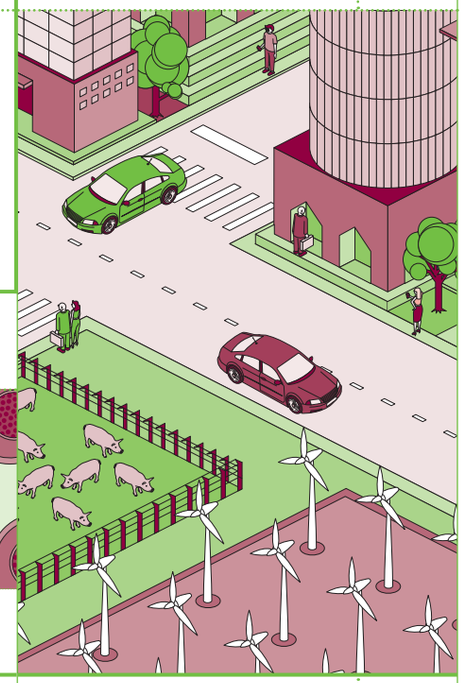
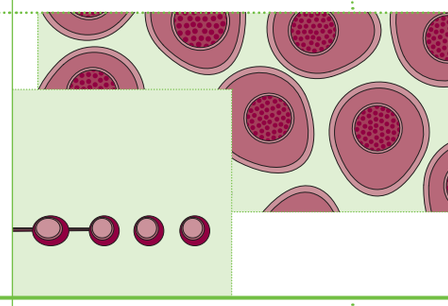
L'Édition of université paris-saclay january

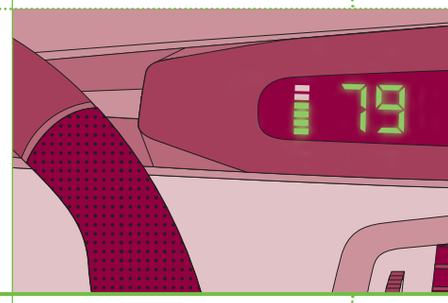
Year: 2019

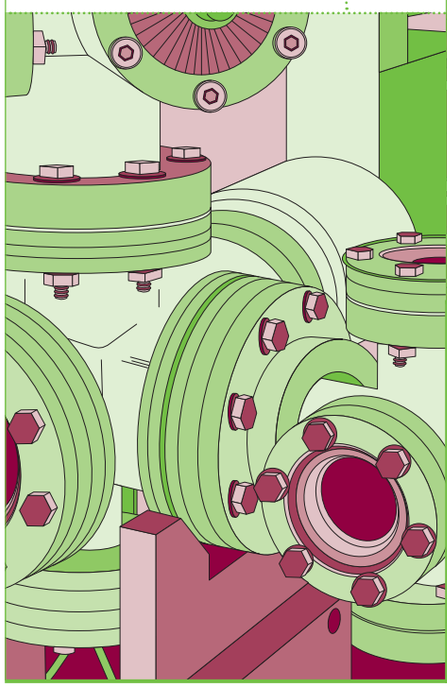
Country: France

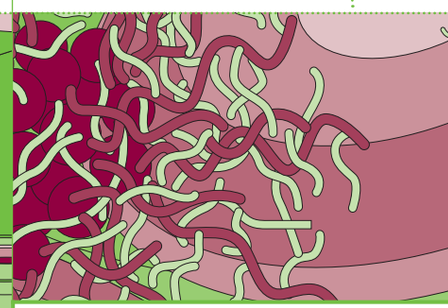
Issue: 9











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RESEARCHERS

Eleven winners, from Université Paris-Saclay's member institutions, were rewarded by the French Academy of Sciences: **David Attié** and **Sébastien Procureur**, engineer-researchers at the **Institute of Research into the Fundamental Laws of the Universe** (CEA Saclay): winner of the **Ivan-Peyches Prize** (thematic prize: application of science to manufacturing); **Giulio Biroli**, researcher at the **Institute of Theoretical Physics** (CEA Saclay): winner of the **Aumale Prize – Foundation of the Institute of France** (thematic prize: physics); **Alexei Chepelianskii**, researcher at the **Solid State Physics Laboratory** (CNRS/Université Paris-Sud): winner of the **Grand Prix Jacques-Herbrand**; **Philippe Ciais**, researcher at the **Laboratory for Sciences of Climate and Environment** (CNRS/CEA/Université de Versailles-Saint-Quentin-en-Yvelines): winner of the **Grand Prix Dolomieu – BRGM**; **Colin Guillarmou**, researcher at the **Mathematics Laboratory of Orsay** (CNRS/Université Paris-Sud): winner of the **Paul Doistau-Émile Blutet Prize** (thematic prize: mathematics); **Riad Haidar**, researcher at **Onera**, winner of the **Aymé-Poirson Prize** (thematic prize: application of science to manufacturing); **François Michel**, voluntary researcher at the **Institute of Integrative Cell Biology** (CNRS/Université Paris-Sud): winner of the **Prize founded by the State**; **Julien Nicolas**, researcher at the **Galien Paris-Sud Institute** (CNRS/Université Paris-Sud): winner of the **Novacap Prize** (thematic prize: chemistry); **Frédéric Pierre**, researcher at the **Centre for Nanoscience and Nanotechnology** (CNRS/Université Paris-Sud): winner of the **Grand Prix Madame Victor-Noury**; **Patrick Wincker**, director of **Genoscope, Institute of Biology François-Jacob** (CEA Saclay): winner of the **Grand Prix "science and innovation" of the CEA.**

Sophie Boulanger-Joimel, teacher-researcher at the **Ecology and Ecotoxicology of Agroecosystems Laboratory** (Ecosys – AgroParisTech/Inra) and **Améline Vallet** (AgroParisTech, Cifor, Cirad), received the **"Young Researcher Prize"** from the French Foundation for Research on Biodiversity, respectively in the category **'Urban Biodiversity'** and **'Research Associating Biodiversity and Development Issues in Southern Countries'**.

Claire Chenu, researcher in the **Functional Ecology and Ecotoxicology of Agroecosystems Laboratory** (Ecosys – AgroParisTech/Inra), was rewarded the **Philippe Duchaufour of European Geosciences Union medal** for her research in soil sciences.

From left to right Sophie D'Ambrosio et Sarah Antier-Farfar © Carl Dinner for the L'Oréal Foundation

Sophie D'Ambrosio, post-doctoral student at the **Joint Research Physics Centre** (CNRS/Thales/Université Paris-Sud) with her "Beyond supercomputers, the super-supercomputers, more powerful and more ecological" and **Sarah Antier-Farfar**, post-doctoral student at the **Linear Accelerator Laboratory** (CNRS/Université Paris-Sud) for her project "Seeking gravitational waves", are both winners of the L'Oréal–Unesco grant for women and science.

Mérouane Debbah © CentraleSupélec

Mérouane Debbah, teacher-researcher in the **Laneas** Laboratory (Large Networks and Systems Group) of CentraleSupélec, received the **Marconi Prize Paper Award in Wireless Communications** for his contribution to designing the Massive Mimo technology, one of the key 5G technologies.

Adrien Loseille, researcher in the **Automatic Mesh Generation and Improved Methods** team (Gamma3) at the Inria, received the **second prize FIEEC (Electrics, Electronics and communications Federation) of Applied Research** for his work on adaptive meshes in collaboration with the SME Lemma.

Marcel Mazoyer, honorary professor in comparative agriculture at **AgroParisTech**, received the **gold medal of the French Agriculture Academy**, for his career and research studies on farming systems.

Vikass Monebhurrun, of the **Electric and Electronic Engineering of Paris laboratory** (GEEPS – CentraleSupélec/CNRS/Université Paris-Sud/Sorbonne Université) received the **IEC 1906 Prize of the International Electrotechnical Commission (IEC)**, which awards his contribution to work on standardization.

Evanghelia Stead, of the **Cultural History of Contemporary Societies Centre** (CHCSC– Université de Versailles Saint-Quentin-en-Yvelines) received the **Hermann Broch Fellowship in modern German literature** of the **Beinecke Rare Book & Manuscript Library** at Yale University, for her Faust "I" project in prints and book objects: Germany, England and France (1808-1932).

Lenka Zdeborová © Lenka Zdeborová

Lenka Zdeborovà, researcher at the **Institute of Theoretical Physics (CEA Saclay)**, is the winner of the **Irène Joliot-Curie "Young Scientific Woman" 2018 Prize**. She is working on applications of methods in Statistical Physics, for automatic learning issues and artificial intelligence, signal processing, inference and optimisation.

STUDENTS

Four doctoral students enrolled in AgroParisTech received the **silver medal of the French Agriculture Academy**, distinguishing an excellent thesis: **Iola Croué**, of the **Animal Genetics and Integrative Biology Laboratory** (Gabi – AgroParisTech/Inra); **Maëlle Gédouin**, of the **French Agronomy, Veterinary and Forestry Institute – Agreenium**; **Anaïs Goulas**, of the **Functional Ecology and Ecotoxicology of Agroecosystems Laboratory** (Ecosys – AgroParisTech/Inra); **Clémence Ravier**, of the **Agronomy Laboratory** (AgroParisTech/Inra).

Three doctoral students, enrolled at Université Paris-Saclay, have won a L'Oréal-Unesco research grant for women and science: **Morgane Morabito**, of the **Normal and Pathological Signalling Laboratory: from the embryo to innovating cancer therapies** (CNRS/Inserm Institut Curie/Université Paris-Sud), for her project "Better treatment of Pediatric Brain Cancer, using new therapeutic approaches"; **Farsane Tabataba-Vakili**, of the **Centre for Nanoscience and Nanotechnology** (CNRS/Université Paris-Sud) and at the Inac (CEA/Université Grenoble Alpes), for her project "Optimising light emitting diode lighting thanks to micro and nanotechnologies"; **Pauline Zarrouk**, of **CEA Saclay**, for her project "Retracing the Evolution of the Universe by mapping its larger structures".

PROJECTS

Two projects supported by Université Paris-Saclay were singled out by the **PEPS prize** "Passion for Teaching and Pedagogy in Higher Education" 2018: The **QuizCoach** project, which aims to use artificial intelligence to create a free, recreational, digital coaching platform for all students and teachers, was rewarded the **Student Pedagogical Innovation**; the project **Safare** – adapting and promoting success – is winner of the **Excellence Certificate, Category Pedagogical Support**.

COMPANIES

The start-up project **Gliss**, run by researchers of the **Biology and Applied Pharmacology Laboratory** (CNRS/ENS Paris-Saclay) received the **Prize of the Best Business Plan HEC Paris Challenge + 2018**. It aims to identify resistance to drugs to optimise each patient's treatment.

The start-up **TheraPanacea**, created by the research laboratories **Inria** and **CentraleSupélec**, won the **First Prize of the AI Challenge Paris Region 2018**. The company, situated at the crossroads of research in applied mathematics, statistical learning and high performance scientific computing, is developing radiotherapy applications associated with artificial intelligence technologies.

© UPSaclay

October 8th, 2018, the GIEC published a new report on the impact of a + 1.5°C global warming. For this sixth report, Université Paris-Saclay provides hosting and administrative management of the technical support unit of task force 1, under Valerie Masson-Delmotte's co-presidency, researcher at the Laboratory for Sciences of Climate and Environment (CEA/CNRS/Université de Versailles Saint-Quentin-en-Yvelines).

I am particularly pleased to sign my first editorial in our journal *'l'Edition'*, to reiterate the importance of the commitment, both here in Paris-Saclay and all around the world, to climate protection and ecological transition. The conclusions of the report are irrevocable, and show the scope of already damaging effects of a warming of 1°C. All scientific communities are committed to this major issue that mobilises knowledge, collective intelligence and innovation, and focuses, more than ever before, on interdisciplinarity.

Resilience, resistance, transition and adaptation to climate change, we are all concerned, and our capacity to research and provide university training is our main concern. It is also the message that our students and fellow citizens are sending out, as we define our strategic plan for 2020. The climate and environmental dimension will obviously be a key item within the teaching and research missions, which cover almost all the skills and interdisciplinary knowledge necessary to address the major challenges facing our society. This issue 9 of our magazine gives an overview, firstly with the work accomplished in Université Paris-Saclay's laboratories, on the impact of environmental changes on health, and modifications to lifestyles, and secondly, on the recent important results achieved in nanomedecine and microfluidic applications to health, and in quantum engineering.

Another key field in our ecosystem of research and innovation highlighted in this ninth *Edition* is photonics, which is embodied in images in our facilities, and in one of the largest European nanophotonic and spintronic laboratories: the Centre for Nanoscience and Nanotechnology (C2N – CNRS/Université Paris-Sud). The teams are currently settling in, and setting up their experimental stations and their experiments; it will be inaugurated in 2019 to be, henceforth, accessible to the communities.

Sylvie Retailleau,
President of Université Paris-Saclay

Members of Université Paris-Saclay

Keywords
Summer schools – Manager of Fablab – MOOC Nano

Title

An eventful summer in experiences in the laboratories

© Christophe Peus for UPSUD

Three summer schools, organised on the Paris-Salay site, were selected within the framework of the Excellence curriculum, destined to Chinese students. A unique occasion for some people to acquire taste for French Research.

France Excellence: this is the name of the programme piloted by the French embassy in China, which enables French summer schools to receive excellent Chinese students. What is the aim of this programme? "*To strengthen possible contacts, to give visibility to a possible PhD in France, to enable potential supervisors to meet and assess future students*", underlines the embassy. Amongst the selected summer schools in 2018, three took place at Université Paris-Saclay:

1) "Climate change in the Arctic – Scientific and Societal Perspectives", run mainly by the people in the Cultures, Environments, Artic, Representations and Climate unit (CEARC – Université de Versailles Saint-Quentin-en-Yvelines), of the Laboratory Climate and Environmental Sciences (LSCE – CEA/CNRS/Université de Versailles Saint-Quentin-en-Yvelines) and the Atmosphere, Environments and Space Observations Laboratory (Latmos – CNRS/Sorbonne Université/Université de Versailles Saint-Quentin-en-Yvelines);

2) "From single Molecule to Cell; from Fundamental to Applications", was run by the teacher-researchers of the Information technology, Bio-Information Technology and Complex Systems Laboratory (IBISC – Université Évry Val-d'Essonne), the Analysis and Modelling for Biology and Environment Laboratory (Lambe – CEA/CNRS/Université de Cergy-Pontoise/Université Évry Val-d'Essonne), the Stem Cell Institute for treating and studying monogenic diseases (I-Stem – French Association against myopathies/Inserm/Université Évry Val-d'Essonne), the Institute of Systemic and Synthetic Biology (iSSB – CEA/CNRS/Université Évry Val-d'Essonne) and the Laboratory of Structure and Normal and Pathological Biomolecules (SABNP – Inserm/Université Évry Val-d'Essonne) and the Genopole;

3) "Nano³ Nanophotonics, Nanoelectronics and Nanomagnetism", was provided by Université Paris-Sud and the Centre for Nanoscience and Nanotechnology (C2N – CNRS/Université Paris-Sud), in partnership with the Orsay Molecular Sciences Institute (ISMO – CNRS/Université Paris-Sud) and the Solid-State Physics Laboratory (LPS – CNRS/Université Paris-Sud).

From the Plateau (of Saclay) to the mountains (of the Jura range)

Climate, genetics, and nanotechnologies: the thematics of these summer schools cover all major contemporary issues. And for the occasion the organising committee imagined it on a grand scale.The 'Nano' course lasted four weeks and "*twelve teacher-researchers and researchers of Université Paris-Sud and the CNRS participated*", specifies Fiona Gerente, in charge of international partnerships at Université Paris-Sud. "*Not only did the students attend lectures and participate in workshops, but they also worked individually on mini projects within the partner laboratories*".

For 'From single Molecule to Cell; from Fundamental to Applications', twenty-three researchers and teacher-researchers presented their studies over the course of fifty-two hours of lessons, directed studies and practical work, spread over three weeks. Promoting entrepreneurial work accomplished by Genopole completed the training, as did a presentation of Genopole-Entreprises, its incubator Saker and the Booster accelerator.

The students following the 'Climate change in the Arctic – Scientific and Societal Perspectives' programme received "*one hundred and six hours of lessons during the month of July*", underlines Jan Borm, Delegate Vice-President in charge of international relations and co-head of the Master 2 'Artic Studies' at Université de Versailles Saint-Quentin-en-Yvelines. Kathy Law "*one of the leading researchers in Latmos*" gave an inaugural lesson. During the summer school, the students went to the Jura, to the Prémanon Polar Worlds Area (previously known as the Paul-Emile-Victor Polar Centre).

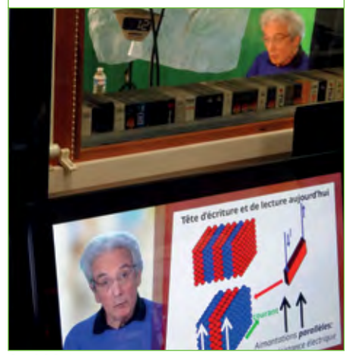
A summer session that will continue into the 2018/2019 university academic year

These summer sessions, which therefore don't only take place within the four walls of a lecture room, also aim to introduce young Chinese people to French language and culture: for example, those who were registered on the 'Nano³' and the 'From single Molecule to Cell; from Fundamental to Applications' programmes, respectively received sixteen hours and thirty hours of foreign language French lessons (FLE). Certain students also discovered Paris (during a foot rally and a cruise on the Seine) and also Chartres, Versailles, Fontainebleau and Étretat, for the Normand coast. "*Such experiences promote exchange*", rejoices Rosemary MacGillivray, in charge of International Delegation missions at Université Paris-Saclay. Jan Born considers that "*the feedback was immediate: one person expressed the desire to come to us to do a doctorate in Siberian anthropology*". Certain students have already signed up for a second season.

www.chine.campusfrance.org/fr/node/302510
www.chine.campusfrance.org/fr/node/302493
www.nano3.u-psud.fr/
www.universite-paris-saclay.fr/en/summer-schools

Title

An interplanetary success for the MOOC Nano



© MOOC Nano

The second season, in the spring of 2018, of the MOOC "Understanding Nanosciences", put forward by Jean-Michel Lourtioz, Vice-President of Université Paris-Sud, and Hugues Cazin d'Honincthun, in charge of the MOOC project and pedagogical head, can lay claim to a great success: 5,520 registrations versus 4,300 for the first session, which represents a 22% increase of candidates. One of the reasons of this success is maybe due to the new dimension of the programme, which is based on the book 'Nanosciences and Nanotechnologies – Evolution or revolution?' (Berlin edition), co-directed by Jean-Michel Lourtioz. The MOOC "*is original as it covers large and transversal fields, from chemistry to physics but also medicine. There is no equivalent in English*", stresses the former.

Significant novelties were implemented in the second season. This concerns, in particular, tracks according to levels. "*It is a bit like skiing*" explains Hugues Cazin d'Honincthun, "*the green run corresponds to 20-30 minutes lesson a week; the blue run to a 'classical' track and the red run contains complementary content.*" Another novelty consists in videos that last about 8 minutes in order to avoid "*speakers talking for an hour or more*", Jean-Michel Lourtioz reminds us. Next season these videos will be available subtitled in English. An extra asset for participants coming from… 66 countries in the world.

This Université Paris-Saclay MOOC, whose principal partner is LabEx NanoSaclay, is supported by Université Paris-Sud, in collaboration with ENS Paris-Saclay and Université d'Orléans.

www.fun-mooc.fr/courses/course-v1:UPSUD+42003+session02/

Title

A diploma for FabLab managers

The first FabLab manager diploma was born at Université Paris-Saclay, in January 2019. The concept was designed by Neil Gershenfeld, (professor at Massachusetts Institute of Technology), at the end of the nineties. Contraction of 'Fabrication Laboratory', the FabLab was designed to be open to co-creation, based on exchange of knowledge and practices, backed by technologies. In France, the first FabLabs were born in the 2010s. The growing vitality and success of these places required professionalization of those who run them. This has now happened. Supervised by Michel Beaudouin-Lafon (professor at Université Paris-Sud and specialist of machine-man interaction) and by Romain Di Vozzo (FabLabs project leader at Université Paris-Saclay/FabLab Digiscope and instructor at the Fab Academy), the State diploma (DE) will count ten students the first year. This number will eventually double. The Fab Academy programme, developed by Gershenfeld, will be completed by classes, given by the university teachers. Over all, the programme will include two hundred and forty hours of teaching, over the course of a year, and four months work experience. It should be noted that while the DE requires a certain level in English, it does not have age limits. This covers all possible fields of opportunity.

www.universite-paris-saclay.fr/fr/de-manager-de-fablab#section-introduction

Keywords
Serious Games and Escape Games – MT180

Title

Learning how to play (and visa versa) with data

© Dan Ramaen

The aim of the 'Arbre des Connaissances' Association is to introduce schoolchildren to the major scientific issues of today through games. Its latest creation, in collaboration with Inria, is dedicated to artificial intelligence.

We all know Rabelais adage: "Science without conscience is but the ruin of the soul". The teams of the 'Arbre des Connaissances' association are convinced of this, and this why, since 2017, they have designed games and debates aimed at schoolchildren. After working on increased humanity and synthetic biology, the association has collaborated with Inria, within the steering committee, and created a new game around artificial intelligence (AI). "*It is a subject of great interest to youngsters*", says the project coordinator Camille Volovitch, "*but they don't necessarily hold the keys. They can easily create fantasies that will either unleash fascination or fear*. The aim of the game is to therefore "*give a central axis for understanding the subject and allow them to ask the necessary questions*".

Adolescent beta-testers

The games to be debated are, each time, co-built with youngsters. The AI game was therefore developed with a class of scientific high-school students, and another of children finishing middle school, under the creator of the game, Alexis Fichet's direction. "*They are our beta-testers*", explains Camille Volovitch. "*A first session enabled us to measure the level of interest and knowledge. In the second session, we tested the game markers and, in the third session, the prototype*".

Welcome to Sowana

In this new Game to Debate, the students embodied different groups in the town: the seniors, the futurists, the "distanced" (living far from the urban poles)… The company Sowana collected the data and suggested solutions to the problems they encountered. The groups then had to decide which seemed the most appropriate to them. "*It's a collaborative game*", explains Camille Volovitch. "*It allows science to be replaced in culture and give a meaning to teachings*". All citizens can help shape the global discussions: the game is available online for free.

www.jeudebat.com
www.arbre-des-connaissances-apsr.org

Title

Final competition, My PhD in 180 seconds (MT180)

© Angélique Gilson

March 14th, 2019, in the Terrasse room (Gif-sur-Yvette), at 6.30 p.m., fifteen finalist PhD students of Université Paris-Saclay will attempt to compete with the MT180 competition stopwatch. They will have 180 seconds, and not a second more, to explain their PhD in simple terms, to a lay public. This contest challenges the students in an exercise of style and mediation on their chosen research subject. The presentation must be clear and the tone appropriate, the candidate must interact with the public who will understand the implications. The jury, who will send two candidates to the national semi-finals, will assess these criteria.

www.universite-paris-saclay.fr/mt180

Title

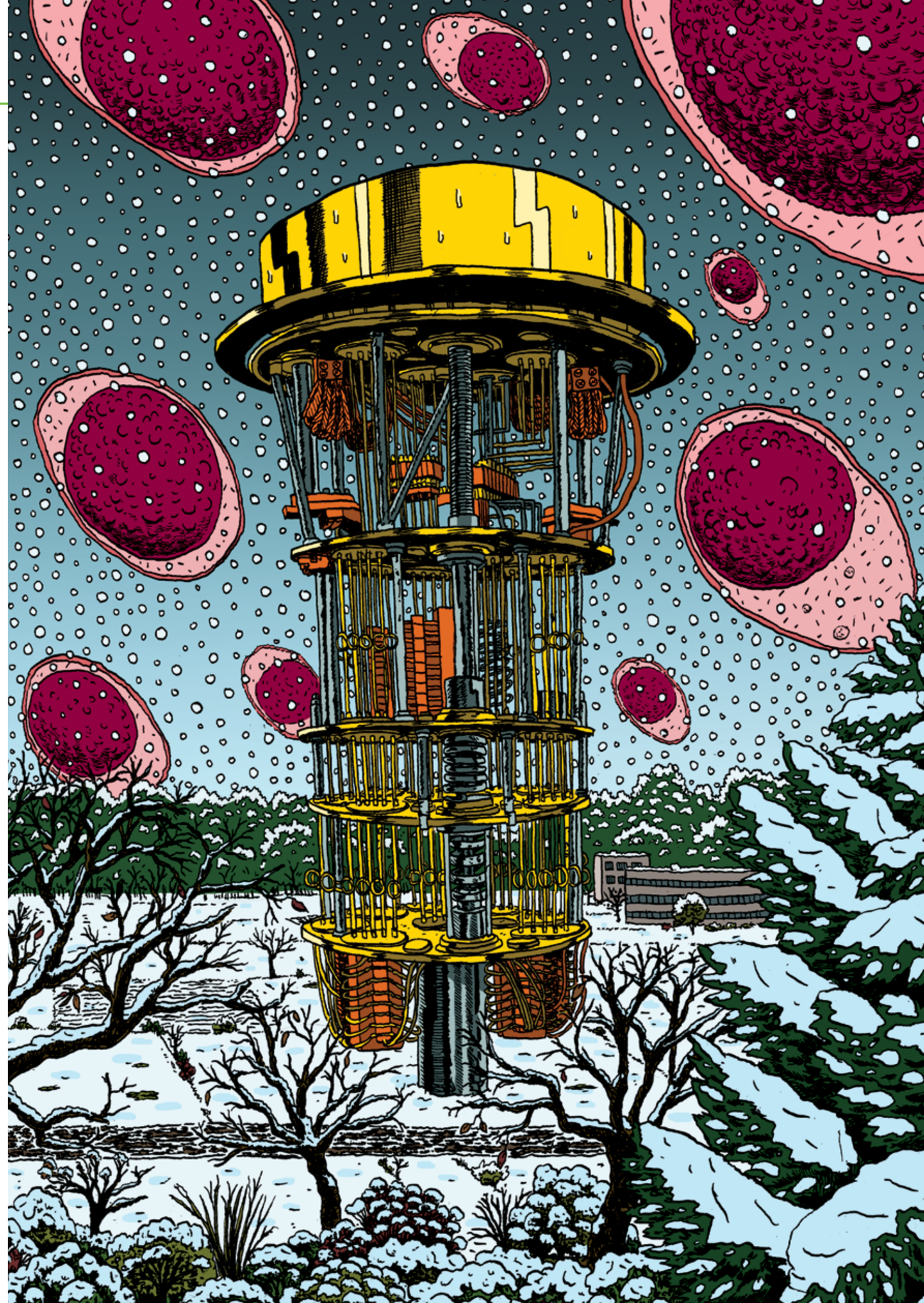
An escape game in the old linear accelerator laboratory

"*The initial idea was to promote scientific instrumental heritage in an original way, fixing as a priority constraint, the place and puzzle-solving, while manipulating historical materials*", explains Romuald Drot, physician and chemist at the Institute of Nuclear Physics (CNRS/Université Paris-Sud), and at the core of the escape game "*Panic in LURE!*" Developed with Marie Itoiz, a science historian, this game was implemented for the Heritage Days, the 15th and 16th of September 2018, and set up its premises in the basement of the building 201 of the museum of Light and Matter. "*The location is historic, this is where research into radiation of the Orsay collision ring, ancestor of the current SOLEIL synchrotron, was developed.*"

> **"Promote scientific instrumental heritage in an original way."**
> **Romuald Drot**

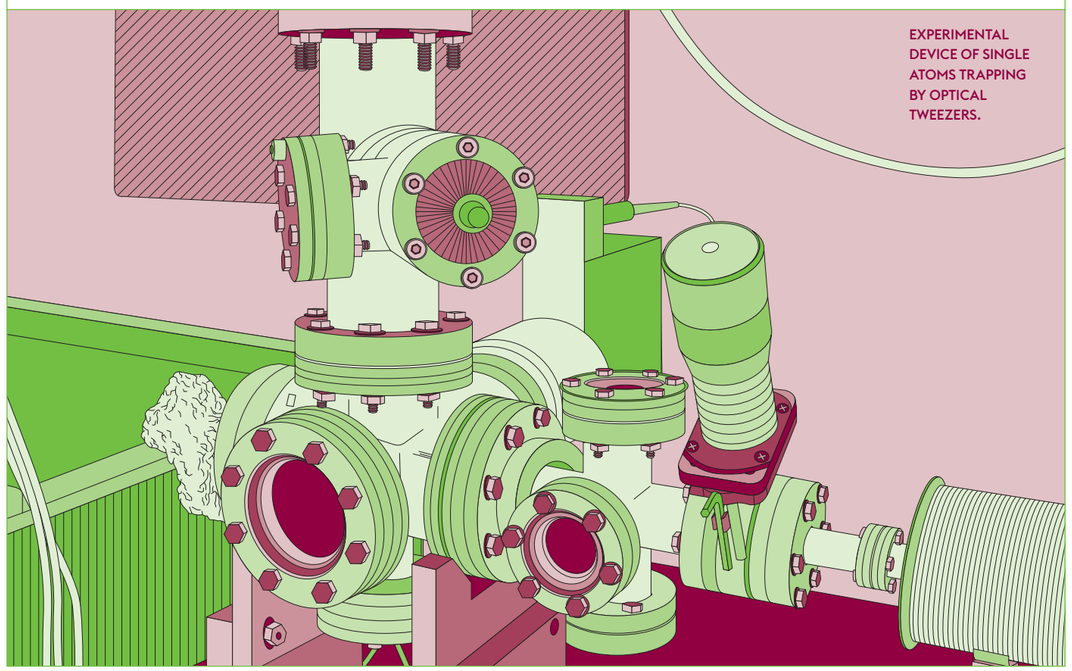
The pitch: September 1975, the Laboratory for Using Electromagnetic Radiation (LURE) has just been created. They are expecting the visit of a few members of government, but the videocassette that retraces the story of the laboratory, that they plan to show, has disappeared. In teams of four or five people, the participants have one hour to find the cassette and save the visit. "*The public got into the game. We were able to hold seven sessions and receive about thirty people, while 200 more were placed on a waiting list!*" A great success, which should launch further escape game initiatives in this location.

Illustrations on the right page and page 18: **Djilian Deroche**



Title

Promises and progress of quantum engineering



EXPERIMENTAL DEVICE OF SINGLE ATOMS TRAPPING BY OPTICAL TWEEZERS.

Quantum captors, quantum simulations, quantum information technology, quantum cryptography… Quantum technologies have progressed greatly over the last few years and form today a booming number of fields of application.

Wave-particle duality, superimposition of states, entanglement… At an infinitesimally small scale, the principles governing the workings of atoms, particles and radiation, no longer respond to the traditional laws of mechanics, thermodynamics or electromagnetism, and transform our vision of the world.

"*Quantum physics were invented at the beginning of the twentieth century, at the cost of a complete revision of "classic" concepts in physics*", Daniel Estève reminds us, head of the Quantronics group of the Laboratory of Condensed Matter Physics (SPEC), at the French National Atomic Energy Commission (CEA). "*This first quantum revolution enabled to explain interaction of light and matter, the behaviour of atoms and their different, more complex structures, as well as the functions of condensed matter. It enabled materials to be mastered and to exploit properties as surprising as superconductivity*". The most innovating applications (transistors, lasers, integrated circuits…) also emerged in the middle of the last century and changed our society.

An effervescent field of research

A second quantum revolution now benefits the conception of new technologies based on treatment and manipulation of quantum objects. "*It's an effervescent field of research!*", confides Philippe Grangier, of the Charles-Fabry Laboratory, of Optics Institute Graduate School. The FET Flagship quantum technologies, launched by the European commission, end of 2017, with a one billion euro package, over a period of ten years, comes to strengthen this development and promotes the transfer towards industry.

In Île-de-France, research is organised within SIRTEQ network (Sciences and engineering in Île-de-France region for quantum technologies). This network counts about a hundred teams from around thirty laboratories – of which, more than a third are part of the IQUPS project of Université Paris-Saclay (see the following Focus page) – and addresses the four thematic lines presented hereafter;

1 – Surpassing the limit of sensitivity of quantum captors

Using the specificity of the quantum states of matter and radiation, researchers develop captors, of great precision, that have applications in atomic clocks, accelerators, gyrometers, gravimeters or ultra resolving magnetometers. "*The quantum captors use superposition of quantum states, which are very sensitive to environment, but also to exterior disturbances*", explains Patrice Bertet, of the Quantronics group. "*Usually, this fragility leads to a loss of coherence. Here, we use it to measure a parameter very precisely, such as the magnetic field.*"

> **"The intention is to exchange them with other quantum systems that we can control, and reproduce the physical behaviour, and then make connections"**
> **Philippe Grangier**

He is exploring, with his colleagues, electron parametric resonance in the quantum system, in order to increase the sensitivity of the captors beyond the natural boundary called 'standard quantum limit', to succeed in detecting a single electronic spin. Researchers use superconducting circuits, cooled to very low temperatures (between 10 and 20 mK) to reduce thermic noise and increase the transmitted signal. Thanks to this technique, they have recently increased sensitivity to 65 spins detected in one second.

2 – Imitating complex quantum systems

Even the current most powerful supercomputers are still challenged in understanding and predicting the macroscopic effects of complex quantum systems containing a great number of particles. "*Many quantum systems cannot be measured, because they are too far, or we do not know how to manipulate them, such as a neutron star*", Philippe Grangier tells us. "*The intention is to exchange them with other quantum systems that we can control, and reproduce the physical behaviour, and then make connections*".

Antoine Browaeys and his colleagues of the Quantum Optics Group of the Charles-Fabry Laboratory have, for example, developed a technique that is capable of entrapping single cold atoms in optical networks, of positioning them, and maintaining them in a controlled manner, in a bidimensional network using optical tweezers, and then observing them using fluorescence. Recently they have managed to model 3D networks comprising up to 72 entrapped single atoms.

3 – Quantic information technology and the troublesome stability of qubits

"*The quantum computer is THE fashionable subject*", summarizes Philippe Grangier. The reason: it promises to perform, with time, far quicker and efficient calculation than classical computers, and reach capacities in treating data that we can hardly imagine. The information that needs dealing with, resides in elementary memory boxes: the quantum bits (or qubits). The technological locks are increasing their coherence time and correcting mistakes. To knock down these barriers, researchers are exploring different physical aids for qubits (superconductors, entrapped ions, photons, electron spins…), none of which is yet favoured.

4 – Ultra-secure communications

Maintaining security and inviolability of data transferred on the Internet, through optical fibre, is a real challenge. Today, secure exchange of data is based on public key cryptography (RSA) and the impossibility to factor great numbers. But progress in algorithms and the eventual emerging of a quantum computer, capable of breaking the code, threatens the system.

This is where secret key quantum cryptography comes in. "*In a quantum canal, polarised photons coding for bits can, for example, be transmitted*", explains Philippe Grangier. "*Any attempt to intercept the message will disturb this polarisation and introduce errors into the transmission*". Measuring the amount of errors allows for a superior limit to the quantity of information known by the spy. "*It is often said that quantum cryptography allows a spy to be detected. This is true, but insufficient: the quantum protocol mainly quantifies the spy's knowledge. If it is small enough, a faultless, secure key is obtained. If it is too big, there is no longer a key and the line is cut*", concludes the researcher.

www.sirteq.org
www.qt.eu

Publications

· S. Probst *et al. Inductive-detection electron-spin resonance spectroscopy with 65 spins/Hz sensitivity*, Applied Physics Letters 111 (20), 2017.

· Daniel Barredo *et al. Synthetic three-dimensional atomic structures assembled atom by atom*, Nature vol. 561, (79 – 82), 2018.

Portrait

Philippe Grangier

© VM/UPSaclay

The intention is to exchange information on Internet and guaranty its secrecy thanks to quantum mechanics.

Philippe Grangier is head of the Quantum Optics group in the Charles-Fabry Laboratory of Optics Institute Graduate School, since 1988. He also coordinates the Sciences and engineering network in Île-de-France region for quantum technologies (SIRTEQ). He is currently focused on researching quantum treatment of information and developing new quantum cryptography protocols, but also manipulating atoms and individual photons in order to carry out simple logical operations with quantum bits.

» focus

An industrial chair to boost quantum information technology

The Nasniq (New Architecture for Nuclear Spins in Quantum Information) was created in 2018, and cofinanced by the National Research Agency (ANR). It involves Atos, a large French company offering digital services, and CEA. It will develop research and innovation in the fields of treating and stocking quantum information, from algorithm simulation to supercomputing.
Run by Daniel Estève, head of the Quantronics group, part of the Laboratory of Condensed Matter Physics of the CEA, the chair's intention is to develop the quantum computer.
The programme aims to develop and test new types of quantum bits (qubits) that are tougher and more able to master quantum coherence; to develop new quantum programmes adapted to hybrid qubits; to promote, in other areas, technologies that were previously intended to quantum information technology.

www.iramis.cea.fr/spec/Pres/Quantro/static/
www.atos.net/fr

» focus

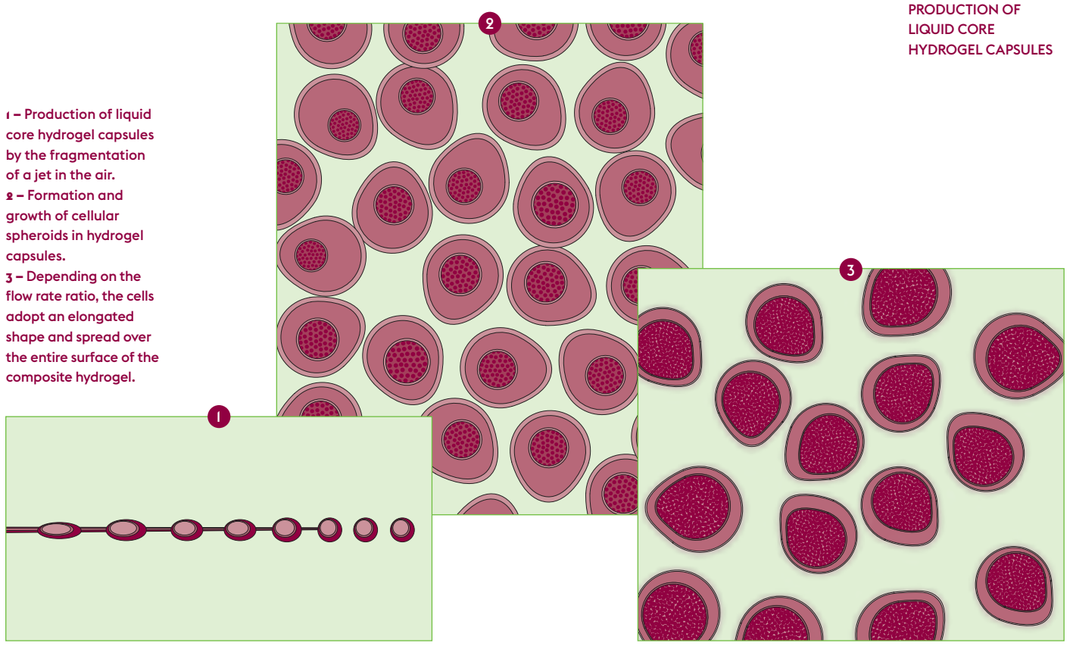
IQUPS, supporting quantum engineering in Paris-Saclay

The strategic research initiative IQUPS (Quantum Engineering at Université Paris-Saclay) was launched in 2017. It aims to structure and strengthen research carried out within the university in the field of quantum engineering, and to increase international visibility. It involves 25 teams and 119 researchers, in 8 laboratories in Université Paris-Saclay. IQUPS seeks to encourage collaborations, to encourage emergence of new ideas and to develop facilities destined to manufacturing quantum devices. IQUPS also organises sessions of courses, accredited by the doctoral schools. They are open to researchers, PhD students and post-doctoral students.

www.universite-paris-saclay.fr/fr/recherche/projet/iqups-ingenierie-quantique#section-introduction

Title

Microfluidics in aid of medicine



Manipulating liquids on a micrometric scale is recent, but the applications are already numerous, in particular in the medical field.

It started with… molecular cuisine. "*A culinary idea was how the idea to encapsulate cells in microspheres of alginate was born: saving pearls*" reveals Pierre Nassoy, researcher at the Phonics, Digital and Nanosciences Laboratory (LP2N – CNRS/Optics Institute Graduate School/Université de Bordeaux). These 3 mm of diameter balls are formed of sodium alginate, jellified in a calcium chloride bath, and used to decorate dishes. Food is encapsulated within, using a microfluidic devise.

Micro-tumours in drops

The same extrusion principle - enabling these multilayer structures to be achieved – applied to a submillimetric scale, results in a microfluidic devise, that gives shape to porous alginate spheres, in which cells are encapsulated and multiplied. "*We, thus created micro-tumours, at Institut Curie*", reveals Pierre Nassoy. The tumour cells deform the alginate capsule as they multiply. The capsule applies, in return, a mechanical force. The spheroids show a necrotic heart surrounded by hypermobile cells. "*The compression could limit tumour growth, but it could also increase appearance of metastasis*", explains the researcher.

When in vitro comes close to the living

On another note, "*between in vitro tests in Petri dishes and those performed on animal models, there is no correlation in efficiency*", Pierre Nassoy reminds us. "*The 3D architecture of the tumour must be rebuilt to discover its behaviour in relation to the treatment*". These 3D models enable us a better preselection of the treatment candidates. Bonus: as up to 5,000 little drops are generated per second, it is possible to proceed to drug screening.

This optimisation is also possible in cellular therapy, for neurodegenerative diseases, as the Treefrog start-up demonstrates (created by two post-doctoral students of the laboratory). "*The culture of stem cells in Petri dishes takes a long time and is not productive. Amplification is multiplied by 100 when the pluripotent cells are encapsulated in the spheroids*", appraises Pierre Nassoy. Stem cells thus cultivated, differentiated from dopaminergic neurons, have been injected into Parkinson rat models, that recovered their initial capacities within four weeks.

Grafting a CD instead of a lung

Microfluidic tools can be used for other purposes. The 2020 Bioart-Lung project, involving the Marie-Lannelongue surgical Centre, Université Paris-Sud and Université Paris-Saclay, CEA, Inserm, CNRS and manufacturers, aims to manage pulmonary arterial hypertension at a terminal stage, when a lung transplant becomes necessary. While awaiting a transplant, oxygenators are necessary to perform gas exchange, in place of the lungs. These big boxes, however, connected to the patient "*prevent the patient from moving. Furthermore, thrombosis occurs at some point so their use is limited to three weeks*", explains Anne-Marie Haghiri-Gosnet, researcher at the Centre for Nanoscience and Nanotechnology (CNRS/Université Paris-Sud). A three-layer microfluidic system has been designed to offset the drawbacks: it consists in a network of micro-capillaries where the blood flows, a fine membrane that is permeable to gas, and a layer filled with air. It takes the form of a 10 cm diameter disk, a few millimetres thick, and looks like a CD. "*It is very light and comprised of PDMS, a biocompatible material that is transparent and used to make soft contact lenses*", adds the researcher. "*It takes several hours to make in a laboratory today, but when we can produce it with a supply chain process, rapid industrial techniques will reduce the time period to an hour or less*".

> **"Stem cells have been injected into Parkinson rat models, that recovered their initial capacities within four weeks."**
> **Pierre Nassoy**

Increasing the debit

This system has been tested with a pig's venous blood. "*We have scheduled a similar experience on a rat where the Pr. Olaf Mercier (who is running the 2020 Bioart-Lung programme) will have grafted an extra-corporal three-layer system. The debit is still too low for the system to be tested on larger animals, but oxygenation is of good quality*", Anne-Marie Haghiri-Gosnet explains. We will then, in the future, consider hooking a patient up to this device in order to enable him to sit and move around. Microfluidic will then be a "pearl"… for patients.

Publications

· K. Alessandri *et al. A 3D printed microfluidic device for production of functionalized hydrogel microcapsules for culture and differentiation of human Neuronal Stem Cells (hNSC).* Lab Chip, 2016

· Zhang Q. *et al. Logic digital fluidic in miniaturized functional devices: Perspective to the next generation of microfluidic lab-on-chips.* Electrophoresis. 2017 Apr;38(7):953-976.

Portrait

Anne-Marie Haghiri-Gosnet

© A-M Haghiri-Gosnet

We don't claim to outdo lung transplants, but to find a temporary alternative.

Anne-Marie Haghiri-Gosnet co-heads the Microsystems and Nanobiofluidic department of the Centre for Nanoscience and Nanotechnology (CNRS/Université Paris-Sud). She graduated from Chimie ParisTech and has, throughout her career, used her physics and chemistry training to contribute to expanding micro and nano-manufacturing development. In the field of micro/nanofluidics, her research work is focused on soft lithograph (a technique that enables patterns to appear on thin films) and associated processes to format biocompatible materials, developing microfluidic platforms for biochemical analysis on chips and developing organs of chips.

» focus

Thirty times more sensitive analysis

Detecting biomarkers through mass spectrometry sometimes lacks sensitivity. To remedy this, Florent Malloggi, researcher in the interdisciplinary Laboratory for Nanometric and Supramolecular Organisation (Lions), within the Nanosciences and Innovation for Materials, Biomedicine and Energy Unit (NIMBE – CEA/CNRS), developed, in collaboration with Sarah Bregant, in the Molecular Engineering of Protein Department of CEA, an interface in the shape of a microfluidic chip. "*It generates drops containing biomarkers in very small quantities*", he explains, "*and the mass spectrometer (a MALDITOF) analyses them with sensitivity that is multiplied by thirty, as the ultraviolet laser focused on the droplet is more concentrated*". They have applied for a patent and the team is working to find direct applications to this discovery.

Publication · K. Mesbah *et al. DMF-MALDI: droplet based microfluidic combined to MALDI-TOF for focused peptide detection.* Scientific Reports 7, 6756 (2017).

» focus

An autonomous diagnosis tool

Being able to give a differential diagnosis to diabetes in the urine: this is possible with artificial cellular micro-reactors developed in collaboration by the teams of researchers of Université Paris-Saclay and Montpellier. These protocaptors comprising biochemical circuits resemble cells, but are not living. The molecules characterise a diabetes or pre-diabetes passing through the membrane, triggering a logical enzymatic reaction and appearance of fluorescence that allows a differential diagnosis, in all conditions.

* The laboratories concerned are: EPI Lifeware of Inria Saclay at Palaiseau, the Research in Information Technology Laboratory (CNRS/Université Paris-Sud) at Orsay, the endocrinology, nutrition and diabetes department of the University Hospital of Montpellier, the Clinical investigation Centre 1411 of the Inserm at the University Hospital of Montpellier, Modelling and Engineering of Complex Biological Systems for Diagnosis Unit (CNRS/ALCEN-PMB) at Montpellier, the Institute for Functional Genomics (CNRS/Inserm), in Montpellier.

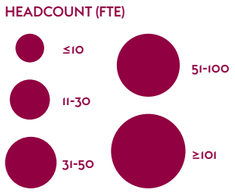
Publication · A. Courbet *et al. Computer-aided biochemical programming of synthetic microreactors as diagnostic devices.* Molecular Systems Biology, 2018.

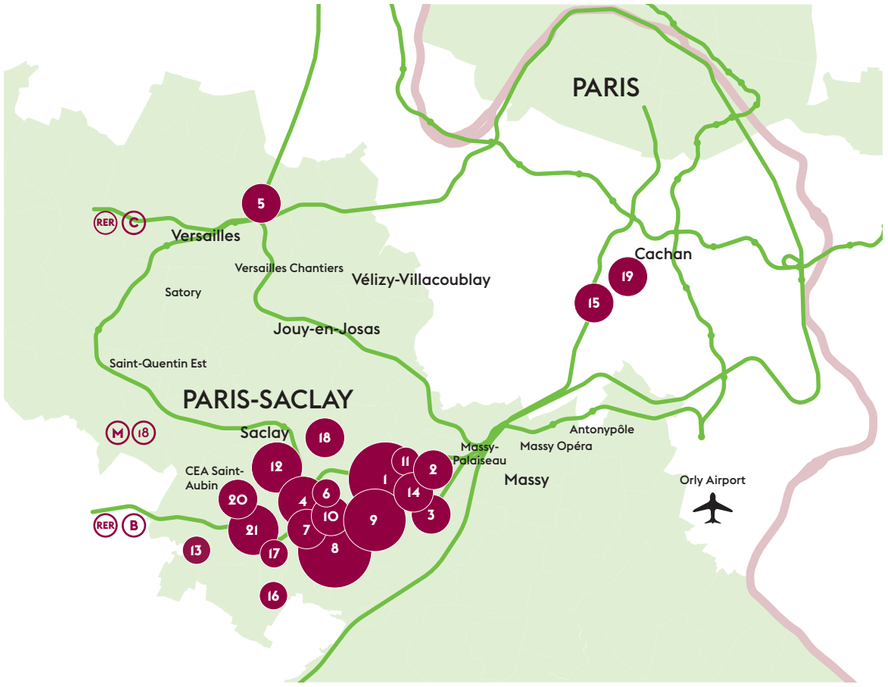
Keywords
Photonic – Reflectivity of glass – Three photon microscopy

Title

Photonics at Université Paris-Saclay

Photonics can be found in the research activity of the many laboratories of Université Paris-Saclay that deal with Wave and Matter Physics (PhOM), Electrical, Optical and Electronic Engineering (EOE) and in Mechanics, Energetics and Processes (MEP), and is also taught at a very high level.





1 — **C2N** (CNRS/UPSud)
2 — **DOTA** (ONERA)
3 — **DPHY** (ONERA)
4 — **GeePs** (Centrale-Supélec/CNRS/UPMC/UPSud)
5 — **GEMaC** (CNRS/UVSQ)
6 — **ICMMO** (CNRS/UPSud)
7 — **ISMO** (CNRS/UPSud)
8 — **LAC** (CNRS/ENS Paris-Saclay/UPSud)
9 — **LCF** (CNRS/IOGS/UPSud)
10 — **LCP** (CNRS/UPSud)
11 — **LEM** (CNRS/ONERA)
12 — **LIDYL** (CEA/CNRS)
13 — **LLB** (CEA/CNRS)
14 — **LPP** (CNRS/École polytechnique/Observatoire de Paris/UPMC/UPSud)
15 — **LPQM** (CNRS/ENS Paris-Saclay)
16 — **LPS** (CNRS/UPSud)
17 — **LUMAT** (CNRS/UPSud)
18 — **NIMBE** (CEA/CNRS)
19 — **PPSM** (CNRS/ENS Paris-Saclay)
20 — **SPEC** (CEA/CNRS)
21 — **Synchrotron SOLEIL**

Three big strategic research lines:

- Quantum engineering
- Nanophotonics
- Optics

21
research units

734
FTE, of which 440 are researchers and teacher-researchers

The thematics in nanophotonics:

- Photonic and plasmonic cavities
- Nanotransmitters
- Single photon sources
- Nanoplasmonics
- Non linear dynamics of photonic nanostructures
- A generation of superior harmonics
- Optomechanics

Nanophotonics is central to two Flagships, specific to NanoSaclay LabEx:

- CONDOR
- On Chip Quantum Optic Quantum Simulation

The IQUPS, Quantum Engineering at Paris-Saclay, is a strategic research initiative, which comprises an important nanophotonic element.

A new display support for virtual images

The GPS integrated into the windscreen may be for tomorrow. One of the technical challenges, for this to be successful, is finding the correct display support, which can reflect the projected image, while preserving visibility through the windscreen. The Centre for Nanoscience and Nanotechnology (CNRS/Université Paris-Sud), the Fresnel Institute and the PSA group are collaborating to develop a system adapted to needs. Silver nanoparticles, placed at the surface of the glass, increase its reflectivity factor to a given wave length, to improve the display performance in the selected colour. In optimising the organisation of the nanostructures, researchers can retain the transparency of the system. This technology has been patented and tested on a 1 cm² surface, and should soon be applied to bigger surfaces. This device aims to improve display performances of Enhanced Vision Systems, in aeronautics, automotive and other applications in augmented reality.

Publication

· H. Bertin *et al., Correlated Disordered Plasmonic Nanostructures Arrays for Augmented Reality.* ACS Photonics, (2018), doi: 10.1021/acsphotonics.8b00168

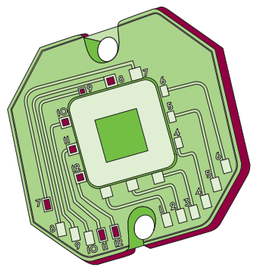
A laser source to see even deeper into tissues

Three-photon microscopy is a growing sector, which is used to observe tissues such as the brain up to 1mm in depth, but requires new sources of adapted light. This is where the laser source, born out of a joint effort between researchers of Charles-Fabry Laboratory (CNRS/ Optics Institute Graduate School) and the Optics and Biosciences Laboratory (CNRS/ Inserm/École polytechnique). A clever process enabled recycling of residue of a wavelength, which allowed two cellular markers to be observed, instead of one. The two-tone images improve, in particular, localisation of several elements, such as the type of cells, within one same sample. A patent has been filed for this invention.

Publication

· K. Guesmi *et al. Dual-color deep-tissue three-photon microscopy with a multiband infrared laser.* Light: Science & Applications 7, Article number: 12 (2018).

Light on the Quandela start-up



Developed from a low-temperature lithography technique (- 270 °C) as the result of the work of the Centre for Nanoscience and Nanotechnology (CNRS/Université Paris-Sud), the innovation of the Quandela start-up consists in creating a chip that can reproducibly emit one single photon through light pulse. The consistency of the photons promotes their use in encoded communication systems and supercomputers. The light source of this start-up, created in 2017, received the Grand Prix of the i-LAB 2018 contest, and is destined to researchers and manufacturers. The next aim: to develop a refrigerating casing, which the chip requires to function, and commercialise a more functional packaging to reach other targets. This new product would enable to take this technology to large-scale computing centres or to communications satellites.

www.quandela.com

A unique chair dedicated to photonics

Since 2017, the campus of CentraleSupélec in Metz accommodates a unique chair in France, dedicated to photonics. Initially created for a period of four years (2017-2020), the chair aims to respond to the major societal challenge of physics of light and optical technologies, to promote them as a vector of economic development. Open within the framework of a specialisation in "photonic and communications systems", to CentraleSupélec engineers and exterior candidates, the chair aims to improve, notably, performances in optical communication systems of information, develop innovating optical computer solutions or optical securing of information, and elaborate new ways of manipulating and stocking optical information.

www.chairphotonics.eu

Photonics are central to Université Paris-Saclay Masters:

15
masters are concerned

348
students are enrolled

Masters Information Engineering, Sciences and Technologies:

Speciality Electronics, Electric and Automatic Energy:

- Master 2 Optic Networks and Photonic Systems
- Master 2 Components and Antennas for Telecoms
- Master 2 Networks and Telecoms
- Master 2 Automatic & Treatment of Signal and Image Processing

Masters Fundamental Sciences:

Speciality Physics:

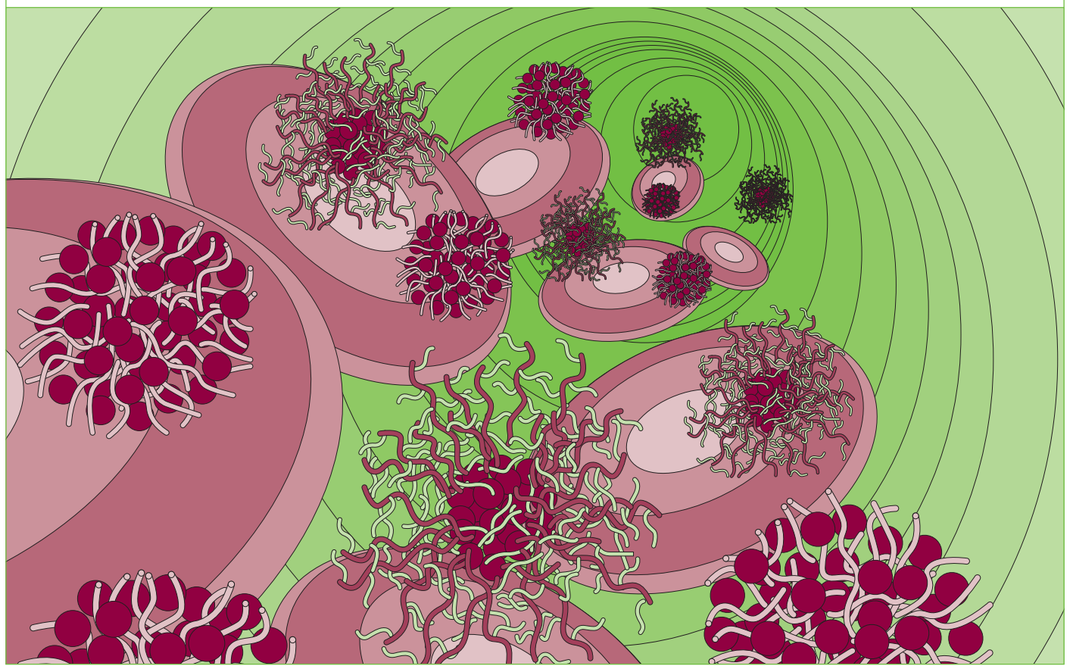
- Master 1 Molecular Nano and Biophotonics for Telecommunications and Biotechnologie
- Master 2 Monabiphot
- Master 2 Optics Laser Matter
- Master 2 Optics Business Division
- Master 2 Fundamental concepts in Physics
- Master 2 Nanosciences
- Master 2 Tools and Systems applied to Astronomy and Space

Speciality Chemistry:

- Master 2 Chemistry, Physics: Instruments, Concepts and Applications
- Master 2 Erasmus+ Serp+
- Master 2 Inorganic chemistry: Molecules Surfaces and Nano-Objects
- Master 2 MOCHI

Title

When nanoparticles are introduced into medicine



When developing nanoparticles in the biomedical field, both the nature of systems and the cellular models used for tests, are concerned. This enriches treatment modality.

Researchers fighting disease will examine all possibilities to improve treatments and reduce side effects. While some will develop new molecular therapies, others will focus on conveying them more efficiently to the target. The basic problem often resides in the site of the action and the physicochemical properties of the molecules, which are vulnerable to any encountered obstacles.

One solution is the use of nanoparticles; these nanometric objects combine medicine and transporters. These vectors encapsulate the active substances and protect them from premature deterioration. These nanoparticle systems are, not only complex and selective, but also simple, furtive, operational, sensitive to endogenous or exogenous stimuli.

A chemical bond that works

When an active substance is linked to its carrier it is called a prodrug. "*This avoids a large quantity of medicine from being released immediately, and systems become less toxic. More active substance reaches the target and less nanoparticles are administered*", explains Julien Nicolas, researcher in the Nanomedecine for Serious Diseases team, at the Galien Institute Paris-Sud (CNRS/Université Paris-Sud).

The team has notably discovered the surprising properties of squalene, a lipid that is part of the same product family as terpenes, naturally present in the body. Like cholesterol, which squalene is a precursor, it interacts with the lipoproteins in the blood circulation, which then transport it to the cancerous cells. The system delivers the drug, like a Trojan horse, carried by squalene, to the heart of the tumours.

Small RNA but great efforts

Liliane Massade used this system in her research on junction oncogene cancers, in the Vectorology and Anticancer Therapies Laboratory (CNRS/Université Paris-Sud) at the Gustave Roussy Institute. Illegitimate chromosomal rearrangement is the source of 20% of cancers, and these are prime targets for a therapy based on the use of small interfering RNAs (or siRNAs), capable of inhibiting the target gene. "siRNAs are hydrophilic molecules that are rapidly dissolved. Squalene stabilises them and makes them capable of passing through membranes to reach the target tissue", Liliane Massade explains. siRNAs characteristic of papillary thyroid carcinomas and linked to squalene can slow tumour growth down by 70 to 80% in model mice!

Within the framework of the collaborative project Nanoprotection of the NanoSaclay LabEx, the researcher is now studying the 1A form of the Charcot-Marie-Tooth disease, a hereditary, neurological disease where duplication of a chromosome causes an approximate 30% overexpression of the PMP22 protein (peripheral myelin protein 22). "The difficulty of this project resides in normalising the gene by partially inhibiting it". One of the different siRNAs, built and tested in vitro, reached this goal. When injected in transgenic mice carrying the disease, a spectacular improvement in their motor function is observed and the disappearance of all other symptoms is noticeable. "We are now going to study the involved cellular and molecular mechanisms and standardise the treatment in order to rapidly proceed to clinical trials".

Synthetic polymers in strength

Central to Julien Nicolas' research, is finding the best carrier, which is easy to synthesise and functionalise while remaining non toxic and efficient. "*Vinyl polymers are ideal for chemical synthesis as they are well defined and easily functionalised. Labile chemical motifs are introduced to render them biodegradable. They are then tested for toxicity in vitro.*" The most promising systems, after incorporation of drug and assessment on diseased cells, will be used for in vivo tests on small animals.

Mimicking the structure of tumours

It is not easy to move on to the in vivo stage: "*We have noticed that some systems that are very efficient in vitro, do not work as efficiently when they are tested in vivo*", Simona Mura explains, researcher in the same team at the Galien Institute Paris-Sud. In vitro study conditions do not reproduce the structural complexity of tumours. This is why the researcher has perfected a 3D culture model. She studied, in particular, pancreatic cancer, which has a very low survival rate. "*Failure in treatments is mainly due to their inefficient distribution in terms of cancerous cells, because of the matrix surrounding these cells, and collapse of blood vessels, which inhibits their conveyance*". She has developed a spheroid model by optimising her cell culture technique. It reproduces pancreatic cancer and its environment. "*Its relevance has been confirmed by histological analysis and cytotoxicity tests*". She now is considering adding microfluidic conditions, to mimic the blood flow and to make this model even more biomimetic.

> **"Today we have new polymers, which are good candidates to come and compete with traditional biodegradable polymers, such as polyesters."**
> **Julien Nicolas**

Gold, a metal that wishes us well

Bruno Palpant and his team work in the Quantic and Molecular Photonics Laboratory (CNRS/CentraleSupélec/ENS Paris-Saclay) and they are studying the therapeutic applications of plasmon resonance of gold nanoparticles. "*We can put the nanoparticle electrons in collective oscillation and heat them in a localised way*", explains the researcher. The variation in temperature induces different effects on cancerous cells. "*By lighting up these nano-objects with a laser, it is also possible to rip off electrons to create free radicals, capable of destroying cancerous cells*".

Publications

· Massaad-Massade L. *et al., New Formulation for the Delivery of Oligonucleotides Using "Clickable" siRNA-Polyisoprenoid-Conjugated Nanoparticles: Application to Cancers Harboring Fusion Oncogenes.* Bioconjug Chem. 2018 Jun 20; 29(6):1961-1972.

· Labouret T. *et al., Plasmon-Assisted Production of Reactive Oxygen Species by Single Gold Nanorods.* Small 2015.

· Lazzari G. *et al., Multicellular spheroid based on a triple co-culture: A novel 3D model to mimic pancreatic tumor complexity.* Acta Biomaterialia 2018, 78, 296-307

· Guégain E. *et al., Degradable polymer prodrugs with adjustable activity from drug-initiated radical ring-opening copolymerization.* Chem. Sci. 2018 Sep 13; DOI: 10.1039/C8SC02256A.

Portrait

Liliane Massade

© LM

From the moment you have a vector that exists naturally in the body such as squalene, preliminary toxicology studies at the clinical stage are reduced.

Liliane Massade is a Doctor of Sciences and Human Genetics (Université Paris Diderot). She is currently running the Targeted Therapies for Neuropathies team, at the Disease and Hormones of the Nervous System Laboratory (Inserm/Université Paris-Sud), at the Kremlin-Bicêtre hospital. She coordinates the collaborative project Nanoprotection of the NanoSaclay LabEx.

» focus

Optimising vectoring medicine using innovative combinatorial imaging.

Cancerology has been revolutionised by cargo nanoparticles, which enable pharmaceutical substances to penetrate into the cells. Up until now, there was no direct way of studying and optimising their interaction with their target. Researchers Ruxandra Gref, of the Molecular Sciences Institute of Orsay (CNRS/Université Paris-Sud), and Alexandre Dazzi, of the Chemistry and Physics Laboratory (CNRS/Université Paris-Sud) and their teams have just put forth a new technique. The laboratories are part of LabEx NanoSaclay, and this collaboration opens up many possibilities in terms of quality control of vector nanoparticles and follow-up of the interactions.

Publication · Mathurin J. *et al. How to Unravel the Chemical Structure and Component Localization of Individual Drug-Loaded Polymeric Nanoparticles by Using Tapping AFM-IR*, Analyst, 2018.

» focus

The complex normative framework of nanos

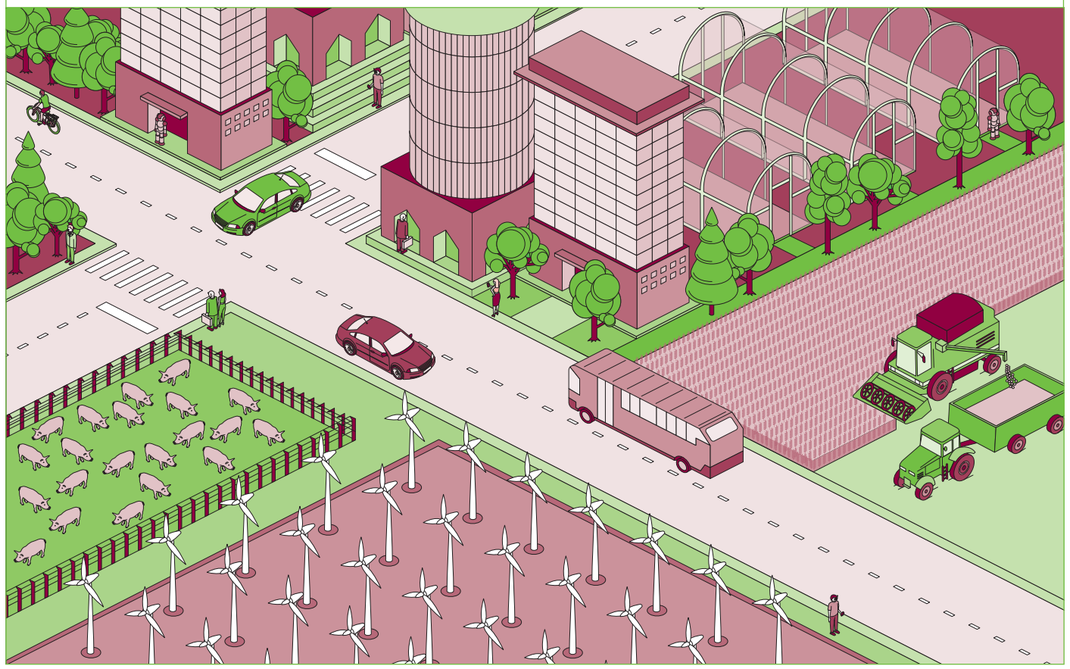
"*Nanotechnology is a relatively new field of research, and it is therefore difficult to assess all possible usage and the risks linked to their exposure*", confides Stephanie Lacour, researcher at the Political Social Sciences Institute (CNRS/ENS Paris-Saclay/Université Paris Nanterre). "*In face of these uncertainties, we are taking a precautionary approach*". In France and in Europe, first regulations relative to nanos date back to 2008-2009. Today they are continuing to be deployed, according to progress, within each State. These technologies are subject to sectorial regulations, according to the field, and modifiable with the development of scientific knowledge.

www.ansm.sante.fr/L-ANSM/Nanotechnologies/Nanotechnologies-et-produits-de-sante/(offset)/0

Keywords
Environmental Health – Climate – Agriculture and Livestock

Title

Environmental changes: what impact on our health?



Human, vegetal and animal health, are strongly impacted by environmental changes. How and what are the possible adjustments? These are the questions that the scientists of Université Paris-Saclay are examining.

The world is changing. It is a banality, yet also a research subject. This is because climate changes, loss of biodiversity and also pollution have impacted human, vegetal and animal health. The researchers of Université Paris-Saclay are focusing on interdisciplinarity, to study these phenomena, as in the ACE-ICSEN project (Adaptation to Environmental Changes – Socio-Environmental Changes Institute).

Launched in 2017, following a call for 'Strategic Initiative' projects by Université Paris-Saclay, it groups seven laboratories* and has three thematic sections: biodiversity, climate change, and health and environment. Sophie Godin-Beekmann, who coordinates the project, explains "*the aim is to place humanities at the heart of each subject*".

Captors and health hazards

The ACE-ICSEN has joined the Polluscope, the National Research Agency, project on environmental health issues, and also the Previpol project. They respectively focus on the use of captors to measure the pollution in the air in volunteers and the measurements of pollens in the air. The Institute has added a humanities dimension to the study by taking an interest, in the first project, in the acceptability of the captors, and in the second, in the change in behaviour due to risks of allergy. "*We aim to improve the epidemiological models in order to provide better tools for larger scale studies*". Explains the coordinator. Two ACE-ICSEN teams are also working on the measurement and analysis of contaminants in the rivers and will map the population affected by this pollution, in 2019. This first stage is essential to identify the risks of pollution and its impact on human health.

Wheat and climate changes

In terms of vegetal health, many researchers are focusing on climate change. Amongst them is a team, grouping scientists of Inra, AgroParisTech, the CEA and the CNRS, that has just published a study on the impact of extreme climate events on wheat yield.

The 2016 observation showed that wheat yield in the main French area had decreased by 20 to 50% in relation to yields observed over the last sixty years. Scientists therefore researched co-occurrences between abnormal climatic events and severe loss in yield. They discovered that the probability of enduring the former increases following an excess of rain, in the spring, and further increases if this excess is combined with a particularly warm end of autumn, as in 2015.

The researchers however believe that uncertainties on future climate are too important to calculate a pertinent probable future yield loss. "*However, we can say that these two variables – temperatures at the end of autumn and rainfall in the spring- were exceptional in 2015-2016, although the first will tend to be more frequent*", summarizes Tamara Ben-Ari, of the Agronomy Laboratory (AgroParisTech/Inra). "*We can therefore believe that loss of yield will also become more frequent. In the future, agricultural systems will have to be resilient to the diverse shocks, from drought to excess rain, that will put them in difficulty*".

Pigs and antibiotics

Resilience, resistance… These are the keys to climate change. The stakes are as high in livestock, where agro-ecological transition and reducing the use of antibiotics is where the ambition lies. Claire Rogel-Gaillard, of the Animal Genetics and Integrative Biology Laboratory (AgroParisTech/Inra), is working on this subject: She is studying cohorts of pigs

> **"We have established that there is a genetic control of immunity parameters, and that it is possible to select animals according to this criteria."**
> **Claire Rogel-Gaillard**

to identify the links between immunity competence and individual variability to resistance to pathogens and answers to vaccination. "*We have established that there is a genetic control of immunity parameters, and that it is possible to select animals according to this criteria*", explains the scientist. "*We are also studying the variables of intestinal microbiote and its interactions with the immunity response. We are also trying to link these individual variables to the variables with the pathogen responses, or to vaccination in livestock, in real conditions.*"

Claire Rogel-Gaillard has shared her work with the colleagues within the Predict project, and this led to a conference, "Health and Predictive Biology", in May 2017, in collaboration with the 'Maison des sciences de l'Homme', Paris-Saclay. The conference proceedings are available, free of charge, and might encourage new interdisciplinary collaborations, essential to work on adapting to climate changes.

* The ACE-ICSEN project groups: The Observatory Versailles Saint-Quentin-en-Yvelines (OVSQ – Université Versailles Saint-Quentin-en-Yvelines); the Cultures, Environments, Arctic, Representations, Climate Laboratory (CEARC – Université Versailles Saint-Quentin-en-Yvelines); the Sciences of Climate and Environment Laboratory (LSCE – CEA/CNRS/Université Versailles Saint-Quentin-en-Yvelines); the Ecology, Systematic, Evolution Laboratory (ESE – AgroParisTech/CNRS/Université Paris-Sud); The Geosciences Laboratory Paris-Sud (GEOPS - CNRS/Université Paris-Sud) ; The Data and Algorithm for an Intelligent and Sustainable City (DAVID – Université Versailles Saint-Quentin-en-Yvelines); the Aging and Chronic Disease Laboratory (VIMA – Inserm/Université Versailles Saint-Quentin-en-Yvelines).

www.msh-paris-saclay.fr/actes-n2-biologie-predictive-pour-la-sante

Publications

· Froger, C. *et al., Tracing the sources of suspended sediment and particle-bound trace metal elements in an urban catchment coupling elemental and isotopic geochemistry, and fallout radionuclides.* Environ Sci Pollut Res, 2018.

· Tamara Ben-Ari *et al., Causes and implications of the unforeseen 2016 extreme yield loss in the breadbasket of France.* Nature Communications. 24 april 2018.

· T. Maroilley *et al., Immunome differences between porcine ileal and jejunal Peyer's patches revealed by global transcriptome sequencing of gut-associated lymphoid tissues.* Scientific Reports volume 8, Article number: 9077, 2018.

Portrait

Sophie Godin-Beekmann

Adapting is also how environmental changes is perceived by the population.

Sophie Godin-Beekmann is an atmospheric physicist at the Atmosphere, Environment and Space Observation Laboratory (LATMOS – CNRS/Sorbonne Université/Université Versailles Saint-Quentin-en-Yvelines) and also President of the international commission on the ozone. From 2012 to 2017 she was Director of the Versailles Saint-Quentin-en-Yvelines Observatory.

» focus

Urban vegetable gardens subjected to pollution

Since 2012, the T4P project has transformed AgroParisTech's roof into an urban vegetable garden. It aims to study, amongst other, the construction of technosols, from urban residue and proceed to a sanitary follow-up of the vegetables. "We have referenced five elements of trace metal with a concentration well below standards for vegetables", describes Baptiste Grard, post-doctoral student at AgroParisTech, in charge of the project. Even though the experiment is only carried out on one sole roof, service rendered is staggering: water retention, storage of carbon, and most essentially, urban public awareness of nature.

Publication · Baptiste Grard *et al., Rooftop farming on urban waste provides many ecosystem services. Agronomy for Sustainable Development*, Springer Verlag/EDP Sciences/Inra, 2018

» focus

Health spanning three generations

The prospective cohort E3N, created in 1990, one of the largest in Europe, is made up of 100,000 women born between 1925 and 1950. The researchers of the Generations and Health Centre, part of the Research in Epidemiology and Health of Populations Centre (Inserm/Université Paris Descartes/Université Paris-Sud/Université Versailles Saint-Quentin-en-Yvelines) expand it further by recruiting their children (and their parents) and their grandchildren. This allows for many research subjects. "*We collaborate, for example, with European work on air pollution", illustrates Marie-Christine Boutron, head of the team. "A post-doctoral student has just revealed that exposure to endocrine disruptors though nutrition is associated with an increase in the risk of type II diabetes*".

Publication · Francesca Romana Mancini *et al., Nonlinear associations between dietary exposures to perfluorooctanoic acid (PFOA) or perfluorooctane sulfonate (PFOS) and type 2 diabetes risk in women: Findings from the E3N cohort study.* International Journal of Hygiene and Environmental Health. Volume 221, Issue 7. 2018.

» focus

A Master 2 in Environmental Health

Training Health Hazard due to environment assessors: This is the purpose of the Master 2 'Public Health and Hazards due to Environment (French School of Public Health/Université Lorraine/Université Paris Descartes/Université Paris-Sud). "*On completion of training, the graduate can establish an accurate sanitary risk dashboard for an identified contamination*", explains Yves Lévi, head of the course in Université Paris-Sud. "*He will then give deciders all the information they need to evaluate if the risk is acceptable or not, and will offer management action*".

www.universite-paris-saclay.fr/fr/formation/master/m2-sante-publique-et-risques-lies-a-lenvironnement#presentation-m2

Section

SEEN FROM ABROAD

Seen from

Manan Suri (India)

© Manan Suri

Dr. Manan Suri is an assistant professor within the department of electrical engineering at the Indian Institute of Technology, in Delhi. His research interests include semiconductor non-volatile memory (NVM) technology, and its advanced applications (neuro-morphic, artificial intelligence, security, computing, sensing, etc).

He started collaborating with Damien Querlioz, currently a researcher at the Centre for Nanoscience and Nanotechnology (Palaiseau), when he was a PhD student in France. After completing his PhD at CEA-LETI, in Grenoble in 2013, he went back to India and talked to his former colleague about pursuing this collaboration. After several years of an informal collaboration, they applied for the PICS project in 2017, which was accepted in early 2018.

> The PICS Project is the first step towards better interaction between our two groups. It helps to make progress. Today, we already have some good results. We are sharing some new higly advanced semiconductor chips designed in my lab. They will be tested both in Damien Querlioz's lab and mine. The results will be collected and analysed jointly.

The key idea is to study emerging nanodevices for low-power computing applications. For three years, the PICS project will support mobility between the two groups and help to combine their complementary skills. Every year, one or two researchers from each team will visit the other group, for a short period of time. In the final year, the collaborators will organize a seminar or workshop, open to the entire scientific community in order to showcase the work and instigate a long-term joint project.

Journal

Healthcare GLOBAL

Title

NEOSPER: SUPPORTING ORTHOPAEDIC SURGEONS THROUGH THE USE OF REVOLUTIONARY TECHNOLOGY

Supporting orthopaedic surgeons, Imane Chaabane, entrepreneurial graduate from Université Paris-Saclay and co-founder of Neosper, speak with Healthcare Global.

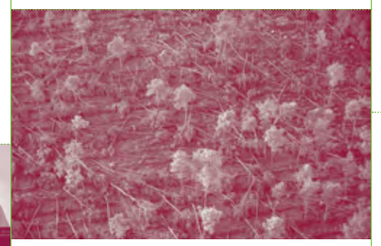
www.healthcareglobal.com/technology/neosper-supporting-orthopaedic-sur-geons-through-use-revolutionary-technology

Journal

rfi

Title

EU FORESTS CAN'T HELP CLIMATE FIGHT: STUDY



Europe cannot rely on its forests to help ward off the effects of climate change, experts warned Wednesday, calling instead for nations to protect their natural resources against the warming planet.

"The amount of carbon captured over the next 90 years by trees – around 2 parts per million (ppm) – would be low compared to the amount of carbon released into the atmosphere under the most likely scenario -- 500 ppm," Guillaume Marie, a climate and environment scientist at the University of Paris-Saclay, told AFP.

http://en.rfi.fr/wire/20181010-eu-forests-cant-help-climate-fight-study

Journal

Health Medicine Network

Title

SCIENTISTS DISCOVER BIOLOGICAL ULTRAVIOLET PROTECTION 'TIMER'

Scientists at Tel Aviv University have discovered a critical 48-hour cycle that is responsible for synchronizing the biological mechanisms that protect our skin from sun damage.

The new study reveals a biological clock dubbed the "UV-protection timer" that both synchronizes the skin's response to ultraviolet rays and mediates a tradeoff between two skin defense systems: stress response and pigmentation.

The research was the product of a collaboration with Prof. Shai Shen-Orr of the Technion-Israel Institute of Technology and Prof. Mehdi Khaled of Université Paris-Saclay. Technion doctoral student Ayelet Alpert also conducted research for the study, published as the cover story in Molecular Cell on October 25.

http://healthmedicinet.com/i/scientists-discover-biological-ultraviolet-protection-timer/

Title

The C2N has moved into its new premises

The first boxes arrived in September 2018. Slowly, the teams occupied the area. Since end of November, everyone – approximately 400 people – is there: The Centre for Nanoscience and Nanotechnology (C2N) has officially taken up residence in the heart of the Saclay plateau, in Palaiseau. 18,000 m² (12,500 m² of useful space), dedicated to research in nanophotonics, nanoelectronics, microsystems, nanobiofluidics, and in materials.

The fusion of the Photonic and Nanostructures Laboratory (CNRS) and the Fundamental Electronics Institute (CNRS/Université Paris-Sud) is now a reality and the teams are working together to turn this pole into a global reference in nanosciences or nanotechnologies. "*People are enthusiastic. The laboratory's identity can emerge*", confides Giancarlo Faini, director of the C2N. This merger has turned the laboratory into one of the largest in European nanophotonics, and it forms, with the other local communities, one of the largest consortiums in spintronics. "*The C2N's strength is its population of researcher-technologists, engineers, and technicians, operating in one same environment. This asset will contribute to advancing knowledge and innovation in a more effective way*".

The building is a true concentrate of advanced technology. The CNRS entrusted overseeing to the Artelia group and to the Michel Rémon workshop. It comprises 3,400 m² of experimental laboratories, 2,900 m² of offices and 2,900 m² of white rooms, destined to the nanotechnologies facility. This is the largest facility in France, and is the Ile-de-France pole of the Renatech network. "*The technical requirements are close to those of manufacturers*", and the stored equipment is sheltered from vibrations, electromagnetic radiation, variations in humidity or temperature, and from dust.

For the moment, the aim is to resume experiments that were suspended during the move, then to strengthen partnerships with neighbouring manufacturers and beyond, to receive the first start-ups and SMEs, within the facility. The C2N aims to capitalise on existing collaborations and strengthen its international visibility in the fields of research. The building will be inaugurated in the spring of 2019.

https://www.c2n.universite-paris-saclay.fr/fr/

© Sergio Grazia

Photographs : (At the top) Southern face of building; (at the bottom) Main entrance of C2N.

Title

IHES has celebrated its 60th birthday in great style

To mark its 60th birthday, the 'Institut des hautes études scientifiques' (IHES) organised throughout the year 2018, a series of scientific events. This advanced research centre in mathematics and theoretical physics, which receives every year more than 200 scientists – a majority of foreigners – for research stays, has also implemented various conferences, a summer school, and the scientific research evening "Clever Mix" (Savant Mélange), last October 16th, at the Sorbonne, in Paris.

The evening gathered several great researchers, passionate about sciences, who came to share their discoveries, their career paths and their enthusiasm for research.

www.sideup.fr/webcast-savant-melange/delayed/fr

Title

DIGIHALL : a future digital pole at the heart of Paris-Saclay

DIGIHALL – North-West pedestrian view – Building seen from the crossroads, © Architecture Studio

New buildings are being erected, on a 27,500 m² plot, on the Nano-INNOV site, in Palaiseau, for the DIGIHALL project, designed to develop a real digital technologies centre on the urban campus Paris-Saclay. This will complete the three existing structures. The Parisian architectural firm, Architecture Studio, has been contracted to oversee. The architectural project comprises a reception building where the Inria will be located, the CEA-List building in the centre of the existing structures, and the SystemX/Systematic building, in the centre of the site and in transition with the Bois Cassé. The purpose is to develop tomorrow's digital technologies in three key fields in transformation of our economy: industry of the future, artificial intelligence, and cyber-physical systems. Construction will begin in December 2019 and finish in February 2024.

© Sergio Grazia

Section

CALENDAR

WE WERE THERE

OCTOBER

Date	Place	Host
29-30-31	Évry	Université Évry-Val d'Essonne

Description

13 DAYS OF VIRTUAL REALITY

The community of virtual and augmented reality, and of 3D, academic and industrial interaction, was invited to exchange and share breakthrough and good practices.

https://jrv2018.sciencesconf.org/

NOVEMBER

Date	Place	Host
8	Gif-sur-Yvette	Centrale Supélec

Description

20 YEARS OF INNOVATION IN ÎLE-DE-FRANCE

An event to spotlight entrepreneurs in public research incubators, the winners of i-Lab, the national contest for creating innovative and technological companies, the winners of the PEPITE contest, to encourage young entrepreneurship in students and researchers.

www.universite-paris-saclay.fr/en/node/16006

DECEMBER

Date	Place	Host
From the 10th to the 14th	Guyancourt	Observatory of Versailles Saint-Quentin-en-Yvelines

Description

ARCTIC WEEK AT OVSQ

The key theme of this international and interdisciplinary conference was climate, environmental and global change in the Arctic. Scientific communications, workshops, five photograph exhibitions, films, cultural events and meetings with the public punctuated the event, which gathered together researchers in social sciences, environmental sciences, experts in artic indigenous knowledge – from Siberia and Greenland – and students.

www.uvsq.fr/arctic-week-a-l-ovsq-402937.kjsp?RH=1188396177402

DON'T MISS

JANUARY

Date	Place	Host
31	Palaiseau	Université Paris-Saclay

Description

MEET MY PLATFORM – LIFE SCIENCES

A day of meetings between platforms and companies, organised by Genopole and the Life Sciences department of Université Paris-Saclay

www.universite-paris-saclay.fr/fr/mmp-sdv

JANUARY – FEBRUARY

Date	Place	Host
Five Thursday afternoons, from 10/01 to 07/02	Palaiseau	Centre for Nanoscience and Nanotechnology

Description

TRAINING IN "Micro-Nanotechnology: Introduction to Procedures"

In order to gain solid foundation in micro and nanotechnologies (lithography, engraving, thin film deposition, plasma and microsystems). Training open to all people wishing to implement technological processes. No prerequisites.

http://cnrsformation.cnrs.fr/stage-19078-La-micro-nano-technologie&Ao-introduction-aux-procedes.html?stage=19078&axe=102

FEBRUARY

Date	Place	Hôte
2, 8, 9, 13	Different places in the Yvelines	Université Versailles Saint-Quentin-en-Yvelines

Description

OPEN HOUSE DAYS AT Université de Versailles Saint-Quentin-en-Yvelines

Future students, come and meet the teachers and students and talk about your professional project.

www.uvsq.fr/les-journees-portes-ouvertes-a-l-uvsq-401850.kjsp?RH=1507821125055

Date	Place	Host
13th to 16th	Paris	French Institute

Description

INTERNATIONAL CONFERENCE "Heritage, Sciences and Technologies"

Cultural and natural heritage is at the heart of our society. Making this heritage available to all, protecting and knowing it better is essential to have a better understanding of our history and favour dialogue between cultures.

www.academie-sciences.fr/fr/Colloques-conferences-et-debats/patrimoines-sciences-technologie.html

MARCH

Date	Place	Host
14	Paris	APCA

Description

THEMATIC DAY "Quality of the Air and Fertilisation: Reduce Ammoniac Emissions"

This event is organised by Comifer, the French committee for study and sustainable fertilisation practices, with a communication by Pierre Cellier, researcher at the Ecosys Laboratory (AgroParisTech/INRA).

www.comifer.asso.fr/fr/evenements/journees-thematiques/215-qualite-de-l-air-et-fertilisation-reduire-les-emissions-d-ammoniac.html

Date	Place	Host
19-20	Campus Paris-Saclay	Université Paris-Saclay

Description

UNIVERSITÉ PARIS-SACLAY will receive the members of the Hcéres committees, who have come to assess the PhD training.

The doctoral college visit will take place on March 19th. Six committees will undertake the visits of the doctoral colleges, over the course of 3 half-days, following the 19th and 20th of March 2019.

www.universite-paris-saclay.fr/fr/actualite/prenez-date-du-19-au-20-mars-2019-luniversite-paris-saclay-accueillera-les-membres-des

MAY

Date	Place	Host
20 – 22	Montpellier	Cirad, INRA

Description

4TH CONFERENCE ON GLOBAL DEFORESTATION

The purpose is to strengthen ties between science, society and public politics. Montpellier will receive, for the first time in Europe, the fourth Conference on Global Deforestation.

https://agroforestry2019.cirad.fr/fr

université PARIS-SACLAY

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READ

THE CONVERSATION

Can autism be treated thanks to the intestine?

Laure Tabouy, researcher at the Neuro-sciences Institute (Université Paris Sud – Université Paris-Saclay), presents the research results on model mice which show that there is a relationship between the host genome and the intestinal flora; this opens up new leads for future research in treating autism: use of probiotics.

www.theconversation.com/soigner-lautisme-grace-a-lintestin-99664

Biofilms, an alternative chemical treatment of crops

Romain Briandet and Caroline Pandin, researchers at Inra, present the advantages of biofilms as an alternative to chemical treatment of crops.

www.theconversation.com/les-biofilms-une-alternative-aux-traitements-chimiques-des-cultures-102897

IN ISSUE NUMBER 10

TO APPEAR IN MAY 2019

Virus and Medicine
Dietary Behaviour
Nanomaterials and Reduced Dimensionality
Interdisciplinarity in Humanities and Social Sciences
Green Chemistry

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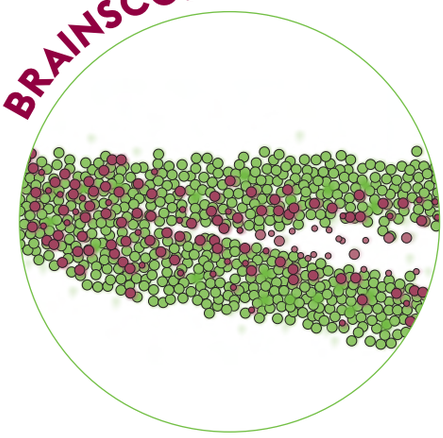
THE STRATEGIC RESEARCH INITIATIVES (IRS) LIFE SCIENCES

BRAINSCOPES

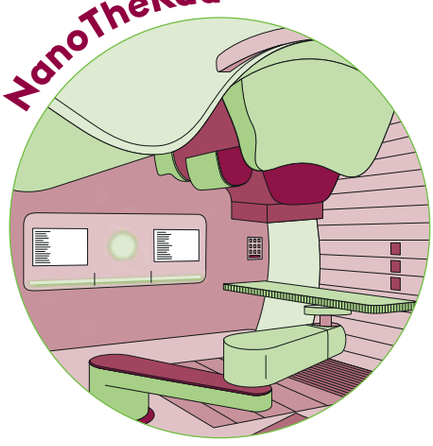


BRAINSCOPES is an interdisciplinary project of neurosciences and optics, which focuses on the architecture and function of the nervous system (healthy or unhealthy), using new imaging technology. Its purpose is to elaborate technologies and methods, of optical or other nature, specific to neurosciences.

BME

BME (BioMedical Engineering) is a multidisciplinary project interfacing with physics, chemistry and information technology related to biology and medicine. The purpose is to innovate in three areas of the living: chemistry and explorative physics of the living cell, new microfluidic, biocompatible and autonomous captors, and systems and imaging methods in medicine.

NanoTheRad



NanoTheRad aims to improve and personalise radio and chemotherapy cancer treatment. It is focusing on developing strategic therapies based on the use of new radiation sources, nano-objects and radio sensitising agents.

NUTRIPERSO

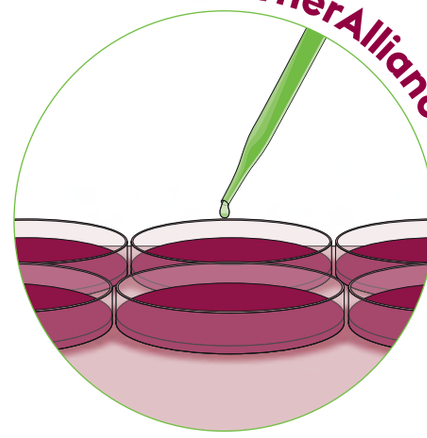
NUTRIPERSO focuses on personalised nutrition and dietary recommendations to prevent causing chronic diseases, such as type 2 diabetes. This initiative seeks to adapt general recommendations according to population or individual background risk, long-term impact on the health, efficiency and cost of operations..

Université Paris-Saclay has certified 23 inter-institutional research projects as strategic research initiatives (IRS). These initiatives gain operating strength around high level scientific and technological issues. They are organised around existing projects and develop knowledge and know-how, in cooperation with the industry.

B2SRI

B2SRI (Biologie des systèmes et synthétique research initiative) is a framework for research teams in formal quantitative sciences and life sciences, around a project in predicative biology and engineering biology. It aims to develop models to solve problems in the fields of health, agriculture and biotechnologies.

BioTherAlliance

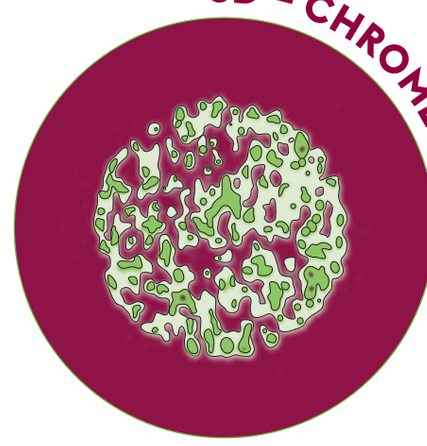


BioTherAlliance forms a cluster of excellence in biotherapies, destined to accelerate clinical and industrial transfer. This transversal project focuses on gene therapy of neurological illnesses, and on cellular engineering, and aims to invent new tools to overcome current technological barriers.

SysABCD

SysABCD (Analytic Systems for Biomarkers and Sustainable Chemistry) involves research partners and hospitals in order to create new synergies between analytical science and sustainable chemistry, and other fields of applications. The initiative aims to develop miniaturised analytical systems, and methods to define biomarkers of illnesses and diagnosis tools.

3D – CHROME



3D – CHROME (3D Chromosome organization) strengthens a research and training network centred on the understanding of biology and chromosomes, their tridimensional organization, and their impact on the development of illnesses and species over the course of their evolution. The purpose is to design imaging technology of chromosomes and living cells.