Annual Report 2014
"ÉCOLE POLYTECHNIQUE IS PRODUCING AND SHARING THE HIGHEST LEVEL OF MULTIDISCIPLINARY KNOWLEDGE FOR AND WITH COMPANIES, SOCIETY AND ITS STUDENTS"
What major achievements, actions, and events marked the year 2014?

Jacques Biot: The past year has seen the diligent implementation of projects that are part of the strategic plan which École Polytechnique adopted at the end of 2013. This made 2014 a year full of achievements and realizations.

At the corporate level, the event of the year was obviously the creation of Université Paris-Saclay, a community of universities and establishments of which we are a founding member and to which, jointly with our partners, we delegated the power to award Master of Research degrees and PhDs, starting in 2016.

Just as important as this partnership was the development of École Polytechnique itself, which has reinforced its brand in its three areas of focus: research, education, and entrepreneurship. New Academic and Teaching Chairs have been signed with regards to major technological issues, publications have been accepted in prestigious international journals, a laboratory for humanities and social sciences was created, new Master’s programs have been made available in collaboration with partner schools notably in the field of data sciences, more and more MOOCs are being launched, and many start-ups created in the laboratories or led by students and alumni received awards and financial support. All of this gives our institution great pride.

We have also consolidated our international policy, which focuses on reinforcing our links with a reduced number of universities that share our values and on boosting our reputation worldwide. The new website we launched in 2014 contributes to this reputation.

Thus, in 2014, l’X has expanded on the means to fulfill its goal: producing and sharing the highest level of multidisciplinary knowledge for and with companies, society and its students while fostering the audacity, entrepreneurial spirit and sense of public interest that characterize its teaching and research.
What will be the highlights for 2015?

The year 2015 will have the same dynamic.

Regarding education, we will modify the curriculum of the Ingénieur Polytechnicien program in order to integrate more components of learning through projects and further develop a managerial and entrepreneurial culture. The launch of our executive education program in March 2015 enables us to expand our market and to offer businesses as well as individuals the scientific, technical and managerial expertise they need to ensure their development in a context of intense technological transformations. Finally, we will expand our French and English MOOC program.

We continue to develop innovation and entrepreneurship: we will inaugurate the building which will house our activities in this field and the first startoppers have joined our accelerator.

At the corporate level, 2015 will confirm the importance of the cooperations within Université Paris-Saclay, and l’X will partner with ENSTA ParisTech, foreseeing closer collaboration between engineering schools.

Finally, in parallel with the consolidation of our strategic agreements, our international policy will put a special focus on Francophone Africa in order to encourage bright African students to apply.

This year you are inaugurating the “X-entrepreneurship” building. What is École Polytechnique’s ambition in terms of economic development?

École Polytechnique has expressed its commitment to economic development. It has therefore put in place a strategic plan which promotes entrepreneurship and innovation. The first step is the construction of a symbolic building designed to house all of the activities involved.

This building is under construction and will be completed in summer 2015. It will be a modular and progressive building, promoting exchanges, circulation of ideas, and entrepreneurial development. In parallel, we have four projects in progress with which we are shaping our accelerator X-UP, launched in April 2015. Through it, the 22 laboratories of our Research Center have privileged access to means of hardware and software prototyping, and to École Polytechnique’s networks of alumni, companies, entrepreneurs and sponsors. L’X also co-designed with HEC a MOOC entitled “creating and developing a technological start-up”. More than 10,000 people from 100 countries throughout the world have registered. The first edition of this course was offered to our students in February as a SPOC (Small private online course).

On March 4, École Polytechnique launched its “executive education” programs. What are your goals in this area?

The goal for executive education is to meet the needs of businesses and individuals by building on École Polytechnique’s scientific, technical, and managerial
expertise. Certificate and degree programs are offered all throughout the professional life of the participants to enable them to master emerging technologies such as big data and connected devices.

Today, technological innovations force companies and administrations to adapt to the new issues stemming from the release of ground-breaking technology. With its new brand, “École Polytechnique Executive Education”, the school offers a unique opportunity to transfer its expertise in science and technology to executives in the industrial and public service sectors who will convert it into a competitive advantage.

What is the nature of the partnership that will be formed between l’X and ENSTA ParisTech?

The administrations of both institutions fully approved and planned a closer collaboration, following the study conducted at the end of 2013, in order to harmonize their strategies in terms of research and education, as well as ways of operating on campus, while respecting the identity of each entity in order to avoid losing any value in the process.

The structure chosen among different options was a partnership between ENSTA ParisTech and École Polytechnique once the latter acquires the legal status of EPSCP (Établissement public à caractère scientifique, culturel et professionnel: scientific, cultural and professional public establishment).

Joint working groups were set up to further define the actions to be taken and the perspectives for this partnership. These groups came up with a proposal for a “convention of association” submitted for approval to the Boards of directors of both institutions in 2015 as a step toward drafting a “decree of association”.

Our ambition is to use this closer collaboration to reinforce our attractiveness and create a coherent center for research and higher education, differentiated by its competence and values, in order to produce and share knowledge on a world-class level. This plan is in line with Université Paris-Saclay, of which our two institutions are founding members.

The École Polytechnique Foundation will launch a second fundraising campaign in collaboration with l’X. What is the update on that?

The Foundation is an essential partner working in very close collaboration with l’X. The next fundraising campaign coordinated by the Foundation and its sister organizations abroad is essential to carry out the ambitions of École Polytechnique and fits in perfectly with our strategy.

At this time, we are actively working with the President of the Foundation, Denis Ranque (X 1970), to put in place a new campaign which is currently in its silent phase. It will be more ambitious than the first, through which €35.2 million were collected in individual donations.

We are convinced that even more members of École Polytechnique community will join in and contribute to the future of l’X.
École Polytechnique

An original model...

In our globalized economies, innovation is the main source of prosperity. For this reason, École Polytechnique is producing and sharing the highest level of multidisciplinary knowledge for and with companies, society and its students by fostering the audacity, entrepreneurial spirit and sense of public interest that characterize its teaching and research. Its original multidisciplinary model, based on science and engineering, ensures close integration between its three progressive graduate-level programs (Ingénieur Polytechnicien, Master’s, and PhD) and its Research Center, with these courses including in-depth development of behavioral and interpersonal skills. École Polytechnique also meets the needs of businesses and individuals in terms of executive education by capitalizing on its recognized scientific expertise. Certificate and degree programs are offered throughout the participants’ careers to allow them to master emerging technologies.

...bolstered by a cutting-edge Research Center

École Polytechnique Research Center boasts 22 laboratories, including 21 joint research units with the French National Center for Scientific Research (CNRS), in 8 major scientific disciplines: biology, chemistry, computer science, economics, pure mathematics, applied mathematics, mechanics and physics. Bringing together 1,600 research staff members, it combines exploring the most fundamental aspects of research for the advancement of knowledge with the development of more applied major fields to meet the scientific, technological and societal challenges of the 21st century. It therefore creates an innovation-friendly ecosystem.
Prestigious international agreements
École Polytechnique has chosen to concentrate its international policy on a small number of specific and highly visible partnerships with institutions with which it shares common values and ambitions. The aim of these partnerships is to set up innovative and high-level strategic cooperation programs. These collaborations strengthen École Polytechnique’s foothold as one of the world’s leading institutions. In 2013, École Polytechnique signed agreements with the MIPT (Moscow) and Caltech (United States) at Master’s level, and it entered into a framework partnership agreement with Technion (Israel). In 2014, it signed a framework cooperation agreement with the University of California, Berkeley and a double-degree agreement with the Instituto Tecnológico de Aeronáutica (Brazil). In China, the ParisTech Shanghai JiaoTong engineering school which École Polytechnique helped create is now welcoming its third class of students. Building these strategic partnerships with targeted players guarantees reciprocal exchanges between students, lecturers and researchers, and this is the approach École Polytechnique intends to implement in order to continue its international development.

A multifaceted future within Paris-Saclay
École Polytechnique is a founding member of Université Paris-Saclay, created on December 29, 2014. It is involved in 11 Labex and 9 Equipex. École Polytechnique is also a founding member of ParisTech, the Paris Institute of Science and Technology, a network which facilitates partners’ international recruitment and ensures social diversity.
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APRIL 26
Class of 2012 students win the International Physicists’ Tournament final

MAY 22-25
École Polytechnique students take part in the Paris International Model United Nations (PIMUN)

SEPTEMBER 30
Launch of École Polytechnique’s new website

NOVEMBER 20
First prize for École Polytechnique’s new visual identity in the Communication et Entreprise Grands Prix

DECEMBER 29
Creation of Université Paris-Saclay of which École Polytechnique is a founding member

MARCH 27
Seminar by physics Nobel Prize winner Serge Haroche

MAY 22
Conference by Xavier Niel, Vice-President and Deputy Director of Strategy at Iliad

JUNE 30
Partnership between École Polytechnique and Technische Universität München strengthened in the presence of the Bavarian Education Secretary

SEPTEMBER
Trip to California and signing of a partnership with UC Berkeley
FEBRUARY
Introduction of a joint Master’s 2 program in Advanced Communication Networks (ACN) with Télécom ParisTech

JULY 3
Introduction of a new joint Specialist Master’s program in Leading International Industrial Projects with ESSEC

JULY 17
Attainment of the Français Langue Étrangère (FLE) quality label

SEPTEMBER 1
Creation of a joint Master’s program in Big Data with Télécom ParisTech
ÉCOLE POLYTECHNIQUE IN 2014

RESEARCHING

APRIL 11
“École Polytechnique Mechanics, Innovation and Industry” day

APRIL 23
First brick laid for École Polytechnique’s new laboratories in the presence of Geneviève Fioraso and Laurent Collet-Billon

JULY 1
École Polytechnique joins the HPC-SME initiative (high-performance calculation)

SEPTEMBER 17
IZEST ELI-NP “Extreme Light’s New Horizons” Conference

OCTOBER 2
Launch of École Polytechnique’s Research Thursdays

OCTOBER
Prestigious publications from the LULI and the CPhT in Science and Nature

OCTOBER 21
Crystallography day at École Polytechnique

INNOVATING

JULY 23
Reception at the Élysée Palace for the 110 winners of the Concours Mondial d’Innovation 2030 award (World Innovation Competition). Among the winning projects, 14 are headed by students from l’X or were developed in École Polytechnique laboratories.

SEPTEMBER 19
Creation of the International Chair on the Internet of Everything with CISCO

OCTOBER 6
Building permit request filed for the Entrepreneurship building

OCTOBER 15
Creation of the Data Scientist chair by École Polytechnique, Keyrus, Orange and Thales
FEBRUARY 13
Welcome ceremony of the 9th “Why shouldn’t I go to a Grande École?” program

APRIL 1-30
“Journey into crystal” exhibition at the Central Library

SEPTEMBER 15
2nd session of École Polytechnique’s Massive Open Online Courses (MOOCs) on Coursera

SEPTEMBER 20-21
Heritage days at École Polytechnique

OCTOBER 10-11
Science Fair at École Polytechnique

JANUARY 30
Zero-gravity flight for an X-CubeSat student, an association that won the CNES competition for weightless discovery flights

MARCH and OCTOBER
Start-up Weekends at École Polytechnique

MARCH 14-15
14 prizes for École Polytechnique at the Defense Grandes Écoles’ Sports Tournament

JUNE
Graduation ceremonies for Class of 2009 students, and 2013 Master’s and PhD students

NOVEMBER 24-28
Campaign for election of the new Student Council
TEACHING
The competitive entrance exam for the Ingénieur Polytechnicien program

A medical examination for everyone

Since 2014, applicants eligible to take École Polytechnique’s competitive entrance exam undergo a medical fitness examination the week prior to their oral tests. This new approach eliminates all risks during the sports contests and ensures future French students will be fit enough to complete their initial military training in September.

Digitization of exam papers and roll-out of tablet grading

Following the successful experiment conducted in 2013, École Polytechnique has extended tablet grading to all of the 2014 competitive entrance exam papers. École Normale Supérieure and ESPCI ParisTech exam papers have also been digitized.

3 academic programs

**Ingénieur Polytechnicien Program**
- 513 students in the Class of 2014
- 1,935 students in the program at the start of the 2014 academic year
- 20% international students

**Master’s program**
- 434 Master’s students
- 51% international students
- 20% women

**PhD program**
- 575 students enrolled in the Graduate School for a PhD
- 40% international students
- 25% women
"For the second year in a row, students have organized the ‘X-prépas’ initiative with École Polytechnique’s support. It involves visiting students in high schools and preparatory classes outside of the Paris region and presenting École Polytechnique to try to disperse the misconceptions they may have about l’X and prevent any form of self-censorship during enrollment on the entrance exam. Several indicators show that École Polytechnique’s entrance exam was abandoned by candidates from these institutions, particularly by young women and scholarship students. We heard the same words time and again: “It’s not for us”, “You must attend a Parisian preparatory class to get into École Polytechnique”, or “I’m going to lose a week of revision time if I take École Polytechnique’s entrance exam”.

A friendly, open discussion with the students often helps deconstruct these clichés. Moreover, the communication materials provided have given students attending a science-based preparatory course clear and accurate information on the education provided at École Polytechnique and the careers available to its graduates. This year, for this second edition, more than 140 students from l’X visited 80 preparatory classes. And we intend to keep at it!"
THE THREE academic programs

The Ingénieur Polytechnicien Program

The overhaul of the Ingénieur Polytechnicien Program is entering its second phase with substantial changes to the curriculum.

An extended internship

The length of Ingénieur Polytechnicien students’ internship has been extended to three months to give them time to become better immersed in the companies.

Greater multidisciplinarity in the second year

Second year students must now choose courses in at least four scientific disciplines from: biology, chemistry, economics, computer science, pure mathematics, applied mathematics, mechanics and physics. This new rule allows those who have a clear idea of their intended career to gain more advanced knowledge in a number of subjects while retaining the multidisciplinary aspect which is the strength of the Ingénieur Polytechnicien curriculum. In practice, the majority of students continue to opt for four or five subjects.

Companies involved in Group Science Projects

For their Group Science Projects, second year students can now work on subjects suggested by companies.

A new Master’s program on data science

Exploitation of large volumes of data requires sophisticated computer science and mathematics techniques in order to extract the relevant information. Today, businesses face growing difficulties when it comes to recruiting Data Scientists capable of grasping these challenges and managing this issue which is strategic to their development. Big Data is a crossfunctional challenge that affects many sectors of the economy: large-scale distribution, public services, high-tech industry, the banking and financial sector and the biomedical sector with the advent of personalized medicine.

To meet this need, École Polytechnique opened the “Mathematics for Big Data Science” Master’s program at the start of the 2014 academic year in collaboration with Télécom ParisTech and ENSAE ParisTech. This program will be part of Université Paris-Saclay’s Master’s offer on the topic “Mathematics and Applications” at the start of the 2015 academic year.

“...We are really pleased with this unique collaboration which draws the best from École Polytechnique, Télécom ParisTech, ENSAE and partners like Université Paris-Sud to shape the versatile and multidisciplinary profiles businesses need."

Frank Pacard,
Vice President for Academic Affairs and Research
International development of Master’s programs

École Polytechnique is developing Master’s programs in which students spend three months abroad. This is the case with the “Climate Environment Applications and Research” (CLEAR) Master’s program with Columbia University and the “Technological Innovation: Engineering and Entrepreneurship” (ITIE) Master’s program with the University of California, Berkeley.

Synergies with Université Paris-Saclay

With the official creation of Université Paris-Saclay on December 29, 2014, of which École Polytechnique is a founding member, the overall Master’s program offer is changing with the creation of new courses, greater clarity and interconnection of the Master’s offer… All these programs will be available in 2015.

In parallel, École Polytechnique, which has an on-site Graduate School – l’École Doctorale de l’X – will be involved with about ten graduate schools of Université Paris-Saclay, at the start of the 2015 academic year. One of them, called “Interfaces” will be hosted on École Polytechnique campus. Although students working on their PhD in École Polytechnique laboratories will enroll with one of the Université Paris-Saclay graduate schools, École Polytechnique will remain responsible for their administrative supervision.

Benjamin Vest, winner of the regional final of the competition “My PhD in 180 seconds” for the Paris region

On May 27, 2014, at Université Paris Descartes, Benjamin Vest from the Aerospace Research Center (Office National d’Études et de Recherche Aérospatiales) / Theoretical and Applied Optics Department rose to the challenge of presenting, in 3 minutes flat, in simple terms, his PhD on «Two-photon absorption for infrared detection».

“My engineer’s education also gave me an appetite for challenge and an entrepreneurial spirit. There was never any doubt I was going to do a PhD. At École Polytechnique and ONERA, I found the subject and team that were right for me. An environment where you can extend the boundaries of knowledge always involves a degree of challenge!”

Wahb Ettoumi, winner of the prize "Le Monde de la recherche universitaire 2014"

Wahb Ettoumi is one of ten winners of the university research prize awarded by “Le Monde” newspaper for his research under the supervision of Marie-Christine Firpo within the Plasma Physics Laboratory. The panel of judges, chaired by 2010 Fields medalist Cédric Villani, chose Wahb from among 109 eligible candidates in hard sciences and 221 in human and social sciences.
PERSONAL DEVELOPMENT AND LEADERSHIP TRAINING, a specificity at l’X

In addition to acquiring scientific and technical knowledge, Ingénieur Polytechnicien students at École Polytechnique develop human and relational skills essential for their future responsibilities.

Human and military training is thus part of École Polytechnique’s pedagogical project.

The 1st year internship

The 1st year internship is a unique model in scientific Grandes Écoles, and it recently inspired the President of the National Assembly, Claude Bartolone: he proposed to the President of the Republic to generalize that type of experience. This internship, mandatory for all French students in the first year of the Ingénieur Polytechnicien program, can be done in the Army or in a civilian body. It builds social skills: students learn about community life, adaptability, teamwork, ethics and public interest.

In 2014, the Direction of Human and Military Training at l’X visited all units hosting students who chose to do their internship in the Army, in order to make sure they are often in contact with populations and that they are working as much as possible in the field rather than the office. Meanwhile, more and more international civilian internships are offered.

Initiation to military life: La Courtine

Laetitia, X 2014

“The initial military training has been very rewarding for me. Strong links have been forged between us classmates, especially within each section. It creates a strong cohesion that helps overcome all the obstacles that we encounter. This training also allowed me to push myself to my limits and try to go beyond them with the support of my group. Finally, it introduced me to the military world that had always intrigued me until then and I enjoyed all the activities!”

30% chose a civilian internship:
- 32 partners
- 12 countries
- 3,541 young people coached by Ingénieur Polytechnicien students
- (middle and high schoolers, university students, young athletes, inmates, adolescents in foster care, young people with social and learning difficulties, hospitalized children, youth with disabilities)

453 students doing this internship

70% chose a military internship

30% Civilian internship

70% Military internship

Heraldry

Land force
National Gendarmerie
Navy force
Air Force
General Division for Armaments
Thomas, who did his internship in an EPIDe Center (Public Center for Integration of the Defence)

"Doing an internship in an EPIDe Center is first about being in daily contact with young people who may not have another solution to get by. Combining the military rigor to the specificities of a social-oriented approach, the goal is simple: to help the participants acquire all the skills they need to succeed in the professional field afterwards. This internship is a unique experience where the students are given major responsibilities: it is about bringing help to those who need it, opening yourself to different environments and backgrounds in a setting where only your human skills can make the difference."

Alix-Anne, who did her internship within the Instruction and Civil Security Intervention Unit No.7 (Land Force)

"I discovered a field oriented towards populations’ assistance and disaster relief. My missions allowed me to understand some of the very specific skills developed by brigade rescuers within the Unit, similar to those of firefighters. I also experienced a world of passion and multitasking with people ready to deal with any major risk. Through their contact, I experienced a very rewarding human experience whose lessons will surely be useful to me in my future professional life."

Encouraging volunteering and social initiatives

The Direction of Human and Military Training supports students’ extracurricular activities. Involvement in social initiatives or in the organization of events outside the student community is encouraged and valued.

Examples of social initiatives:

- Une Grande École, Pourquoi Pas Moi?
- Cheer Up!
- X-Microfinance
- ASLIVE...

Sports, an important part in the Ingénieur Polytechnicien program

Students choose 1 out of 15 sports which they practice 6 hours per week during their studies. This intensive practice, supervised by a section leader, enables them to get to know themselves better and to have healthy competition.

Learning about exemplary careers

The Direction of Human and Military Training organizes conferences where students get to meet personalities from the business or associative environment. Students learn about social issues that enrich their personal reflection and contribute to develop their scientific approach of questioning the world.

They came at l’X in 2014:

Alexandre de Juniac, CEO of Air France-KLM Group, Pierre-André de Chalendar, CEO of Saint-Gobain, Thierry Le Hénaff, CEO of Arkema, Xavier Niel, Chief Strategy Officer of Iliad, Yeming Wang, General Manager of HUAWEY, Philippe Pouletty, Honorary Chairman of France Biotech, Valérie Faudon, Marketing Director of AREVA, Charles-Édouard Vincent, Director of Emmaüs Défi Paris, Jean-Claude Trichet, Former President of the European Central Bank, Hubert Védrine, Former Foreign Minister of France, Philippe Huberdeau, Diplomat at the Quai d’Orsay, Marc Lièvremont, Former coach of the France rugby team, Stéphane Audouin-Rousseau, President of the International Research Center of the Great War, Arnaud Guillemin, DGSI, Laurent Malier, Director of CEA-Leti, François Brottes, Deputy from the Socialist Party...
École Polytechnique now provides continuing professional development

On March 4, 2015, l’X launched École Polytechnique Executive Education, a brand which covers its entire continuing professional development offer. Its objective is to meet the needs of businesses and individuals in terms of continuing professional development, by capitalizing on its expertise in sciences and technologies. Certificate and degree programs are offered throughout the participants’ careers to allow them to master emerging technologies. The offer draws on the excellence of the lecturers-researchers and École Polytechnique laboratories as well as the experience of the Collège de Polytechnique. École Polytechnique has indeed acquired a 100% share in the company X-ROM which operates the brand “Collège de Polytechnique” which continues to specialize in short, bespoke training courses.

New continuing professional development programs

Data Sciences Starter Program
Launched in October 2014 by École Polytechnique, the first “Data Sciences Starter Program” session which ended in December was a major success. This certificate program offers an introduction to data science and Big Data in France. It is intended for professionals with a technical or managerial profile, to provide them with training in how to interact with experts and consultants. It combines lectures with practical work on machines.

“The modules offered are designed for anyone with a basic knowledge in computer science or statistics. No programming experience is necessary”, specifies Erwan Le Pennec, one of six École Polytechnique professors on the program’s teaching team, who also holds the Data Scientist Chair at École Polytechnique. After a successful first session, a second one has been scheduled between May and June 2015.

“Professionally, I will soon have the opportunity to implement the advanced algorithms that we studied during the training program. The tools and softwares I discovered such as “Map Reduce”, “Hive”, “Python and its libraries” will be useful to me on a daily basis for accessing or handling large volumes of data”.

Julie, Expert Statistician at Keyrus.

“Technically our continuing professional development offer is part of École Polytechnique’s strategy and missions, bringing economic players the scientific, technical and managerial expertise they need to ensure their development in a context of intense technological change and tougher international competition”.

Jacques Biot, President of École Polytechnique
An advanced Master’s program with ESSEC

At the start of the 2014 academic year, École Polytechnique and ESSEC launched an Industrial Project Management program in partnership with MI-GSO (Alten Group) and Alstom. Both academic and practical, the objective of the advanced Master’s program in “Leading International Industrial Projects” (LIIP) is to teach professionals in the space of one year how to manage international industrial projects. This partnership with ESSEC demonstrates the complementarity of the two institutions and their capacity to train engineers who meet industrial needs in the face of international challenges.

Second edition of the Stanford Ignite-Polytechnique program

Modeled on the entrepreneurship program offered at Stanford Graduate School of Business since 2006, Stanford Ignite-Polytechnique launched its second edition in September 2014. This modern academic program, which places emphasis on teamwork, aims to create a long-term community of entrepreneurs. Alongside its courses, taught by Stanford GSB and École Polytechnique faculty members, and conferences given by world-renowned experts, students are coached throughout the program by innovative entrepreneurship professionals, including industry experts, business angels, and top executives.

Franz Bozsak, a post-doctoral researcher at the Hydrodynamics Laboratory (LadHyX) of École Polytechnique and founder of Instent, attended the first edition: "These three months of exceptional experiences and hard work enabled my Instent project to become one of the winners in the World Innovation Competition (Concours Mondial d’Innovation 2030). Instent develops intelligent stents, which are small spring-like tubes used primarily in the medical field to treat blocked arteries. These intelligent stents enable doctors to provide remote post-op monitoring for their patients. Cardiovascular disease is a serious issue for public health and society, not only in the western world but on a global scale. The Stanford Ignite-Polytechnique Program helped me immensely to develop all of the ‘business’ aspects of the project".
AN INNOVATIVE TEACHING METHOD: MOOCs

Courses renewed on Coursera

In 2013, École Polytechnique was the first French institution to offer MOOCs (Massive Open Online Courses) on the American platform Coursera. Following the success of the first MOOCs, in 2014 École Polytechnique renewed the courses on Coursera, but also on the FUN (France Université Numérique) platform.

In 2014, Coursera and FUN offered:

Four of École Polytechnique’s iconic courses
• “Algorithm design and implementation” by Benjamin Werner and Dominique Rossin, Professors of Computer Science at École Polytechnique.
• “Introduction to probabilities” by Sylvie Méléard, Professor of Applied Mathematics, with Jean-René Chazottes and Carl Graham, Researchers at the CNRS and Assistant Professors at École Polytechnique.
• “Introduction to the theory of distributions” by François Golse and Yvan Martel, Professors of Mathematics at École Polytechnique.
• “Nonlinear optics” by Manuel Joffre, Professor at École Polytechnique and Director of Research at the CNRS, and Vincent Kemlin, Lecturer at École Polytechnique.

And a new MOOC:
• “Physics of silicon solar cells”, by Bernard Dréville, Professor and Director of the Master’s in Renewable Energy Science and Technology (REST) at École Polytechnique, and Joaquim Nassar, Lecturer and Dean of Studies at École Polytechnique.
Visit from Daphné Koller, President and Co-founder of Coursera to École Polytechnique

On December 11, 2014, Daphné Koller hosted an information and discussion session at École Polytechnique for lecturers-researchers from the Université Paris-Saclay institutions either involved in creating a MOOC or interested in the venture. This meeting, held at the site of Coursera’s leading French partner, was also an opportunity for Coursera’s President and Co-founder to discuss the future and challenges of e-learning in France and abroad.

École Polytechnique
MOOC student testimonials

“I would like to express my appreciation for this well-structured MOOC which gave a panoramic insight into the subject while clearly explaining the underlying physics and its practical implications.”

Dominique (France)
Physics of Silicon Solar Cells course

“Thank you so much for your clear explanations, excellent quality visuals and the course’s structure which I thought was very well put together.”

Hadrien (Japon)
who completed the Nonliner Optics course

Lecturer-researcher testimonials

“The MOOC is a modern teaching format, allowing a wider and more varied public to be reached. Students, professionals or people who simply want to acquire new knowledge follow our “Physics of Silicon Solar Cells” MOOC. Of the 28,000 people enrolled in our course, 28% are from developing countries.”

Bernard Drévillon
Professor and Director of the Master’s in Renewable Energy Science and Technology (REST) at École Polytechnique

“I have taught in several developing countries. During my classes, it became clear that the students did not have the material and financial means nor the political assistance required to pursue studies in Europe. Online courses could therefore be a way of meeting their needs.”

Sylvie Méleard
Professor of Applied Mathematics at École Polytechnique

“For professors and students alike, the MOOCs are an educational tool which is complementary to face-to-face courses. Without replacing them, they allow students to advance, add to or even test their knowledge in a subject matter.”

Manuel Joffre
Professor at École Polytechnique and CNRS Director of Research at the Laboratory of Optics and Biosciences
CAREER OPPORTUNITIES
preparing students for administration, industry, business and research

Career opportunities for École Polytechnique students continue to be very diverse: since its creation, l’X prepares them for positions at the highest level in public service as well as industry, business, services, or academia.

Survey was conducted in 2014

Ingénieur Polytechnicien program

Opportunities of Ingénieur Polytechnicien Class of 2013 graduates

A growing entrepreneurial spirit

École Polytechnique fosters and supports its students’ entrepreneurial and innovative spirit. The Innovation Center promotes the development of high potential innovative business projects at l’X and within Université Paris-Saclay. This lively, friendly and open site hosts École Polytechnique’s innovation and entrepreneurship awareness-raising and training activities. It is an incubator, a prototyping space, an interactive place dedicated to the organization of events, conferences and meetings with investors.

Evolution in the percentage of Ingénieur Polytechnicien students pursuing a PhD after their graduation from l’X from 2010 to 2013

The increasing number of Ingénieur Polytechnicien students who pursue their studies through a PhD program confirms École Polytechnique’s leading position as an international higher education and research institution of excellence.

Focus on industry

Alumni’s detailed industry sector representation
Master’s programs

Opportunities of Class of 2013 Master’s graduates

PhD program

Career opportunities by sector of activity of École Polytechnique doctoral graduates who defended their thesis in 2010

Change in PhD graduates’ choices by sector of activity from 2010 to 2013

Find our complete survey on www.polytechnique.edu

39% of graduates choose the corporate sector

The number of young graduates pursuing towards a PhD rose by 3%
Welcoming and integrating international students

To further improve the quality of the welcome international students receive, in May 2014 École Polytechnique created the International Students Support and Service Center (BASIX). Three staff members are responsible for welcoming and supporting École Polytechnique international students. They support these students throughout their administrative formalities and encourage their integration into campus life.

In September 2013, a branch of the Essonne sub-prefecture was opened at École Polytechnique to help reduce the time it takes students and scientists belonging to state-subsidized institutions of the Plateau de Saclay to obtain a residence permit. École Polytechnique is now one of four French centers that hold the three-star Français Langue Étrangère (FLE) quality label, having been awarded the highest score for French language teaching across all the specified criteria: education and teaching, lecturers, welcome, facilities, and management.

The dedicated services and support provided to international students throughout their stay, to better foster their integration into the student community, are a key aspect of École Polytechnique internationalization, alongside the development of an international network of alumni sharing its values, contributing to its renown and boosting its appeal.

Celebration of the 50th anniversary of diplomatic relations between France and China

This 50th anniversary coincides with the 100th anniversary of the arrival of the first Chinese student at École Polytechnique and École Polytechnique’s 220th anniversary. A delegation made up of the President of Shanghai Jiao-Tong University (SJTU) and the Vice-Presidents of Tsinghua University, Peking University and SJTU was welcomed at the event on April 3 and 4, 2014. This meeting was organized in an effort to strengthen cooperation with the three Chinese universities.
A double-degree agreement with Brazil’s Instituto Tecnológico de Aeronáutica (ITA)

Signed in December 2014, this agreement allows the selected students to obtain a degree from both the ITA and École Polytechnique, by spending two and a half years at École Polytechnique before completing their research internship and their fourth year at the ITA. Each year, École Polytechnique welcomes an average of 7 to 8 students from the ITA on the Ingénieur Polytechnicien program. Faculty exchange will also play a major role in the interaction between the two institutions.

A mission on the West Coast and a partnership with Berkeley

A delegation from École Polytechnique and the École Polytechnique Foundation traveled to the West Coast of the United States from September 7 to 13, 2014. On the agenda: meeting with the alumni and strengthening of academic partnerships. President Jacques Biot met around sixty alumni at the Résidence de France, mostly Silicon Valley entrepreneurs, as well as École Polytechnique exchanges’ students.

To strengthen these academic collaborations in education and research, École Polytechnique delegation visited four of its partner universities: Berkeley, Stanford, Irvine and the University of California in San Diego. It signed a Memorandum of Understanding (MoU) on entrepreneurship and innovation with UC Berkeley’s Institute of Transportation Studies.

École Polytechnique international development in Africa

The symposium “Innovation, Industrialisation et Développement durable : pour une Côte d’Ivoire émergente en 2020” (Innovation, Industrialization and Sustainable Development: for an emerging Côte d’Ivoire in 2020) that took place at l’X in January 2014 marked the first step towards increasing cooperation with West Africa. École Polytechnique wants to develop access to and use of MOOCs (Massive Open Online Courses), in the Côte d’Ivoire’s higher education institutions. In parallel, a first year student from the Ingénieur Polytechnicien program completed his personal development internship giving educational support at the Côte d’Ivoire’s Institut National Polytechnique Houphouët-Boigny. A delegation from École Polytechnique visited Senegal and Côte d’Ivoire in December with the same goal of strengthening École Polytechnique links with these two countries.

École Polytechnique continues its international outreach policy in Asia

For several years now, in a context of strong economic growth in China, École Polytechnique model – training engineers and scientists “à la française” – has been highly commended by both Chinese and French industrialists present there. École Polytechnique wants to continue these efforts by developing high-level strategic relations with other university partners in Asia. In 2014, an agreement was formalized with the Institute of Technology of Cambodia (ITC). École Polytechnique is also strengthening its academic partnerships with Vietnam. Each year, École Polytechnique welcomes around ten Vietnamese students, mostly from the prestigious Hanoi University of Science (HUS) and Hanoi University of Science and Technology (HUST) either in the Master’s programs or the Ingénieur Polytechnicien program.
Our research strategy involves combining the in-depth study of the most fundamental aspects of research for the advancement of knowledge with their interdisciplinary synergy to meet the scientific, technological and societal challenges of the 21st century. Our Research Center is nationally and internationally renowned and the prizes and distinctions our research staff receive each year along with the very positive assessments given to our laboratories by the Evaluation Agency for Research and Higher Education (AERES) testify to this.

Our researchers and former students also demonstrate their creativity and audacity by carving out their careers as entrepreneurs. In 2014, several of them were honored with prestigious innovation prizes.

**Nobel Prize**

**NOBEL PRIZE IN ECONOMIC SCIENCES**

Jean TIROLE  
Alumni,  
Class of 1973

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**CNRS Medals**

**CNRS GOLD MEDAL**

Gérard BERRY  
Alumni, Class of 1967  
Chairman of the Council of Education and Research

**CNRS SILVER MEDAL**

Yves SIROIS  
CNRS Director of Research at the Leprince-Ringuet Laboratory and manager of the CERN’s CMS experiment for France

**CNRS BRONZE MEDAL**

Alessandra RAVASIO  
Researcher at the Laboratory for the Use of Intense Lasers
French Academy of Sciences Prizes

ACADEMY OF SCIENCES PLUMEY PRIZE
Basile AUDOLY
Professor at the Department of Mechanics

ACADEMY OF SCIENCES PAUL DOISTEAU-ÉMILE BLUTET PRIZE
Sébastien BOUCKSOM
CNRS Director of Research at the Laurent Schwartz Mathematics Center and Professor at the Department of Mathematics

NEW MEMBERS OF THE ACADEMY OF SCIENCES
Jean-Michel CORON
Alumni, Class of 1975
Antoine GEORGES
Alumni, Class of 1980
Researcher at the Theoretical Physics Center, Professor at the Department of Physics and the Collège de France
Stéphane MALLAT
Alumni, Class of 1981

ACADEMY OF SCIENCES 2013 GAY-LUSSAC HUMBOLDT PRIZE
Émilian DUDAS
CNRS Director of Research at the Theoretical Physics Center

ACADEMY OF SCIENCES, GEORGES CHARPAK PRIZE
Christophe OCHANDO
CNRS Head of Research at the Leprince-Ringuet Laboratory

Call for Projects Winner

ERC STARTING GRANT
Konstantinos DANAS
CNRS Head of Research at the Mechanics of Solids Laboratory

ERC PROOF OF CONCEPT
Victor MALKA
CNRS Director of Research at the Applied Optics Laboratory

Prizes and Distinctions from Foreign Institutions

WILLIAM CROOKES’ PRIZE FROM THE EUROPHYSICS CONFERENCE ON ATOMIC AND MOLECULAR PHYSICS OF IONIZED GASES
Pascal CHABERT
CNRS Director of Research at the Plasma Physics Laboratory

DAVID BATES MEDAL FROM THE EUROPEAN GEOPHYSICAL UNION
François FORGET
CNRS Director of Research at the Dynamic Meteorology Laboratory

HAMBURG PRIZE FOR THEORETICAL PHYSICS
Antoine GEORGES
Researcher at the Theoretical Physics Center, Professor at the Department of Physics and the Collège de France
HANNES ALFVÉN PRIZE FROM THE EUROPEAN PHYSICAL SOCIETY

Patrick MORA
CNRS Director of Research
and Director of Institut Lasers et Plasmas,
Professor at the Department of Physics

EUROGRAPHICS YOUNG RESEARCHER PRIZE

Maks OVSJANIKOV
Lecturer in the Department of Computer Science,
Holder of the Jean Marjoulet Professorship Chair,
Researcher at the Computer Science Laboratory

FRIEDRICH WILHELM BESSEL RESEARCH AWARD FROM THE HUMBOLDT FOUNDATION

Bertrand RÉMY
Professor at the Department of Mathematics
and Researcher at the Laurent Schwartz
Mathematics Center

CHAIRMAN OF THE AMERICAN GEOPHYSICAL UNION FALL MEETING PROGRAM COMMITTEE OF 2014-2016

Denis-Didier ROUSSEAU
CNRS Director of Research
at the Dynamic Meteorology Laboratory

E. FABRE INTERNATIONAL PLASMA AWARD

Stéphane SEBBAN
CNRS Researcher at the Applied Optics Laboratory

LEWIS FRY RICHARDSON MEDAL FROM THE EUROPEAN GEOPHYSICAL UNION

Olivier TALAGRAND
CNRS Emeritus Director of Research
at the Dynamic Meteorology Laboratory

ERWIN PLEIN NEMMERS PRIZE IN ECONOMICS

Jean TIROLE
Alumni, Class of 1973

Prizes and Distinctions from Foundations

L’ORÉAL-UNESCO FOR WOMEN IN SCIENCE GRANT

Sophia CHEN
Post-doctoral Researcher at the Laboratory
for the Use of Intense Lasers

Innovation Prize

WORLD INNOVATION COMPETITION 2030

Philippe BAUMARD
University Professor, Visiting Researcher
at the Management Research Center,
founder of Akheros
and Nicolas IOOSS
Alumni, Class of 2010

Franz BOZSAK
Holds PhD from Ecole Polytechnique (mechanics)
Post-doctoral Researcher at the Hydrodynamics
Laboratory and founder of Instent
WORLD INNOVATION COMPETITION 2030

Rémi DANGLA
Alumni, Class of 2005
Holds PhD from École Polytechnique (mechanics)

and Magali DRONIOU
Post-doctoral Researchers at the Hydrodynamics Laboratory and co-founders of Stilla Technologies

Steven VAN ZUTPHEN and Étienne ALMORIC
Co-founders of Magpie Polymers, spin-off of the Heteroelements and Coordination Laboratory

NORBERT SÉGARD PRIZE
François SYLLA
Holds PhD from École Polytechnique (physics)
Co-founder of SourceLAB, spin-off of the Applied Optics Laboratory

Phd Student Awards

BEST POSTER AWARD AT THE IEEE PVSC CONFERENCE AND COLD PLASMA NETWORK EXCHANGE DAYS

AVS BEST STUDENT AWARD IN THE “PLASMA DIVISION”

Bastien BRUNEAU
PhD student at the Interface and Thin Layers Physics Laboratory and graduate teaching assistant at the Department of Physics

FIRST PRIZE IN THE ÉCOLE DE CHIMIE DE RENNES – RENÉ DABARD THESIS AWARD
EUGÈNE SCHUELLER PRIZE

Laurent DEBIEN
Holds PhD from École Polytechnique (chemistry)

LE MONDE UNIVERSITY RESEARCH PRIZE

Wahb ETTOUMI
Holds PhD from École Polytechnique (physics)

PESM (PLASMA ETCH AND STRIP FOR MICRO-ELECTRONICS) WORKSHOP BEST POSTER AWARD

Mickaël FOUCHER
PhD student at the Plasma Physics Laboratory

RENÉ PELLAT THESIS PRIZE FROM THE SOCIÉTÉ FRANÇAISE DE PHYSIQUE

Ilya MARINOV
Holds PhD from École Polytechnique (physics)

PARIS REGION “MY PHD IN 180 SECONDS” PRIZE WINNER

Benjamin VEST
PhD student at École Polytechnique-ONERA

UNIVERSITÉ FRANCO-ALLEMANDE (UFA) SPECIAL JURY PRIZE

Alexander ZEH
Holds PhD from École Polytechnique (computer science)
“There is plenty of room at the bottom” was the title of R. Feynman’s presentation in 1959 at Caltech during the American Physical Society convention. Fifty years later, this vision has become a reality, largely due to the progress made in managing small time and space scales and in multiphysics coupling. Synthesis of carbon nanotubes, graphene foils and active nanoparticles, nanostructuring of surfaces and thin layers: these are just a few of the research avenues being explored in École Polytechnique laboratories which can be used to design new smart materials or active surfaces, multipurpose devices and sensors, miniature autonomous biosensors, and new catalysts.

Communicating with heat signals

Today, data capture and processing mainly involve the use of devices based on transport and magnetic order. Thermal transport could also be effective for creating sensors and even high-performance circuits. This has been demonstrated by a study carried out by the Irradiated Solids Laboratory – LSI (CNRS, École Polytechnique, CEA) which explores all the couplings between gradients and electric and/or thermal transport, in the presence of magnetization. Researchers have been able to fully model new effects, similar to an “anisotropic thermal Hall effect”, by the derivation of a new phenomenological equation, including the effects linked to the material’s magnetization.

Materials under the microscope

The Mechanics of Solids Laboratory – LMS (CNRS, École Polytechnique, École des Mines, École des Ponts) and Irradiated Solids Laboratory (LSI) are completing a fine-scale study of the deformation and damage mechanisms of various materials, in particular nanostructured alloys. The high-performance and versatile atomic force microscope (Bruker’s Dimension Icon) jointly acquired thanks to funding from the André Citroën Chair, École Polytechnique and the CNRS, will enable them to make these observations before ultimately working on these materials in situ, and to study surface electrochemical phenomena. Moreover, for the first time the LMS has been able to successfully compare the deformation of salt samples under load in 2D using optical microscopy, and 3D using Soleil synchrotron microtomography. Similarly, researchers have successfully compared the crystalline structures obtained with 2D vision and 3D analysis.

An aromatic silicon nanocrystal to produce terahertz waves

Situated between infrared and microwaves, terahertz waves are currently used for numerous applications: computer systems, high-speed telecommunications, non-destructive medical and biological tests, security systems, etc. Yet they remain costly and complex to use. The Interface and Thin Layer Physics Laboratory – LPICM (CNRS, École Polytechnique) offers an original approach to producing a terahertz radiation by using an aromatic silicon nanocrystal. Subnanometric in size and low cost, such nanocrystals could be used in various nanometric devices.
Laurent Debien, awarded first prize in the René Dabard Thesis Award and Eugène Schueller Prize winner

Holder of a PhD of the Organic Synthesis Laboratory – LSO (CNRS, École Polytechnique), Laurent Debien has won awards from the École Nationale Supérieure de Chimie de Rennes and the Association des Diplômés de Chimie Paris-Tech. Under the supervision of Professor Samir Zard, he has developed new radical chemical species reactions used in the preparation of high value-added products which are in high demand in industry. Up until now, toxic heavy metals were frequently used to generate them. However, they are harmful to the environment and their use was therefore greatly hindered.

Key innovations for the chemicals industry

The Organic Synthesis Laboratory (LSO), which specializes in developing new synthesis methods, has filed patents for original polymerization processes used by Rhodia and Xanthem. Applications in materials sciences, pharmacology and even agrochemistry stem from the new, less costly and more active chemical reactions developed by the laboratory. The obvious interactions with the chemicals industry has led the researchers to work in collaboration with companies like Novartis, L’Oréal, Oril and Syngenta. In order to reach out to companies, the laboratory has organized two mini-symposia in collaboration with Syngenta and Bayer CropScience.

A “two-in-one” material

Researchers at the Irradiated Solids Laboratory (LSI) and the Applied Optics Laboratory – LOA (CNRS, ENSTA ParisTech, École Polytechnique) have discovered a surprising property of bismuth telluride (Bi2Te3) thanks to the FemtoARPES platform which can be used to study the ultra-fast dynamics of structures in materials. It alone presents a characteristic which appears when two semi-conductive materials are combined side by side: the Schottky barrier. In Bi2Te3, this occurs in the coupling between the material’s surface and volume, with very different properties. The LSI has also succeeded in improving the electrical conductivity in volume of bismuth telluride by adding high-energy electron irradiation defects with the Irradiation System for Scientific Innovation and Uses (SIRIUS) accelerator. This has allowed the initial atomic-scale defects to be overcome. This work is a further step towards understanding and improving this remarkable material which could be used in the electronics of the future.

Guiding light in nanostructures

The Solid Chemistry team of the Condensed Matter Physics Laboratory – PMC (CNRS, École Polytechnique) has developed a simple and robust procedure for producing materials (dielectric layers) using the sol-gel technique, capable of optimizing the path of light in thin layers. This work, carried out in collaboration with researchers from the Interface and Thin Layers Physics Laboratory (LPICM), École Polytechnique Fédérale de Lausanne and Saint-Gobain, could lead to applications for the optimization of photoactive layers, in photovoltaics or lighting for example.
Meeting the energy needs of nine billion people by 2050 while limiting greenhouse gas emissions is the biggest scientific and technological challenge ever faced by humankind. École Polytechnique laboratories are working to rise to these challenges by making renewable energies more competitive and conventional energies safer and more efficient, by improving the performance and sustainability of storage procedures, designing smart methods for managing power grids, improving nuclear containment material, improving energy efficiency and analyzing innovative transportation systems, taking into account environmental impact and perfecting the prediction capabilities of digital climate models based on increasingly precise experiments.

**Proven efficiency of new procedures and materials for energy**

The work on solar energy and its storage carried out at the Interface and Thin Layers Physics Laboratory (LPICM) has been made a reality with the commissioning of a multi-chamber reactor. With this reactor, researchers have been able to significantly increase the output of innovative solar cells: from 9% for radial junction cells to up to 20% for heterojunction cells. They have also developed new electrodes for lithium-ion batteries. Lastly, they have revolutionized graphene synthesis: the ability to make nanocrystalline graphene deposits at low temperature on any substrate, allowing it to be produced directly on the desired substrate thus eliminating the need for a transfer which affects the quality of the graphene.
More efficient blue and green phosphorescent organic LEDs

Researchers from the Interface and Thin Layers Physics Laboratory (LPICM) have overcome one of the last barriers to obtaining stable blue light in organic electroluminescent diodes (OLED). In collaboration with the Institut des Sciences Chimiques de Rennes, the École Normale Supérieure Cachan, and the Saclay CEA (French Atomic Energy Commission), they have developed new groups of organic semi-conductors used successfully for the first time in blue and green Electro-Phosphorescent Organic Light-Emitting Diodes (PhOLEDs). These innovative materials could ultimately be used by industry, particularly to make screens brighter and more energy efficient.

The promising chemistry of redox ligands

The Molecular Chemistry Laboratory – LCM (CNRS, École Polytechnique) studies redox-active ligands, molecules which play an important role in improving certain chemical reactions which are heavily used by industry. They represent an essential alternative for replacing noble metals like palladium, platinum and rhodium with abundant and inexpensive metals. The LCM has won renown in this field with two scientific articles in the Journal of the American Chemical Society and Angewandte Chemie International Edition as well as an article in the 2014 special issue “New Talent: Europe” of the Dalton Transactions journal.

Combating hospital waste in wastewater

Reducing the micropollutants present in water is a major part of improving the quality of aquatic environments and public health. The Biotech project, selected and financed by the French National Agency for Water and Aquatic Environments (ONEMA) and the Loire-Brittany Water Agency, will test under real conditions an innovative treatment to limit the micropollutants discharged by Poitiers University Hospital into the sewage system. Stéphane Bouchonnet’s team from the Molecular Chemistry Laboratory (LCM) will work alongside researchers from the Institute of Chemistry of Poitiers: Materials and Natural Resources, in partnership with Grand Poitiers, Poitiers University Hospital, the SME SEREP, Veolia Water and ANIOS laboratories.
Studying the climate by measuring vegetation fluorescence from space

The Dynamic Meteorology Laboratory – LMD (CNRS/INSU, UPMC, ENS, École Polytechnique) has organized the fifth international scientific symposium on the remote sensing of vegetation fluorescence. This measurement is an indicator of plant photosynthesis activity, which plays a key role in the absorption of atmospheric CO₂, the main cause of global warming. This study helped evaluate recent advances in the use of vegetation fluorescence for remote sensing of the functioning of the earth’s ecosystems and agrosystems. To improve the climate models, the FLEX (FLuorescence EXplorer) spatial mission, in which the LMD participates, is a candidate in the European Space Agency’s future Earth Explorer 8 mission.

Water for ORCHIDÉE

The Interfaces and Troposphere team of the Dynamic Meteorology Laboratory (LMD) is perfecting the ORCHIDEE model for studying the continental water cycle in the Mediterranean region. The researchers have embarked on new developments for ORCHIDEE after observing differences between data recorded on the ground and estimates of the water flows that rivers carry to the Mediterranean Sea. ORCHIDEE has enabled them to study the mechanisms associated with extreme rainfall in the Mediterranean region, like that observed at the end of 2014. This heavy rain is associated with temperature anomalies recorded at the sea's surface. This study therefore shows the impact of the interactions between oceanic and atmospheric phenomena on extreme rainfall which can constitute more than 10% of accumulated rainfall.

Mechanics serving subsoil exploitation

The subsoils of certain regions are used to store hydrocarbons, nuclear waste or for salt mine exploitation, but in order to carry out this type of activity, the sites’ physical properties must be known and their safety ensured. As part of an international collaboration, the Mechanics of Solids Laboratory (LMS) tested the deformation of salt from the commune of Hauterives. This material is found in the cavities used for gas storage in the Drôme region. The deformation speeds observed are the lowest the laboratory has ever recorded. These results therefore confirm the reliability of French facilities.
He who sows the wind shall reap the data

What influence can the interaction of the wind have on plant life? To answer this question, Emmanuel de Langre and Pascal Hémon, researchers at the Hydrodynamics Laboratory – LadHyX (CNRS, École Polytechnique), placed a tree in a wind tunnel to study the movement of its leaves when subject to different artificial wind speeds. This full-scale experiment enabled a vast amount of data to be recorded for the first time that will make it possible to create accurate models of the evolving spatial organization of plants when subject and not subject to wind.

Three-times award winner Bastien Bruneau

Bastien Bruneau, a PhD student at the Interface and Thin Layers Physics Laboratory (LPICM) and graduate teaching assistant at École Polytechnique, won the best poster award at the Photovoltaic Specialists Conference (PVSC) organized by the Institute of Electrical and Electronics Engineers (IEEE) and during the Cold Plasma Network exchange days. He also received the American Vacuum Society (AVS) best student award in the plasma division. He is working on crystalline silicon and the new concepts used in photovoltaics.

A more efficient electrode material for lithium-ion batteries

Silicon-based materials have energy storage capacities that are ten times higher than carbon-based materials. Yet they are not used in lithium-ion batteries sold on the market because they cannot handle a large number of charge/discharge cycles. Electrochemists and physicists from the Condensed Matter Physics Laboratory (PMC) have discovered that certain silicon-carbon alloys can significantly increase the number of charge-discharge cycles. This research, carried out by the ParisTech Renault Sustainable Mobility Institute, will ultimately lead to the creation of more efficient batteries.
Transposing advanced concepts and tools in physics, chemistry, optics and mechanics to improve understanding of the living world and develop more efficient diagnostics and treatments; modeling and simulating biological processes and evolution; designing new materials and minia-ture devices that can communicate with each other to make medicine more personalized. All of these biology-related topics embody the specific nature of this research at École Polytechnique and form an inter-disciplinary synergy that drives its growth.

A new health research team

Within the Biochemistry Laboratory – BIOC (CNRS, École Polytechnique), Alexis Gautreau’s team has joined the “XBIO, Biology and Interfaces” program. Its aim is to understand how cells maintain or change their shape depending on their purpose in the body. More specifically, the researchers are focusing on the polymerization of actin, a protein at the center of these processes. This membrane remodeling plays a crucial role in the body and its deregulation determines the development of cancers, and in particular the formation of metastatic diseases.

An innovative integrated circuit for schizophrenia diagnosis

As part of the European Trimage project, the Omega unit (CNRS/IN2P3, École Polytechnique) has developed a complex integrated circuit (ASIC) for brain trimodal medical imaging. For the first time it will allow three complementary technologies to be integrated: Electroencephalography (EEG), Nuclear Resonance Imaging (NRI) and Positron Emission Tomoscinintigraphy (PET). By combining this new trimodal scanner, doctors will have access to a turnkey solution to schizophrenia diagnosis and monitoring.

Discovery of a new protein synthesis mechanism: cyclodipeptide synthases

Proteins play a fundamental role for all living organisms. The predominant mechanism in their biosynthesis involves a supra-macromolecular complex called ribosome. Yet there is another mechanism that uses cyclodipeptide synthases, enzymes capable of diverting transfer RNA from their canonical function to produce dipeptides. Discovered in 2009 by a team from the CEA-IBITECS, their mechanism was recently clarified by a collaborative work between this team and the Biochemistry Laboratory (BIOC). These enzymes, which are present in numerous species, are capable of producing biologically active molecules, including antibacterial, antifungal and antitumoral molecules. This work therefore paves the way for the engineering of these enzymes with the ultimate goal of biologically producing potentially non-natural active molecules of therapeutic interest.
Organization of tissue collagen: measuring without seeing

For the first time, researchers from the Optics and Biosciences Laboratory – LOB (INSERM, CNRS, École Polytechnique) have successfully measured the properties of fundamental assemblies of collagen at the nanometric scale. They have developed a technique that combines transmission electron microscopy and second harmonic generation imaging capable of measuring below the optical resolution. The development of multiphoton microscopes and endoscopes raises hope for the imminent transfer of this quantitative approach to in vivo medical imaging. This work has been published in *Nature Communications*.

Multicolored revolution in imaging

A multi-disciplinary team of researchers from the Optics and Biosciences Laboratory (LOB) and the Institute of Genetics and Molecular and Cellular Biology (Université de Strasbourg, CNRS, Inserm) has developed a new fluorescence imaging strategy that enables the fast observation of intact biological tissue with a subcellular resolution. Using this approach, researchers have been able to image the heartbeats of a zebrafish embryo and recreate the cellular movements in 3D with sufficient spatio-temporal resolution to follow each cell individually during a cardiac cycle. Its application in the study of heart formation in vertebrates and pathologies that cause heart malformations can now be contemplated. More generally, the work published in *Nature Methods* opens up many prospects for biological and biomedical imaging.

Modeling bacterial biofilm growth

Numerous bacterial species can join together to form biofilms. The impacts of these films can be negative in the case of corrosion or nosocomial diseases, or positive for water purification. Maxime Ardre’s thesis, jointly supervised by Mathis Plapp and Hervé Henry, researchers at the Condensed Matter Physics Laboratory (PMC), and Carine Douarche from the Université Paris-Sud, has enabled a digital model to be developed which reproduces the early stages of the development of a biofilm formed by *Bacillus Subtilis*.

Hodoscope for ionic therapy

The Leprince Ringuet Laboratory – LLR (CNRS/IN2P3, École Polytechnique) has delivered the latest devices to the Vienna MedAustron Center in Austria, one of Europe’s most advanced ion beam therapy and research centers. The hodoscope manufactured by the laboratory will make it possible to control the quality of the particle beams applied to patients in their cancer treatment. This scintillating fiber detector measures the position and profiles of therapeutic ion beams.
Since the creation of the laser more than 50 years ago, continued progress in decreasing pulse length (a few femtoseconds) and in increasing their energy makes it possible to achieve high powers. Today, the Apollon project has reached 10 PW, while the future will bring the Zetawatt. Such power makes it possible to achieve considerable flow surface densities and recreate conditions found in the stars and planets in the laboratory. The objective is to understand the behavior of matter in these extreme conditions and help manage fusion energy. They can also make it possible to create secondary radiation sources, design new applications for non-destructive testing and proton therapy, and even develop new particle accelerator technology. These projects make École Polytechnique laboratories international leaders.

Understanding and predicting solar flares

Tahar Amari’s team from the Theoretical Physics Center – CPhT (CNRS, École Polytechnique) and the team from the Astrophysics, Interpretation - Modeling Laboratory (CNRS, CEA, Université Paris-Diderot) have identified a key phenomenon in the triggering of solar flares. Using satellite data and models, the researchers were able to monitor the evolution of the solar magnetic field in a region with flare behavior. Their calculations reveal the formation of a magnetic rope that emerges from the interior of the Sun and is associated with the appearance of a sunspot. They show that this structure plays an important role in triggering the flare. By characterizing the transition to the flare, their work opens the way to forecasting the solar storms that impact Earth. They made the cover story of Nature dated October 23, 2014.
The world’s largest gamma ray observatory detects its first pulsar

Located in Namibia, the HESS-II observatory detected thousands of gamma rays coming from the Vela pulsar located around 1000 light years from Earth in the Milky Way. Thanks to a new giant telescope, the H.E.S.S. collaboration, to which the Leprince-Ringuet Laboratory (LLR) contributes, identified its first pulsar, a neutron star which corresponds to the collapsed core of a massive star after a supernova explosion. These initial results open up the possibility of exploring and unveiling numerous cosmic sources of gamma rays (supermassive black holes, galaxy clusters, supernovas, double stars and pulsars in particular) in a new energy field.

Stéphane Sebban winner of the Edouard Fabre international prize

Stéphane Sebban, researcher at the Applied Optics Laboratory (LOA), was rewarded by the Edouard Fabre international prize for his pioneering work on the X-ray laser produced during the interaction between an intense femtosecond laser and a plasma. This prize was awarded during the International Conference on Parallel Processing (ICPP). It rewards established researchers who have carried out a research activity within fifteen years of obtaining their PhD on Physics and Developing the Scientific Community for Inertial Confinement Fusion.

The 2014 Hannes Alfvén prize awarded to Patrick Mora

Patrick Mora, researcher at the Theoretical Physics Center (CPhT), is the second French person to receive this prestigious international prize awarded by the European Physical Society. He was rewarded for his work on laser-produced plasmas. This work concerns both controlled thermonuclear fusion physics and laser acceleration of particles (electrons and ions). Patrick Mora is also Director of the Lasers and Plasmas Institute, Professor of Physics and former Director of the CPhT.

François Sylla wins the 2014 Ségard Nobel Prize

François Sylla, who completed a PhD at the Applied Optics Laboratory (LOA) and is co-founder of the start-up SourceLAB, won the 2014 Norbert Ségard “Creative Young Engineer” prize. Thanks to the €15,000 grant, François Sylla and his colleagues will be able to continue developing his start-up which specializes in the design and manufacture of innovative radiation and particle source solutions using laser-plasma technology.
Producing compact energy particles

Located in Namibia, the HESS-II observatory detected thousands of gamma rays coming from the Vela pulsar located around 1000 light years from Earth in the Milky Way. Thanks to a new giant telescope, the H.E.S.S. collaboration, to which the Leprince-Ringuet Laboratory (LLR) contributes, identified its first pulsar, a neutron star which corresponds to the collapsed core of a massive star after a supernova explosion. These initial results open up the possibility of exploring and unveiling numerous cosmic sources of gamma rays (supermassive black holes, galaxy clusters, supernovas, double stars and pulsars in particular) in a new energy field.

Publication of the third Fermi catalog

The Fermi spatial telescope has published the third catalog of the gamma sources it has detected. This international space mission, in which the Leprince-Ringuet Laboratory (LLR) participated, is dedicated to the study of the most violent phenomena observed in the universe like pulsars and black holes. With over 3,033 sources, this list is twice as long as the second catalog published in 2012, and more than ten times longer than the inventory made by its predecessor Egret.
Pascal Chabert awarded the William Crookes Prize

The William Crookes Prize was awarded to Pascal Chabert, Director of the Plasma Physics Laboratory – LPP (CNRS, École Polytechnique, UPMC, Université Paris-Sud), by the European Physics Society (EPS) and Plasma Sources Science and Technology (PSST) journal. This prize rewards his immense contributions in the field of radio frequency plasma physics and their applications in microelectronics and spatial propulsion.

Large-scale stellar jet formation explained

Using a patented experimental device and supercomputer simulations, researchers have managed to explain, very much in keeping with astrophysical observations, the formation of jets emitted by young stars. This model, which involves the interstellar magnetic field, was developed by an international collaboration led by French teams from the Laboratory for the Use of Intense Lasers – LULI (CNRS, École Polytechnique, CEA, UPMC), the Laboratory for the Study of Radiation and Matter in Astrophysics and Atmospheres – LERMA (Observatoire de Paris, CNRS, UPMC, Université de Cergy-Pontoise, ENS) and the National High Magnetic Field Laboratory – LNCMI (CNRS).

Sophia Chen winner of the L’Oréal-UNESCO grant

Sophia Chen, post-doctoral researcher at the Laboratory for the Use of Intense Lasers (LULI), is one of twenty winners rewarded by the L’Oréal Foundation-UNESCO For Women in Science program. Her research contributes to a major challenge for the future of humanity: finding a new source of clean energy. Sophia Chen has developed an ion spectral selection technique that makes it possible to specifically measure their slowdown, particularly in plasmas.
EXPLORING ABSTRACT STRUCTURES TO DEDUCE THEIR INTRINSIC PROPERTIES, LOOKING FOR UNDERLYING RELATIONSHIPS BETWEEN GEOMETRY AND ALGEBRA, BETWEEN THE INFINITELY SMALL AND THE INFINITELY FAR AWAY, UNDERSTANDING THE MATHEMATICAL STRUCTURE OF PHYSICS EQUATIONS TO DEDUCE NEW SOLUTION CLASSES AND DISCOVER NEW PARTICLES. RESEARCH IS CONDUCTED IN ALL OF THESE TOPICS AT ÉCOLE POLYTECHNIQUE AND DRIVEN SOLELY BY THE INCENTIVE TO LEARN MORE ABOUT THE WORLD WE LIVE IN. OCCasionally, NEW CONCEPTS EMERGE THAT LEAd TO GROUND-BREAKING INNOVATIONS.

TRIBUTE PAID TO THREE MATHEMATICIANS

Bertrand Rémy, Professor of Mathematics and member of the Laurent Schwartz Mathematics Center – CMLS (CNRS, École Polytechnique), Pierre Raphael and Jérémie Szeftel, Professors at École Polytechnique Department of Mathematics, attended the International Congress of Mathematicians in Séoul as guest speakers. This event, organized under the aegis of the International Mathematics Union, brought together thousands of mathematicians from all over the world. The invitations extended to these three mathematicians illustrate the vitality and international renown of their mathematics research. Bertrand Rémy was also honored by the Humboldt Foundation, receiving the Friedrich Wilhelm Bessel Research Award. Pierre Raphael and Jérémie Szeftel jointly received the Academy of Sciences Alexandre Joannidès Prize.

SÉbastien Boucksom, winner of the Academy of Sciences Paul Doisteau-Émile Blutet Prize

This biennial prize was awarded to Sébastien Boucksom, researcher at the Laurent Schwartz Mathematics Center (CMLS) and Professor at the Department of Mathematics. He was rewarded for his very important work in complex geometry and analysis. His results, which combine extremely new and varied ideas, help shed significant light on many questions, some of which had remained unresolved for decades.

ÉMILIAN DUDAS AWARDED THE GAY-LUSSAC HUMBOLDT PRIZE

The Alexander von Humboldt Foundation awarded the Gay-Lussac Humboldt Prize to Émilian Dudas, researcher at the Theoretical Physics Center (CPhT) and Professor of Physics at École Polytechnique. He specializes in applying the cord theory to particle physics and studies the possible extensions of the current standard model which could explain the presence of dark matter in our Universe.
Antoine Georges winner of the Hamburg Prize for Theoretical Physics and elected member of the Academy of Sciences

Researcher at the Theoretical Physics Center (CPhT) and Professor at the Department of Physics and the Collège de France, Antoine Georges was rewarded for his innovative work in the field of condensed matter physics. He is also one of the co-inventors of the theoretical approach Dynamical Mean-Field Theory which yielded breakthroughs in our understanding of strongly correlated materials. His research is focused on the physics of quantum systems with strong correlations in different fields, from materials with strong electron interactions to the study of ultracold atoms.

Yves Sirois winner of the CNRS Silver Medal

Yves Sirois, researcher at the Leprince Ringuet Laboratory (LLR), received the CNRS silver medal for all of his work. Manager of the CMS Group (Compact Muon Solenoid) for France, he actively contributed to proving the existence of the Higgs boson. With his team, he developed the strategy and interpretation tools for the discovery channel in 2012, and subsequently measurement of the properties of the Higgs boson.
A nalyzing the growing amounts of available data and extracting buried information and knowledge, maximizing and protecting the flow of information, checking the reliability of critical software on which many systems depend, developing systems equipped with the ability to learn and make decisions and improving communication between humans and machines. These issues are all crucial in a society where the progress of digital technology is seemingly inexorable. Discovering new concepts, formalizing them, improving existing algorithms and adapting them to new architectures... École Polytechnique laboratories are at the forefront of these research topics.

Big Data in partnership with the Caisse Nationale d’Assurance Maladie

The Cnamts – Caisse nationale d’assurance maladie des travailleurs salariés (French National Health Insurance Fund for Employees) and École Polytechnique have signed a three-year research and development partnership agreement to promote the development of big data technologies applied to public health issues. This collaboration aims to deploy new avenues for exploiting data in the Sniram - Système National Inter Régimes de l’Assurance Maladie (National Health Insurance Cross-Scheme Information System). The team from the Applied Mathematics Center – CMAP...
(CNRS, École Polytechnique) will exploit and analyze one of the largest health databases in the world. Their skills will be called on in response to wider use of the medical-administrative databases. This research is part of École Polytechnique Data Science Initiative which also integrates the Data Scientist Chair created by École Polytechnique, Keyrus, Orange and Thales, and held by the École Polytechnique Foundation.

**A French-German prize for Alexander Zeh**

Alexander Zeh was rewarded for his thesis with the 2014 Special Jury Prize from Deutsch-Französische Hochschule (Franco-German University). He completed his thesis at École Polytechnique and the University of Ulm in Germany under the supervision of Martin Bossert and Daniel Augot. Entitled “Algebraic Soft- and Hard-Decision Decoding of Generalized Reed-Solomon and Cyclic Codes” his research concerns the challenges of algebraic coding theory which is essential to reliable communication of information.

**A paper that will stand the test of time**

Dale Miller, researcher at the Computer Science Laboratory – LIX (CNRS, École Polytechnique), received the 2014 “Test-of-time” Award from the series of Logic in Computer Science (LICS) conferences for his article written in 1994 entitled “A multiple-conclusion meta-logic”. The LICS “Test-of-Time” Awards reward the scientific articles that have best withstood the test of time. To select the winners, the jury bases its decision on the impact the article has had since its publication.

**Gimbal Audio: Sound immersion guaranteed**

Led by François Alouges and Matthieu Aussal, researchers at the Applied Mathematics Center (CMAP), the Gimbal Audio project proposes a personalized spatialized sound solution on headphones. The device, which can be fitted to the listener’s headphones, provides very high-quality natural and dynamic sound immersion. Supported by École Polytechnique, the start-up project received pre-maturity funding and won the AEF-RUE competition, providing the opportunity to meet investors and manufacturers who are keen to support them in their value creation process.
Whether natural or artificial, complex systems are everywhere. Although there is still no unanimously accepted formal definition of their nature, they are characterized by the interaction of components of various sizes and a heterogeneous, uncertain nature whose overall evolution is dominated by couplings and retro-actions. A field where modeling faces conceptual challenges in describing the different components and their interactions correctly and defining the original condition and expected use. A field where simulation requires suitable languages and scalable, configurable software architecture. A field where applied mathematics, computer science, biology, physics, mechanics and economics overlap. A field where collective properties sometimes reveal surprises.

Weeroc at the ready

Weeroc, a start-up created from the OMEGA unit is now in its post-incubation period. Specialized in the design of microelectronic circuits that meet the needs of manufacturers in sectors as diverse as medical imaging, nuclear and spatial, Weeroc already produces circuits used to equip detectors of international collaborations or for industrial applications.

CoSyNUS, a new research team

Following the arrival of Éric Goubault, Emmanuel Haucourt, Samuel Mimram and Sylvie Putot, the Computer Science Laboratory (LIX) has created the new CoSyNUS team, coordinated by Sylvie Putot. The team’s research relates to the analysis of computer programs, essential to verifying they are working properly and forecasting their maintenance. This work which brings major economic and societal challenges, is stirring up great interest in the industrial world. The team has privileged contacts and agreements with the Education and Research Chair “Complex Systems Engineering” supported by Thales, Dassault Aviation, DCNS, the DGA – Direction Générale de l’Armement (Defense Equipment and Support Agency), and the academic partners Télécom ParisTech and ENSTA ParisTech, and with the CEA LIST, the Atomic Energy Commission’s lead computer systems laboratory.

Mickaël Foucher, best poster award

The best poster award was given to Mickaël Foucher who has a PhD from the Plasma Physics Laboratory (LPP), at the Plasma Etch and Strip for Microelectronics workshop. His thesis is part of a comprehensive experimental study carried out by the laboratory on dichlorine and dioxy-
gen plasmas and their mixtures, used intensively in the microelectronics industry. These results give better insight into the fundamental mechanisms at work in these complex systems which are extremely important to industry.

Light on the theory of solar cells

The energy produced from solar panels is due to the creation of electron-hole pairs which are also called excitons. Gaining a better understanding of their formation, linking and propagation mechanism is essential to manufacturing efficient solar cells. Theorists from the Irradiated Solids Laboratory (LSI) have developed a calculation capable of describing and predicting the dispersion of excitons in a material subject to radiation. More specifically, they have succeeded in ramifying a model which updates certain properties of the Bethe-Salpeter equation. The next step will concern the transition from theory to application.

The Plasma Physics Laboratory in space

The five sets of magnetic antennas built by the Plasma Physics Laboratory (LPP) have passed all the tests to be part of NASA’s MMS (Magnetospheric Multiscale) space mission set to be launched in March 2015. These devices have received financial support from the French space agency, the CNES (Centre National d’Études Spatiales). They measure fluctuations in the Earth’s magnetic field to help understand its dynamics.
Formalizing society’s organizational processes, analyzing innovation processes in industry, in the relationships between the organization and creative abilities of businesses, identifying concepts in market structuring and regulation, analyzing changes in science and techniques and the relationships between technology and change in society and its organization, developing quantitative approaches to market fluctuations and public policies. École Polytechnique laboratories study all of these challenges facing society and more besides.

Adopt the right TEMPO

The management of economic, financial and natural uncertainties is a fundamental concern for the businesses that face these risks (insurance, banks, aviation, industrial risks, etc.). It is therefore essential to have effective tools to allow them to adapt to these uncertainties in real time. The TEMPO – TEMps d’intervention Optimaux pour l’aide à la décision (optimal intervention time for decision-making support) project, led by Emmanuel Gobet, aims to develop decision-making support IT tools that determine the best intervention times using mathematical algorithms developed at the Applied Mathematics Center (CMAP).

Romaric Servajean-Hilst, awarded a prize by the IPSERA

Romaric Servajean-Hilst, PhD student at the Interdisciplinary Institute for Innovation – I3 (CNRS, École Polytechnique), received the IPSERA Bursary Award during the International Purchasing and Supply Education and Research Association (IPSERA) conference, the main academic conference devoted to purchasing management and strategy. The prize rewards his communication, co-written with Katia Picaud, on “The Implication of Purchasing in Open Innovation”. More generally, Romaric Servajean-Hilst is interested in the management of innovation cooperations and partnerships and client-supplier relations integrating joint innovation projects.

Patricia Crifo, Knight of the National Order of Merit

Patricia Crifo, lecturer-researcher at the Center for Economics, Statistics and Sociology – EXCESS (ENSAE Paris Tech, CNRS, École Polytechnique), has been awarded the title Knight of the National Order of Merit. She is interested in business innovations and their social and environmental consequences. More specifically, her research focuses on Corporate Social and Environmental Responsibility (CSER), green growth, technical progress, work organization and human capital.
École Polytechnique Interdisciplinary Laboratory (LinX) was created to devise new configurations of knowledge on the interfaces between sciences and technologies and social sciences. This multidisciplinary research concerns the history and philosophy of science, technology and democracy, the ethics and politics of knowledge, and ecology and sustainable development. It therefore allows the interlinking of insights into innovations and creations by combining tools from complementary disciplinary traditions. This laboratory benefits from the resources of École Polytechnique Central Library’s Historical Resources Center, which is renowned the world over in the field of the history of science and technologies.

Pierre Picard, SCOR-Geneva Risk and Insurance Review Best Paper Award

Pierre Picard was rewarded by the SCOR prize - Geneva Risk and Insurance Review for his article “Optimal Risk Financing in Large Corporations through Insurance Captives”. A Professor of Economics, specialized in insurance and risk matters, he has held the Insurance and Major Risks Chair created at École Polytechnique by AXA in the context of the Fondation du Risque. His current research work concerns risk management for large corporations, catastrophe risk insurance, insurance fraud detection and health insurance.

Insights into LinX

The Interdisciplinary Laboratory - LinX - has organized several meetings between Science and Society. It participated in the design and organization of exhibitions dedicated to the famous mathematicians Lagrange and Hadamard as well as First World War General Pellé. LinX was also involved in the Lagrange film documentary produced by Fields medalist Cédric Villani and directed by Frédéric Brechenmacher. Similarly, the “Science and literature” meetings have taken an interest in the critical presuppositions and methods of the various types of recent research that has yielded innovative insights.
INNOVATING AND TAKING ACTION
Two new academic and research chairs in 2014

The Data Scientist chair
Signed in October 2014 between École Polytechnique, Keyrus, Orange and Thales, the Data Scientist education and research chair aims to support data science training programs applied to Big Data, through an engineering program, co-accredited by École Polytechnique and Télécom ParisTech, in order to create a new recruitment pool for companies. It will require a full-time five-year teaching post from September 2015 and will welcome various international visiting professors. It should be noted that professionals from Keyrus and Orange take part in the Data Science Starter Program (see page 22).

The Internet of Everything international chair
Minister of Defense Jean-Yves Le Drian and President of CISCO John Chambers have sponsored the international education and research chair Internet of Everything signed in September 2014. This chair will enable École Polytechnique students to gain a practical understanding of the technological change of the “Internet of Everything” which is transforming all sectors of our societies and economies.

Helping students into employment
École Polytechnique Internship, Guidance, Job Integration and Business Relations service (SOIE) accompanies and supports students in their career plans, in partnership with businesses. These businesses become involved in student life in various ways: company visits, practice interviews, suggesting subjects for Group Science Projects, internship offers, jury members during internship oral assessments etc.

THE « CAREER CENTER »
École Polytechnique students benefit from a completely personalized space on the Jobteaser platform. Once logged on, each student has access to offers from the companies they are interested in and information posted by École Polytechnique on company visits or workshops organized by the SOIE service, and they can also apply to internship offers directly.

FIGURES
18 academic and research chairs
21 corporate sponsors
480 companies paid the apprenticeship tax in 2014
Since 2014, companies have been able to come directly to the campus to conduct their internship recruitment interviews, generally following an initial contact during the X-Forum job fair, organized by École Polytechnique students. Moreover, a CIFRE (Industrial Agreement for Training through Research) day has been organized for PhD students, with a visit to the laboratories, a discussion area, posters, etc. Around sixty companies attended to promote this thesis funding method.

In order to hone the career plans of the future doctors, at the end of September corporate human resources professionals participated in the Doctoriales training sessions and exchange seminars which were very innovation-oriented. The students could take part in practice interviews and visit companies recruiting doctors.

The job fair: an SME/Start-up village

For the 2014 X-Forum job fair, the organizing team secured the presence of 16 SMEs and start-ups, giving preference to technological start-ups. These businesses do not always have institutionalized recruitment processes and École Polytechnique students are very enthusiastic about meeting more reasonably sized companies: Blablacar, My Little Paris, Withings, Paymium and 1000mercis were all present on Thursday November 13. On Wednesday 12, an “innovation” area welcomed large corporations and start-ups created by École Polytechnique students.
Research collaborations

Three projects from École Polytechnique laboratories, winners of the 2014 A.S.T.R.E. call for projects of the General Council of Essonne

For several years now, the General Council of Essonne via its Support Action for Technology and Research in Essonne (A.S.T.R.E.) mechanism, has supported local players from the world of research in order to promote and encourage relations between public research laboratories and businesses.

• LadHyX (CNRS/École Polytechnique) - Digital PCR: presented by Charles Baroud with the Essonne-based start-up Stilla Technology, the project concerns the use of microfluidic chips for digital PCR analyses – amplification of a DNA strand chain. Ongoing developments should lead to experimental simplification of these analyses, potentially reducing their cost and contributing to their widespread use.

• LOB (CNRS/École Polytechnique/INSERM) - AD-ASOPS: presented by Manuel Joffre with the Essonne-based SME Greenfield Technology, the project aims to develop an innovative pump-probe spectroscopy system which makes it possible to measure the dynamics of a biochemical reaction over very long time scales and with very low resolution (subpicosecond). The patented technological concept overcomes the optomechanical limitation of traditional systems and can be implemented at lower cost using laboratories’ existing femtosecond facilities.

• LPICM (CNRS/École Polytechnique) - ELU: presented by Erik Johnson with the Essonne-based SME TFSC-Instrument, the Essonne Lead User (ELU) project should make it possible to better characterize the thin layers used in electronic components, sensors and solar panels. The TFSC-Instrument system accurately measures the lifespan of carriers in a semiconductor. Optimizing this parameter, which is very sensitive to the quality of the surfaces or interfaces, and therefore the associated thin layer deposition processes, is key to improving the output of solar cells, for instance.

Collaboration with Total and CNRS extended for three years

On January 1, 2014, École Polytechnique, CNRS and TOTAL Group extended their strategic partnership in the field of photovoltaic solar cells. The joint Photovoltaics Silicium research team (École Polytechnique, Total) counts around thirty researchers and PhD students, almost half of which are employed by Total Group, and has significant manufacturing resources. Since its cre-
ation in 2009 until its renewal in 2014, the joint research team has published over fifty articles and communications and its work has led to the filing of several patents. Its major scientific results include the development of innovative plasma processes, plasma-assisted epitaxy at 200°C of silicon on III-V materials, and the creation of silicon nanowire-based radial junction cells and heterojunction cells with a 20% output.

Technology transfers

In 2014, École Polytechnique signed six new operating agreements on technologies developed in its laboratories:

- A communication of expertise for the manufacture of nanopoints for surface characteristics, signed with Horiba Jobin Yvon: this technology helps improve the spatial resolution of surface characterizations using Raman spectroscopy, and specifically those concerning nanostructured surfaces.

- Five patent operating licenses:
  - A laser-target interaction device, signed with the start-up SourceLab: this invention greatly improves the quality of secondary particle sources generated through laser-target interaction by stabilizing the solid target moving in front of the very intense laser beams.
  - An air handling system, signed with the start-up Air Serenity: this technology makes it possible to treat all indoor pollution whether of chemical origin or caused by microparticles or microorganisms. The system is fitted with air quality analysis sensors, it is energy-efficient and autonomous for six months.
  - Image recognition, signed with American company Decorwiser: this invention would be used to generate virtual views from different angles, applied to the real estate industry and online property visits.
  - Dielectric diffraction network, signed with Horiba Jobin Yvon: these networks are characterized by excellent laser flow resistance; they are therefore particularly well-suited to the very intense lasers obtained through temporal spreading, amplification then compression of laser pulses.
  - Microfluidic devices and processes, signed with the start-up Stilla Technologies (three patents): this patent portfolio protects the biological analysis processes and systems that use microfluidic chips. The Digital PCR process is based on the generation, manipulation and fixation of large numbers of nanodrops of biological solutions requiring analysis.

École Polytechnique holds almost 150 sets of patents, a third of which are jointly owned with industrial partners. Within its 22 laboratories, it develops cutting-edge technologies aimed at meeting the needs of businesses. A catalog of offers is available on the website.

www.polytechnique.edu
ENCOURAGING entrepreneurial spirit and innovation

An entrepreneurial ecosystem at the heart of École Polytechnique campus

The aim of the Entrepreneurship and Innovation Center is to promote the emergence of innovative business creation projects with high-potential and technological content at École Polytechnique and Université Paris-Saclay. Intended to stimulate and host the projects of students, researchers and entrepreneurs from École Polytechnique and its partners, the Entrepreneurship and Innovation Center will open its doors at the start of the 2015 academic year.

It will offer project leaders:
• Pre-equipped work areas: prototyping areas (mechanical, electronic, 3D printing, manipulations), co-working, meeting and conference areas.
• Acceleration areas for business creation projects and young start-up hosting areas.
• Access to support, mentoring and expertise services and resources.
• Privileged access to networks of entrepreneurs, experts, investors and partner incubators.

Three Master’s programs dedicated to entrepreneurship and innovation

To encourage innovation and give its students the taste and desire for entrepreneurship, École Polytechnique offers three Master’s combining lectures with role plays:
• the Project - Innovation - Conception (PIC) Master’s,
• the Network Industries and the Digital Economy (IREN) Master’s,
• the Technological Innovation: Engineering and Entrepreneurship (ITIE) Master’s.

Dreem, improving the quality of sleep

A typical example of projects carried out under École Polytechnique ITIE Master’s program, Dreem was created in March 2014 by two graduates (M2015) from the ITIE Master’s, Quentin Soulet de Brugière and Hugo Mercier. Dreem is developing a wireless headband aimed at improving the quality and duration of deep sleep. Dreem has received numerous rewards, specifically by the World Innovation Competition 2030, the 2014 Paris Grand Prix de l’Innovation, the Jean-Louis Gérondeau Zodiac Aerospace prize and the CEPAME (California École Polytechnique Alumni for the Master in Entrepreneurship) Fellowship prize, awarded by Friends of École Polytechnique and funded by the United States West Coast Alumni.

A new MOOC dedicated to the creation of technology start-up companies

In 2014, École Polytechnique and HEC Paris joined forces to create a MOOC (Massive Open Online Course) dedicated to the future founders of technology companies. Available on the Cour-
sera platform from April 1, 2015, the MOOC “Creating and developing a technology start-up” is coordinated by École Polytechnique Lecturer Romain Beaume and HEC Paris Professor Étienne Krieger.

Awards for many École Polytechnique start-ups

Two École Polytechnique alumni winners of the MIT Innovators Under 35 prize

Rémi Dangla (Class of 2005), co-founder of Stilla Technologies, a start-up hosted at the Hydrodynamics Laboratory (LadHyX). Rémi also won the World Innovation Competition 2030, the I-LAB 2014 competition and the fifth edition of the NETVA (New Technology Venture Accelerator) program.

David Vissière (Class of 1999), founder of Sysnav in 2008. David also received the Engineer of the Year Special Recognition Award 2010 from business magazine L’Usine Nouvelle and the 2013 Pépite Innovation prize from the Haute-Normandie region.

16 École Polytechnique champions in the World Innovation Competition 2030

On July 23, 2014, the French President welcomed at the Élysée Palace the 110 “future champions of the French economy” discovered during the World Innovation Competition 2030. Among them were 16 projects developed by former students, PhD students and lecturer-researchers of École Polytechnique: Stilla Technologies, Instent, Elvesys, CardioLogs, Ynsect, Wandercraft, Magpie Polymers, Dreem, FeetMe, Akheros, HeyCrowd, Endocontrol, Fruition Sciences, Shift Technology, Rhenovia Pharma and Cybel.

Instent, an École Polytechnique laboratory start-up

A spin-off of the Hydrodynamics Laboratory (LadHyX), Instent is developing an innovative remote surveillance system to equip stents, the little pieces of metal placed inside arteries to prevent them from becoming blocked. Created in April 2014 by Franz Bozsak, who holds a PhD from LadHyX, the start-up is also a winner of the World Innovation Competition 2030 and the national competition for innovative companies Tremplin Enterprises co-organized by the Sénat and ESSEC.

On-campus entrepreneurship events

École Polytechnique Start-up Weekend

Organized by student association “Cabinet Start-Up”, École Polytechnique Start-up Weekend is open to entrepreneurs and students from engineering, design, business and computer science schools, as well as curious visitors who share the same entrepreneurial spirit. Two editions were held in 2014.

The Saclay Pitch Night

A joint initiative organized by École Polytechnique and HEC Paris, each month the Saclay Pitch Night offers Paris-Saclay students and entrepreneurs the chance to come and present their start-up projects, share their ideas or join a project.
A POWERFUL network

Why was the Alumni Association created?
LBG: It was created to give soul to École Polytechnique student community and foster lasting friendships. We coordinate a network of 25,000 members with, in particular, École Polytechnique themed groups, the big year-group or intergenerational meetings (Magnans), the distribution of La Jaune & La Rouge journal, the annual ball, and monthly breakfasts with a special guest.

What support does the Alumni Association offer its former students?
LBG: As well as coordinating École Polytechnique community, the Alumni Association (AX) has two other main missions; one is to create solidarity between alumni and students, and the other is to increase École Polytechnique’s influence. Solidarity is understood in a very broad sense: it ranges from supporting young graduates in business creation or by acting as a guarantor, to providing financial support to alumni who are having difficulties.

The careers office plays a major role in this mission. It assists all graduates and students in making choices concerning their careers and their professional development aspirations, as well as helping them to look for jobs in both France and abroad. It is supported by a Careers Commission and networks of sector-specific contacts and business correspondents. It has also developed a web platform called Manageurs.com with its counterparts in the alumni associations of the most prestigious French engineering and business schools.

Solidarity is also strongly encouraged among our international students. As well as providing administrative assistance, the AX also has a mentoring program for Ingénieur polytechnicien students who are supported by former students. In collaboration with several regional groups, it also organizes local economic fabric discovery weekends for language immersion students.

Moreover, the AX actively supports the Grandes Écoles Au Féminin association, which brings together alumni representatives from ten Grandes Écoles (including École Polytechnique). In particular, it supported the 2014 survey published at the start of 2015 on the relationships between gender diversity and change, which highlights the collective gain of gender diversity for organizations.

Can you tell us more about your support mission to École Polytechnique?
LBG: The AX was created by merging the Emergency Fund and the Society of Friends of École Polytechnique. The latter’s mission of promoting École Polytechnique’s influence remains of paramount importance. The association is involved in École Polytechnique life and the development of its project, particularly through its presence on École Polytechnique Board of Directors, that of the Foundation and of the Campaign Committee. In 2014, we participated in various missions on École Polytechnique and interactions with the supervisory body.

Furthermore, the activities organized by the AX contribute to École Polytechnique’s influence. In 2014 this included events like the celebrations of the Great War, Corporate Economic Intelligence Day, the Smart City Symposium with Agro Paris Tech and ENA and the annual ball. Also in 2014, under the aegis of the fiftieth anniversary of the diplomatic relations between France and China, it welcomed the Ambassador of the People’s Republic of China to France, Chinese companies, French companies developing their activity in China and Chinese partner universities.
150th anniversary of the AX

Three major events are organized for the 150th anniversary of the École Polytechnique Alumni Association in 2015. The yearly Ball was held on May 29 at the Château de Versailles; a Magnan meeting, gathering all former students willing to participate, will take place on campus on October 10; and lastly, a symposium of the 150th anniversary will be held on December 10 on the theme of 1001 Characteristics of the Innovative, Responsible and Socially-Conscious Engineer.

La Jaune et la Rouge is given a new lease of life

Michel Berry,
President of the editorial committee

“The Alumni Association monthly magazine wanted to get closer to its young alumni and therefore homed in on their career paths to launch the new and improved “La Jaune et la Rouge” in 2014. The first issue focused on the classes of 2000 and later. New sections have been introduced in order to dedicate more space to testimonials. “News from around the world” gives the floor to former students who have set off across the globe, “Portrait” presents the careers of atypical École Polytechnique graduates, “Adventure” shows that graduates can find a hectic working life very fulfilling; and “Discoveries” focuses on the results of those who opted to go into research. This revitalized formula is here to stay and includes articles from students completing their internships, personal development training program or group science projects.”

GUESTS AT THE AX BREAKFASTS IN 2014

This network influence is also achieved through the breakfasts organized for École Polytechnique students, which have been attended by Hervé Mariton (UMP), Anne Lauvergeon (Innovation 2020 Commission), Jean-Bernard Lévy (Thales), Michel de Rosen (EUTELSAT), Pierre Gattaz (MEDEF), Stéphane Richard (Orange) and Xavier Fontanet (ESSILOR former chairman).

AMONG THE ALUMNI

CAC 40 company owners, leading entrepreneurs in France and abroad, congressmen and women, a 2014 Nobel Prize winner, a bishop, doctors, researchers and internationally renowned artists. An incredibly rich and diverse array of talents and careers.
INNOVATING AND TAKING ACTION

SUPPORTING THE GROWTH STRATEGY
The École Polytechnique Foundation

Interview

What is the École Polytechnique Foundation?

**DR**: Created in 1987 by twenty leading French companies at the request of Bernard Esambert (Class of 1954), the chairman of École Polytechnique Board of Directors at the time, and with the support of the Alumni Association, the École Polytechnique Foundation builds bridges between the business world and École Polytechnique, including its students and research professors.

The Foundation is a recognized public-benefit organization that works to promote École Polytechnique. This status entitles it to receive donations, bequests and other gifts from both individuals and companies. The funds raised are directed to École Polytechnique facilities, students, and research professors.

The Foundation is a key component of École Polytechnique and is currently pursuing several missions essential to the development of l’X. What are they?

**DR**: In the interest of promoting École Polytechnique, the Foundation focuses on fulfilling four ambitious objectives.

1. **Funding École Polytechnique’s growth**: With Jacques Biot, École Polytechnique is embarking on a robust long-term growth strategy. The Foundation supports these efforts by funding École Polytechnique’s development in terms of education, research, internationalization, innovation, entrepreneurship and diversity via its fundraising campaigns, which reach out to the entire École Polytechnique community.

2. **Building long-term relations with businesses**: The Foundation is an essential link between École Polytechnique and businesses. Contributing to over fifteen academic and research chairs at École Polytechnique, the Foundation organizes Liaison Committees with business partners twice a year (CLEX), thus allowing École Polytechnique to present major academic developments and business partners to share their recruitment expectations. FX-Conseil, an École Polytechnique subsidiary, helps promote technological achievements to businesses and particularly those originating from École Polytechnique’s expertise and research center.

3. **Promoting innovation, entrepreneurship and research**: The Foundation grants numerous awards to encourage students to pursue these three themes, which are of strategic importance to École Polytechnique. In 2014, the Foundation honored Benjamin Michel (Class of 2003) with the Pierre Faurre Award to acknowledge the early and very promising industrial career of this young École Polytechnique student. The €12,000 prize is awarded every year during a ceremony at École Polytechnique. The Foundation also supports the Jean-Louis Gerondeau/Zodiac Aerospace Award, which incubates projects likely to turn into start-ups. Dreem, Airthium and CardioLogs were all winners of this prize in 2014 and were selected from among a growing number of very high-quality projects. The Foundation further encourages Ingénieur Polytechnicien students’ exposure to research with its third-year Best Internship award. Lastly, X-Création, a joint subsidiary of École Polytechnique and the Foundation, funds start-up creation in the laboratories.

4. **Supporting students**: The École Polytechnique Foundation and its team of volunteers, who mainly come from the corporate sector, place students at the heart of their actions. As well as allocating students various types of financial aid, the team also helps build their professional careers by organizing meetings (called Amphis Métiers N-10) with young alumni who graduated within the last ten years. In addition, the team participates in all the juries of the leadership development internships (in year one of engineering program), the business internships (in year two) and the Group Science Projects. From 2015 onwards, volunteers will also be tutor-advisers for the business internships. Lastly, the team also organizes short business internships for supervisors.
The École Polytechnique Foundation is currently preparing its upcoming fundraising campaign. Can you tell us more about it?

DR: The Foundation is a vital driver of growth for École Polytechnique. In a context of strong competition between academic and scientific institutions, École Polytechnique must work hard to hold on to its status as one of the world’s leading education and research institutions. The Foundation is actively preparing a new fundraising campaign that will reach out to both individuals and companies. With an even more ambitious goal than during the first campaign, the Foundation will put all its efforts into meeting the challenges of the 21st century, as well as École Polytechnique’s expectations and requirements.

**THE 2014 WINNERS OF THE JEAN-LOUIS GERONDEAU/ ZODIAC AEROSPACE AWARD**

**DREEM**, a project led by Quentin Soulet de Brugière and Hugo Mercier (M2015)
To combat deep sleep disorders, Dreem has developed a wireless headband that sends synchronous sound stimulation to the sleeping person’s brain. This system addresses a public health concern.

**AIRTHIUM**, a project led by Andreï Klochko (Class of 2007)
Airthium aims to produce a new type of very energy-efficient reversible compressor which makes it possible to store, and then recover low-temperature industrial heat and energy produced during off-peak hours.

**CARDIOLOGS**, a project led by Yann Fleureau (Class of 2010)
Cardiovascular diseases are the leading cause of death worldwide, and CardioLogs aims to provide general practitioners with a reliable and automatic diagnosis tool for quickly detecting cardiovascular diseases in their patients.

Jean-Bernard Lartigue
(Class of 1965)
General Representative of the École Polytechnique Foundation

Find the Foundation:
www.fondationx.org
on Twitter: @FX_EP
on Facebook: facebook.com/fondationecolepolytechnique

Contact:
fondation@fondationx.org
campagne@polytechnique.fr
+33 (0)1 53 85 40 10
SHARING
École Polytechnique is involved in many diversity promotion actions, through its Diversity and Success Center, which coordinates the activities linked to this theme. École Polytechnique’s projects are varied and include:

- programs aimed at allowing young people from disadvantaged backgrounds who have the necessary abilities and desire to successfully enter higher education;
- targeted measures to promote École Polytechnique programs to young girls to encourage them to follow scientific careers;
- awareness-raising actions carried out with École Polytechnique students to get them to address the issue of disability as citizens and future professionals.

Raising young women’s awareness of scientific studies and careers

In March 2014, the “X au féminin” student association welcomed 55 female senior high-school science students from the department of Eure, with the support of the Diversity and Success Center. During this meeting, the aim was first to reassure the students by showing them what it means to enter into long-cycle higher education. “École Polytechnique not only guarantees its students a professional future, but also the opportunity to discover, after the hard years of undergraduate study, a balanced and stimulating way of life: the opportunity to practice sports, get involved in associations and set off for studies abroad”, explains Aude, Class of 2012.

The “X au féminin” association, made up of young female École Polytechnique students, organizes actions designed to rid young women who do not dare to embark on scientific careers of their complexes. The biggest event of the year was the organization of a round table on June 2, 2014: “What opportunities are available to female engineers?” where scientists came to talk about their experiences.
Social responsibility: the professions and diverse career opportunities uncovered

The "Mercredis métiers de l’X" (MMX) [École Polytechnique Profession Wednesdays], organized by École Polytechnique Diversity and Success Center since December 2014, are attended by high-school students from all the Essonne-based schools. These interventions are presented by professionals who come to talk about their profession or themes such as gender equality, women in science and studies abroad.

Changing attitudes to disability

In May 2014, the Diversity and Success Center organized two major days to raise awareness of disabilities. This event, organized in a bid to inform, enabled those attending to learn about the challenges of developing a managerial approach to disability. The aim was also to change attitudes towards disability by speaking openly about the issues and informing the participants of the facilities set up for disabled people. École Polytechnique students and staff members were able to take part in forums and conferences as well as a blind dining experience. Disability has also been taken into account in several events organized by École Polytechnique, including the Science Fair which welcomed a group of deaf visitors in 2014.

Equal opportunities program and social openness actions

École Polytechnique equal opportunities program includes the initiative: “Why shouldn’t I go to a Grande École?” Since 2006, thirty tenth grade pupils have joined this initiative every year for a three year period. The high schoolers visit the campus every Wednesday to take part in tutorial sessions run by École Polytechnique students who commit themselves for an academic year. The activities are varied, ranging from learning expression techniques to team projects. The high schoolers also take part in cultural outings, visits to companies and workshops to increase their general knowledge. In April 2014, an agreement was signed between École Polytechnique and Renault to enable high-school students to learn about Renault’s business activity and the challenges it faces. The involvement of a large number of players from École Polytechnique, its partners (Diversity and Success Center, the project manager for this initiative, tutors and contributors) and schools are key to the program’s success.

The Trainee Researchers operation

Since 2014, École Polytechnique has taken part in the Trainee Researchers initiative which welcomes school children and high-school students to its laboratories. The initiative is managed by École Polytechnique Diversity and Success Center. One Wednesday a month, the trainee researchers work in pairs with an École Polytechnique researcher on a research project. Fully immersed in this way, they are able to learn all about this profession and serve as ambassadors when they return to their schools. The objective is to show that there is no barrier between the world of science and that of education. The program’s success lies in the mobilization of all the research professionals within the Saclay platform who are eager to pass on their knowledge in a spirit of dialog, sharing and mutual enrichment.
Public outreach: sharing information on science and researchers’ professions

The Science Fair on October 10 and 11, 2014
In October 2014, almost 2,000 visitors came to École Polytechnique to attend the Science Fair. In association with ENSTA ParisTech, the Institut d’Optique Graduate School and Inria, École Polytechnique presented a mutualized program on campus. Over the course of two days, researchers from École Polytechnique laboratories hosted a variety of fun activities for school children and families, to share their experiences and their passion for the research professions, including scientific activities, laboratory visits and a series of fascinating conferences. A fireworks display put on by École Polytechnique students marked the end of this friendly family event. In 2015, the Science Fair’s main theme will be “Light”.

Research Thursdays
Launched in October 2014, Research Thursdays allow journalists and a diverse public, through strategic themes, to explore the world of research, discover the latest innovations of École Polytechnique laboratories and anticipate the challenges of the future. During each meeting, two or three researchers present their research along with its context. Open to the public, they highlight the multidisciplinary and interdisciplinary nature of the work carried out within École Polytechnique Research Center. These meetings take place on the first Thursday of each month until June 2015 and are organized on École Polytechnique’s eight strategic themes which are detailed on pages 30-55.
Making educational excellence accessible

French pioneer on the Coursera online platform and now present on FUN (France Université Numérique), École Polytechnique launched a second session of MOOCs (Massive open online courses) on Coursera in October 2014. The initial MOOCs’ success has allowed École Polytechnique to extend its offer. Free, interactive and very high-quality lessons at the public’s fingertips, the MOOCs are truly revolutionary, serving as “a complementary learning tool” according to Frank Pacard, Vice President for Academic Affairs and Research.

Sharing scientific historical resources

Heritage Days
The École Polytechnique Central Library (BCX) opened its doors on the European Heritage Days organized on September 20 and 21. Visitors were able to discover École Polytechnique’s historical and heritage collections, and take a guided tour of an exhibition entitled “Le général Pellé “la guerre ne tardera pas” Regards de polytechniciens”. The exhibition’s opening ceremony commemorated the centenary of the Great War. In collaboration with the students, the library and the Historical Resources Center (CRH) communicate École Polytechnique’s heritage throughout the year. They also welcome students for their practical work on history of science. They manage loans of archived objects to other institutions and organize historical conferences. In 2014, two other exhibitions were held: one paid tribute to the fiftieth anniversary of the disappearance of Jacques Hadamard and the other presented crystallography through scientific work carried out by École Polytechnique researchers, during the International Year.

Promoting and enriching the library’s historical fund: the SABIX
A non-profit association set up in 1986 under the French law of 1901, the Society of Friends of the Library and the History of École Polytechnique (SABIX) seeks to extend École Polytechnique’s influence and encourage studies on its history and that of sciences and technologies. Two or three times a year it publishes reports devoted to these subjects or about famous École Polytechnique students. SABIX also contributes to École Polytechnique’s heritage stored at the library by paying for archives and work restoration costs. In 2014, it published two new reports: issue no. 54 “Edme-François Jomard (1777-1862), Un “Égyptien” de Polytechnique”, and no. 55 “Hervé Faye (1814-1902) ou l’art de la rupture”.

The SABIX also actively contributed to the exhibition illustrating the life and work of General Maurice Pellé, Class of 1882, who had a very unique destiny.
FOCUS

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In 2014, École Polytechnique forged ahead with its lecturer-researcher recruitment policy to fill the posts required following the set-up of new courses, notably in the Paris-Saclay Master’s programs and new curricula on the Ingénieur Polytechnicien program, and to create or strengthen research teams on innovative subjects, such as big data and complex systems.

Within the scope of the support functions, an internal mobility policy was launched to encourage staff in their professional development aspirations. The policy advertises posts open to recruitment reserved for internal staff members, and provides personalized support to help everyone seize the transfer opportunities available to them.

In line with the long term “disability” policy presented at the end of 2013, 2014 saw a wealth of awareness-raising actions carried out jointly with INRIA Saclay and ENSTA ParisTech. Two full days in May and a week in November were devoted to this theme, with conferences, the distribution of leaflets on Acknowledging the Status of Disabled Workers, a show, various events including a blind dining experience, and workshops presenting equipment and software adapted for people with disabilities.

An electronic leave management application, CAL’X, including the various types of leave and compensatory time off, has been successfully launched. This operation was widely promoted and all players were very involved.

2014 was also a year with a particularly high number of staff elections. February saw the election of civil and military staff representatives, including students, to the Saclay Social Committee, grouping together for the first time four institutions of the Ministry of Defense, including École Polytechnique and ENSTA ParisTech. December 4 was a day of national elections, aimed at renewing the staff representatives on the Technical Committees of the Ministry and École Polytechnique, and on the various joint commissions as well as the commission d’avancement des ouvriers de l’État (commission for the advancement of public-sector workers).

Lastly, two École Polytechnique development projects were the subject of constructive social dialog during several work meetings attended by teaching, research, technical and administrative staff representatives. On the one hand, this concerns preparing for École Polytechnique’s transition to Public Scientific, Cultural and Professional Institution (EPSCP) status which tallies better with its higher education and research mission, and on the other hand, its integration into the Paris-Saclay community of universities and institutions.
THE BUDGET

**EXPERDITURES**

- Facilities (maintenance and renovation) €18 M
- Employees not on a contract payroll €59 M
- Expenditures financed by third parties (sponsoring, research contracts …) €7 M
- Other expenditures €35 M

Total expenditures €119 M

**INCOME**

- Government subsidy (Ministry of Defence and Ministry of National Education, Higher Education and Research) €76 M
- École Polytechnique ressources (tuition fees, housing…) €19 M
- Miscellaneous income €15 M

Total income €110 M
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M. Pascal MANIGOT
Research personnel member of École Polytechnique

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Condensed Matter Physics Laboratory

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EXCESS

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LinX-SHS

Computer Science
LIX

Pure Mathematics
CMLS

Applied Mathematics
CMAP

Mechanics
LMD

Physics
LMS

Languages and Cultures
OMEGA

Academic Department

lOB refers to both academic and research departments of biology and physics

PMC refers to both academic and research departments of physics and chemistry
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The Pre-Planning Board

Decisions made by the Board of Directors pertaining to the competitive entrance examination (its structure and organization, the appointment of examiners, the distribution of exam locations by subject and category, etc.) are prepared by the Pre-Planning Board. Annual reports on the previous exams are presented to it and it remains abreast of any changes planned for the preparatory classes or the École Polytechnique curriculum.

The Post-Planning Board

The Post-Planning Board’s mission is to provide information and suggestions to the Board of Directors regarding the changing career opportunities for French and foreign students in the public sector and the various sectors of the economic and scientific world. To best meet the needs of the various recruiters, the Board formulates the appropriate proposals relating to advanced courses and École Polytechnique’s outreach to the different sectors.
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Director-General
M. Frank PACARD
Vice President for Academic Affairs and Research

Ms. Laura FIONI
Head of the Internships, Orientation, Career Counseling and Business Relations Office
CONTACT US

Email addresses
firstname.lastname@polytechnique.edu
(without accent)

Postal adress
École polytechnique
Route de Saclay
91128 Palaiseau cedex
FRANCE

Website
www.polytechnique.edu

Facebook
École polytechnique

YouTube
École polytechnique channel

Twitter
@Polytechnique