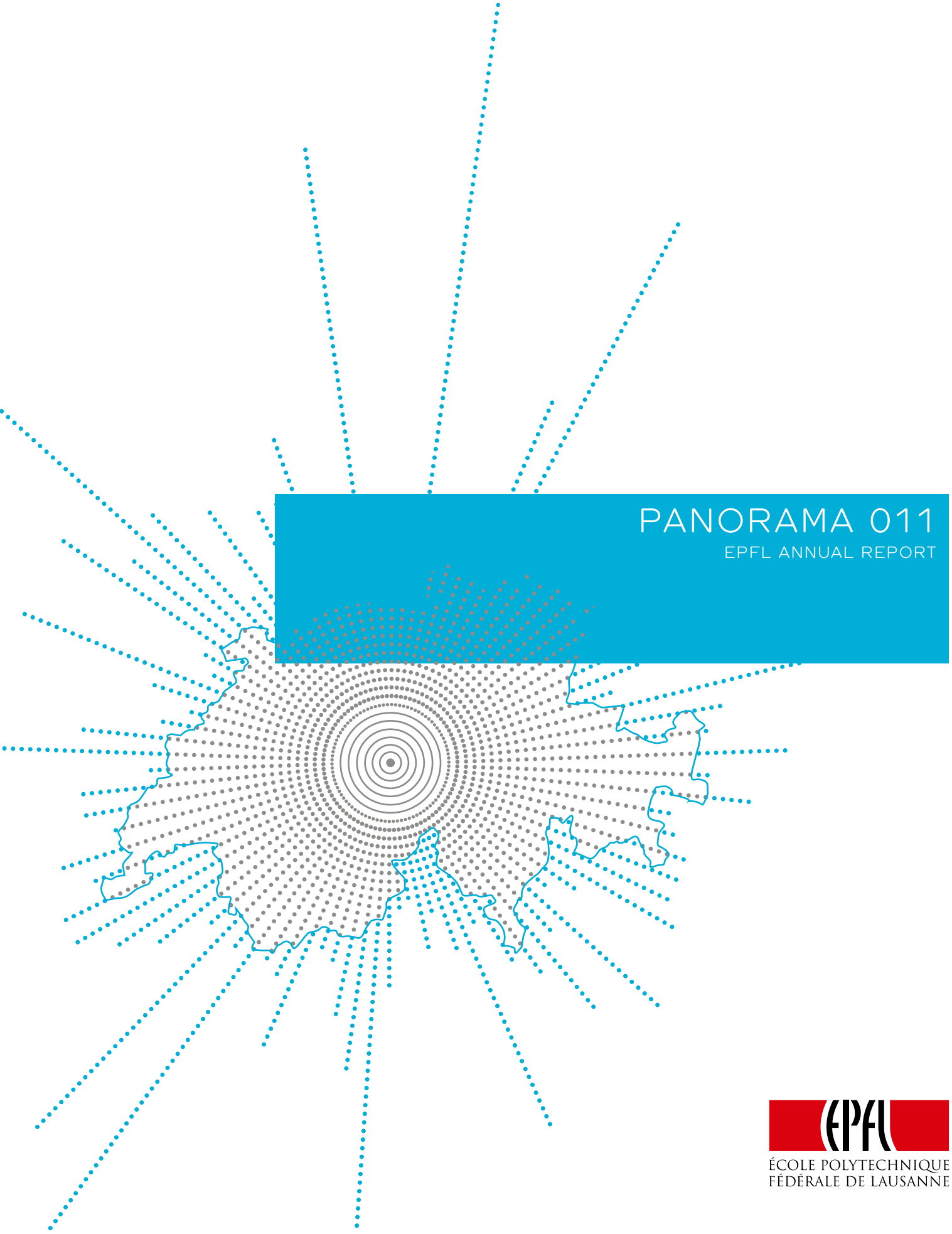


PANORAMA 011

EPFL ANNUAL REPORT

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Generating knowledge and responding to societies concerns is the title of the chapter devoted to research in this report. It would be difficult to find a better description of the balance that a Federal Institute must strike between its visionary spirit at the source of cutting-edge research and its attention to the rather concrete expectations of society. These expectations are varied: contributing to ensuring a sustainable energy supply, furthering the innovative strength of the Swiss economy and finding solutions to the challenges presented by human longevity, to name but a few. I am proud to say that in all these areas, and many others besides, the two Swiss Federal Institutes of Technology and the four Research Institutes of the ETH Domain bring promising solutions.

Beyond these practical concerns, readers will also be captivated by the visionary force of science. EPFL knows how to spark strong motivation for research and this has not gone unnoticed. After years of insufficient recruiting in the sciences, the growing number of students at EPFL, as well as at ETHZ, is a true asset to our country. We have recreated enthusiasm for sciences among the younger generation and we must now continue to invest in this endeavor.

New generations will bring us new approaches and we must therefore develop new education and teaching methods and continue to promote cultural diversity. Scientific and economic cooperation in the Lake Geneva Region, and in all of French-speaking Switzerland, has brought about remarkable expansion. The same is true for the whole country; in this era of global competition, Switzerland must maintain its investment in education and teaching, as well as in research and innovation. But it must also take advantage of its cultural wealth: we will all be called upon to strengthen our exchanges and to learn from each other – and the ETH Domain has a duty to play a national role in this. We will thus contribute to making Switzerland a country proud of its traditions and, at the same time, focused on innovation and the future.

Fritz Schiesser
President of the ETH Domain

Year after year, EPFL works at establishing its place in the Swiss and international arenas. And the scientific and academic results are there: a record increase in the number of students, scientific results of the first order, multiple successes in the spectrum of European financing. The year 2011 was also marked by an event that has symbolic value for institutions like ours, the very positive outcome of the survey conducted among our students in the context of the 'Campus 2011' study on the quality of the education provided.

In addition to our present endeavors, we need to place our future in a global perspective. Like the United States, where despite widespread beliefs to the contrary, the federal government remains by far the main provider of funding for scientific research, Switzerland has been able to set up a high-performance system of subsidies, based on healthy competition. Each institution has had to find its place in this ecosystem. To arrive at such a result, a visionary spirit and political courage were necessary. The federal government and the cantons are the key players in this system and must remain so. Research is a long-term investment, counter-cyclical compared to the usual expectations of traditional Research & Development. We need this tenacity. Globalization and growing competition leave no room for laxity. Although it has taken dozens of years to climb the ladder of excellence, it would take many fewer to lose the ground we have gained.

The world is changing and so is Switzerland. In addition to the image of reassuring tradition and well-tempered pragmatism, today there is a new dimension, a country turned toward the future and innovation. There is nothing contradictory in this. The 'High-Tech Switzerland' will not immediately obscure the image of watches and chocolate. These two images will continue to coexist, above all because each one of them is an authentic, albeit partial, reflection of Swiss diversity. This annual report will give you only a partial glimpse of the diversity of the activities and ambitions of EPFL. But I have every reason to believe that this glimpse will capture your interest and make you want to know more about us. On behalf of EPFL, I wish you pleasant reading.

Patrick Aebischer
President EPFL

The world is changing, and so is education...

A banner year for EPFL the 'Campus 2011' survey conducted among students revealed that 93% of them are proud of their school and 76% think that the education provided to them is ''excellent'' or ''very good''. These results confirm the quality of the investment we have made into teaching.

For, even if research is often in the limelight, we must constantly keep in mind that the most important added value of a university always remains the education it offers. In 2011, 656 students obtained a Masters degree. These figures are the result of ongoing adaptation of our course offerings and pedagogical methods. Students change, and so does the way they learn. Our research laboratory on teaching methods, CRAFT (Center for Research and Support of Training and its Technologies), evaluates teaching while continuously developing new educational systems, based on the most promising technical innovations as well as on the knowledge that we gain about the learning process.

To top all of this, 2011 saw unprecedented growth in the number of students beginning their studies, a significant increase for the third consecutive year. New students in the first year numbered 1601, a rise of 13%. This explosion in the size of the student body necessitated a complete review of our infrastructure to provide more workspaces, improve the rooms designated for practical exercises and develop group work sessions in the form of tutoring. These adaptations were applauded by the students, and will be fully implemented between now and 2013, allowing us to increase by 20% the number of workspaces available.

Philippe Gillet
Vice-President for Academic Affairs

EPFL students rate their school

On the whole, EPFL students are happy: 93% say they are proud of their School according to an extensive survey conducted by the CRAFT (Center for Research and Support of Training and its Technologies). The 'Campus 2011' study polled 2583 students, 44% of the entire student body, and provides a good representation of how the students perceive the institution in general, the quality of teaching, the structure of the study programs, the infrastructures and campus life in general. In particular, the practical sessions and laboratory work scored highly and the new tutoring program, set up last year for first-year Bachelors students, received very positive reviews.

A previous survey, carried out in 2004, had brought to light certain problem areas, such as a serious lack of workspaces, the desire for better academic services guidance and better access to the world of employment in their chosen field. These demands were met in part by the creation of the Student Services Desk and the Rolex Learning Center, as well as by setting up business internships.

Higher satisfaction levels than in 2004

The students exhibit a much higher satisfaction level in 2011 than in 2004. An impressive 76% evaluate EPFL education and training as very good or excellent, a spectacular rise, since this figure was only 43% eight years ago. Many more agree with the statement, "My study program corresponds to my expectations," 91%, an increase of 5% over 2004.

"This study, like the first, will be the basis for improvements", explains Albertine Kolendowska, Research Associate for Educational Affairs. She underlines the fact that the report is currently being submitted to a large constituency of various authorities and associations at the School, which will make subsequent recommendations.

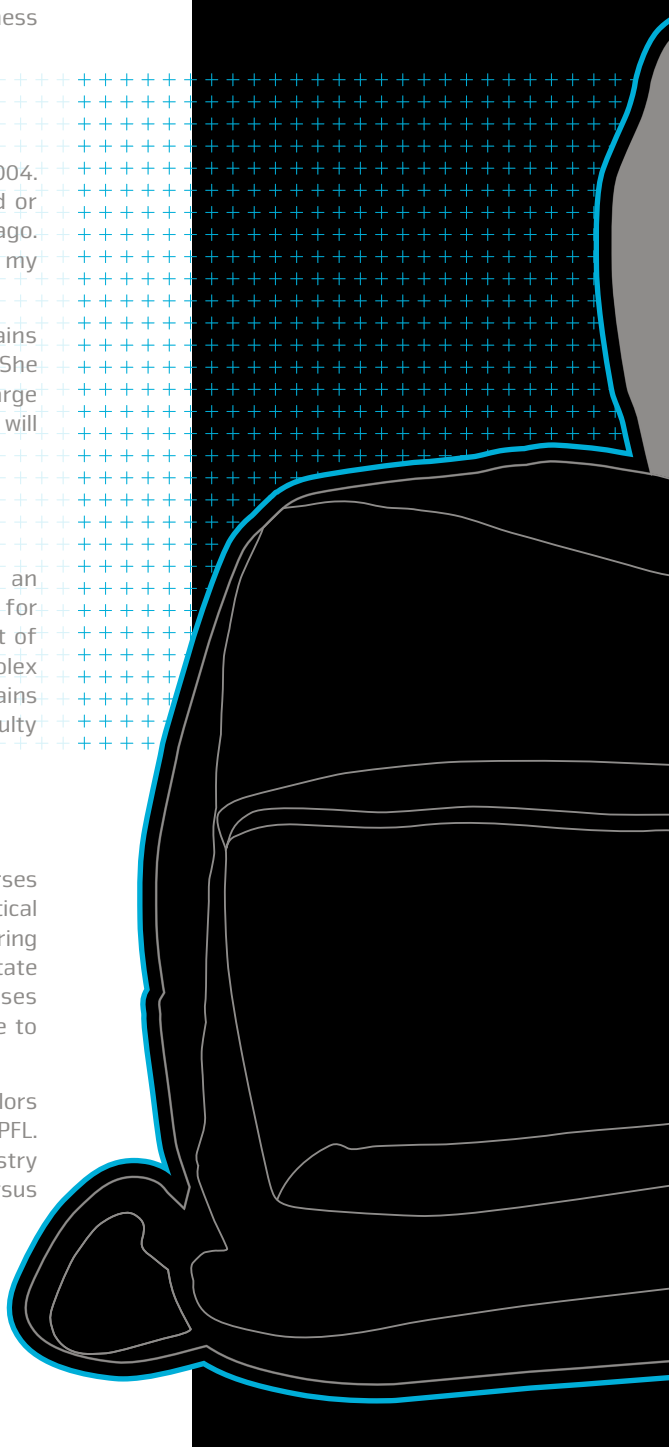
Five hours more work per week

It is noteworthy that students now spend more time studying, with an increase from 47 hours per week in 2004 to 52 hours per week in 2011. As for infrastructure, the need for more printers and the insufficient comfort of some classrooms were pointed out. The lack of workspaces, which the Rolex Learning Center, victim of its own success, has not entirely resolved, remains a concern: half of the respondents say that they regularly encounter difficulty in finding a place there.

Toward careers in business and industry

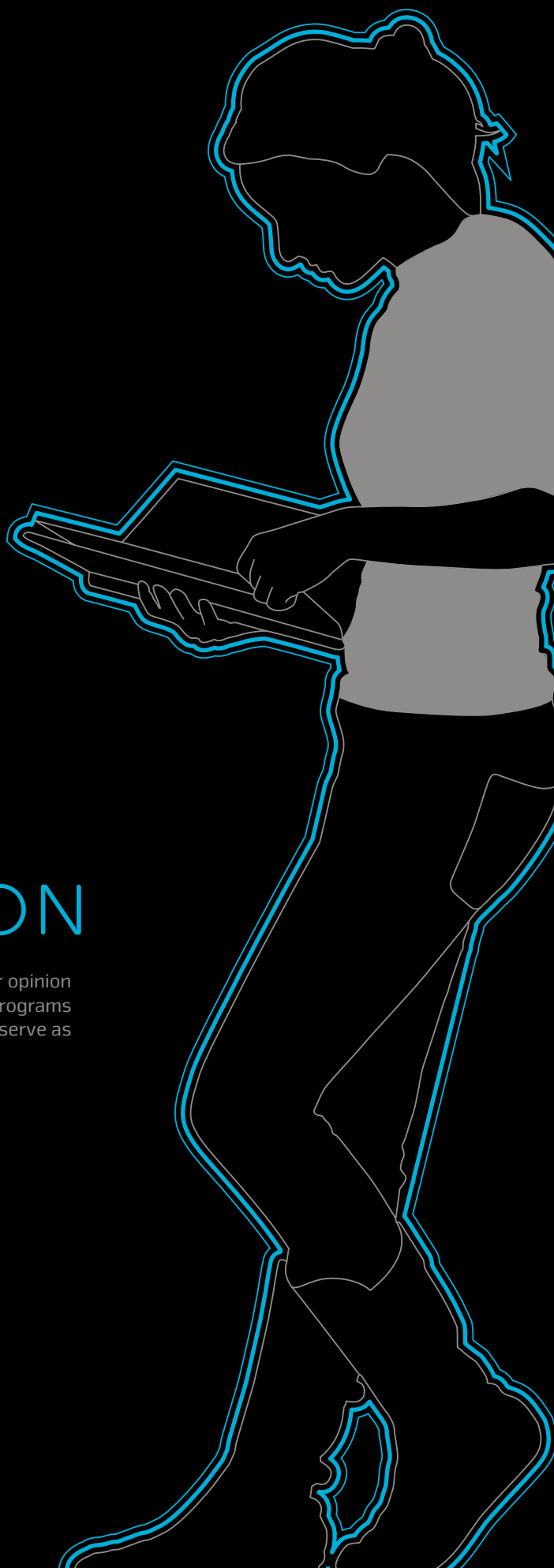
On the teaching front, the current proportion of math and physics courses in the first year is favorably viewed by two-thirds of students. The practical exercises and laboratory work are particularly appreciated, as is the tutoring experience, introduced in the first Bachelors year: 88% of respondents state that it helps them to better understand their studies. Humanities courses glean a narrow majority of positive opinion, showing that they struggle to convince in an engineering school.

When asked about their plans for the future, 74% of the first-year Bachelors students say that they would like to continue in the Masters Program at EPFL. However, more students are now considering a job in business or industry rather than pursuing an academic career: 62% of respondents in 2011 versus 54% in 2004.



A SURVEY REVEALS STUDENT SATISFACTION

In 2011, members of the student body were asked their opinion on the quality of the teaching, infrastructures, study programs and campus life at EPFL. The results of this survey will serve as a basis for concrete future developments



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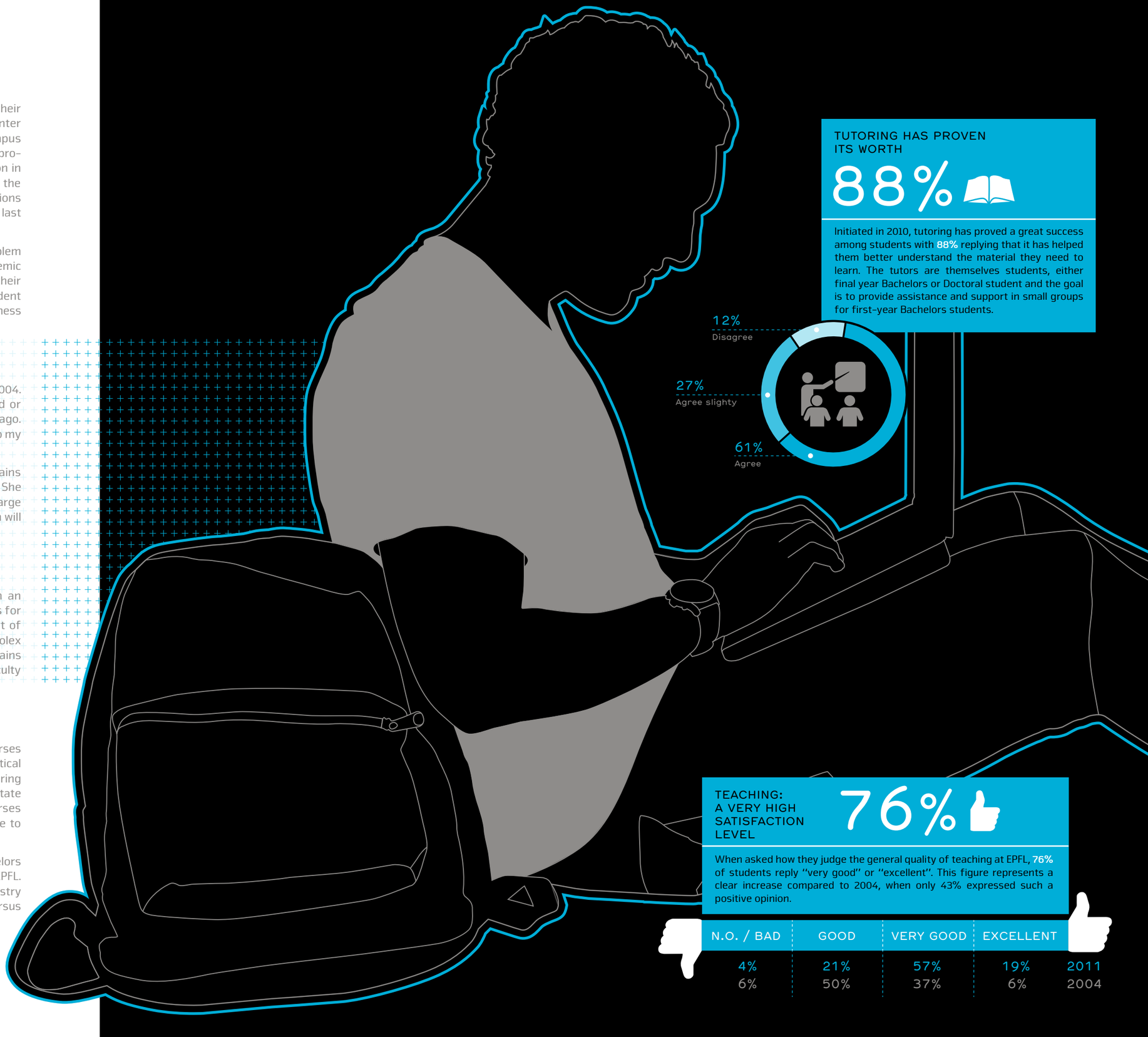
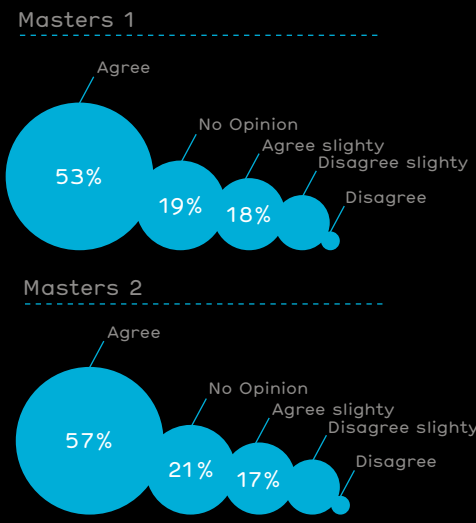




PROFESSIONAL IMMERSION WIDELY APPRECIATED

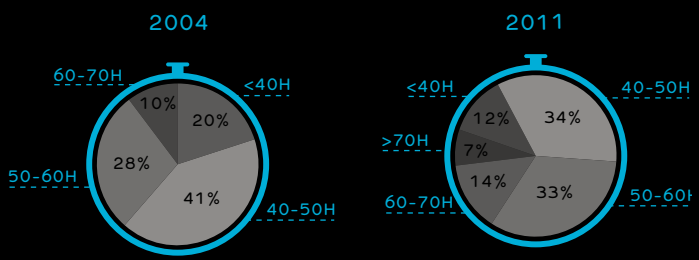
70%

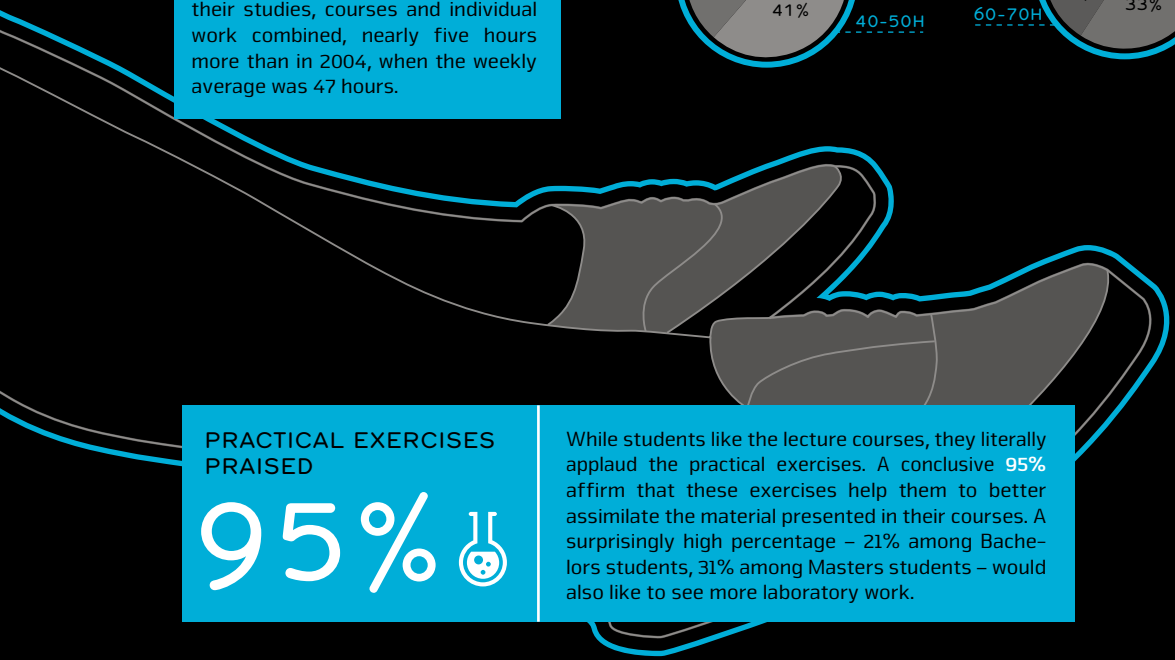
The Masters students appreciate the early immersion in professional milieux provided by internships in business and industry, which have been mandatory in the past two years for all Masters candidates. A striking **70%** of participants describe them as a useful kick-start to their careers.

FIVE MORE HOURS PER WEEK

52H

In 2011, students said they dedicated an average of **52 hours** per week to their studies, courses and individual work combined, nearly five hours more than in 2004, when the weekly average was 47 hours.





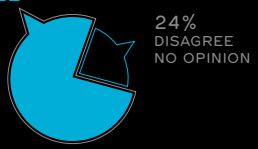
PRACTICAL EXERCISES PRAISED

95%

While students like the lecture courses, they literally applaud the practical exercises. A conclusive **95%** affirm that these exercises help them to better assimilate the material presented in their courses. A surprisingly high percentage – 21% among Bachelors students, 31% among Masters students – would also like to see more laboratory work.

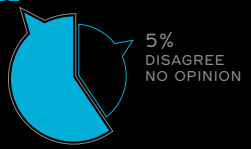
Q.1. THE LECTURE COURSES ARE USEFUL

76% AGREE



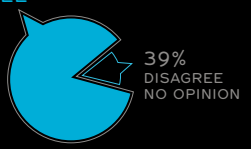
Q.2. THE PRACTICAL EXERCISES HELP ME TO ASSIMILATE THE COURSE MATERIAL

95% AGREE



Q.3. THERE ARE SUFFICIENT PRACTICAL EXECISES AND LABORATORY HOURS IN THE COURSES

61% AGREE



EPFL AND HARVARD MEDICAL SCHOOL BRIDGE THE CULTURAL GAP

The Bertarelli Program in Translational Neuroscience is an international teaching and research collaboration between Harvard Medical School and EPFL. One key to developing a successful, long-term research relationship is the student exchange program taking place over the next three years.

Four EPFL students settled into the academic life and harsh north-eastern climate in Boston at the beginning of the 2011 winter semester. They are the first of 18 Bertarelli Scholars; nine Masters-level EPFL students traveling to Harvard Medical School (HMS) plus nine of their US counterparts taking the plane in the other direction over the next three years. These students are part of the Bertarelli Program in Translational Neuroscience, officially launched in 2011 with a two-tier agenda; 1) along with the student exchange program, 2) six research grants are financed at $3.6 million from the Bertarelli Foundation – combining neuroscience and engineering to tackle neurological disabilities such as paralysis and deafness.

The next students to benefit from the scientific and cultural exchange will come from Harvard Medical School in the summer of 2012. By then, the first four scholars from EPFL will have already returned to share their experiences with their friends and the science they learned with their peers in the lab. So far, it appears to be the educational experience of a lifetime, especially if one considers a higher education in the Sciences to comprise both hard-won scientific expertise and singular life experiences that turn young students into young adults.

Six Groundbreaking Research Projects

Back in the lab, five of the six projects bring scientists and physicians from HMS together with EPFL bioengineers to create new methods to diagnose and treat a wide range of hearing loss afflictions, from those that are genetically based to those caused by damage from excessive noise. A sixth project will build on novel research on spinal cord stimulation done in Switzerland, taking it a step further by implementing stretchable electronics directly on the spinal cord and attempting to rebuild severed connections through stem cell regeneration therapy.

TEACHING INDUSTRIES TO MANAGE RISK

Risk management is a key factor for industry. Two EPFL professors have launched a continuing education course for professionals.

Thierry Meyer teaches at EPFL and has worked for a number of years in industry. He is familiar with the constraints facing the sector in the area of risk management and has found real know-how in this field on the campus. In the context of the UNIL-EPFL department for Continuing Education, he has set up a course intended for professionals, with the goal of sharing the School's competencies with the world of industry.

The program is designed to provide key skills for applying theoretical concepts and dealing with legal constraints in real situations. The course leads to a Certificate of Advanced Studies (CAS) recognized by the ECTS credit system and is open only to persons with sufficient previous professional experience. The instructors come from EPFL, but also from outside organizations, such as SUVA (Swiss Accident Insurance Fund), Swiss industry or the medical field.

MASTERING THE COMPLEXITY OF OUR ELECTRONIC DEVICES

Teaching students to master the complexity of current electronic devices? An EPFL professor uses the hidden pedagogical potential of a portable game console.

Electronic devices include more and more functions – graphic display, communication, GPS, etc. – that present real challenges for students. David Atienza, professor at EPFL, has developed a course specially designed for his electrical engineering students to learn how to approach this complexity. Using a Nintendo console as a teaching tool, the participants had to program a game including as many functions as possible.

''The students have very good knowledge of how to create various electrical components and devices. Now we want them to learn to combine them, in order to develop a complete system,'' explains David Atienza. The professor's original idea was to work on a smartphone, but the number of components was too high. The Nintendo DS portable game console finally proved to be the ideal medium.

The course delved into the creation of multi-player applications – requiring wireless communication functions – or involving social network connectivity functions. Fascinated by his idea, other professors intend to take inspiration from his lead for their own courses.

SUCCESS FOR TWO STUDENT SPACE PROJECTS

The Swiss Space Center at EPFL is taking off. In 2011, the SwissCube satellite delivered its first images, and the students won a European Space Agency (ESA) contest to send a prototype sensor into space.

SwissCube, the first Swiss satellite created by students, had as its mission to photograph luminous phenomena in the upper atmosphere. Several months after receiving the first images, a sensor designed to orient satellites in space was selected by the European Space Agency (ESA) for an experimental flight: another success for the EPFL students. The Swiss Space Center has clearly demonstrated its intention to train qualified and bold talent for the space sector.

It was in March 2011 that the Swiss Space Center team received the first images from SwissCube. They showed the airglow – the luminescent phenomenon resulting from the formation of O_2 oxygen molecules after their separation by solar radiation. To achieve this result, the technicians had to work extremely hard to stabilize the satellite, which was rotating after a technical hitch occurred during ejection from the rocket.

Originally designed to work for several months at the most – temperature variations and radiation severely test the electronics – SwissCube resisted extreme conditions in space for over a year; a success for the some 200 students involved in the project, at EPFL but also at the University of Applied Sciences and Arts of Western Switzerland, the universities of Berne and Neuchâtel as well as at the University of Applied Sciences and Arts of Northwestern Switzerland.

In December 2011, a new Space Center project was crowned with success. A gravitational force sensor, perfected by students and capable of detecting the center of the Earth with extreme precision, was selected by ESA to be placed aboard a rocket launched from Sweden. The efficient and resistant device, named Gravity Gradient Earth Sensor, is intended to replace optical sensors generally used by satellites enabling better orientation in the vacuum of space. The system was launched in March 2012 and will be tested under microgravity conditions at an altitude of nearly 100 kilometers.

200

Students involved in the Swisscube project.

MOBILITY GRANTS BOOST ACADEMIC CAREERS

Among doctoral students who were granted fellowships for prospective researchers by the Swiss National Science Foundation (SNSF), giving them the possibility to carry out research abroad, 24% have obtained professorships, some of them at EPFL.

The objective of this grant program is to ensure that there is a constant new supply of graduate scientists, to encourage mobility, and to support women's careers. Research experience abroad is now a major component in any scientific career. It is practically indispensable for becoming a professor, and is a major asset in being selected for important positions. The SNSF grant is awarded for a period of 18 months, and includes allowances for personal expenses, travel expenses, and the possibility of a contribution toward research and symposium participation costs. The amount granted depends on marital status, family-related responsibilities, and the cost of living in the destination country. They are awarded independently of nationality, sex or family status. Only the applicants' abilities are taken into account and the only condition for applying is to have obtained a doctoral degree from EPFL. In addition, this type of financing is extremely positive, as SNSF grant recipients are ambassadors for EPFL worldwide.

ACQUIRING TANGIBLE SKILLS

The EPFL Mechanical Engineering department is adapting its course offerings. A pilot project will help meet the particular needs of professors, students, business owners and managers.

The 'Competencies' program has as its objective a new definition of the Bachelors and Masters curricula. This pioneering project was conducted by the Mechanical Engineering department in collaboration with CRAFT (Center for Research and Support of Training and its Technologies) at EPFL, the University of Fribourg as well as the Rectors' Conference of the Swiss Universities (Crus). It will later extend to all departments at EPFL and other Swiss universities.

The objectives are to harmonize teaching, to give students reference points on the skills that they are going to acquire and to supply businesses and industry with better knowledge and skills to be expected from graduates. The project began with an extensive survey, particularly focused on industries, to better define their needs. A team of teachers was able to extract five macrocompetencies that must be integrated into the skills acquired by students – for example bilingualism.

Detailing course objectives and content in this way will allow for course optimization by identifying incoherencies or redundancies. This will also make it easier to replace a professor who is absent due to illness and to manage transitions when professors retire.

METHODS THAT PROMOTE THE AUTONOMY OF FUTURE ENGINEERS

Gone are the days of large lecture halls where fearful students drank in the knowledge of their professors. The digital revolution in progress at the turn of the 21st century has not only democratized access to knowledge, but has also contributed to shifting the centers of learning and to disrupting the organization of education.

This fundamental sociological fact has profoundly changed students' relationship with knowledge. Today, it is not sufficient for an institution to nourish students' minds with the knowledge it believes will be useful to them. The School must primarily give them the tools and methods with which they can orient themselves in today's world and prepare for that of tomorrow.

Our School must also guide students in the passage from high school to EPFL. This is one of the *raisons d'être* of the generalized tutoring program, whose positive effects were already felt at EPFL in 2011 and is much appreciated by the students (tutoring is a program in which a more advanced student works with a small group of new arrivals in exercise session). According to the results of the recent student survey (see pages 8–10), 88% consider that it has helped them to better understand the material to be learned.

By rethinking the role of practical exercises and projects in education and by promoting work in small groups, EPFL now gives all students the possibility to discover and develop their skills and creativity. This approach brings to light talents that would have gone unnoticed in a lecture hall. It also prepares the students for interdisciplinary work based on the particular competencies of each person – a way of approaching problems which will give them a considerable advantage when they have to work in collaboration with others in a company or research laboratory. The ambitious *Teaching Bridge* project and its satellite programs all over the campus fit exactly into the scheme of this concept.

The efforts made in parallel to promote 'campus life' by the creation of new student housing, shops and services on the grounds, also play their part in constructing an ideal environment for nurturing the engineers and researchers of the 21st century.

NEARLY 8,500 STUDENTS AT EPFL

Enrollment figures in September 2011 for the new academic year indicate a rise of nearly 13% compared to the preceding year. Civil engineering, mechanical engineering, architecture and mathematics are confirming their appeal to new students.

8,442

Students matriculated in 2011.

Growth continues in the number of students at EPFL. The 2011–2012 academic year showed an optimistic increase in the student body for the fourth consecutive year a record. For all disciplines combined, new students numbered 1601, 13% more than the preceding year.

These newcomers to the classrooms are joining students who are already in study programs at EPFL. The total number of students in the academic year 2011–2012 approached 8,500 (8,442, an 8.8% gain over September 2010). The number of students in Bachelors courses rose by 10%, the number in Masters programs by 15% and, finally, there are 4% more doctoral candidates than in 2010–2011.

Industrial placements now available for all

A new addition for 2011 is the requirement for Masters students in engineering courses to complete an internship of at least eight weeks in business or industry to obtain their diploma. This gives them early hands-on experience in the realities of the working world.

This is just one example of EPFL's dynamism in terms of its primary mission: teaching. These changes have occurred within the context of a major reassessment that will ultimately lead to a fundamental reorganization of the Bachelors program. In the future, there will be more interdisciplinary content and an even stronger emphasis will be placed on practical exercises.

Generating knowledge and responding to society's concerns

For decades, the scientific world has trained brigades of experts ever more specialized in their fields. To such a point that, today, computer scientists, biologists or materials scientists speak their own languages and have difficulty understanding each other. This is the challenge of the future in research: decompartmentalizing knowledge and forcing researchers toward more transversality. Technological platforms are one means of acheiving this and at EPFL we host, amongst others, the Biomedical Imaging Center (CIBM) and Cadmos (the Center for Advanced Modeling Science), a computing center shared by the University of Lausanne, the University of Geneva and EPFL. In 2011, the newly renovated Center of MicroNanoTechnology (CMI), enhanced with various clean rooms, was inaugurated. These rooms, whose low dust level and controlled environment provide the conditions necessary for the manufacture and prototyping of numerous microtechnology and microelectronic applications, are unique in their genre. But 2011 was also fraught with major events for our society. Fukushima and its social, economic and environmental consequences have put energy and environmental concerns back at the center of interest.

Research is finally, above all, a matter of women and men who care passionately about progress. The academic year was rich in research results and high-level international publications, in the fields of astrophysics and particle physics, but also in pollution and cancer research – sectors in which the public harbors great expectations. The examples of this research presented here, demonstrate the complexity of these subjects and the diversity of the issues and problems that we must confront.

Philippe Gillet
Vice-President for Academic Affairs

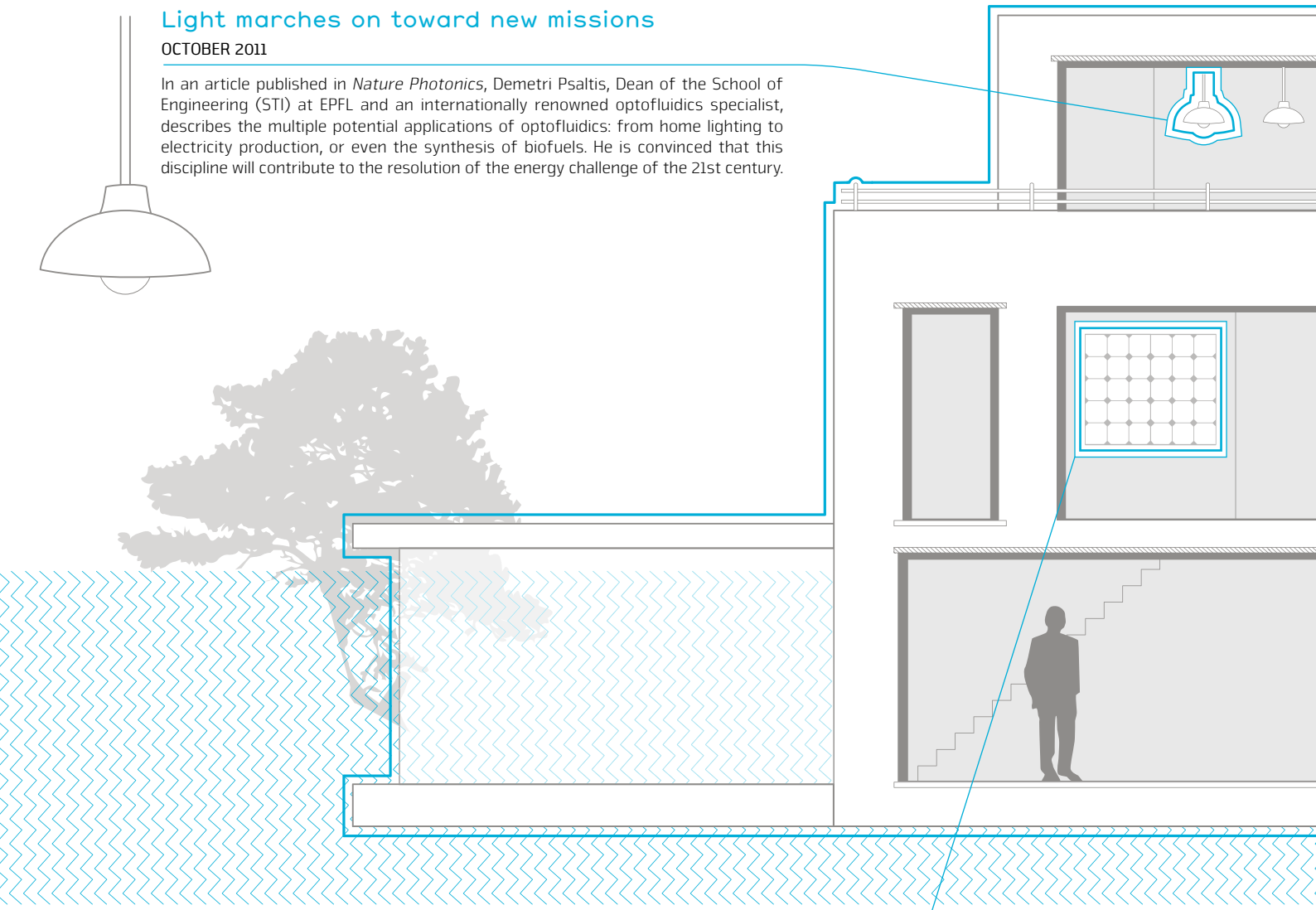
FROM ELECTRICITY PRODUCTION TO CONSUMPTION, EPFL PREPARES SWITZERLAND FOR PHASING OUT NUCLEAR POWER

The greatest challenge of the 21st century will certainly be finding solutions for the lack of electrical energy. Numerous steps have been taken in 2011 at EPFL, both in the fields of production itself and in energy savings.

Light marches on toward new missions

OCTOBER 2011

In an article published in *Nature Photonics*, Demetri Psaltis, Dean of the School of Engineering (STI) at EPFL and an internationally renowned optofluidics specialist, describes the multiple potential applications of optofluidics: from home lighting to electricity production, or even the synthesis of biofuels. He is convinced that this discipline will contribute to the resolution of the energy challenge of the 21st century.



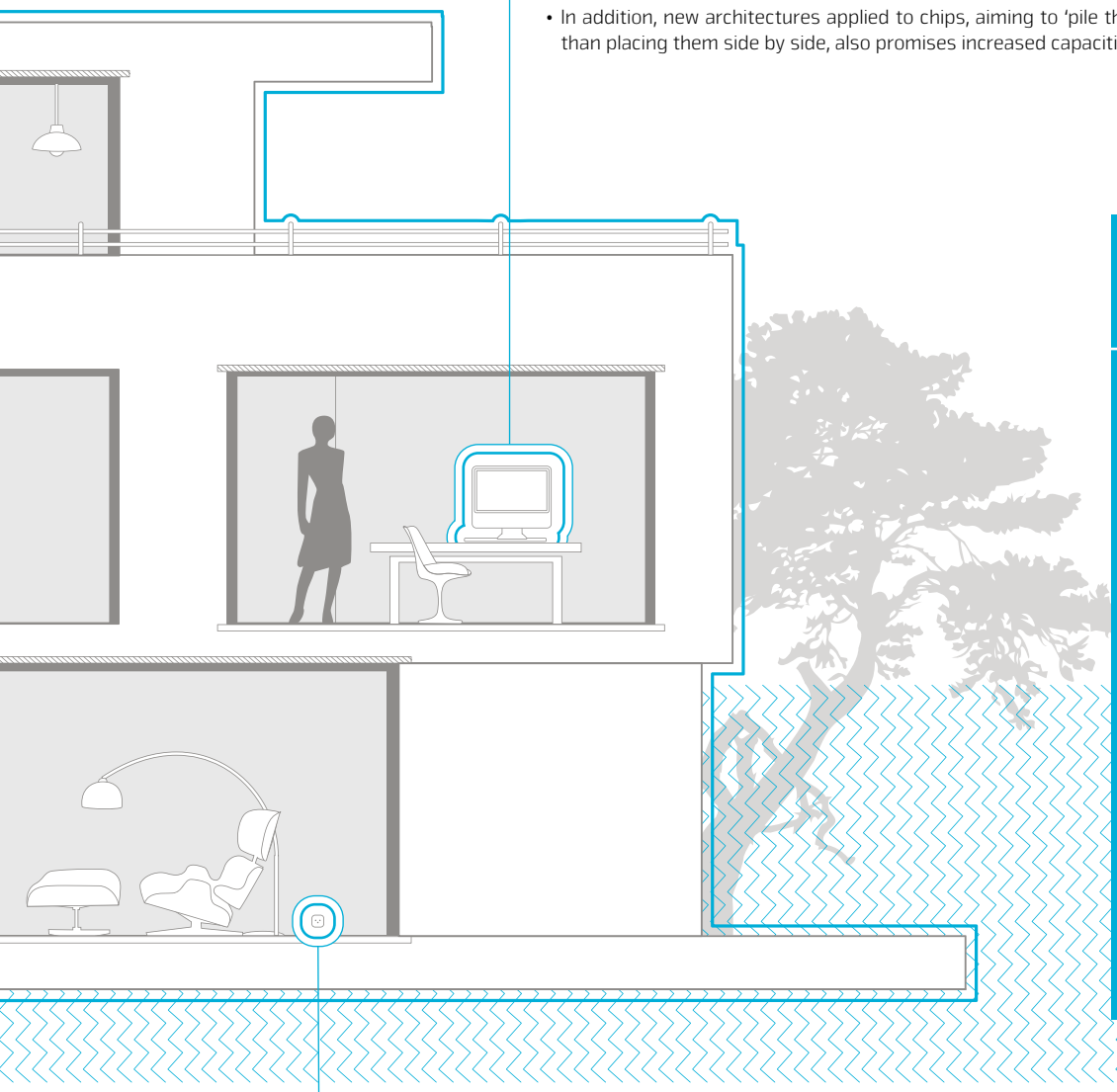
Record efficiency with coloured solar cells

NOVEMBER 2011

Perfected by Michael Graetzel at EPFL, these dye-sensitized 'colored' solar cells, inspired by plant photosynthesis, can be placed on flexible supports or transparent glass. One can only begin to imagine their innumerable possible uses in architecture. In November 2011, scientists succeeded in obtaining a record yield of 12.3% power conversion efficiency with cells dyed green using porphyrin. This efficiency is equivalent to that obtained with silicon cells.

Reducing the energy needs of computers whilst maintaining their power

- The EcoCloud consortium, launched at EPFL in May 2011, brings together expertise from academic laboratories and industrial partners in order to reduce the electricity consumption of computers – in particular those at huge 'Data Centers' which, in the United States, already use more than Switzerland's total energy consumption.
- Among the most promising developments, recourse to a material aimed as a substitute for silicon, molybdenite, has already begun to prove its worth. In December, EPFL presented a circuit based on this substance. Tomorrow's processors will be able to be made smaller and less energy-hungry thanks to the work of the Laboratory of Nanoscale Electronics and Structures (LANES).
- In addition, new architectures applied to chips, aiming to 'pile them up' three dimensionally rather than placing them side by side, also promises increased capacities with lower energy consumption.



APRIL 2011 - A giant model to improve hydroelectric power plants

The renewable energy source most present in Switzerland remains hydraulic energy, supplying 57% of the country's electricity needs. It will also play an increasingly important role as a regulator, compensating for the variable output of solar and wind turbine sources.

In its laboratories, EPFL has built a 1:30 scale model of the pump-turbine installation at the new hydroelectric plant 'Veytaux 2', used by the city of Lausanne and located between Lake Hongrin and Lake Geneva. This enormous model allows scientists to optimize the design and efficiency of the new plant based on the first Veytaux plant, which will continue to operate in parallel.

Toward intelligent management of electricity consumption

APRIL 2011

- The EPFL start-up, eSmart, winner in 2011 of the first prize of the City of Lausanne's PERL (Prix Entreprendre Lausanne Région) award, offers a simple solution that makes it possible to manage the electricity consumption of an entire building in a very detailed way, thanks to a software program.
- Ultimately, information on buildings' consumption could be put on a network at the neighborhood, or even city, level, thanks to a micro-chip dedicated to grid-based organization of electricity circulation, developed in the Electronics Laboratory at EPFL.

TWO EPFL PROJECTS AMONG SIX EUROPEAN PILOTS FOR THE FET FLAGSHIP PROGRAM

The Union European has made innovation a top priority with the launch of the FET Flagship program. The scale of the initiative is unprecedented with finance of up to a billion Euros over ten years at stake for each of the chosen scientific project(s). After an initial selection amongst over 20 European projects, six were retained for a second round. Among these finalists, two EPFL-led projects, the Human Brain Project and Guardian Angels, were announced at the official launch in Budapest on May 4, 2011. The final selection is expected at the beginning of 2013.

Human Brain Project

A network of European universities will develop a platform for simulating the Human Brain. In doing so, they intend to build one of the most ambitious research tools ever conceived in the areas of neuroscience, medicine, computing and robotics.

The goal of the *Human Brain Project* is to simulate the human brain and will bring together 13 of Europe's most prestigious research institutions from Germany, the UK, France, Spain, Switzerland, Sweden, Austria and Belgium. In total, over 100 institutions from around the globe will also participate in the project, in domains as diverse as neuroscience, genetics, applied mathematics, computing, robotics and social sciences.

The *Human Brain Project* proposes an innovative approach in order to understand how the brain functions. The brains complexity – it's billions of interconnected neurons and their associated chemical and electrical signaling pathways – mean that observing and understanding its function is extremely difficult. Simulating how the brain works will overcome this difficulty with the aim of giving scientists the possibility of observing and experimenting in real-time at many levels, from groups of neurons right up to the activity of the entire cortex.

With over 60,000 neuroscience articles published last year alone, the project will group an enormous quantity of data from universities and hospitals worldwide. This observed data will form the basis for mathematicians and computer scientists to build a more complete database of brain disease. Centered at Lausanne's teaching hospital, the CHUV, the short-term goal will be to provide a better diagnostic tool for clinicians, leading to more personalized treatment for patients suffering from a range of neurological disorders.

The *Human Brain Project* will revolutionize the way neuroscientists work, creating a unique and vital tool for the future of brain research both in the lab and the clinic. It will improve our understanding of neurological disorders and provide a test platform for development of potential drug targets.

The project will also turn technology on its head. The brain is capable of things that even the most powerful computers in the world can only dream of, and all for an average energy expenditure of approximately 20 watts. By learning from how the brain works, we can drastically improve the computers of tomorrow.

Guardian Angels

Guardian Angels for a Smarter Life brings together a network of universities and industrial partners from across Europe, under the direction of EPFL and ETHZ. The project aims to develop intelligent and autonomous systems that will accompany us in our everyday lives.

Guardian Angels devices will be smart, discrete and autonomous, measuring diverse physical and environmental parameters as well as analyzing and communicating the data. ''One of the main characteristics of our devices will be their zero-power capacities: bio-inspired systems that will harvest energy from renewable sources such as light or movement,'' explains Adrian Ionescu, project coordinator at EPFL.

Sufficiently compact and streamlined to be incorporated into the fabric of clothing, *Guardian Angels* devices will provide a support tool for monitoring various body signals including heart rate and blood sugar levels amongst others. They will limit the increase in healthcare costs associated with monitoring and caring for our aging population and allow the elderly to maintain their quality of life in familiar surroundings, even in the case of reduced mobility or mental capacity.

Other applications for *Guardian Angels* will be in environmental monitoring and detection of potential danger. Communication across a network of devices could be used as an early warning system in case of natural disasters.

Finally, development of devices that detect emotional states could be invaluable for certain vulnerable members of society, providing severely handicapped patients with a means of communicating via thoughts or assisting sufferers of autistic spectrum disorders to communicate their needs and emotions.

Over 20 universities, research institutes and industrial R&D laboratories in 13 European countries will participate in the project including the CEA, IBM, PSA Peugeot Citroen and Intel to name but a few. Research groups with expertise in areas as diverse as energy production and storage, ultra-low power electronics, computation and data analysis will bring the technology together to make *Guardian Angels* a reality.

OTHER FET FLAGSHIP PILOT PROJECTS

ETHZ and University College London – FuturICT
Futur ICT will collect and analyze a maximum amount of data on every aspect of our society in order to create a model that will allow us to predict phenomena such as finiancial crises and political conflicts.

Chalmers University of Technology – Graphene
An excellent conductor of electricity, resistant and extremely light, Graphene has been described as the material of the future, in particular in the field of electronics.

Max Planck Institute for Molecular Genetics – IT Future of Medicine
Researchers are aiming to revolutionize medicine by creating virtual patients. Our individual avatars could accompany us from birth at every doctor's visit.

Scuola Superiore Sant'Anna, Pisa – RoboCom
Robots that will carry out the tasks we find most tedious are already becoming a reality, but for the machines of the future to really function, they first need to learn how humans communicate.

A SUMMER IN THE DEPTHS OF LAKE GENEVA

In summer 2011, dozens of scientists from around the world explored the depths of Lake Geneva aboard Russian MIR submersibles. They also harvested large quantities of data that they will analyze to better understand and protect the largest lake in Western Europe.

After close to 90 dives in Lake Geneva, the MIR submarines returned to Russia. In all, 16 scientific projects benefited from the *elemo* program in fields as varied as the study of micropollutants, the physics of the lake and bacteria. Thanks to the Russian submersibles, scientists were able to collect an enormous quantity of data in record time in order to assess the health of the lake. Completed in August, the initiative has now given rise to intense follow-up work in laboratories.

Physicists, chemists, biologists and geologists took advantage of this unique opportunity to work on the preservation of an environment that is under considerable pressure – the lake has more than a million and a half inhabitants living around it. The study of water currents allows scientists to understand how pollutants circulate. Numerous sediment samples shed light on the accumulation of heavy metals and other molecules at the bottom of the lake. As for bacteria, the distribution of various species is a precise indicator of the degree of pollution.

Universities from all over the world have joined EPFL to participate in the *elemo* program – from England, Russia, France, Spain, Australia, Germany and the United States. In Switzerland, the project brought about close collaboration with the Swiss Federal Institute of Aquatic Science and Technology (EAWAG), as well as with the universities of Geneva and Neuchâtel.

Coordinated by EPFL and sponsored by Ferring Pharmaceuticals and the Honorary Consulate of Russia in Lausanne, the *elemo* project has updated our knowledge of Lake Geneva. On the basis of such scientific work, it will be possible to make better decisions for the protection of this unique ecosystem.

MODEL SHOWS HOW FAÇADE POLLUTANTS MAKE IT INTO THE ENVIRONMENT

Researchers at EPFL's Ecological Engineering Laboratory have now modeled the flow of biocides from building façades into river basins with surprising accuracy, which could lead to stricter regulations in Switzerland and abroad.

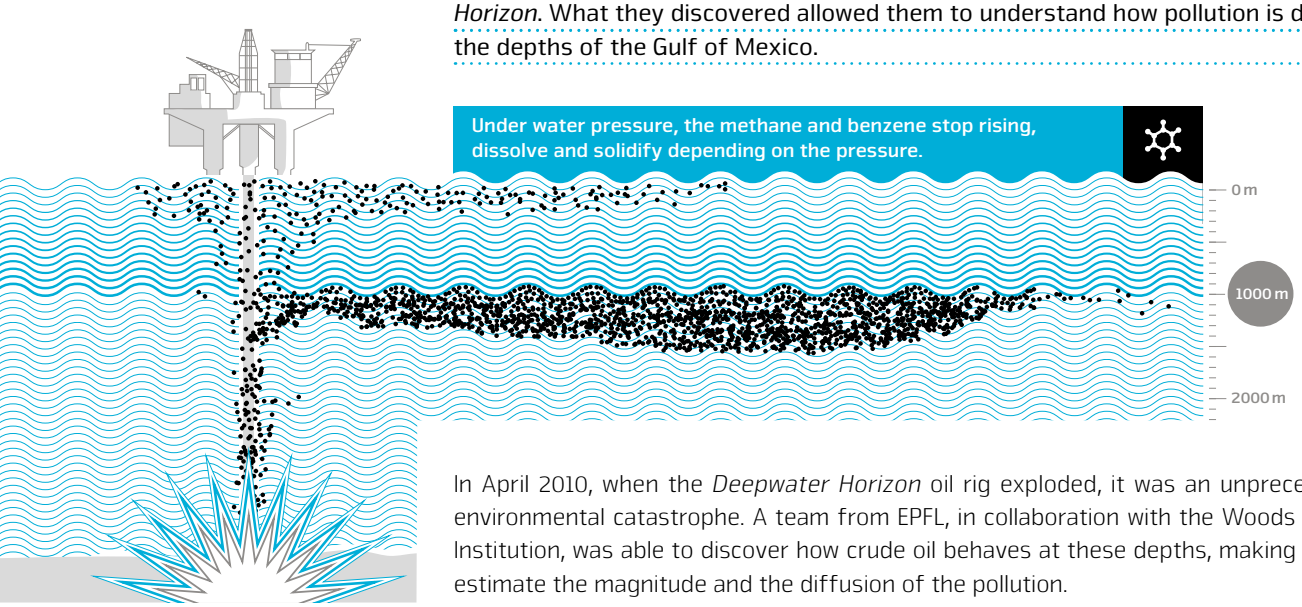
Chemicals engineered to kill microorganisms, called biocides, are added to exterior paints in order to prevent molding and plant growth in 60% of Swiss buildings. Washed off of building facades during heavy rains, however, these chemicals can end up in soil, groundwater and river basins where they attack bacteria, fungi and algae at the bottom of the food chain.

Using the *Vauchère* river in Lausanne as a test site, researchers from the Ecological Engineering Laboratory (ECOL) have developed a model that accurately predicts levels of the three main biocides, used in industrial paints, in water run-off.

The model proved accurate up to a couple of nanograms per liter, an impressive feat considering the variety and complexity of variables. The model's strength comes from its ability to simplify urban surface hydraulic behaviors – how water is channeled down streets and gutters or lawns and gardens – and still remain extremely accurate. Establishing a working model has the advantage of reproducibility as well as reducing dependency on expensive testing.

FAR BELOW THE DEEPWATER HORIZON OIL SPILL

Researchers gathered oil directly as it escaped from the base of the oil platform *Deepwater Horizon*. What they discovered allowed them to understand how pollution is diffused in the depths of the Gulf of Mexico.



In April 2010, when the *Deepwater Horizon* oil rig exploded, it was an unprecedented human and environmental catastrophe. A team from EPFL, in collaboration with the Woods Hole Oceanographic Institution, was able to discover how crude oil behaves at these depths, making it possible to better estimate the magnitude and the diffusion of the pollution.

Previous research initiatives had revealed that, at a depth of approximately 1,000 meters, the vertical plume of hydrocarbons rising to the surface spreads and gives rise to a second, horizontal flow. For the first time, Samuel Arey of the Environmental Chemistry Modeling Laboratory and his colleagues were able to explain the composition of the second flow escaping from the plume by showing the role of gases, such as methane or benzene. Under water pressure, these light hydrocarbons stop rising, dissolve and solidify depending on the pressure. In this way the pollution spreads to areas far from the base of the well.

BISPHENOL A: MOTHERS' EXPOSURE INCREASES CANCER RISK FOR CHILDREN

Mothers exposed to Bisphenol A during pregnancy or while breastfeeding could transmit an increased risk of breast cancer to their children. This important discovery was the topic of a publication in October.

Many countries are taking measures to limit young children's exposure to Bisphenol A (BPA). The focus has mainly been on baby bottles that, when heated, emit a significant quantity of the molecule. However the mother also transmits this substance to the fetus *in utero*, or to her baby during breast feeding. Researchers at EPFL have discovered that this indirect exposure could bring about a modification in the development of the child's mammary glands and predispose them to breast cancer.

An indirect and precocious contact with BPA produces similar effects to those induced by contact with diethylbestrol (DES), a medication known for doubling breast cancer risk in women over 50 years old who were exposed *in utero*, explains Cathrin Brisken, director of the study. ''Until now, the public debate has been centered on direct exposure. But there is increasing evidence that the diseases can come from exposure *in utero*.''

BPA is present everywhere including in plastics, thermal paper, CDs, cooking utensils, making it difficult for the mother to avoid contact with it. Nonetheless, a relatively small dose can produce significant effects. ''We exposed pregnant mice to doses similar to those to which we are exposed in our environment,'' explains the researcher.

The female offspring of these mice exposed to BPA clearly show that their mammary glands' response to hormones is modified over the long term. The same could be true for humans, according to the biologist. ''The problem is that in Western countries it is impossible to find people who are not exposed to BPA, so we cannot establish a test population. Nevertheless, we can no longer ignore the possibility that an increase in breast cancer rates is caused by exposure to BPA or other endocrine modifiers.''

PROTEINS SHED LIGHT ON THE EYE'S LENS

The only transparent part of the human body, the lens of the eye, is made up of proteins that still hold many mysteries. Solving them would allow us to better understand the eye and its diseases, such as cataracts.

The eye's lens can be affected by a cataract – a partial or total loss of its transparency – the primary cause of blindness worldwide. Cataracts are caused by mutations of proteins triggered by genetic factors, diabetes, or ultra-violet light. The lens, once formed, does not re-generate itself and it is therefore essential to understand the properties of the proteins responsible for its transparency in order to determine how certain diseases affect it. The objective is to treat the disease early on, rather than trying to manage its effects later, which is often unsatisfactory.

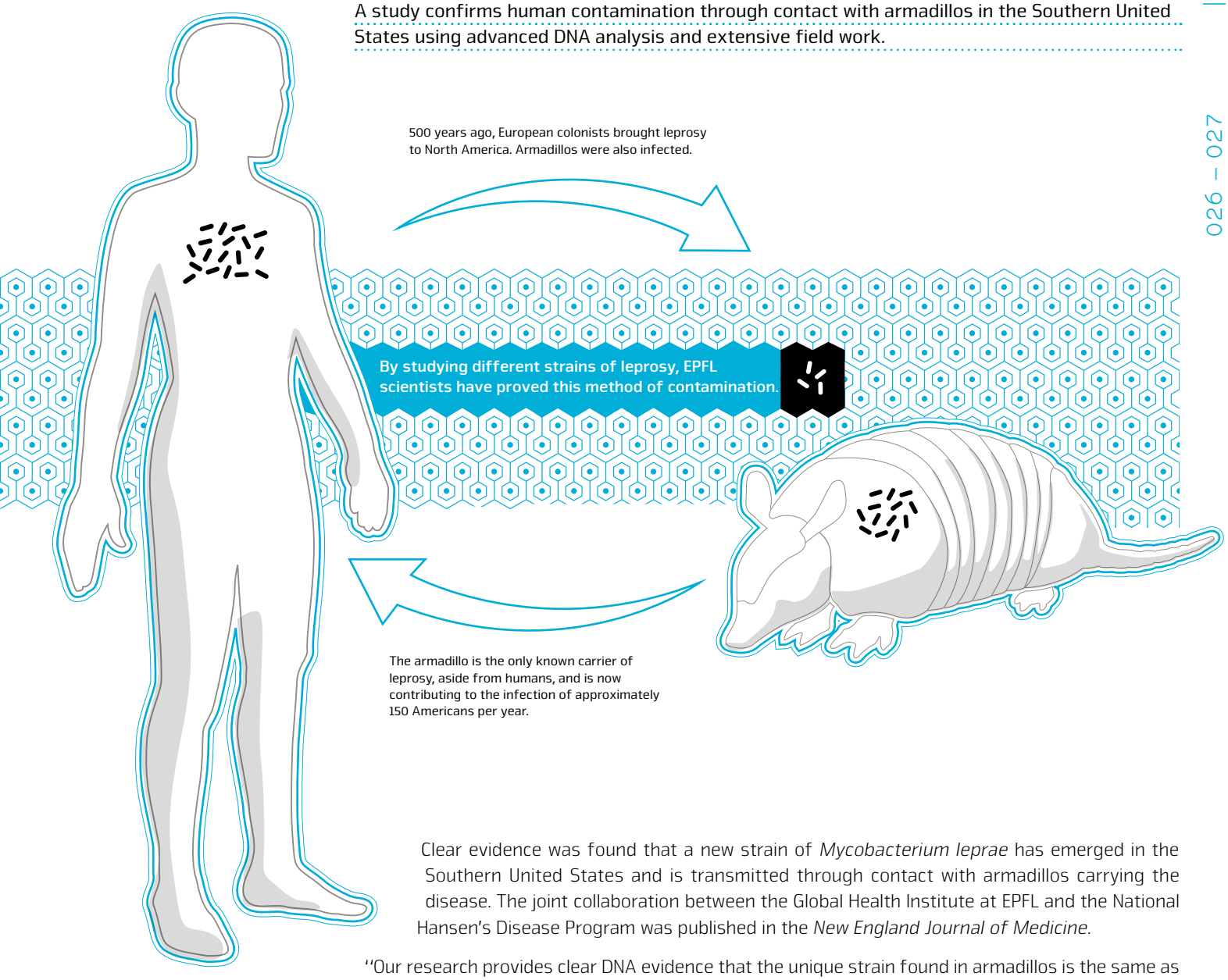
Giuseppe Foffi and team have postulated that weak links form between different groups of proteins within the normal lens and they have now confirmed using simulations that transparency depends on these very weak interactions.

No. 1

Cataracts are the main cause of blindness worldwide.

EPFL TEAMS UP WITH US SCIENTISTS TO FIND INDIGENOUS CASES OF LEPROSY

A study confirms human contamination through contact with armadillos in the Southern United States using advanced DNA analysis and extensive field work.



Clear evidence was found that a new strain of *Mycobacterium leprae* has emerged in the Southern United States and is transmitted through contact with armadillos carrying the disease. The joint collaboration between the Global Health Institute at EPFL and the National Hansen's Disease Program was published in the *New England Journal of Medicine*.

''Our research provides clear DNA evidence that the unique strain found in armadillos is the same as the one in certain humans,'' explains Stewart Cole, head of the Global Health Institute.

The researchers used gene sequencing to identify the new strain and cross check it with other known strains from Europe and Asia, and used genotyping to identify and classify the population infected. It became clear that leprosy patients who never travelled outside the US but lived in areas where infected armadillos are prevalent were infected with the same strain as the armadillos, prompting researchers to state that ''Frequent direct contact with armadillos and cooking and consumption of armadillo meat should be discouraged.''

A CYBER SKIN THAT FEELS

The prosthetics of the future could be fitted with electronic skin, directly linked to the nervous system. This could allow burn victims or amputees to regain lost sensation.

An artificial electronic skin connected to the nervous system – this is the challenge for Professor Stéphanie Lacour and her laboratory at EPFL. For the past 10 years, this scientist has been exploring the world of stretchable electronics.

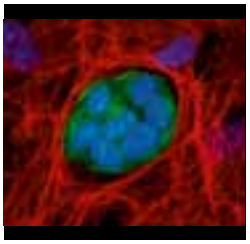
There are multiple challenges: connecting the neurons to an electronic bio-extensible system, developing flexible components, and managing to integrate them into an elastic material capable of responding to biomechanical needs. We call this 'electronic biomimicry.'

The thousands of nerve endings which run through it make the skin a complex and difficult to imitate sense organ. Skin is also flexible and elastic, stretching by 10% to 20% at the elbow. An electronic glove would have to be able to withstand these significant and complex distortions in two and three dimensions.

In her Laboratory for Soft Bioelectronic Interfaces (LSBI), Lacour is working with experts in micro/nanofabrication, electronics, robotics, and also in bioengineering and life sciences.

EARLY DETECTION OF METASTASES

Secondary tumors develop only in the presence of a protein identified by an ISREC / EPFL team. These results could open the door to new therapeutic options.



An EPFL team was able to identify a protein that plays a major role in metastasis development. By blocking this protein, scientists were able to prevent the formation of secondary cancers in mice. They were able to pinpoint several conditions necessary for the propagation of cancer. ''In particular, we were able to identify a protein, periostin, in the niches where metastases develop,'' explains Joerg Huelsken, holder of the EPFL Debiopharm Chair in Signal Transduction in Oncogenesis. ''Without this protein, the cancer stem cell does not initiate metastasis; instead, it disappears or remains dormant.''

Naturally present in the extracellular matrix, periostin plays a role in fetal development. In adults, it remains active only in specific organs – the mammary glands, bones, skin and intestine. This new research appears to prove that it plays an essential role in the environment needed by a cancer stem cell to develop a metastasis. Mutant mice, lacking this protein, have proved their resistance to the formation of secondary tumors.

''We have also developed an antibody that binds to this protein, making it inoperative, and we are hoping to use it to block the process of metastasis formation,'' states Joerg Huelsken. These experiments that blocked the periostin protein resulted in very few side effects in the mice. ''This doesn't necessarily mean the same will hold true in humans,'' the researcher cautions. ''We're not even sure that we'll be able to find an equivalent antibody that will work in humans.'' These discoveries are nonetheless very encouraging, especially since we now know that malignant tumors tend to spread more quickly than was previously believed. Preventing the development of metastases would thus appear to be an important therapeutic option that could limit the deleterious effects of cancers.

REMOTE REMOVAL OF ANTI-PERSONNEL MINES

A device developed at EPFL, in cooperation with Colombian universities, enables the remote-control explosion of improvised land-mines by using electromagnetic energy.

20 m

Researchers can explode landmines at a distance of 20 m on average.

'Improvised explosive devices' (IEDs) commonly called 'roadside bombs' are very difficult to detect. Scientists at EPFL's Electromagnetic Compatibility Laboratory have developed a device enabling the remote explosion of these mines, by using the energy from their electromagnetic impulses.

To perfect their device, researchers had to confront two major technical difficulties: first, finding a way to induce a current strong enough to set off, at a distance, the detonators of the mines, sometimes buried deep in the ground; second, being sure to attain the resonance frequencies of these mines, which are all different from one another.

Scheduled to run for a total of four years, the project financed by cooperation@epfl and the Swiss Agency for Development and Cooperation (SDC), has been undertaken in colaboration with the National University of Colombia and the University of the Andes.

HOW WILL SWISS RADIOACTIVE WASTE BE HANDLED?

EPFL scientists have been working on the issue of radioactive waste for the last 10 years. In addition to their geo-mechanical expertise, they create materials and develop tools for the verification of multiple barrier systems.

Switzerland has been using nuclear energy for nearly 40 years to generate electricity, and its five nuclear power stations cover about 38% of the country's consumption. Nuclear power is the second largest source of electricity in Switzerland after hydro-electricity. However, gradual phase-out of nuclear power is planned and the last installation is scheduled for closure in 2034. The federal law on nuclear energy stipulates that nuclear waste must be managed in Switzerland and, more specifically, that the waste is to be stored in repositories in deep geological strata.

38%

of Swiss electricity is generated using nuclear power.

There are two categories of waste: low- to medium-level radioactive waste, whose lifespan is short – from a few dozen years to a maximum of 300 years - and highly radioactive waste, which will take several million or even billions of years to become inactive. The latter is called 'final waste'.

The 'final waste' will be vitrified, meaning that it is mixed with a glass matrix, which can resist heat, irradiation and degradation through contact with water for about 300,000 years. Each glass cylinder will then be placed in a steel container and stored in a network of tunnels one kilometer deep. Several sites are currently being evaluated in Switzerland. Finally, the tunnels will be injected with sodium bentonite, a clay that expands in volume when exposed to moisture. Bentonite can absorb several times its mass in water and, when injected into the storage tunnels, it expands and fills the spaces between the cylinders and the rock.

In the underground environment, water is omnipresent and is considered enemy number one. It can damage the packaging by corrosion, with two consequences: the formation of gas and the release of radioactive particles that could be transported into the water table. Heat is also an important factor; the waste generates temperatures of the order of 150 degrees Celsius over hundreds of years, and these coupled thermo-hydro-mechanical-chemical processes are currently under investigation by the Soil Mechanics laboratory (LMS).

PROTECTING THE VALAIS BY STUDYING A RIVER THAT RUNS THROUGH IT

Work is underway to model sediment deposits carried by the Naviscence River and simulate possible scenarios for the future of the Zinal ski area, which could be threatened by the river. These research results could be of interest to other regions of the Valais.

Mountain streams transport all kinds and sizes of sediment loads, primarily rocky debris which can accumulate and become dangerous. This is the case for Zinal, located on the Naviscence River. The river rises in the Zinal glacier at the southern end of the Anniviers Valley, and is fed by several other, smaller streams as it winds its way down towards the village. Evacuating these materials to the plain below is nearly inconceivable and a solution is needed to deal with these pileups of rock and gravel, whose quantity is predicted to increase ever faster as glaciers and permafrost melt under the effects of global warming. Research has been conducted by the EPFL's Environmental Hydraulics Laboratory and CREALP (The Research Center on Alpine Environment in Sion) both in the laboratory and in the field to better understand the mechanisms at work in sediment transport and deposit. Scientists have studied the possibility of leaving them where they are, in the valley, without creating an adverse visual impact in protected areas.

MATHEMATICS AT THE SERVICE OF THE FOREST

Extreme temperatures have a severe impact on vegetation. The result is that, with climate change, some species of trees are disappearing from Swiss forests. Mathematical models developed at EPFL are coming to the rescue.

Biologists have long taken an interest in the progression of average temperatures. However, it is now acknowledged that it is extreme climate situations that actually modify vegetation. Jacques Ferrez, Chair of the Statistics Department at EPFL, and at the Swiss Federal Institute for Forest, Snow and Landscape (WSL), has published the results of a mathematical study based on ten years of data gathered in fourteen Swiss forests. These statistics enable us to understand how forests adapt to their climate. Better knowledge of the influence of these extreme temperatures under the canopy helps foresters in their decision-making. They can thus avoid maintaining tree species that are, in any case, doomed to disappear. City planners can also refine their choice of trees when designing parks and other recreational areas. In the end, statistical tools enable the comparison of the influence of various ecosystems on extremes of temperature that prevail under the canopy.

TECHNOLOGY FOR MAPPING BEDROCK IN ANTARCTICA AND SOUNDING ICE ON MARS

New antennas developed at EPFL can now sound ice layers up to several kilometers thick, as well as the bedrock underneath them. This technology should be of interest to geologists, climatologists and space scientists.

Manufactured by Professor Juan Mosig's Electromagnetics and Acoustics Laboratory (LEMA), EPFL's antennas, attached to an airplane in Antarctica, made it possible to analyze, with unprecedented precision, the composition of an ice layer nearly 3,000 meters thick, and to study the profile and depth of the underlying bedrock. This is a major advance, especially since no precise map of the bedrock buried under the ice already exists.

3,000 m

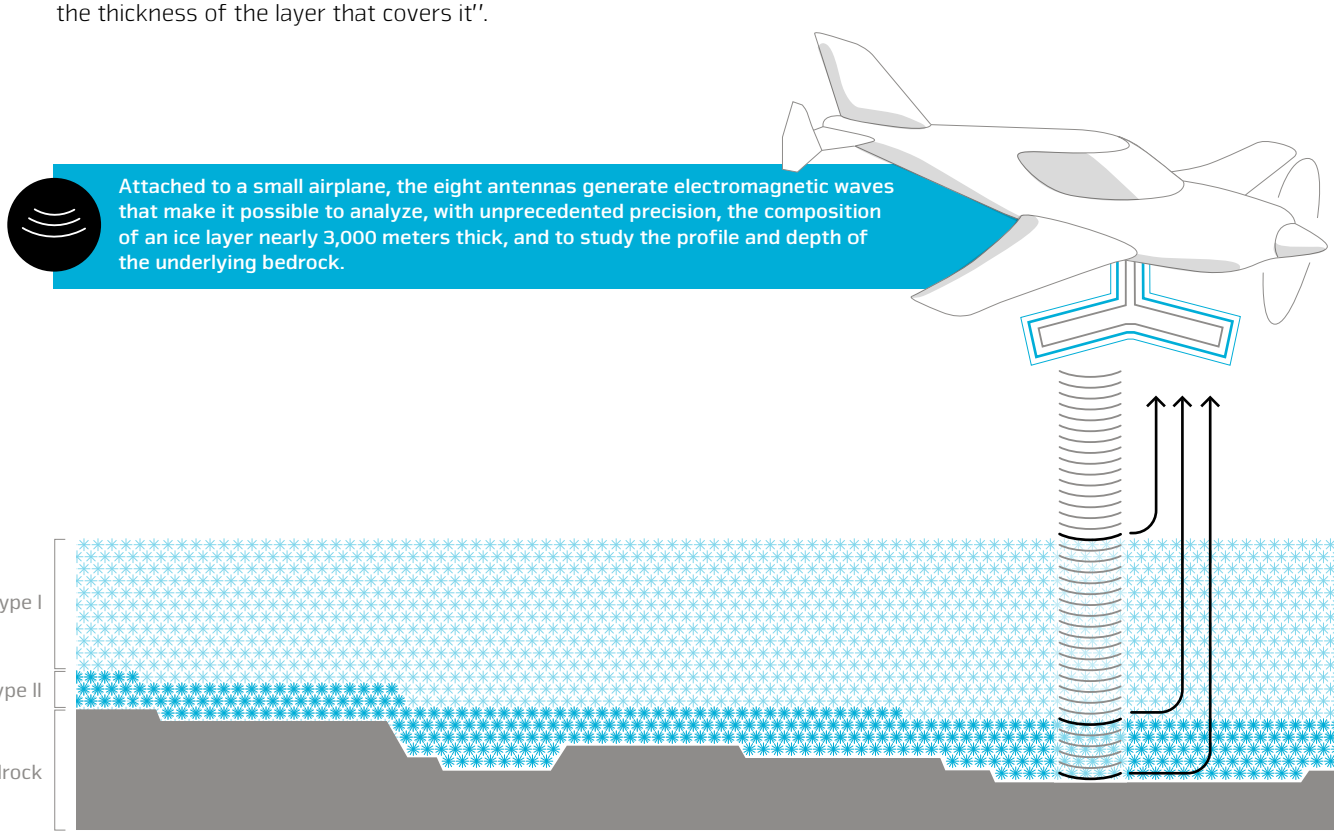
The depth of the Antarctic Ice Sheet.

Satellite planned by the European Space Agency

The EPFL antennas are part of a project known as POLARIS (Polarimetric Airborne Radar Ice Sounder), launched by the European Space Agency (ESA) and run by the Technical University of Denmark (TUD). If the tests, undertaken by plane in winter 2010 in Greenland and in spring 2011 in Antarctica, prove conclusive, the next step will be to attach these antennas to a satellite in order to analyze the Earth's entire ice layer. Eventually, ESA even aims to use this technology to study the different ice types present on Mars or on the moons of Jupiter and Saturn.

Attached to a small airplane, the eight antennas generate electromagnetic waves at a frequency of 450 Megahertz, which are in the ultra-high frequency bandwidth (UHF), similar to the waves of traditional televisions. ''Depending on its frequency, a wave can either pass through a substance or be absorbed by it'', explains Professor Mosig. ''UHF waves have the advantage of easily penetrating the ice.''

Every time a change occurs in the property of the ice, a part of the wave ricochets, returning an echo picked up by the antennas. This echo is much stronger when the wave reaches the bedrock. ''Each material, because of its properties, will alter the wave phase that is returned. Through this natural signature and the time taken by the wave to return, we can identify the type of material present, and the thickness of the layer that covers it''.



COULD THE HIGGS BOSON EXPLAIN THE SIZE OF THE UNIVERSE?

The universe would not be the same without the Higgs boson, a legend of particle physics that plays an essential role in the beginning of the universe.

The race to prove the existence of the Higgs boson has begun at CERN's Large Hadron Collider. Finding this Holy Grail of physics would help explain why the majority of elementary particles possess mass. In the universe's first moments, everything was unimaginably dense. But under these conditions, why would gravity not have slowed down its initial expansion? The theory of the Higgs boson allows us to describe the speed and magnitude of the expansion, according to Mikhail Shaposhnikov and his team from EPFL's Laboratory of Particle Physics and Cosmology. In this infant universe, the Higgs, in a condensate phase, would have behaved in a way that changed the laws of physics as we know them today—the force of gravity would have been reduced. It is the hypothetical existence of the Higgs boson that allows physicists to explain how the universe expanded at such an incredible rate. If the theory is verified with data from the Planck satellite, it would clear up several questions about our universe's past and future. The research was published in July 2011 in the journal *High Energy Physics – Phenomenology*.

EPFL ANTENNAS CHOSEN BY ESA FOR NANO-SATELLITES

The European Space Agency (ESA) has chosen EPFL to design antennas for its next generation of satellites. They will equip nano-satellites – the future major market for communication, experimentation and space observation.

An important factor in these new, small-scale satellites is their communication system. Following an international competition, ESA has chosen EPFL's Satellites for its new generation of nano-satellites. These antennas are the result of a cooperation between the Laboratory of Electromagnetics and Acoustics, the JAST company located in the EPFL Science Park and the EPFL Space Center. It is therefore a 100% Swiss consortium.

ESA sees a big market for medium-size satellites like the nano-satellites. With their reduced weight, the cost of launching is lower, and they can serve many purposes. They are of a suitable size for staying close to the Earth to perform observations of our planet. They can be deployed in groups for telecommunications, or be permanently focused on a celestial body to study exoplanets. This kind of satellite can even be envisioned for Deep Space Missions to Mars or beyond.

SKI JUMPING: ALTUS, FORTIS, CAPTUS

Quantifying the performance of a ski jumper in real conditions.
A feat accomplished, thanks to a measurement system developed at EPFL.

During ski jumps, athletes must perform a complex set of movements at speeds over 90 km/h. They must both optimize the power which propels them upwards and adopt a position which projects them forward. Take-off is therefore the crucial phase. To date, coaches have no data on the parameters of the jump itself.

In order to understand and analyze how someone like Simon Ammann or Andreas Küttel approaches the different phases of a jump, the researchers at the Laboratory of Movement Analysis and Measurement (LMAM) have fitted their jumpsuits and those of 35 athletes with sensors, that memorize jump data. Thanks to the built-in accelerometers and gyroscopes, the sensors work like a miniature laboratory.

Such measurements, coupled with close cooperation with the coaches, have demonstrated statistically that the parameters used make it possible to analyze and explain the quality of a jump. This research will help to develop tools which can be used for training junior athletes and, subsequently, to examine and optimize the performances of champions.

200-METER-LONG BRIDGES WITHOUT EXPANSION JOINTS: IS IT POSSIBLE?

Expansion joints pose major problems in the maintenance of highway bridges. After a few decades, the junction points between the structure and the road begin to show signs of deterioration. Scientists at EPFL are attempting to do away with this costly technique.

All year long, bridges undergo variations in temperature and all kinds of weather changes. They are therefore fitted at each end with concrete and steel joints enabling the structure to flex. The Achilles' heel of these elements, positioned on the abutment between the ground and the bridge, is due to the fact that they are continuously in contact with air, water and de-icing salts. After 25 to 30 years, wear and tear take their toll, and the cost of maintenance reaches into six figures.

To avoid these inconveniences, short- and medium-length bridges are now built without expansion joints. The bridge is extended with a transition slab which is buried under the embankment and absorbs the distortions. Currently, this technique only applies to structures with a maximum length of 60 meters. In October 2011, several EPFL laboratories pooled their resources and proceeded to a life-size test to confirm the hypothesis that it is possible to build very long bridges without expansion joints.

30 years

The lifespan of expansion joints that can be extremely costly to replace .

AIR QUALITY SENSORS TAKE A RIDE ON CITY BUSES

OpenSense, a project run by four laboratories at EPFL and one at ETHZ, is studying the possibility of installing sensors on the roofs of buses that circulate in cities. The goal is to measure the urban air quality more precisely.

The OpenSense project aims to measure air quality using sensors installed on buses and trams. Run by four laboratories at EPFL and one at ETHZ, this program is taking advantage of existing public transportation and telephone networks to collect data on weather, the presence of fine particles and the quantity of pollutants.

The challenges are to develop climate- and traffic-resistant sensors as well as to organize the networking of the data they collect using mobile telephone systems. In spring 2011, a test sensor box was installed on the roof of a Lausanne Public Transportation bus and another on a tram in Zurich.

A complementary study was launched with the Nokia Research Center in Lausanne (NRCL) to study other applications, such as a warning service for people who are particularly sensitive to variations in pollution levels such as children, asthmatics, the elderly or people with allergies.

EPFL PAVES THE WAY FOR POSTBUS TO DEVELOP

A study commissioned by PostBus Switzerland Ltd. and carried out by three EPFL laboratories identifies the needs and expectations of the Swiss public regarding 'combined' mobility, in order to improve its capacity in Switzerland's metropolitan areas.

Changes in territorial organization, in the distribution of populations, and in their accompanying mobility needs have led PostBus Switzerland Ltd., a subsidiary of Swiss Post, to continually adapt its service. Thanks to 'Optima', an EPFL-led three-year study carried out by some twenty researchers, PostBus Switzerland now has additional tools in hand with which to direct its strategic development in the most relevant manner possible.

The intermediate results show that PostBus has significant growth potential. Nearly two-thirds of the Swiss population lives in suburban areas, and this group is an ideal target for PostBus services. Moreover, the Swiss population is already used to changing transport during a single trip. The studies have also shown that more than 80% of the population would be likely to use PostBus services or increase their use of them.

2011, an excellent harvest of innovations

EPFL is continuing in its growth phase – with now over 100 invention disclosures – but it is not only a purely numeric progression. The quality of the results is reflected in an increase in the licenses granted to these innovative technologies. The share of research collaboration contracts has also set a record, more than CHF 25 million, which will finance research projects responding to fundamental, academic questions as well as practical, industrial ones.

Even if the difficulty of taking risks remains engrained in European culture and risk-capital is somewhat in decline, the figures confirm a reawakening of the entrepreneurial spirit. Something is happening on the campus. The ecosystem, largely supported by EPFL through initiatives such as the *Innogrants*, is seeing a blossoming of numerous ambitious projects and a greater number of young entrepreneurs. And recognition follows: the visibility of EPFL in terms of research also has proved an attraction for investors beyond the local ecosystem; funding has come from other parts of Switzerland and even from renowned international sources.

The aim of EPFL is to create a place that makes people want to do things: the desire to discover, invent and innovate.

It is a pioneering institution in Europe. In 2011, the Science Park celebrated the 20th anniversary of its founding and EPFL continues to pursue its mission to create value through the creation of spin-offs and company research centers. In the same vein, *Cap à l'international* allows young entrepreneurs to find markets that may be interested in their products as quickly as possible.

And there is a 'population growth' at Innovation Square: 11 major corporations live side by side with the 100 start-ups in the Science Park.

The entrepreneurs not only try, but they succeed in attracting attention. Among its start-ups, EPFL usually saw only one company per year benefit from risk capital support. But in just 18 months, we have witnessed substantial investments in four start-ups. Kandou, Aleva, Scala/Typesafe, and Biocartis illustrate far and wide the interest that our young entrepreneurs have succeeded in arousing among venture capitalists at an international level.

Adrienne Corboud Fumagalli
Vice-President for Innovation and Technology Transfer

VOLVO and VOLKSWAGEN want to improve the future of driving

EPFL and 16 partners, including Volvo and Volkswagen, joined together in a European project called HAVEit (Highly Automated Vehicles for Intelligent Transport) whose objective is to improve the safety and efficiency of vehicles. Among its major innovations, a vehicle the *hybrid driveline control* was presented in Sweden. This bus equipped with technology developed at EPFL in the Laboratory of Microengineering for Manufacturing (LPM), improves the energy efficiency of hybrid motors by anticipating events. For example, thanks to a camera connected to an onboard computer, capable of detecting the color of a traffic light at a distance of 130 meters.

Producing and storing hydrogen – the challenges of a fuel for the future

Clean and efficient, hydrogen is considered the fuel of the future. But it still remains expensive to produce and difficult to store.

To produce hydrogen, water must be split into oxygen and hydrogen molecules. Electrolysis makes this reaction possible, but it is a particularly energy-hungry process. It is possible to use platinum as a catalyst to improve the production rate, but platinum is a rare and costly metal. An EPFL team, led by Xile Hu, discovered an efficient molybdenum-based catalyst, amorphous molybdenum sulphides, found abundantly in nature, are efficient catalysts and hydrogen production costs can be significantly lowered. EPFL has already started an international patent filing based on the discovery, which opens numerous perspectives for industrial applications.

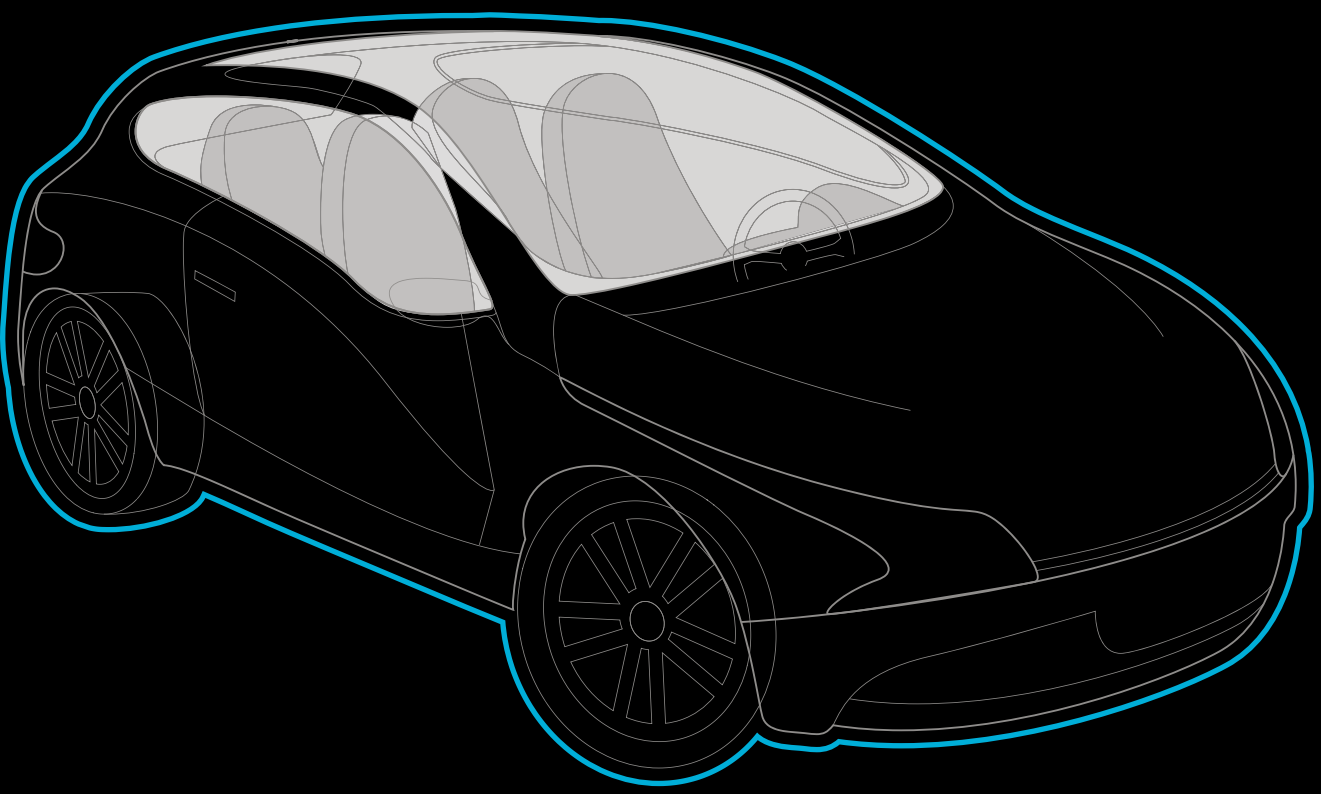
Storing hydrogen is another challenge to be met. Extremely flammable, this gas must be kept in cumbersome pressurized containers. Its use as an automobile fuel presents problems, aside from the danger of explosion, it would be difficult to fill the tank quickly. Thanks to research conducted by Gabor Laurenczy, professor in the *Laboratory of Organometallic and Medicinal Chemistry* (LCOM), these obstacles could be overcome. Using an inexpensive catalyst, scientists could transform hydrogen into formic acid, then again into hydrogen. Stored as formic acid, the fuel is liquid at ambient pressure and temperature and hardly flammable. It could then be re-transformed into hydrogen little by little according to need. The prototype is compact and could easily fit under the hood of a vehicle.

Compressed air at the pump – already a reality

In the context of a partnership with Motor Development International (MDI), which develops compressed air vehicles, EPFL scientists have solved the main drawback inherent in this technology: recharge time. They have developed a prototype for a quick-stop recharge station that can fill a tank in less than three minutes. This marks a decisive step forward for these vehicles, which are already in use on the tarmacs of some airports. This new recharging process has been verified in practice on a small-scale prototype. During this accelerated compression, the air heats up in the vehicle's tank. When it cools down, it contracts and the pressure is reduced, decreasing the vehicle's autonomy. Alfred Rufer's team designed a system that recirculates the air during filling in order to fill the tank optimally and obtain an excellent energy yield.

L'EPFL IS WORKING ON THE CAR OF THE FUTURE

In direct partnership or through European programs, the School is cooperating with the world's major vehicle manufacturers, including Volkswagen, Nissan, PSA Peugeot Citroën, Volvo, Daimler and Nissan. From the body to the motor, scientists and industry experts are working together to make this means of transportation more reliable, economical and ecological.



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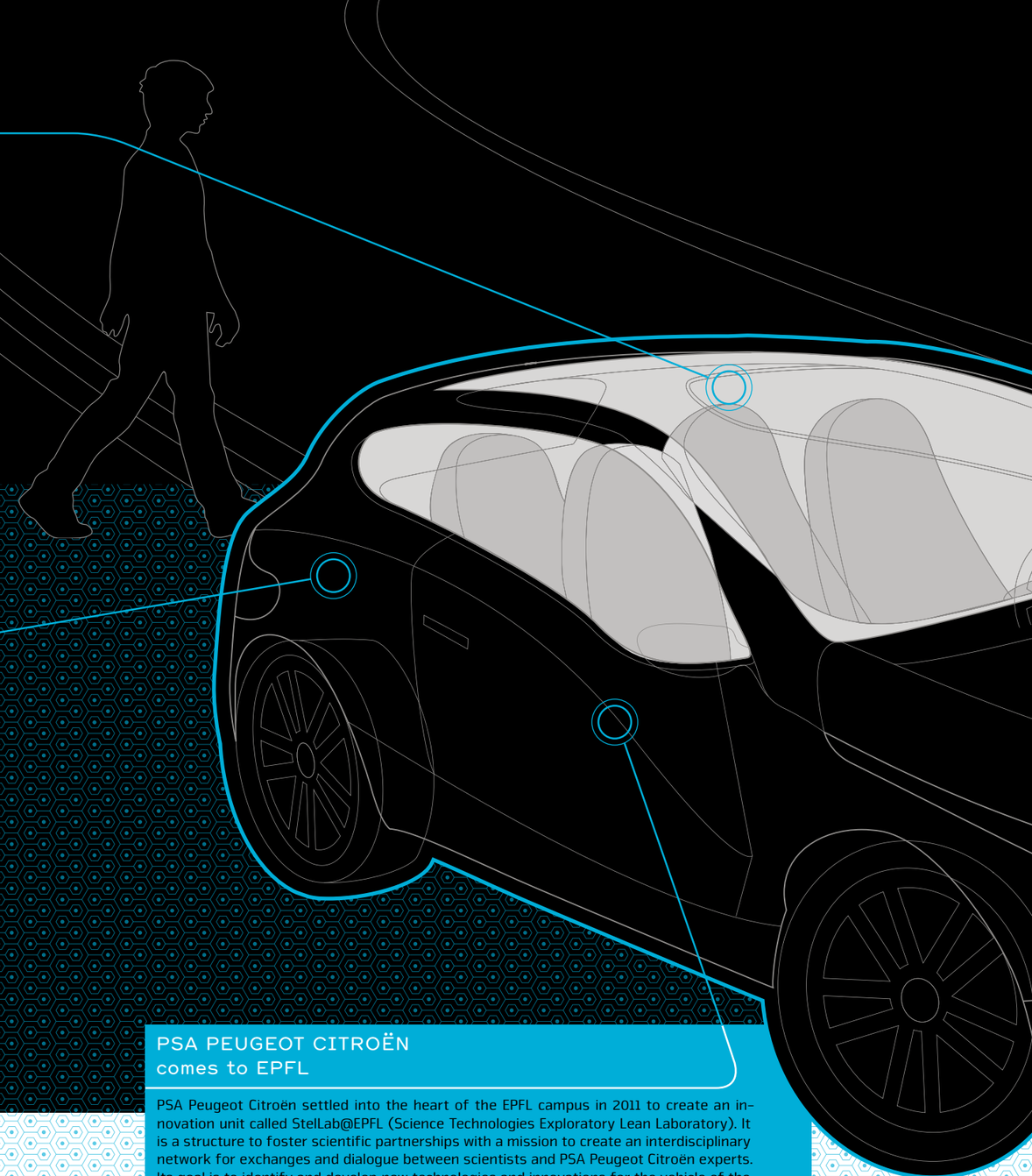

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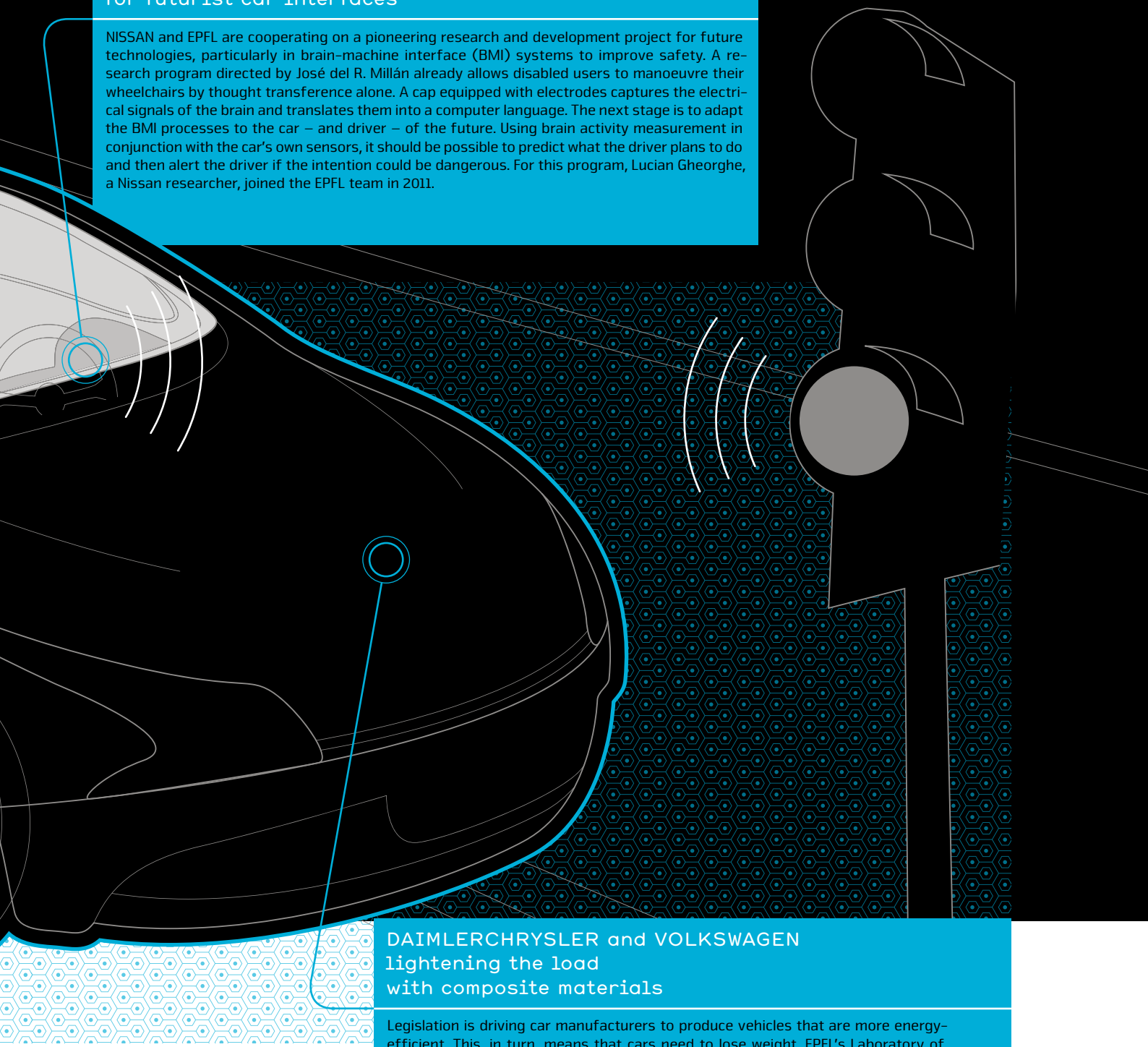
PSA PEUGEOT CITROËN comes to EPFL

PSA Peugeot Citroën settled into the heart of the EPFL campus in 2011 to create an innovation unit called StelLab@EPFL (Science Technologies Exploratory Lean Laboratory). It is a structure to foster scientific partnerships with a mission to create an interdisciplinary network for exchanges and dialogue between scientists and PSA Peugeot Citroën experts. Its goal is to identify and develop new technologies and innovations for the vehicle of the future. The auto maker wants to explore various paths in the fields of materials, robotics and environmental protection and intends, for example, to launch research projects for replacing fossil fuels.

NISSAN teams up with EPFL for futurist car interfaces

NISSAN and EPFL are cooperating on a pioneering research and development project for future technologies, particularly in brain-machine interface (BMI) systems to improve safety. A research program directed by José del R. Millán already allows disabled users to manoeuvre their wheelchairs by thought transference alone. A cap equipped with electrodes captures the electrical signals of the brain and translates them into a computer language. The next stage is to adapt the BMI processes to the car – and driver – of the future. Using brain activity measurement in conjunction with the car's own sensors, it should be possible to predict what the driver plans to do and then alert the driver if the intention could be dangerous. For this program, Lucian Gheorghe, a Nissan researcher, joined the EPFL team in 2011.



DAIMLERCHRYSLER and VOLKSWAGEN lightening the load with composite materials

Legislation is driving car manufacturers to produce vehicles that are more energy-efficient. This, in turn, means that cars need to lose weight. EPFL's Laboratory of Composite and Polymer Technology is participating in the European research program HIVOCOMP, in cooperation with leading research universities and auto makers such as Daimler and VW. The goal is to develop innovative materials for the automobile industry. Jan-Anders Månson, head of the laboratory, is in charge of preparing demonstration pieces with the first due to come out in 2013. For each piece, a complete energy balance sheet must be calculated because making a vehicle lighter to reduce fuel consumption is pointless if the pollution generated in manufacturing the lighter materials is more significant.

EPFL CREATES UNSCRATCHABLE GOLD IN COOPERATION WITH A WATCHMAKER

EPFL scientists have created 18-karat gold that is harder than tempered steel and virtually unscratchable. They combined a gold alloy with boron carbide, an extremely hard ceramic used in bulletproof vests.

With a Vickers hardness scale measurement of 1,000, this gold is harder than most tempered steels (approximately 600 Vickers). Only a diamond can scratch it. This discovery is the result of a three-year cooperation between the Mechanical Metallurgy Laboratory in EPFL's Institute of Materials, under the leadership of Professor Andreas Mortensen, and the Swiss watchmaking company Hublot.

Infiltration under pressure

By definition, gold is very soft. Hardening it while maintaining the 18-karat limit is therefore quite complex. Powdered boron carbide is heated to a temperature of nearly 2,000°C, at which it forms a rigid, porous structure. A liquid molten gold alloy (3% aluminum) is infiltrated under very high pressure into the pores of this structure, and then solidified. The result is a ceramic-metal composite material made up of two kinds of crystals that are intimately interconnected, like two three-dimensional labyrinths. The resulting gold contains 3% aluminum, 75% gold and 22% boron carbide.

2,000°C

The temperature required to form a porous ceramic into which molten gold is poured.

A NEW MOTOR FOR THE WATCHES OF TOMORROW

An electromagnetic motor, invented by EPFL's Integrated Actuators Laboratory, will enable the watchmaking industry to build watches that are three times more efficient.

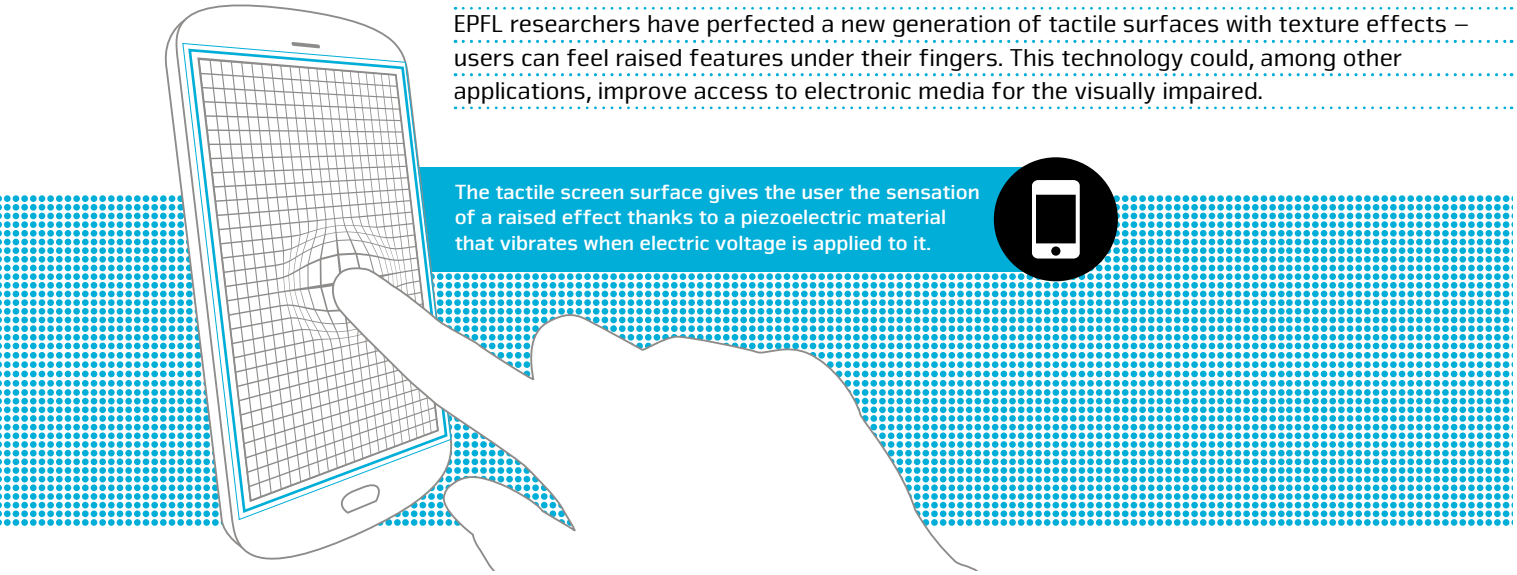
Tomorrow's wristwatches will be more efficient with batteries that will last much longer. In addition to telling time, they might offer additional functions such as a telephone, a compass or other applications requiring increased energy capacity.

EPFL's Integrated Actuators Laboratory (LAI), in Neuchatel, has made a major step in this direction with the invention of a watch motor whose efficiency is three times greater than current motors. The scientists are proposing an electromagnetic drive system. Using a fixed magnet and three phases instead of a single phase, this device has required its inventors to overcome several challenges.

To obtain these three phases, two or three cumbersome copper coils are required. The designers were therefore driven to invent a new configuration and geometry for the motor. In addition, to reduce costs, a new complex manufacturing process entailing 24 operations was developed.

A TOUCHSCREEN YOU CAN REALLY FEEL

EPFL researchers have perfected a new generation of tactile surfaces with texture effects – users can feel raised features under their fingers. This technology could, among other applications, improve access to electronic media for the visually impaired.



The tactile screen surface gives the user the sensation of a raised effect thanks to a piezoelectric material that vibrates when electric voltage is applied to it.

Researchers have developed a technique to control the texture of a screen so that the 'feeling' of specific areas can be modified underneath a user's fingertips. This technology was developed by EPFL's Integrated Actuators Laboratory (LAI) in Neuchatel and is intended for use on smartphones, computers, and vending machines.

This innovation will make devices more ergonomic. It will add another layer of information, enriching the consultation of online documents and internet sites, making video games more entertaining, or even facilitating access to smartphones and other electronic devices for the visually impaired.

To obtain this relief effect, the scientists used a piezoelectric material that vibrates when electric voltage is applied to it. The material expands and then returns to its original shape very rapidly, all at the nanometer scale. The micro-vibrations generated create a very thin layer of air between the surface and the user's finger, giving the sensation of a raised effect.

A MUCH FASTER METHOD FOR MAKING TRANSISTORS

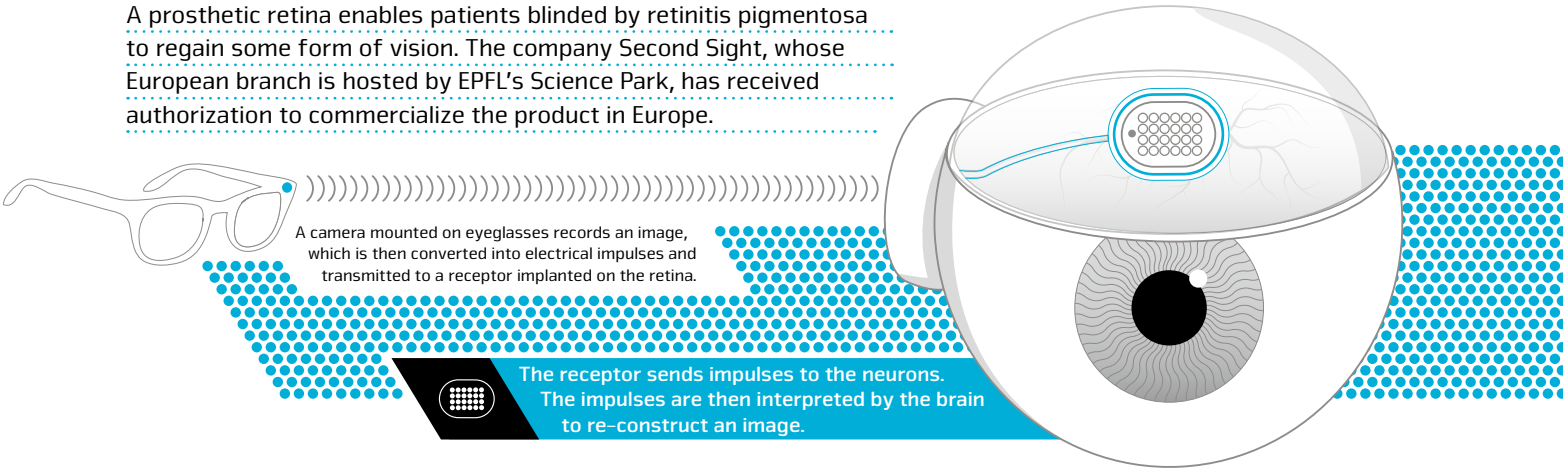
EPFL scientists are currently investigating the use of a 'moving stencil technique' or dynamic stencil lithography, a faster and cheaper method for manufacturing the miniscule structures that make up transistors and silicon chips.

In its static version, stencil lithography already demonstrates great advantages compared to the complicated and expensive processes used to make chips and transistors. The principle is simple: A substrate and a stencil with apertures of 100 to 200 nanometers (placed on top of the substrate) are put into an evaporator. During the metal evaporation, the stencil acts like a mask, and the metal is deposited on the substrate in a very specific pattern. The only disadvantage is that it is impossible to obtain different patterns in a single deposition.

Researcher, Veronica Savu, who works in EPFL's Microsystems Laboratory, led by Professor Juergen Brugger, is interested in a more promising method – dynamic stencil lithography. Her research was highlighted on the cover of the scientific journal *Nanoscale* in summer 2011. It involves creating custom designs using the same stencil. ''Our stencil with a single aperture can be moved during metal evaporation, and we can draw different patterns with the same stencil, such as a square, a circle, a line, etc.''.

GETTING SIGHT BACK – THANKS TO AN ARTIFICIAL RETINA

A prosthetic retina enables patients blinded by retinitis pigmentosa to regain some form of vision. The company Second Sight, whose European branch is hosted by EPFL's Science Park, has received authorization to commercialize the product in Europe.



For patients suffering from retinitis pigmentosa, it might literally mean some light at the end of the tunnel. A prosthetic retina can now allow them to regain the ability to identify their surroundings. Developed by *Second Sight Medical Products*, whose European base is located in EPFL's Science Park, this implant is beginning to be commercialized in Europe. Some ten patients have already benefited from the commercial product.

The device consists of a small camera mounted on eyeglasses, which records an image that is then converted into electrical impulses and transmitted to a receiver implanted on the retina, at the back of the eye. The receiver sends these impulses to the neurons, and the impulses are then interpreted by the brain to re-construct an image.

Today, the prosthetic retina has already been implanted in 30 patients as part of clinical trials. All of them have regained the ability to discern day from night. Twenty-nine of them can manage to find an object in a room and more than half can detect movement. Twenty-four can read letters on a computer screen while seven noticed a clear improvement in their visual acuity, and managed to read newspaper headlines. The start-up is working in cooperation with three EPFL laboratories to improve its system.

CAMERA REVEALS BLOOD CIRCULATION

A device for observing blood circulation in the skin using a small camera, developed by *Aïmago*, a start-up in EPFL's Science Park, will facilitate the work of burn specialists and reconstructive surgeons, for example, in breast reconstruction after cancer.

The quality of blood circulation under the epidermis allows specialists to determine precisely the severity of a burn. On the screen of the device developed by Aïmago, a start-up company located in EPFL's Science Park, the microcirculation in the tissue is displayed in real time. It is a gain in both time and reliability for the clinician.

The EasyLDI device, invented in EPFL's Biomedical Optics Laboratory (LOB), has an extremely simple appearance. It consists of a screen facing the user, a camera on the other side and a flexible arm. When the device is held above the area to be observed, the blood flow is displayed like a topographical map. The color variations reveal differences in circulation intensity over a skin surface of approximately 50 cm^2 in area and 1–2 mm in depth. The instrument is based on laser Doppler technology. Other areas of medicine, such as reconstructive surgery, wound healing, diabetes, rheumatology and neurosurgery could also benefit from this innovation.

A TOOL TO TRACK HEART RATE IN REAL TIME ON A SMARTPHONE

Patients and their doctors can now immediately be alerted of heart rate anomalies via mobile phone and can thus quickly take any necessary measures.

Detecting the onset of cardiac arrhythmias and intervening rapidly in case of a heart attack is the goal of a device developed in EPFL's Embedded Systems (ESL) and Telecommunications Circuits Laboratories (TCL).

This tool is one of a new generation of intelligent and autonomous embedded systems, called 'wireless body sensor networks', which consume very little energy and monitor human biological signals.

The system is miniaturized, light and non-invasive. Connected to a wireless network, it continuously monitors the user's heart rate remotely and in real time by means of complex algorithms. If an anomaly is detected, information is sent via smartphone to the patient and to medical personnel, who can take appropriate measures.

Other applications, such as monitoring athletic training, food consumption or physical activity are also possible. This invention is also part of the *Guardian Angels* research project (p. 23), whose goal is to develop personal assistance devices.

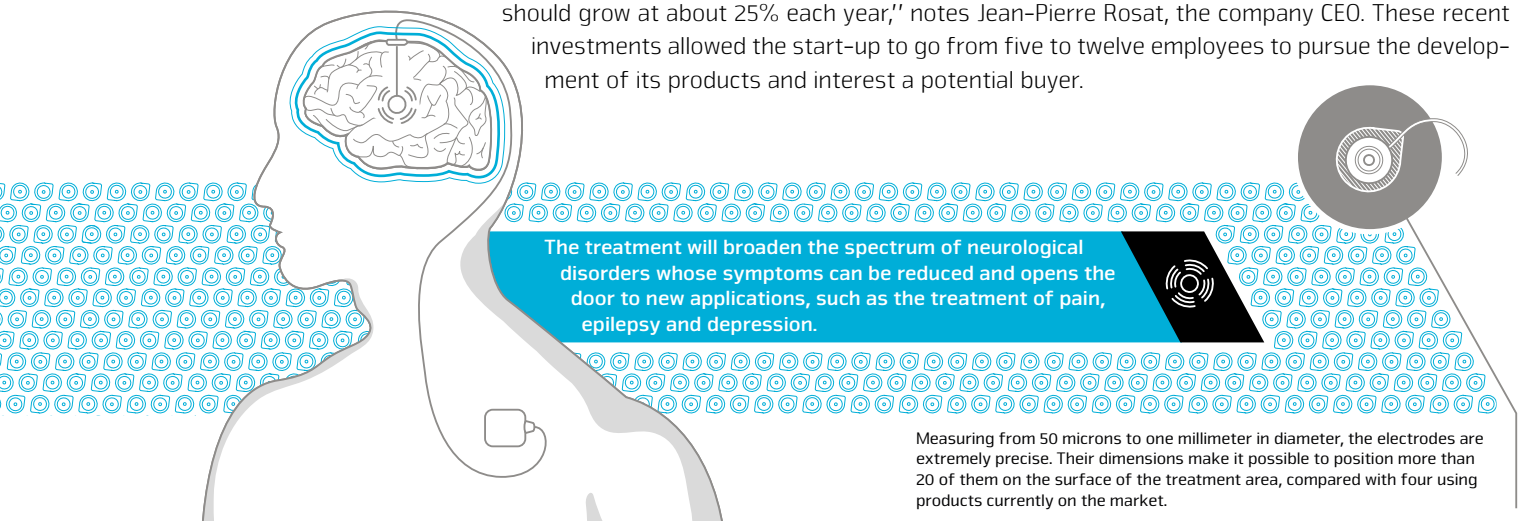
ALEVA, AN EPFL SPIN-OFF, RAISES 10 MILLION SWISS FRANCS

One of the biggest financing rounds for furthering the work of a doctoral student was completed in 2011. The microscopic electrodes developed by *Aleva Neurotherapeutics* could revolutionize Deep Brain Stimulation.

The young EPFL spin-off, Aleva Neurotherapeutics, raised CHF 10 million in August. This is certainly a School record for an innovative product resulting from doctoral work over the last 10 years. The microelectrodes currently in clinical trials could revolutionize Deep Brain Stimulation (DBS) by reducing side-effects, the risk of complications, and costs.

Measuring from 50 microns to one millimeter in diameter, they will enable improved precision. Their dimensions will make it possible to position more than 20 of them on the surface to be treated, compared with only four using products currently on the market. This will result in broadening the spectrum of neurological disorders whose symptoms can be reduced.

At a time when Deep Brain Stimulation (DBS) is gaining new applications such as the treatment of pain, epilepsy and depression, the market for these products is estimated to be around CHF 450 million. "It should grow at about 25% each year," notes Jean-Pierre Rosat, the company CEO. These recent investments allowed the start-up to go from five to twelve employees to pursue the development of its products and interest a potential buyer.



The treatment will broaden the spectrum of neurological disorders whose symptoms can be reduced and opens the door to new applications, such as the treatment of pain, epilepsy and depression.

Measuring from 50 microns to one millimeter in diameter, the electrodes are extremely precise. Their dimensions make it possible to position more than 20 of them on the surface of the treatment area, compared with four using products currently on the market.

USING VIRTUAL REALITY TO RECOVER FROM A CEREBROVASCULAR ACCIDENT

It is possible to regain mobility using a 3D avatar after a cerebrovascular accident (CVA). Developed by *MindMaze*, an EPFL spin-off, this device can be used every day at home.

The 'Nano', developed by Tej Tadi during his doctoral work at the EPFL Laboratory of Cognitive Neuroscience, represents a small revolution in rehabilitation after a cerebrovascular accident. This therapy, based on virtual reality, uses equipment that fits into a small briefcase. It consists of a screen, a webcam, a pair of dark glasses, a helmet fitted with electrodes, and a glove. The physiotherapy is based on a simple principle: the patient observes a scene, via the glasses, that virtually represents him/her in order to progressively reactivate certain regions of the brain near the damaged ones. When the patient moves their active hand, they see the 3D avatar of his disabled limb moving through the glasses. This activates a region of the cortex adjacent to the damaged area, which gradually takes over.

The exercises are then carried out with the disabled limb: stretching the arm, picking up or pointing at an object. The medical staff can receive remote feedback with a 3D-image of the brain, allowing them to observe the patient's progress. The start-up, *Mindmaze*, founded by Tej Tadi, plans to put the device on the market this year.

NEW START-UP REAPS THE BENEFITS OF SCALA – AN EPFL INVENTION

Having raised $3 million dollars, Martin Odersky has created Typesafe, a company that is enabling his programming language *Scala* – a promising alternative to Java – to gain usage on the Internet.

Twitter, Foursquare, LinkedIn and the internet site of the British newspaper The Guardian (guardian.co.uk) have adopted this programming language, developed at EPFL by Martin Odersky. The professor, based in the Faculty of Computer Science and Communication, also launched Typesafe, a new company with its offices at the EPFL Science Park. The company will give a serious boost to the *Scala* language. Scala is becoming popular with programmers, particularly for internet applications, since it is concise and enables, on average, a 50% reduction in the number of lines of code. Moreover, it is very close to Java, which has become a true standard on the internet. Finally, it is open source, which means that hundreds of people from all over the world contribute to its development, although EPFL remains the owner of the copyright. With his new company, Martin Odersky is paving the way for the future of computing.

EPFL SPINOFF TURNS THOUSANDS OF 2D PHOTOS INTO 3D IMAGES

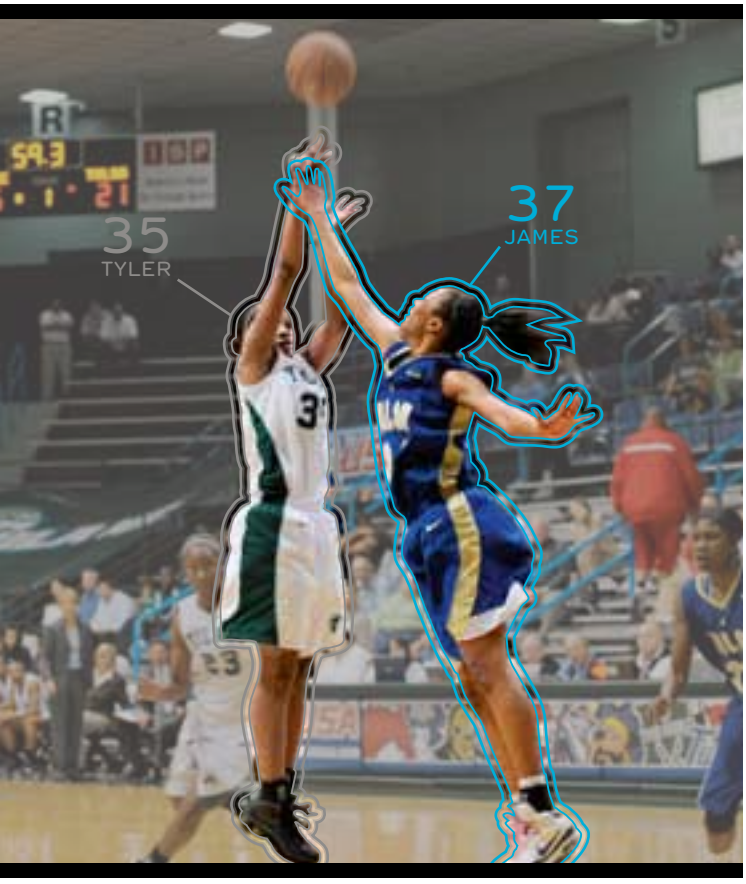
New EPFL spin-off *Pix4D* generates 3D images from simple snapshots and drones using cloud computing and takes time into account as well. Individuals and small businesses looking for fast, cheap, large-scale 3D models can get them without a big investment.

Instead of waiting for Google to update its satellite data or for an expensive plane to fly by and take high-resolution photos, it is now possible to send relatively inexpensive flying drones into the air to take pictures as often as desired. Researchers in EPFL's Computer Vision Laboratory have developed a computer program that generates a 3D image from up to thousands of these 2D shots. And with all the processing done in the cloud, the client doesn't need a powerful computer of his or her own.

The EPFL start-up *Pix4D* offers the modeling service with an added plus: a fourth dimension–time. With *Pix4D's* 3D models, you can navigate in all directions as well as change the date on a timeline to see what a place looked like at different times of the year. The company is collaborating with another EPFL startup called *senseFly* to market their software as a package with *senseFly's* micro aerial vehicles, or autonomous drones.

NEW TECHNOLOGY TRACKS MULTIPLE ATHLETES AT ONCE

Following the movements of athletes during televised matches, even when they are not visible on camera is highly desirable. EPFL's Computer Vision Laboratory has perfected an innovative system for this task, which could have implications for marketing or security.



The tool developed by EPFL's Computer Vision Laboratory makes it possible to keep track of a player on the field or court, even when the player is hidden among others. No need to continuously try to follow players; they are represented on a screen with a superimposed image bearing their jersey color and number, so their identity is always clear. This system can also provide useful information for coaches, commentators and television viewers, such as statistics on movements and actions.

Eight standard cameras and three algorithms developed by scientists (Jerôme Berclaz, Horesh Ben Shitrit, Engin Turetken, and Pascal Fua from EPFL in collaboration with François Fleuret from IDIAP) make the system work. The result is impressive. A company has bought the prototype to create, with doctoral student Horesh Ben Shitrit, a marketable tool that can be used for international sporting competitions. ''Other applications, like tracking pedestrians to monitor traffic in an area, or following the movement of customers in a store for marketing purposes, are being planned,'' adds Ben Shitrit.

The campus of tomorrow will be multi-faceted and versatile

Our campus is in a state of major transformation. Since it's creation in the 1970s, the site west of Lausanne has continually grown at the pace of its academic development. Today, it is the northern part of the campus that is expanding to accommodate large international science conventions and to further increase student-housing capacity. In the immediate future, the lecture halls and classrooms will be reviewed and the former mechanical engineering halls and central library will be renovated to become home to the Center for Neuroprosthetics and certain central services. After that, our goal to marry engineering sciences and the humanities will take shape in the form of buildings dedicated to interfaces between arts and sciences. These developments were made possible thanks to the federal government and PPP (public-private partnerships) funding.

But the challenges are still numerous, and the support of the federal government and private donors is ever more indispensable. The number of students continues to grow, as well as the number of foreign companies who wish to establish themselves in the Lake Geneva Region. The years 2012 and 2013 will also be decisive for our large European FET Flagship projects.

The campus of tomorrow needs to be fluid and flexible, and all forms of knowledge will be ever more disseminated throughout society. In Neuchatel and, since 2012 in Valais, the EPFL has affirmed its presence in French-speaking Switzerland and set up institutes closely tied to the industrial and economic activities of these cantons. On the international level, EPFL is at the head of ambitious partnerships, whether it be through our network of North-South cooperation (Rescif) or through our collaborations with Harvard and MIT. Finally, the campus is ever more open to society through our initiatives with the young and the general public–almost 100,000 visitors participated in our outreach activities in 2011.

Francis-Luc Perret
Vice-President for Planning and Logistics

THE CAMPUS CONTINUES TO GROW

Spectacular and exemplary

The 'Northern Quarter' is out of the ground! Construction work on the Swiss Tech Convention Center and lodging for more than 500 students began in January 2011 and will last three years.

FINANCING
Entirely funded by two investment funds from the Credit Suisse Asset Fund.
Budget: CHF 225 million.

MODULARITY
The Gala system will allow the 3,000-seat auditorium to be easily converted into smaller spaces according to the user's needs.

SOCIAL LIFE
In addition to new housing for 520 students, a number of shops and services will be located in the new area.

ECOLOGY
The Swiss Tech Convention Center will also serve as a testing ground for several energy technologies developed at EPFL. Three geothermal piles will serve as building supports and heat exchange systems and the building will incorporate a further improved heat exchange system using lake water. In addition, the Center's main atrium windows will be equipped with transparent Graetzel solar cells that will generate electricity.

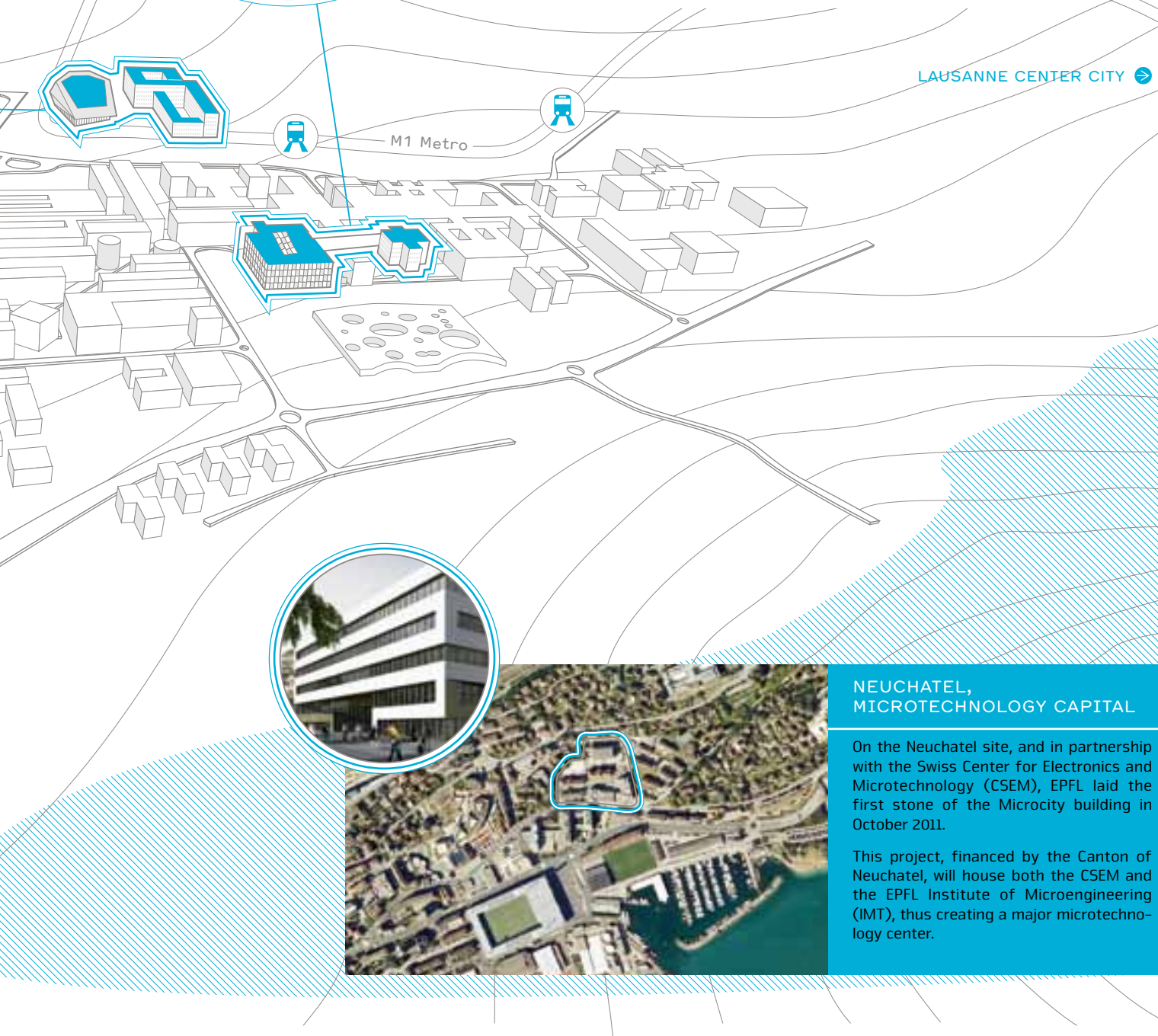
Building renovation

Architect Dominique Perrault, famous for his work on France's National Library, was chosen in January 2011 to transform the former mechanical engineering hall and central library.

Located in the heart of the campus, these buildings will give new life to the main axis of circulation leading from the Rolex Learning Center to the M1 metro station. They will be an integral part of Dominique Perrault's urban plan for the School and will accommodate the Center for Neuroprosthetics, laboratories and administrative areas.

Long-term development

In the second phase of the project, the ambitious 'Teaching Bridge' should establish a link between two historic parts of the EPFL campus, the Centre Midi and the Centre Est. It would house rooms for a new type of practical exercise, designed to modernize the education offered to students. Its realization is dependent upon obtaining private funding.



NEUCHATEL, MICROTECHNOLOGY CAPITAL

On the Neuchatel site, and in partnership with the Swiss Center for Electronics and Microtechnology (CSEM), EPFL laid the first stone of the Microcity building in October 2011.

This project, financed by the Canton of Neuchatel, will house both the CSEM and the EPFL Institute of Microengineering (IMT), thus creating a major microtechnology center.

EPFL SCIENTISTS IN HAITI TO COMBAT CHOLERA TRANSMISSION

Two EPFL laboratories have rallied around Terre des Hommes Lausanne. They have created a working group with two aims: developing tools capable of predicting how cholera bacteria spread, and organizing efficient healthcare initiatives.

In January 2010, an earthquake – over 7.0 on the Richter scale – devastated Port au Prince. A state of emergency was declared. Over 10,000 NGOs, as well as United Nations personnel, were dispatched to the country. This aid was confronted with serious outbreaks of cholera. Without waste water treatment facilities, everything flowed into the rivers, which transported the bacteria and spread the disease.

In 2011, researchers in hydrology, microbiology and epidemiology traveled to the site to verify a spatial model, was developed at EPFL, that allows to predict the distribution of pathogenic bacteria. This tool designed to improve care logistics. During their trip, members of the Laboratory of Ecohydrology (ECHO) and the Laboratory of Molecular Microbiology (UPBLO) were able to gather essential data to better understand the phenomenon.

NORTH-SOUTH TECHNOLOGY COOPERATION TAKES OFF

The first summer school of the Network of Excellence in Engineering Sciences of the French-speaking Community (RESCIF) took place in October 2011. This network comprising 14 North and South educational institutions aims to generate cooperative ventures centered on three themes of concern for the future: water, energy and nutrition.

Created in October 2010 at the Francophonie Summit in Montreux, at the initiative of EPFL and with the official support of the Swiss authorities, the RESCIF network brings together 14 francophone technology institutes in Asia, Africa, Europe, and the Americas. It aims to generate cooperative ventures on three themes essential to the future: water, energy and nutrition.

In April 2011, the presidents of these universities defined a first series of projects. They are divided into four categories: setting up joint research and teaching laboratories, a project in Haiti with the goal of rebuilding two universities, development of a 'Student RESCIF' to stimulate direct exchanges among students at the master and doctorate levels at all the member institutions and the launch of a competition to find new ideas, innovations and start-ups. The first summer school was held in Rabat from October 12 to 14, 2011, and bought 35 researchers working on the topic of water together.

REVEALING THE ARTIST BEHIND ARCHITECT LE CORBUSIER

ENAC professor Roberto Gargiani is the author of a richly illustrated book with 1,350 full color photographs, plans, and sketches entitled 'Le Corbusier: Béton Brut and Ineffable Space, 1940–1960.'

"I received your handwritten letter from the 28th of September 1962 with eight color photographs, five of which are of the High Court with its new colors. I am extremely bothered and saddened to see such colors. I never gave the order for such colors. . ." So begins a letter from architect Charles-Édouard Jeanneret (better known as Le Corbusier) to his cousin Pierre Jeanneret about the Chandigarh, India, worksite. It is just one of many such letters and other unpublished documents that Anna Rosellini and Roberto Gargiaini uncovered in the archives of the Fondation Le Corbusier in Paris. All together, these bring new light to the architectural oeuvre of the 20th century's most famous architect.

The exhaustive research carried out by the authors provides valuable new insight into the aesthetic principles of Le Corbusier during the post World-War-II period. They explain his manner of defining the final artistic quality of the work directly at the construction site as if he were dealing with a sculpture or tableau, for example. *Béton brut*, a term invented by Le Corbusier at the beginning of the 1950s to describe his use of exposed concrete, is analyzed from all angles for the first time: fabrication, final formation and texture, and surface treatment.

Gargiani and co-author Anna Rosellini describe the convergence of artistic expression into what Le Corbusier defines as the *espace indicible* (ineffable space), including both the role of tapestries and paint to qualify these spaces and the use of photography to study the unexpressed potential of his architecture and paintings.

The book examines questions of optics, artistic vision, and the psychophysiology of perception in parallel with technical questions about materials. This examination of Le Corbusier's last and fundamental works decodes both the architect's vision and his quest for architectural and artistic solutions – solutions that are still defining the course of modern architecture today.

EUROTECH: EPFL STRENGTHENS ITS PRESENCE IN BRUSSELS

Four European institutes of technology are joining forces. The primary objective of the consortium is to strengthen the presence and influence of these universities at the headquarters of the European Union. A research program and cooperative projects are also planned.

Creating an office in Brussels is one of the primary goals of the Eurotech network. This consortium of four institutes of technology (EPFL, the Technical University of Denmark, Eindhoven University of Technology and the Technical University of Munich) will have a coordinator at the headquarters of the European Union, who will represent the four institutions.

A common research program centered on ''technical solutions to the great challenges of our society'' will also constitute an essential part of the activities. Still in the testing phase, it began this year on the theme of 'clean technologies'. Between now and the end of the year, specific research topics, as well as the desired mode and means of cooperation will be defined. One million euros per year and per institution are to be invested.

Cooperation agreements with regard to courses and teaching will also be part of the package. A bilateral project, for example, will allow EPFL students in environmental sciences to take courses for one or two years at the Technical University of Denmark and vice-versa, in order to enrich the palette of courses offered.

ACADEMIC RESEARCH MEETS THE CHALLENGES OF THE WATCHMAKING INDUSTRY

Developing new high-tech materials and cutting edge technologies is the goal of the Patek Philippe Chair. Created in cooperation with EPFL, the Chair will be associated with the Institute of Microengineering (IMT) and based in Neuchatel.

One of Switzerland's leading watchmaking companies, Patek Philippe, joined forces with EPFL to create the Patek Philippe Chair, dedicated to the application of new micro- and nanotechnologies to watchmaking.

This Chair will be part of the Neuchatel-based Institute of Microengineering (IMT), which has been part of EPFL since 2009. Thanks to its advantageous location near the Jura region, the historical home of many watchmaking company headquarters, this Chair will build a bridge between the private sector and academic research.

The watchmaking industry provided more than 50,000 jobs and CHF 19.3 billion in exports in 2011. To maintain this position and its competitiveness, the industry must continually innovate.

The research touches on all production phases: from manufacturing processes to escapement mechanisms to components that must be made more efficient, uniform, robust and easy to assemble. A particularly important area of exploration will be developing new, high-tech materials.

ROBOTS AND CHEMISTRY AT THE FOREFRONT IN 2011

Some thirteen thousand participants came to the Robotic Festival, beating the record for attendance. EPFL also highlighted laboratory work in this 'Year of Chemistry.'

13,000

Visitors on campus for the 2011 Robotics Festival.

iCub demonstrations fill halls. This humanoid robot developed in Italy serves as an experimental platform for many laboratories worldwide. The public had the opportunity to interact with this little machine about the size of a three and a half year old child that can see, speak, learn to recognize things and learn to use them. iCub has some fifty degrees of freedom of movement, compared to 200 for the human body.

But an undeniable hit of the festival was the arrival of 'Superpattt', a robotic insect-like toy several centimeters long, distributed to more than 5,000 children. These lucky kids could watch excitedly as their little bugs with vibrating legs ran obstacle courses or meandered through labyrinths.

The Robotic Festival is coordinated by Francesco Mondada and Mariza Freire of the Laboratory of Robotic Systems (LSRO) at EPFL, in cooperation with numerous schools, universities of applied sciences, other universities and companies in Switzerland and Europe.

Chemistry can taste good!

In honor of the International Year of Chemistry (2011), five workshops and shows were set up for school children at EPFL. One of the workshops held particular appeal for lovers of fine food. Participants had the delicious pleasure of extracting essential oil from oranges to flavor chocolate. The chemistry show concocted strange mixtures on stage resulting in impressive pyrotechnic reactions. The audience was spellbound.

In addition, three science camps for girls were dedicated to the discovery of this discipline. The participants, from 11 to 13 years of age, were able to work in a real chemistry laboratory, perform specially designed experiments and meet researchers. Finally, more than 2,500 pupils participated in the chemistry workshop developed for the French-speaking schools in Switzerland, thanks to the travelling bus 'Science, ça m'intéresse!'

OUTLOOK

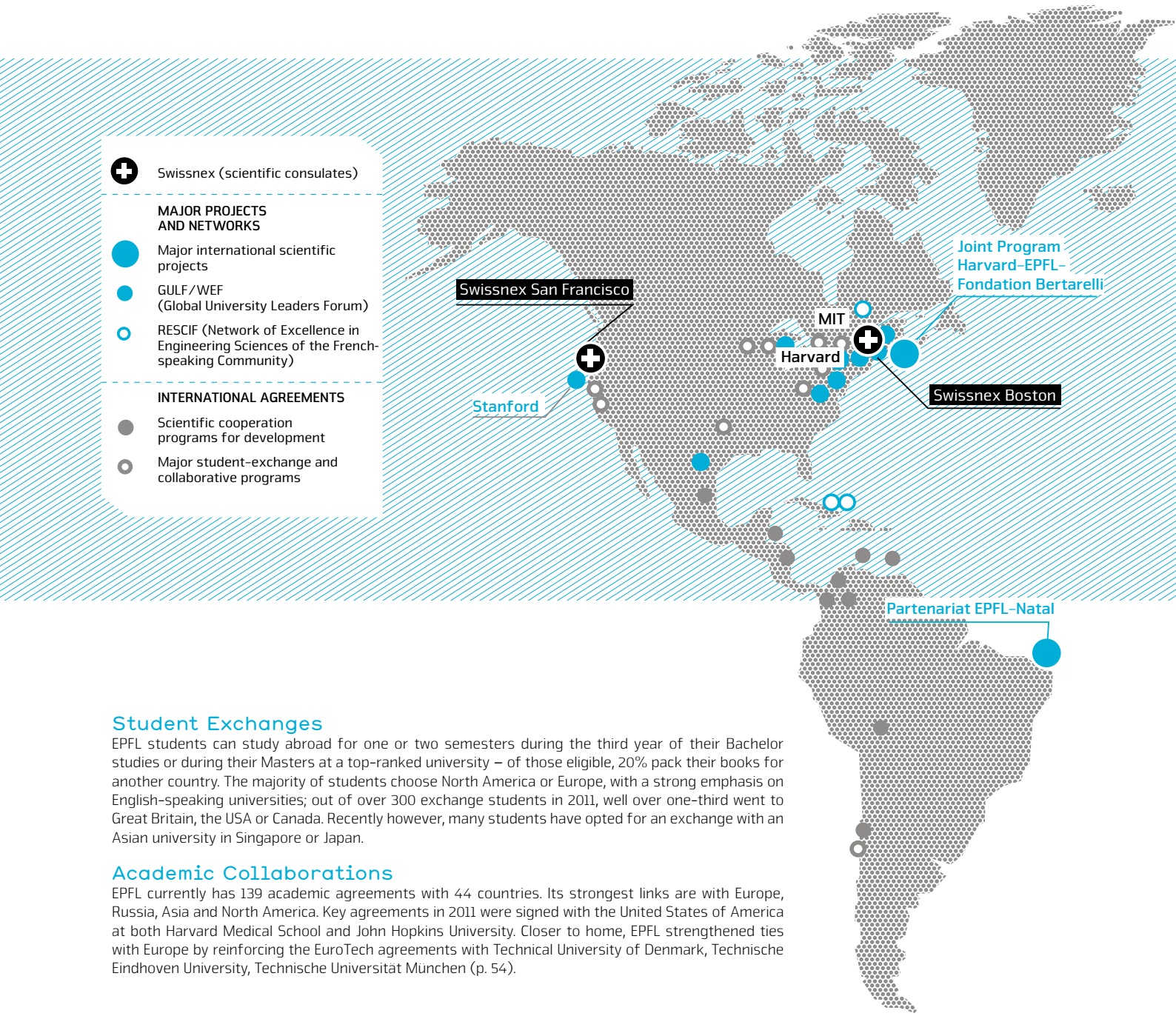
EPFL's International Outlook

EPFL contributes to Switzerland's reputation abroad as a country that invests in its future by encouraging science and technological excellence as well as promoting high educational standards.

Through collaborations with other universities around the world, student exchange programs and attracting the brightest scientific talent onto campus, EPFL is not only a local motor of economic and cultural growth but sends a positive message of Swiss innovation and education far beyond Swiss borders.

Atop the list of landmark international collaborations in 2011 is an important joint program in neurosciences signed between Harvard Medical School and EPFL – the first of its kind (p. 12). Yet international scientific collaborations also happen on a small scale; over 20% of eligible EPFL students travel abroad to participate in exchange programs, creating intimate links between countries that span a whole generation.

EPFL's ties with its European neighbors have been strengthened by the ongoing collaboration between EuroTech (p. 54) as well as its excellent results in obtaining European Research Grants. Worldwide, the EPFL-led network RESCIF (p. 52) was launched in 2011 and combines resources among French-speaking countries to spur development.



Student Exchanges

EPFL students can study abroad for one or two semesters during the third year of their Bachelor studies or during their Masters at a top-ranked university – of those eligible, 20% pack their books for another country. The majority of students choose North America or Europe, with a strong emphasis on English-speaking universities; out of over 300 exchange students in 2011, well over one-third went to Great Britain, the USA or Canada. Recently however, many students have opted for an exchange with an Asian university in Singapore or Japan.

Academic Collaborations

EPFL currently has 139 academic agreements with 44 countries. Its strongest links are with Europe, Russia, Asia and North America. Key agreements in 2011 were signed with the United States of America at both Harvard Medical School and John Hopkins University. Closer to home, EPFL strengthened ties with Europe by reinforcing the EuroTech agreements with Technical University of Denmark, Technische Eindhoven University, Technische Universität München (p. 54).

European Research and Grants

The European Research Council (ERC) has awarded EPFL a total of 48 grants over the last five years for a total sum of over 90 million Euros – placing EPFL in the company of Cambridge and Oxford for the top-tiered European universities in grant allocation.

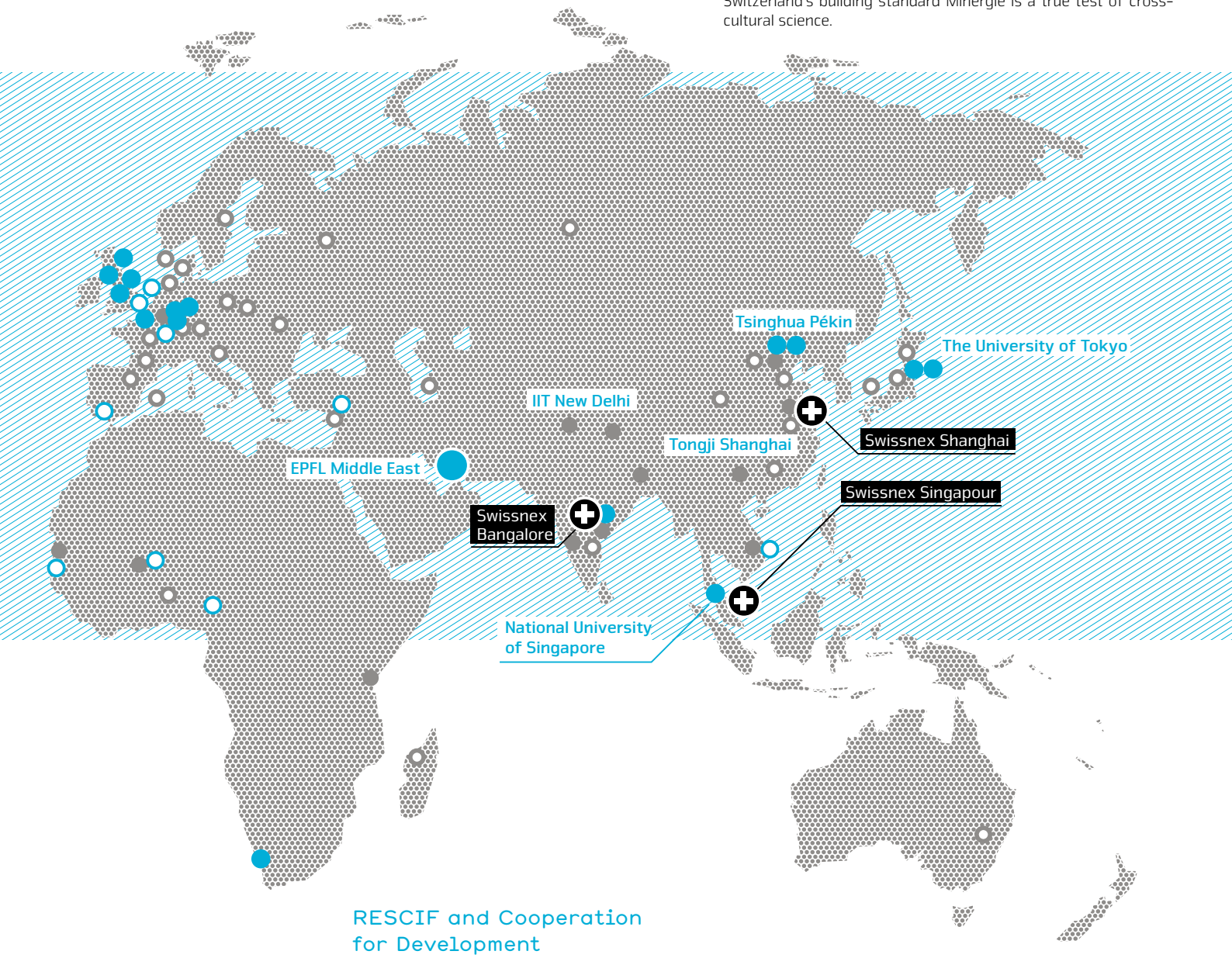
EPFL also excels in Europe's more general research grant program, the The Seventh Framework Programme (FP7). FP7 groups all research-related EU initiatives together, including ERC grants. EPFL currently benefits from the EU program with financing at over 210 million Euros and had 65 grant proposals accepted in 2011.

EPFL Middle East (ME) – Executive Education, Master's Program and PhD projects

Ras Al Khaimah, UAE. The specialized EPFL ME Master of Science in Energy Management and Sustainability started in September 2011 with 20 pioneering students. The emphasis on energy management is designed to build a curriculum that matches the needs of Middle East countries with EPFL's expertise.

In 2011, EPFL Middle East organized a number of executive courses around the themes of transportation and infrastructures in Dubai and Ras Al Khaimah.

Currently, twelve doctoral students are working on projects that span various domains such as wind engineering, smart grids, and architecture. A doctoral project to assess the feasibility of applying Switzerland's building standard Minergie is a true test of cross-cultural science.

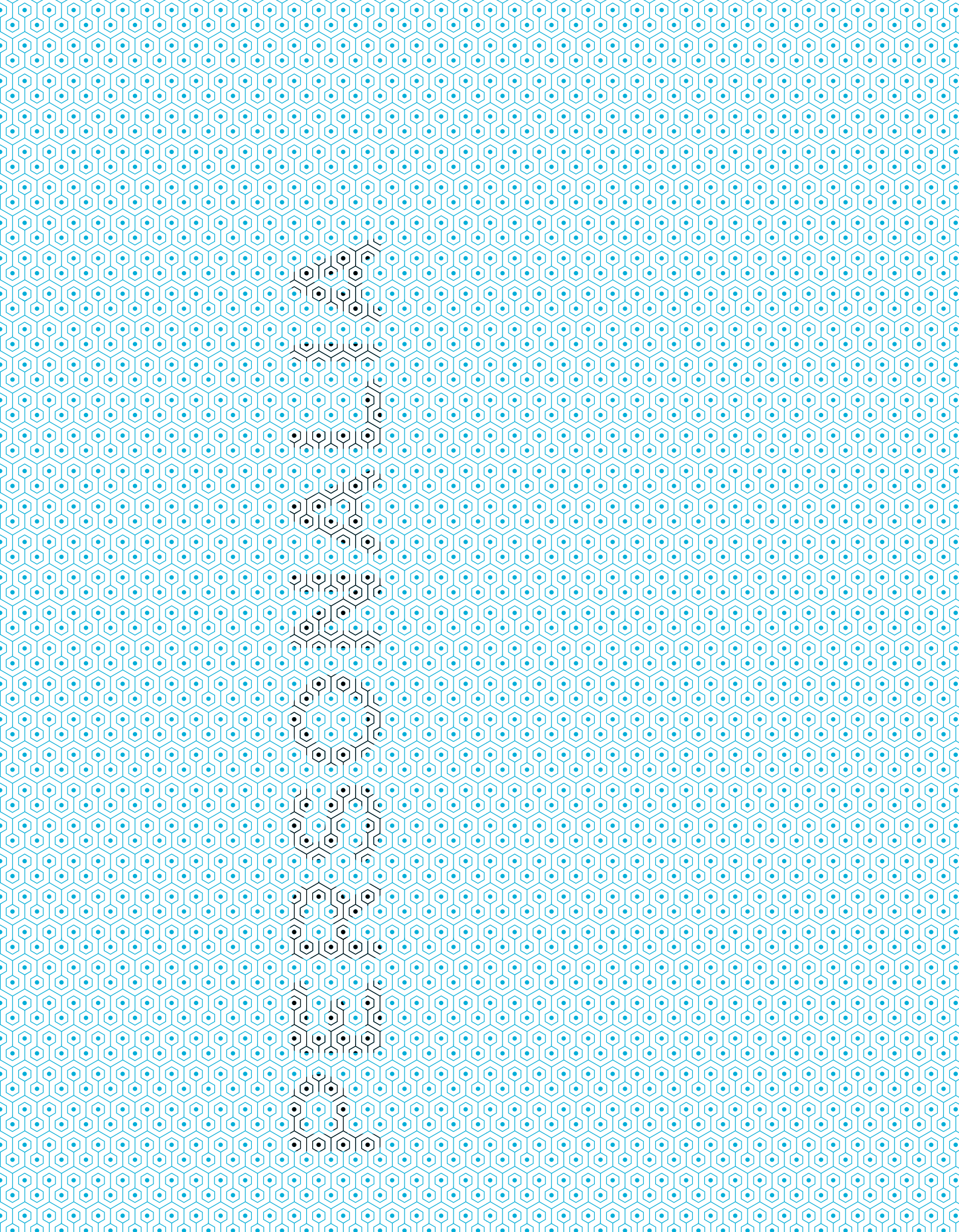


RESCIF and Cooperation for Development

Launched in 2011, The EPFL-led Network of Excellence in Engineering Sciences of the French-speaking Community (RESCIF) groups French-speaking European, American, African and Asian universities, into a global network with the goal of encouraging technological innovation (p. 52).

Other cooperations headed by EPFL include agreements with Chile, China and Brazil – all aimed at pooling human and scientific resources to better manage water, energy and nutrition in developing countries.

OUTLOOK



PROFESSORS NOMINATED IN 2011

Fabrizio Carbone

Tenure Track Assistant Professor of Physics

CADMOS Chair in Numerical Algorithms and High-Performance Computing

Daniel Kressner

Tenure Track Assistant Professor of Mathematics

Michele De Palma

Tenure Track Assistant Professor of Life Sciences

Dario Floreano

Full Professor of Intelligent Systems

Edgard Gnansounou

Adjunct Professor of Energy Planning

Herbert Shea

Associate Professor of Microsystems for Space Technologies

Jean-Philippe Thiran

Associate Professor of Signal Processing

Neva Foundation Chair in bio-organic chemistry and molecular imaging

Elena Dubikovskaya

Tenure Track Assistant Professor of bio-organic chemistry

Hilal Lashuel

Associate Professor of Life Sciences

CADMOS Chair in Scientific Computing and Uncertainty Quantification

Fabio Nobile

Associate Professor of Mathematics

EOS Holding Chair in Electrical Networks

Mario Paolone

Associate Professor of Electrical and Electronic Engineering

Aleksander Madry

Tenure Track Assistant Professor of Computer Science

Satoshi Takahama

Tenure Track Assistant Professor of Atmospheric Chemistry and Air Quality

Patrick Thiran

Full Professor of Computing and Communication Systems

IRP Chair in Spinal Cord Repair

Grégoire Courtine

Associate Professor of Life Sciences

Joseph Sifakis

Full Professor of Computing and Communications Systems

Debiopharm Chair in Signal Transduction in Oncogenesis

Joerg Huelsken

Associate Professor of Life Sciences

Kevin Sivula

Tenure Track Assistant Professor of Chemical Engineering

Katerina Argyraki

Tenure Track Assistant Professor of Computing and Communication Systems

George Candea

Associate Professor of Computing and Communication Systems

Paolo Ienne Lopez

Full Professor of Computer Science

Petrosvibri Chair in long-term underground storage of CO_2

Lyesse Laloui

Associate Professor of Geo-engineering and CO_2 storage

Olivier Martin

Full Professor of Nanophotonics and Optical Signals

Silvestro Micera

Associate Professor of Bioengineering

Jamie Paik

Tenure Track Assistant Professor of Mechanical Engineering

Romuald Houdré

Adjunct Professor of Quantum Optoelectronics

Jeffrey Jensen

Tenure Track Assistant Professor of Life Sciences

César Pulgarin

Adjunct Professor of Chemistry of Advanced Oxidation Processes

Donna Testerman

Adjunct Professor of Group Theory

Thomas Weber

Associate Professor of Operations Management

Pierre Collin-Dufresne

Professor of Finance

Michael Lehning

Full Professor of Cryospheric Science

Anders Meibom

Full Professor of Earth Sciences

Frank Nüesch

Adjunct Professor of Materials Science and Engineering

DONORS 2011

THANK YOU TO ALL OUR DONORS

EPFL would like to sincerely thank all donors for their tremendous commitment to science, education and development. In 2011 they have contributed extensively to the quality of research, teaching and life on campus

Argaman Foundation
Collaborative program in Neuroscience with the Hebrew University of Jerusalem

Amplidata
Digitalisation and valorisation of the Montreux Jazz Festival archives

Audemars Piguet SA
Digitalisation and valorisation of the Montreux Jazz Festival archives

Axa Research Fund
Grants for PhD students and postdoctoral researchers

Banque Cantonale Vaudoise
Sports and Health Center

Fondation Bertarelli
Bertarelli Foundation Chair in Cognitive Neuroprosthetics
Bertarelli Foundation Chair in Neuroprosthetic Technology

Mrs Sylviane Borel et M. Daniel Borel
The WISH Foundation for the promotion of women in Science

Constellium
Constellium Chair in Materials research

Debiopharm SA
The Debiopharm Chair in oncologie

Consulat honoraire de la Fédération de Russie
elemo (exploration des eaux lémaniques)

Fondation Defitech
Defitech Chair in Non-invasive Brain-machine Interfaces

EOS Holding SA
The EOS Chair in Distributed Electrical Systems

Dr Julia Jacobi
The Julia Jacobi Chair in Photomedecine

KPMG SA
INNOGRANTS for the promotion of entrepreneurial spirit

Pierre Landolt et associés Banque Landolt & Cie
The Landolt Chair in Innovation Strategies for a Sustainable Future

Loterie Romande
Public exhibition for the elemo project (Lake Geneva exploration)

Mr Charles Maillefer
The Euler Program for mathematically gifted children

Montreux Sounds SA
Digitalisation and valorisation of the Montreux Jazz Festival archives

Fondation Neva
The Neva Chair in Bio-organic Chemistry and Molecular Imagery
Collaborative program in diabetes with PERM State University, Russia

Patek Philippe SA
The Patek Philippe Chair in Micro-nanotechnologies

Mr Frederik Paulsen
elemo (exploration des eaux lémaniques)

Professor J. Rappaz
The Euler Program for mathematically gifted children

Mrs Theresa Rydge
Digitalisation and valorisation of the Montreux Jazz Festival archives

Merck Serono SA
The Merck Serono Chair in oncology, The Merck Serono Chair in neurodegenerative diseases
The Merck Serono Chair in Drug Delivery

Mr Vasiliev Shaknovsky
Digitalisation and valorisation of the Montreux Jazz Festival archives

Mr Dan Stoicescu
The Euler Program for mathematically gifted children

Nestlé SA
The Nestlé Chair in Energy Metabolism

Fondation Novartis
Scholarships for Masters courses in the Life Sciences

Petrosvibri SA
The Petrosvibri Chair for CO_2 Storage

Mr Jacques de Saussure
The Euler Program for mathematically gifted children

La Poste
La Poste Chair in network Industry Management

Fondation de famille Sandoz
The Sandoz Family Foundation Chair in Neural Coding and Neuroprotheses

Swiss Finance Institute
Supports seven Chairs in Financial Engineering

Swissquote SA
The Swissquote Chair in Quantative Finance

Fondation swissUp
The swissUp Chaire for the Promotion of Women Professors

We would also like to thank the following supporters of our collaborative program with the Hebrew University of Jerusalem in Neuroscience.

Mr & Mrs Nordmann, Mr David, Lasphere SA, Mr Maurice Alain Amon, Mr Benveniste, Mr Benguigui, Mr Ohay, Mr Amar, Mr Shama, Mrs Jacoby, Juledja Ltd, Mr Assaraf, Mr Rubensein Epous, Maus Frères SA, Philnor Stiftung, Mrs Cohen, Mirelis investrust SA, Mr de Picciotto, Mrs Netter, Mrs Lagonica, Mr & Mrs Guessous Schinasi, Art Administration Ltd, SAS Prince d'Arenberg.

HIGH-LEVEL SCIENTISTS HONORED

Four internationally renowned scientists received honorary doctorates at the Masters graduation ceremony in 2011.

Hanna and Antonio Damasio created the Brain and Creativity Institute at the University of Southern California, which seeks to better understand the neurological underpinnings for a large array of mental functions – from emotion and decision-making to innovation and creativity. Famous for their books, they use advanced brain imaging techniques and the most recent research on brain function. They have demonstrated the activation of cortical and sub-cortical trajectories in face and object recognition and have identified neurological sites involved in the processing of emotions.

Roberto Car co-developed the ab-initio molecular dynamics method also known as the 'Car-Parrinello method'. This theory has had an enormous impact on the creation of molecular simulations, with practical applications in basic sciences. The approach represents a major advance in computational physics and has influenced the methodology for calculating the structure of solids, liquids and molecules. Currently a professor in the United States, Roberto Car was an assistant at EPFL in the late 1970s.

An honorary doctorate was also bestowed upon **Subra Suresh**, director of the National Science Foundation, the American government agency which supports fundamental research and education in all the non-medical domains of science and engineering. This specialist in biomechanics was Head of MIT's Department of Materials Science and Engineering from 2000-2006 and Dean of the School of Engineering before assuming his position at NSF.


Hanna Damasio


Roberto Car


Antonio Damasio


Subra Suresh

ORGANIZATION

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President

FRANCIS-LUC PERRET
Vice-President for Planning and Logistics

PHILIPPE GILLET
Vice-President for Academic Affairs

ADRIENNE CORBOUD FUMAGALLI
Vice-President for Innovation and Technology Transfer

SCHOOLS

SB
BASIC SCIENCES

Mathematics
Physics
Chemistry and Chemical Engineering

SV
LIFE SCIENCES

STI
ENGINEERING

Materials Science & Engineering
Mechanical Engineering
Microengineering
Electrical Engineering

IC
COMPUTER & COMMUNICATION SCIENCES

Communication Systems
Computer Science

ENAC
ARCHITECTURE, CIVIL AND ENVIRONMENTAL ENGINEERING

Environmental Engineering
Civil Engineering
Architecture

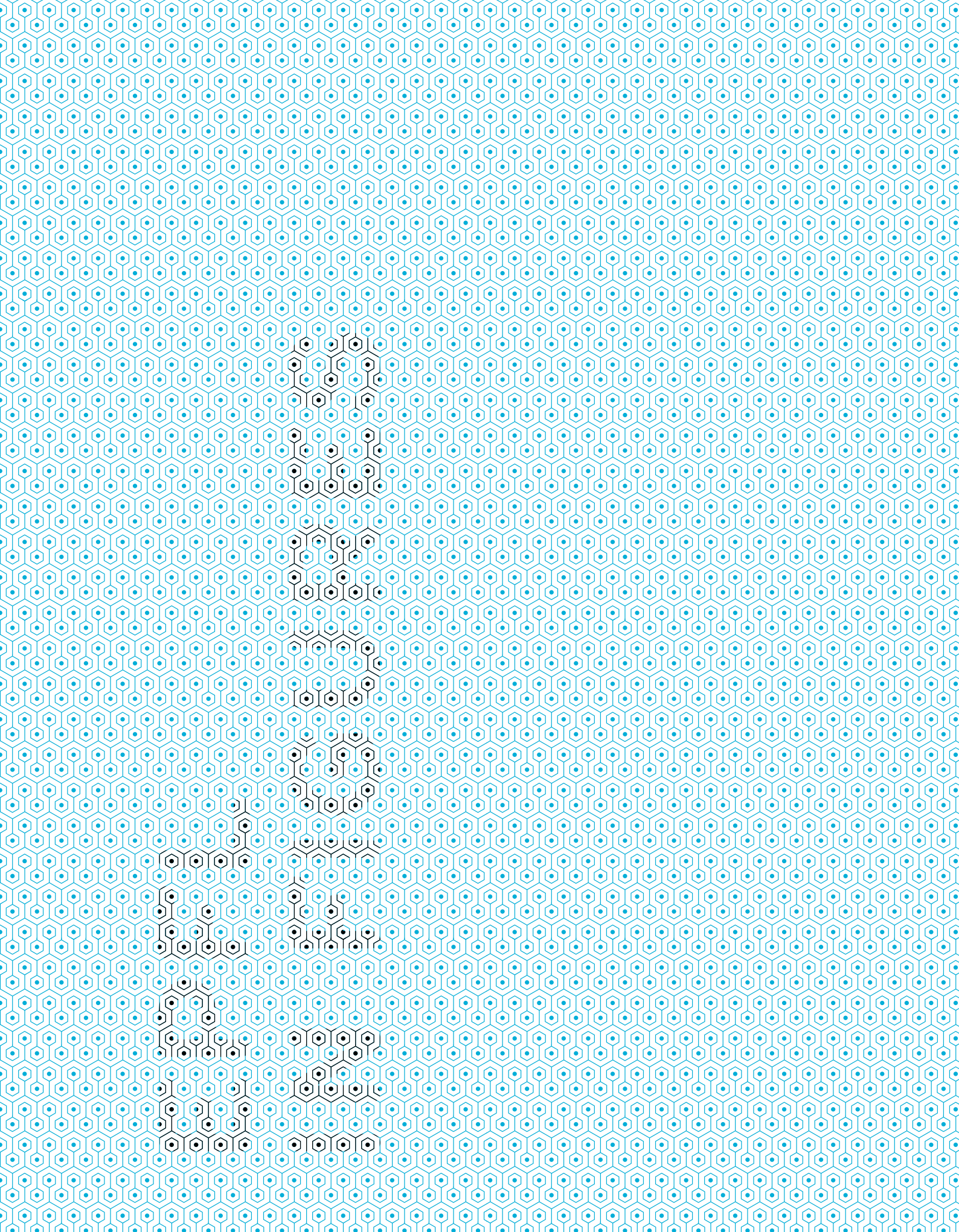
COLLEGES

CdH
COLLEGE OF HUMANITIES

Human and Social science

CdM
MANAGEMENT OF TECHNOLOGY

Management of Technology
Financial Engineering



OVERVIEW OF BACHELORS, MASTERS AND DOCTORAL CANDIDATES

Bachelors & CMS candidates

	Total Bachelors & CMS candidates	Total new matriculations (Bachelors years 1, 2 and 3 & CMS)*	% candidates matriculated
Autumn semester 2009–2010	2,133	1,586	74%
Autumn semester 2010–2011	2,402	1,442	60%
Autumn semester 2011–2012	2,892	1,625	56%

*excluding students retaking a year

Masters candidates

	Total new Masters candidates	Total new matriculations (Masters years 4 & 5)**	% new matriculated candidates
Autumn semester 2009–2010	1,298	160	12%
Autumn semester 2010–2011	1,762	205	12%
Autumn semester 2011–2012	1,855	258	14%

**students with a non-EPFL Bachelors degree (excluding retakes)

Doctoral candidates

	Total Doctoral candidates	Total new Doctoral matriculations	% matriculated Doctoral candidates
2008	1,576	474	30%
2009	2,589	504	19%
2010	3,395	485	14%
2011	3,355	478	14%

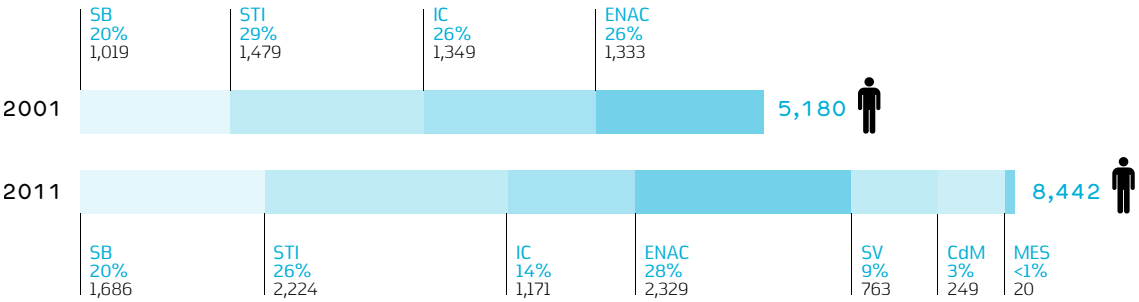
STUDENTS BY FIELD AND STUDY LEVEL

	Bachelors	Masters	Doctoral	Continuing Education	Total
Basic Sciences (SB)	877	343	466		**1,686**
Mathematics	290	83	76		**449**
Physics	331	145	231		**707**
Chemistry and Chemical Engineering	256	115	159		**530**
Life Sciences (SV)	375	149	239		**763**
Engineering (STI)	1,020	547	657		**2,224**
Materials Science & Engineering	141	79	126		**346**
Mechanical Engineering	382	146	98		**626**
Microengineering	347	150	196		**693**
Electrical Engineering	150	172	237		**559**
Computer and Communication Sciences (IC)	558	341	272		**1,171**
Communication Systems	213	118	61		**392**
Computer Science	345	223	211		**779**
Architecture, Civil and Environmental Engineering (ENAC)	1,534	459	288	48	**2,329**
Environmental Engineering	281	115	85		**481**
Civil Engineering	411	118	112	9	**650**
Architecture	842	226	91	39	**1,198**
Management of Technology (CdM)		102	53	94	**249**
Management of Technology		48	38	94	**180**
Financial Engineering		54	15		**69**
Energy Management and Sustainability (MES)		20			**20**
Total	4,364	1,961	1,975	142	**8,442**

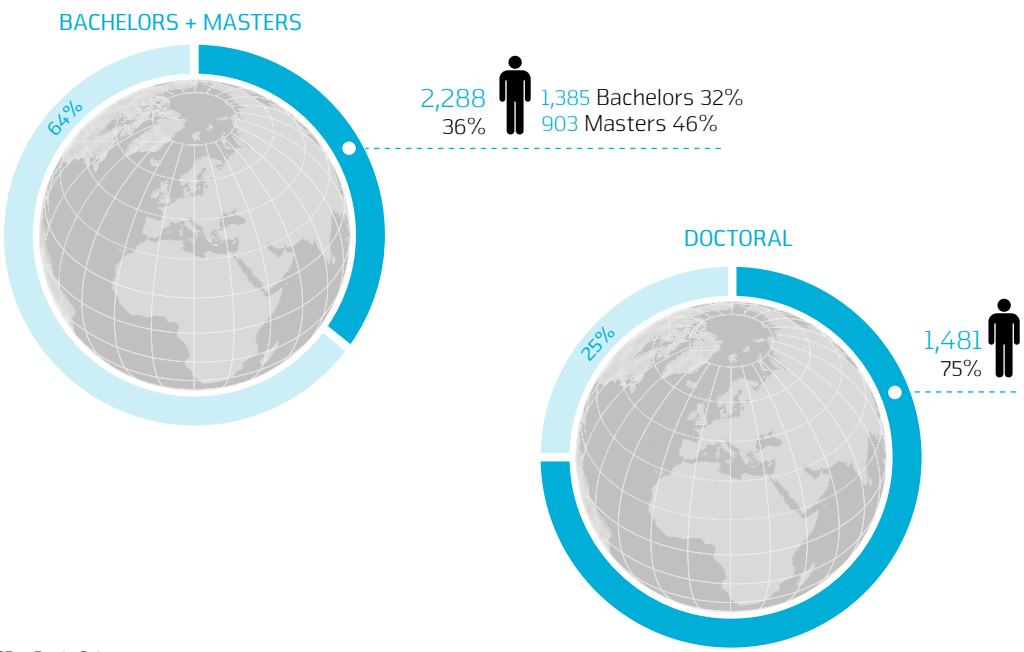
Bachelors & Masters students
6,325

STUDENT BODY

A decade of growth (by Faculty*)



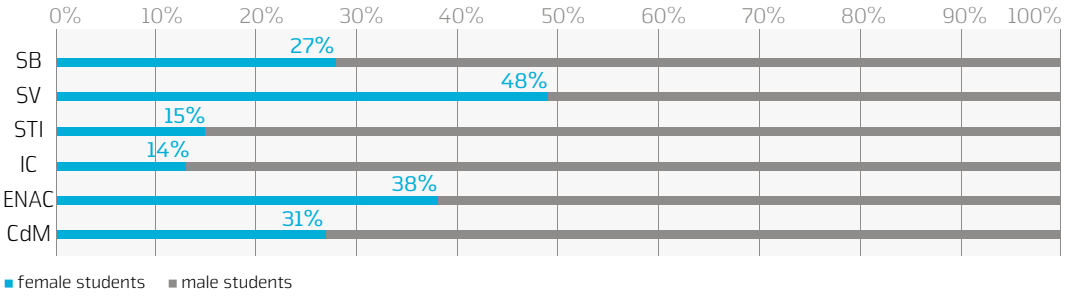
Overseas students (excluding residents in Switzerland)



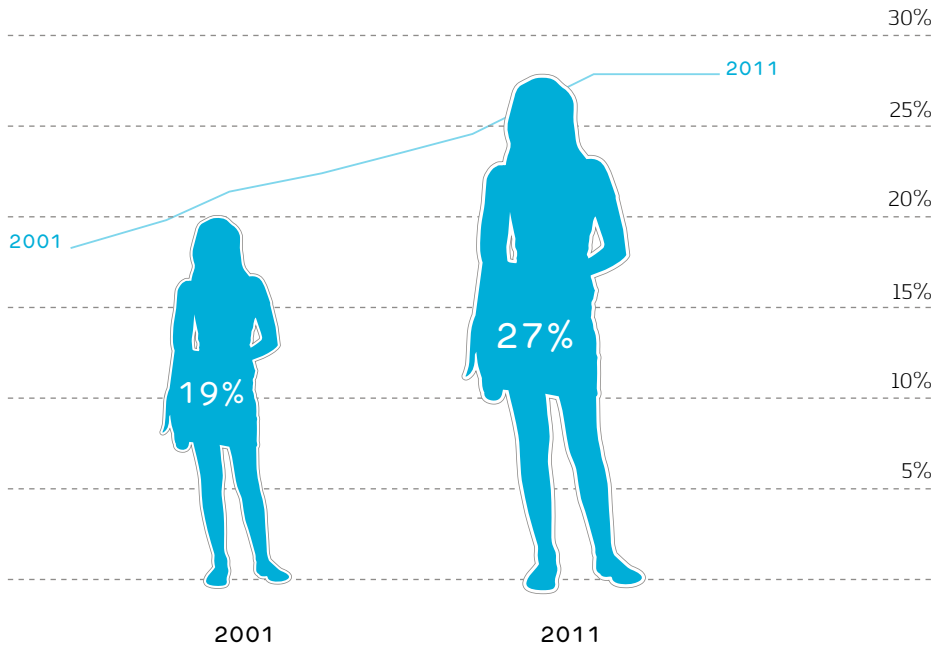
*SB = Basic Sciences
SV = Life Sciences
STI = Engineering
IC = Computer and Communication Sciences
ENAC = Architecture, Civil & Environmental Engineering
CdM = Management of Technology
MES = Energy Management and Sustainability

Women at study**

Proportion of women students by faculty*



Growth in the Percentage of Women Students



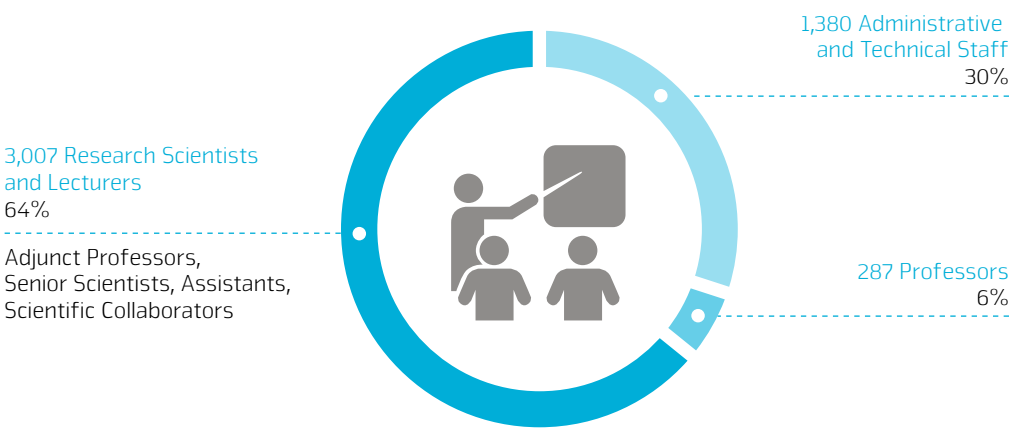
** Bachelor, Master, Doctoral and Continuing Education

EPFL PERSONNEL BY FACULTY AND DEPARTMENT (FULL-TIME EQUIVALENTS)

	Total
Basic Sciences (SB)	**1,097.7**
Mathematics	174.5
Physics	534.3
Chemistry	388.8
Life Sciences (SV)	**682.3**
Engineering (STI)	**1,187.2**
Materials Science	220.8
Mechanical Engineering	283.0
Microengineering	408.1
Electrical Engineering	275.3
Computer and Communication Sciences (IC)	**457.3**
Communication Systems	174.6
Computer Science	282.7
Architecture, Civil and Environmental Engineering (ENAC)	**542.9**
Environmental Engineering	167.7
Civil Engineering	192.7
Architecture	182.5
Management of Technology (CdM)	**80.9**
Management of Technology	43.1
Financial Engineering	37.8
Central services	**625.4**
Total	**4,673.6**

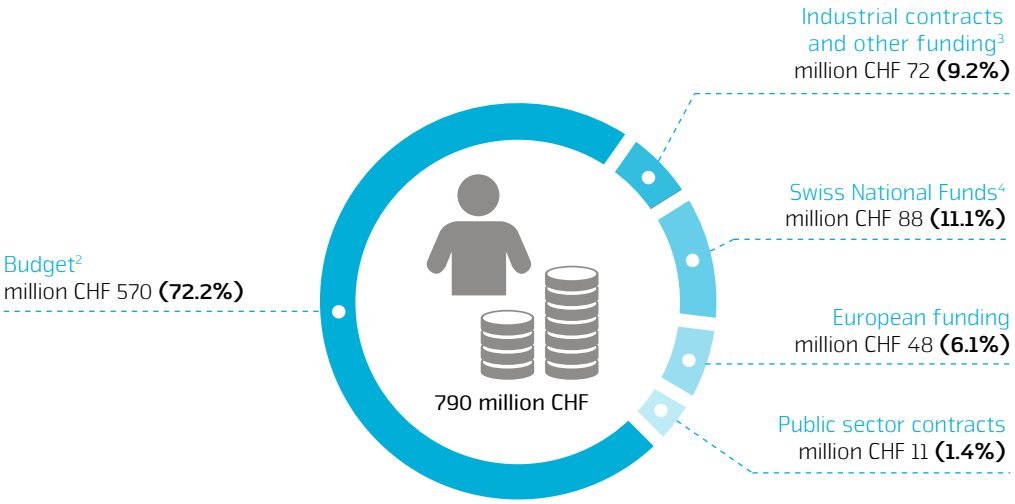
PERSONNEL BY CATEGORY (FULL-TIME EQUIVALENTS)

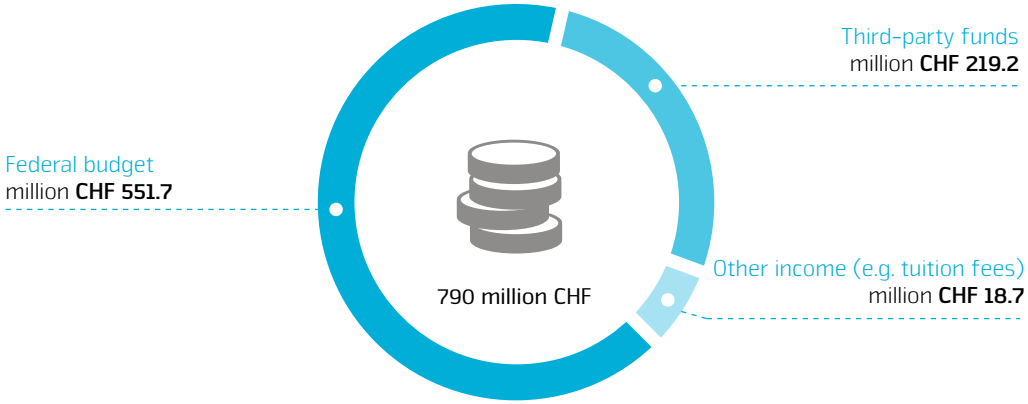
	Total	Government funded	Third party funded (public & private)
Professors	**286.9**	260.8	26.1
Professors	**162.7**	159.0	3.7
Associate Professors	**49.1**	48.1	1.0
Tenure Track Assistant Professors	**62.2**	53.5	8.7
Swiss National Fund Assistant Professors	**12.9**	0.2	12.7
Research Scientists and Lecturers	**3,006.5**	1,282.4	1,724.1
Adjunct Professors	**50.9**	50.3	0.6
Senior Scientists	**65.9**	60.9	5.1
Assistants (incl. Doctoral students)	**1,825.5**	627.6	1,197.9
Scientific Collaborators (incl. Postdoctorates)	**1,064.3**	543.6	520.6
Administrative and Technical Staff	**1,380.2**	1,201.0	179.2
Administrative Staff	**661.9**	598.7	63.2
Technical Staff	**718.3**	602.3	116.0
Total	**4,673.6**	2,744.2	1,929.4
		59%	41%



FINANCES*

ANNUAL EXPENDITURE[1]





[1] Total expenditure including construction (including Federal Office for Buildings and Logistics [FOBL] allocation)
[2] Expenditure covered by the ordinary budget and internal sources of income (tuition fees, services, financial revenue etc.)
[3] Sponsoring, foundations, commited and reserved funds, congresses, continuing education etc
[4] Including NCCR and NanoTera/SystemsX project funding

* Figures correspond to EPFL budgetary accounts which may differ from those issued by ETH financial accounting. This is due to account closing differences with no monetary impact.

ANNUAL EXPENDITURE (kCHF)

	Personnel	Running costs	Invest-ments	**Total**	Third-party funding
Basic Sciences (SB)	125,072	21,133	14,506	**160,711**	54,626
Mathematics	22,491	3,136	181	**25,808**	6,107
Physics	65,662	10,895	9,045	**85,602**	31,358
Chemistry	36,920	7,102	5,280	**49,302**	17,161
Life Sciences (SV)	71,442	23,030	4,803	**99,275**	40,465
Engineering (STI)	123,413	22,341	7,749	**153,512**	64,048
Materials Science	22,833	4,414	1,837	**29,085**	10,947
Mechanical Engineering	31,076	6,125	1,167	**38,368**	15,080
Microengineering	44,041	7,216	3,531	**54,788**	23,117
Electrical Engineering	25,463	4,586	1,223	**31,272**	14,904
Computer and Communication Sciences (IC)	46,148	5,612	897	**52,657**	15,845
Communication Systems	19,515	2,266	211	**21,992**	5,385
Computer Science	26,634	3,346	686	**30,666**	10,460
Architecture, Civil and Environmental Engineering (ENAC)	63,564	11,967	5,092	**80,623**	21,382
Environmental Engineering	18,311	3,559	3,698	**25,568**	7,378
Civil Engineering	21,805	4,015	1,293	**27,113**	8,514
Architecture	23,448	4,393	101	**27,943**	5,490
Management of Technology (CdM)	10,178	2,113	26	**12,317**	4,029
Management of Technology	5,812	1,746	16	**7,575**	2,708
Financial Engineering	4,365	367	10	**4,742**	1,321
Central services	90,403	89,150	9,876	**189,429**	18,764
Construction (separate balance sheet)			40,998	**40,998**	
Total (excluding construction)	530,222	175,345	42,959	**748,526**	219',59
Total expenditure	530,222	175,345	83,957	789,524	219,159

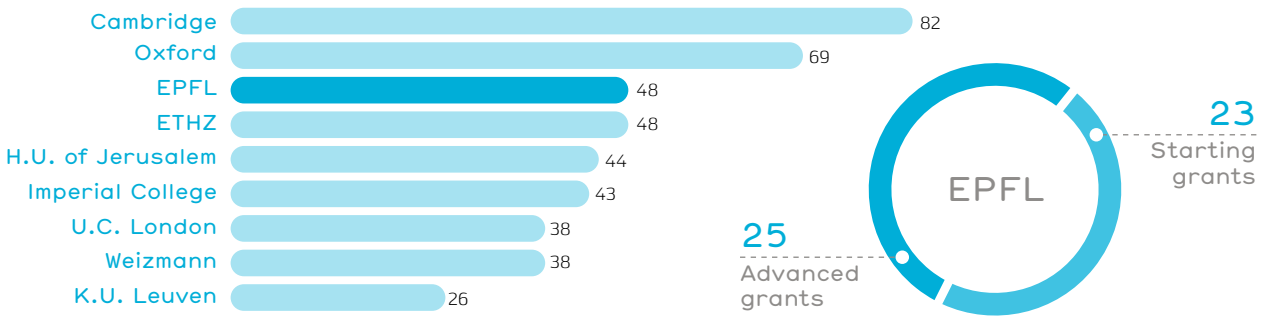
RESEARCH

International Academic Ranking

	2007	2008	2009	2010	2011
QS World University Ranking – Global	**43** (117)	**14** (50)	**12** (42)	**10** (32)	**11** (35)
QS World University Ranking – Engineering & Technology	**9** (47)	**8** (44)	**9** (44)	**7** (31)	**6** (28)
ARWU (Shanghai) – Global	**54** (143)	**47** (130)	**45** (126)	**48** (134)	**48** (131)
ARWU (Shanghai) – Engineering, Technology & Computer Science	**3** (28)	**2** (18)	**1** (15)	**2** (20)	**2** (20)
Leiden Ranking Crown Indicator – Top 250		**2** (40)		**1** (15)	

European Ranking (World Ranking)

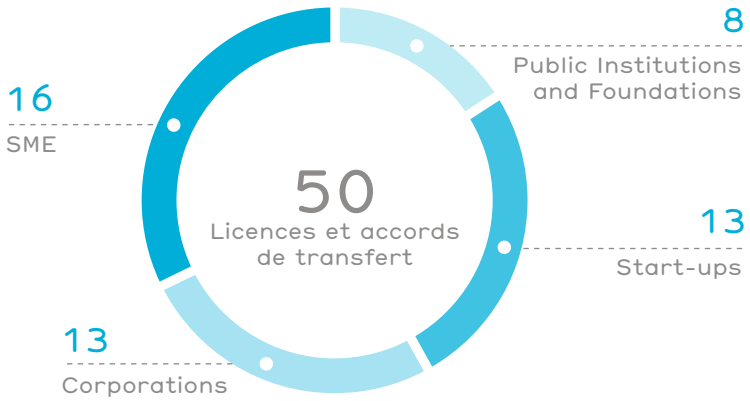
Number of European Research Council grants awarded (cumulative from 2007 – 2010)



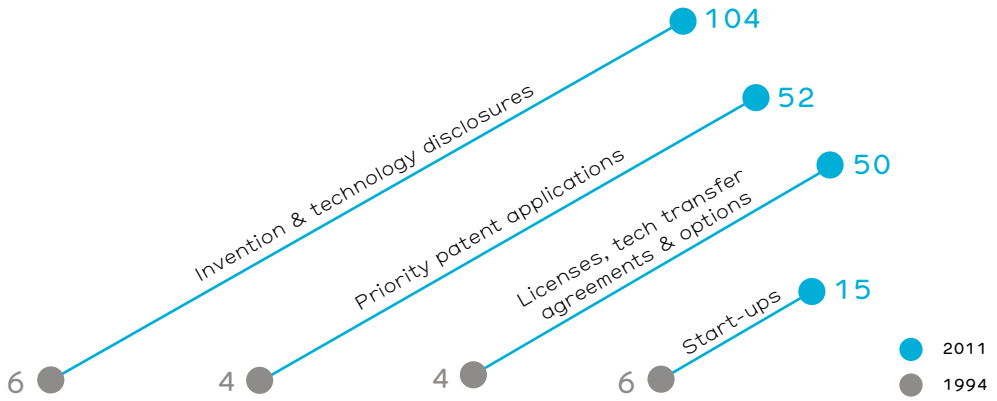
TECHNOLOGY TRANSFER

Technology transfer by faculty

	Patent registration	Licensing	Start-ups created
Basic Sciences (SB)	13	4	1
Life Sciences (SV)	9	5	2
Sciences and Techniques (STI)	21	28	9
Computer and Communication Sciences (IC)	9	9	3
Architecture, Civil and Environmental Engineering (ENAC)	0	4	0
Total	52	50	15



Growth of Technology Transfer



SUSTAINABILITY

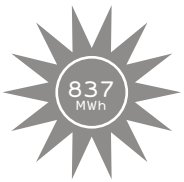
An extract from the 2010 – 2011 EPFL Sustainability Report

Energy consumption

	2010	2011
ELECTRICITY (MWh)		
Total electricity purchased (EPFL)	**71,574**	**75,405**
Electricity sold to third parties	**5,018**	**7,426**
Total electricity produced on site	**3,298**	**2,353**
Production from combined heat and power facility	3,245	1,516
Production from solar park	53	837
HEATING / COOLING (MWh)		
Total heat consumption (academic)	**34,341**	**27,159**
PROCESSES (MWh)		
Total energy consumption (academic)	**8,790**	**8,479**
Gas for steam production	8,671	8,449
Gas for other processes	119	30

Production from EPFL solar park

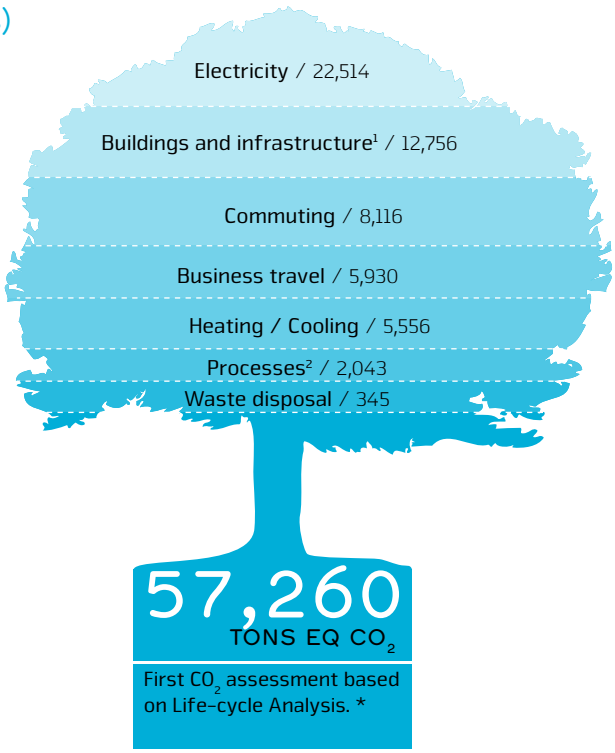
2010



2011

Total CO_2-eq EMISSIONS (campus)

(tons eq CO_2)



* Study carried out in association with EPFL spin-off Quantis. Student mobility, food, material and equipment not taken into account

[1] Construction, running costs and demolition of buildings

[2] Steam production for Life Sciences

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

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