchers of the #DRES and @beta\_economics laboratories (@cnrs @unistra)



### At the crossroads of law and fiction

—How can the general public become familiar with legal concepts which can sometimes be obscure? In partnership with the MédiaDroit association, researchers came up with the idea of using examples drawn from fiction. In 2017, superheroes were under the spotlight with the theme: "from The Punisher to the lawyer". Hulk, Batman, Superman and the many situations they find themselves in allowed the speakers to talk about superheroines, organized crime, patents and the jurisdiction of the state in international law.

Droit, religion, entreprise et société



## LIST OF LABORATORIES AS OF JANUARY 1ST 2018

The subjects presented in this booklet are the result of research led in the laboratories of the CNRS, the Inserm, the University of Strasbourg and the University of Haute-Alsace, in partnership with establishments of graduate studies and research, national and international research organisms and companies.

The list of research units following the evaluation carried out by the Haut Conseil de l'Évaluation de la Recherche et de l'Enseignement Supérieur (HCERES) in 2017.

You can find the CNRS scientific news online at [alsace.cnrs.fr](http://alsace.cnrs.fr) or at [journal.cnrs.fr](http://journal.cnrs.fr)

THE LABORATORIES

GLOSSARY

### INSB

— **Architecture et réactivité de l'ARN**  
ARN, CNRS  
[www-ibmc.u-strasbg.fr/spip-arn](http://www-ibmc.u-strasbg.fr/spip-arn)

— **Biotechnologie et signalisation cellulaire**  
BSC, CNRS/Unistra - [bsc.unistra.fr](http://bsc.unistra.fr)

— **Centre d'investigations neurocognitives et neurophysiologiques**  
CI2N, CNRS/Unistra - [ci2n.fr](http://ci2n.fr)

— **Centre de neurochimie**  
CNRS - [inci.u-strasbg.fr/fr/ups.html](http://inci.u-strasbg.fr/fr/ups.html)

— **Chronobiotron**  
CNRS/Unistra - [chronobiotron.u-strasbg.fr](http://chronobiotron.u-strasbg.fr)

— **Génétique moléculaire, génomique et microbiologie**  
GMGM, CNRS/Unistra - [gmgm.unistra.fr](http://gmgm.unistra.fr)

— **Immunologie, immunopathologie et chimie thérapeutique** - I2CT, CNRS (ex ICT)  
[www-ibmc.u-strasbg.fr/spip-ict](http://www-ibmc.u-strasbg.fr/spip-ict)

— **Institut de biologie moléculaire et cellulaire**  
IBMC, CNRS - [www-ibmc.u-strasbg.fr](http://www-ibmc.u-strasbg.fr)

— **Institut de biologie moléculaire des plantes**  
IBMP, CNRS - [ibmp.cnrs.fr](http://ibmp.cnrs.fr)

— **Institut de génétique et de biologie moléculaire et cellulaire**  
IGBMC, CNRS/Inserm/Unistra - [igbmc.fr](http://igbmc.fr)

— **Institut des neurosciences cellulaires et intégratives** - INCI, CNRS - [inci.u-strasbg.fr](http://inci.u-strasbg.fr)

— **Laboratoire de biomagerie et pathologies**  
LBP, CNRS/Unistra - [www-lpb.unistra.fr](http://www-lpb.unistra.fr)

— **Laboratoire de neurosciences cognitives et adaptatives** LNCA, CNRS/Unistra - [lnca.fr](http://lnca.fr)

— **Modèles insectes de l'immunité innée**  
M3I, CNRS (ex RIDI)  
<http://ibmc-m3i.cnrs.fr/fr/accueil-ridi/>

— **Plateforme de chimie biologique intégrative de Strasbourg**  
PCBIS, CNRS/Unistra - [pcbis.fr](http://pcbis.fr)

### INC

— **Chimie de la matière complexe**  
CMC, CNRS/Unistra  
[complex-matter.unistra.fr](http://complex-matter.unistra.fr)

— **Institut Charles Sadron**  
ICS, CNRS - [ics-cnrs.unistra.fr](http://ics-cnrs.unistra.fr)

— **Institut de chimie et procédés pour l'énergie, l'environnement et la santé**  
ICPEES, CNRS/Unistra - [icpees.unistra.fr](http://icpees.unistra.fr)

— **Institut de chimie de Strasbourg**  
[institut-chimie.unistra.fr](http://institut-chimie.unistra.fr)

— **Institut de science des matériaux de Mulhouse**  
IS2M, CNRS/UHA - [is2m.uha.fr](http://is2m.uha.fr)

— **Institut de science et d'ingénierie supramoléculaires**  
ISIS, CNRS/Unistra - [isis.unistra.fr](http://isis.unistra.fr)

— **Laboratoire de conception et application de molécules bioactives**  
CAMB, CNRS/Unistra - [camb.cnrs.fr](http://camb.cnrs.fr)

— **Laboratoire d'innovation moléculaire et applications**

LIMA, CNRS/Unistra (ex LCM) - [lima.unistra.fr/](http://lima.unistra.fr/)

— **Laboratoire d'innovation thérapeutique**  
LIT, CNRS/Unistra - [medchem.unistra.fr](http://medchem.unistra.fr)

— **Nanomatériaux pour les systèmes sous sollicitations extrêmes**  
NS3E, CNRS/Unistra /ISL - [ns3e.cnrs.fr](http://ns3e.cnrs.fr)

### INSHS

— **Archéologie et histoire ancienne : Méditerranée et Europe**  
Archimède, CNRS/Unistra  
[archimede.unistra.fr](http://archimede.unistra.fr)

— **Bureau d'économie théorique et appliquée**  
BETA, CNRS/Unistra/Université de Lorraine  
[beta-umr7522.fr](http://beta-umr7522.fr)

— **Droit, religion, entreprise et société**  
DRES, CNRS/Unistra - [dres.misha.cnrs.fr](http://dres.misha.cnrs.fr)

— **Dynamiques européennes**  
DynamE, CNRS/Unistra - [dynamie.unistra.fr](http://dynamie.unistra.fr)

— **Maison interuniversitaire des sciences de l'Homme Alsace**  
Misha, CNRS/Unistra - [misha.fr](http://misha.fr)

— **Sociétés, acteurs, gouvernement en Europe**  
Sage, CNRS/Unistra - [sage.unistra.fr](http://sage.unistra.fr)

### INSU

— **École et observatoire des sciences de la Terre**  
EOST, CNRS/Unistra - [eost.unistra.fr](http://eost.unistra.fr)

— **Institut de physique du globe de Strasbourg**  
IPGS, CNRS/Unistra - [ipgs.unistra.fr](http://ipgs.unistra.fr)

— **Laboratoire d'hydrologie et de géochimie de Strasbourg**  
LHyGeS, CNRS/Unistra - [lhyges.unistra.fr](http://lhyges.unistra.fr)

— **Observatoire astronomique de Strasbourg**  
CNRS/Unistra - [astro.unistra.fr](http://astro.unistra.fr)

### INSMI

— **Institut de recherche mathématique avancée**  
Irma, CNRS/Unistra - [irma.math.unistra.fr](http://irma.math.unistra.fr)

### INSIS-INS2I

— **Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie**  
ICube, CNRS/Unistra/Engées/Insa  
[icube.unistra.fr](http://icube.unistra.fr)

### IN2P3

— **Institut pluridisciplinaire Hubert Curien**  
IPHC, CNRS/Unistra - [iphc.cnrs.fr](http://iphc.cnrs.fr)

### INEE

— **Laboratoire image, ville, environnement**  
LIVE, CNRS/Unistra - [live.unistra.fr](http://live.unistra.fr)

### INP

— **Institut de physique et chimie des matériaux de Strasbourg**  
IPCMS, CNRS/Unistra - [ipcms.unistra.fr](http://ipcms.unistra.fr)

### Les dix instituts du CNRS

— **Institut des sciences biologiques (INSB)**

— **Institut de chimie (INC)**

— **Institut écologie et environnement (INEE)**

— **Institut des sciences humaines et sociales (INSHS)**

— **Institut des sciences de l'information et de leurs interactions (INS2I)**

— **Institut des sciences de l'ingénierie et des systèmes (INSIS)**

— **Institut national des sciences mathématiques et de leurs interactions (INSMI)**

— **Institut de physique (INP)**

— **Institut national de physique nucléaire et de physique des particules (IN2P3)**

— **Institut national des sciences de l'Univers (INSU)**

### liste des sigles

#### CNRS

— **DIRE** : direction de l'innovation et des relations avec les entreprises du CNRS

— **INIST** : institut de l'information scientifique et technique

— **OMES** : observatoire des métiers et de l'emploi scientifique

— **SAP2S** : service d'appui à la politique et à la prospective scientifiques

#### Services de la délégation Alsace

— **SFC** : service financier et comptable

— **SPV** : service partenariat et valorisation

— **SRH** : service ressources humaines

— **STL** : service technique et logistique

— **MESR** : ministère de l'Enseignement supérieur et de la Recherche

— **SATT** : société d'accélération de transfert de technologies

### ÅNGSTRÖM (ATOMIC SCALE) : Å

Size of an atom, 10 times smaller than one micrometre ( $1\mu\text{m} = 10^{-6}\text{m}$ ).

### RNA

The ribonucleic acid (RNA) is chemically close to DNA (deoxyribonucleic acid), of which it is a copy used for the synthesis of proteins in the cell.

### CHROMATIN

Chromatin is a complex of molecules found in cells. Its function is to package DNA into a more compact shape for it to fit into the very limited volume of a cell nucleus. It is the principal component of chromosomes.

### HYBRIDISATION

The process of Hybridisation consists in crossing two individuals from two different varieties. It leads to a hybrid lineage, comprised of mixed characteristics from the two parents.

### MACROPHAGE

Macrophages are a type of white blood cells (leukocytes) of the immune system. They can absorb and digest foreign particles in order to eliminate them from the body in a process called phagocytosis.

### NUCLEOTIDE

A nucleotide is an organic molecule and the base element of DNA and RNA. Nucleotides can be comprised of five different nitrogenous bases: adenine, guanine, cytosine and thymine for DNA and uracil, used instead of thymine in RNA.

### ORGANELLE

An organelle is a specialised structure, delimited by a membrane, and located inside a cell.

### ELECTRIC POLARISATION

When a charged particle is subjected to an electric field, it is moved by this field under the action of a force. However, under the action of an external electric field, the individual particles will locally move relative to each other, the particles of opposite electrical charges moving in opposite directions.

### RIBOSOME

Ribosomes are molecular complexes composed of proteins and RNA. In cells, their function is to synthesise proteins by decoding the information contained in messenger RNA.



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