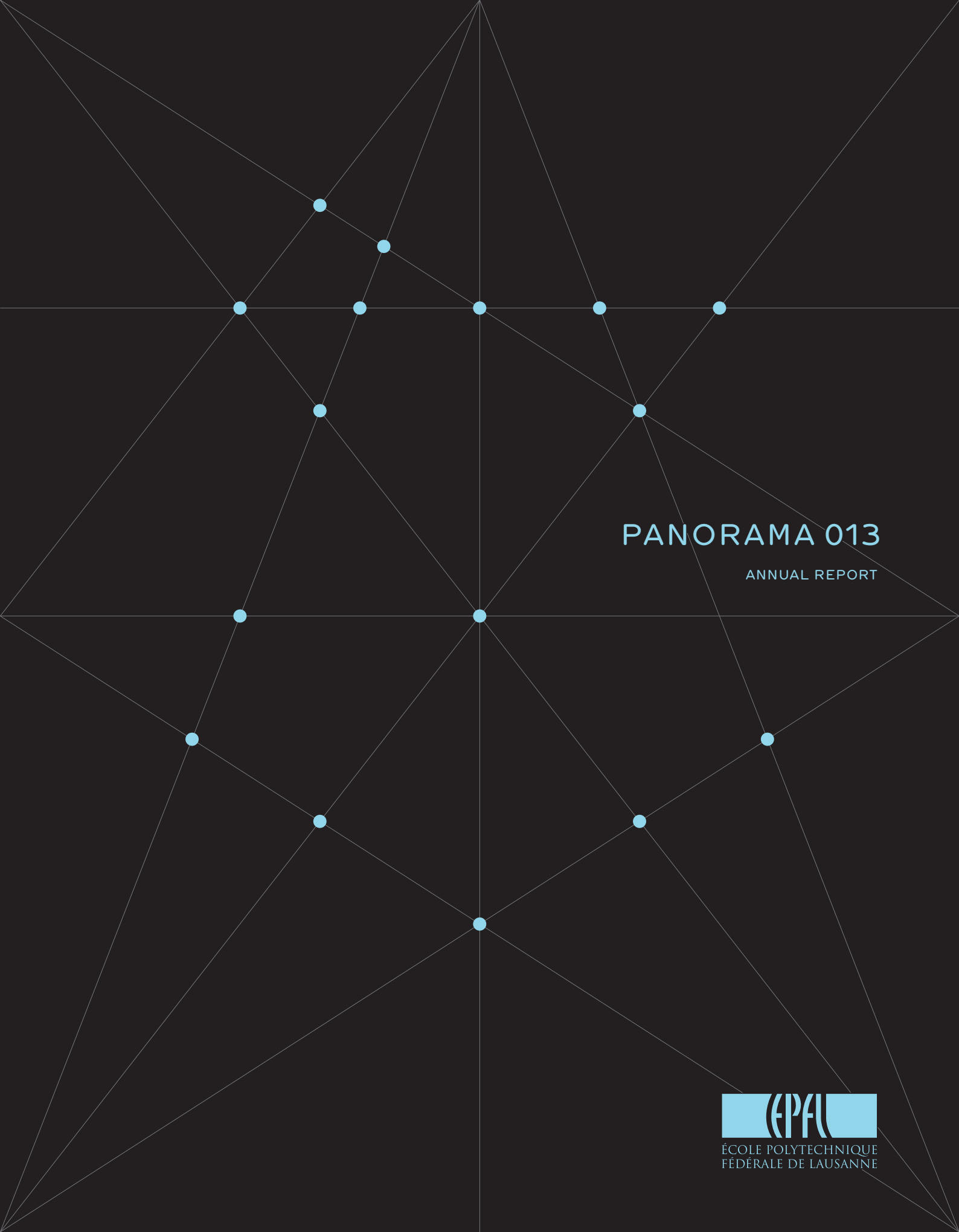


PANORAMA 013

ANNUAL REPORT

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

PANORAMA 013

ANNUAL REPORT

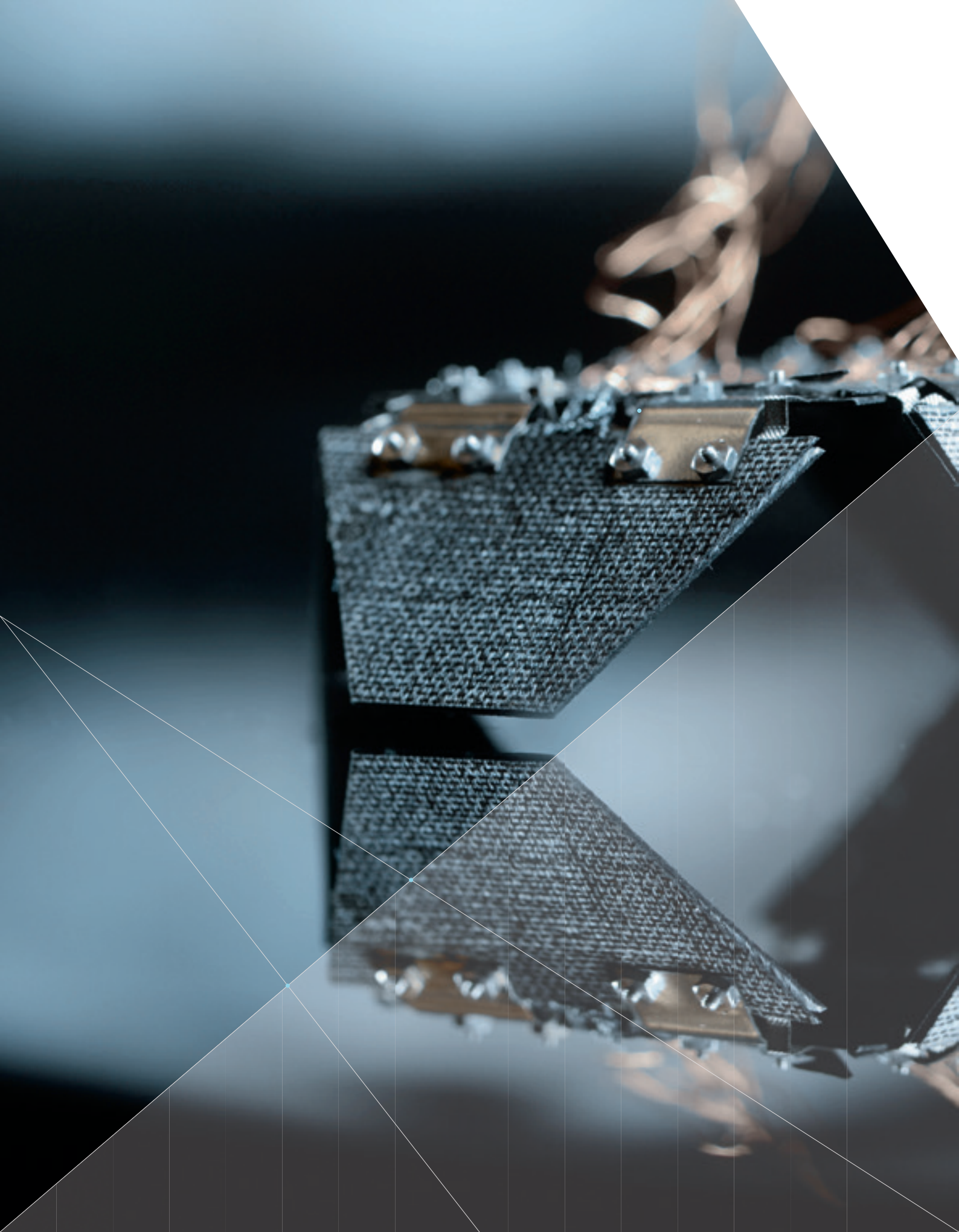
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

CONTENT


ONLINE COURSES
HUMAN BRAIN PROJECT

2013 was the year of the Human Brain Project. It was an opportunity to demonstrate Switzerland's preeminent position in European scientific research and technology. Let me remind you: before our brain research project was selected and granted half a billion francs in funding by the European Commission, it had to compete with five other projects that had made it to the final cut, three of which were Swiss! This is an incredible success for a country with only 8 million inhabitants. In this annual report there is a special section describing the objectives and major milestones of this extraordinary project. • Reseach brings universities the visibility they need to attract and retain the world's best intellects. It also gives another image of our country to those living outside our borders, one that goes beyond the familiar stereotypes. We are pround that we can help focus the spotlight on this important dimension – a Switzerland that's open, innovative and dynamic. • That said, we must make our mark within the country as well. We did this in Neuchâtel, where we have more than doubled the number of research teams since the merger between the Institute of Microengineering and EPFL, in 2009. In Valais, the land of glaciers and mountain reservoirs, our regional branch is participating in the development of hydropower. In Geneva, at the former headquarters of Merck Serono, we find researchers working on the Human Brain Project and other teams doing research on biotechnology and neuroprostheses. Finally, in Fribourg, we are working among other things on housing and sustainable architecture. • But our most important contribution will always be our students and our graduates. First in Europe to embrace the new trend of online education, we have been able to measure the rich pedagogical potential of online courses. In these pages, you will also have the opportunity to discover how students put their knowledge into practice and demonstrate extraordinary entrepreneurial spirit. Once on the job market, they put their skills and creativity to work for the entire community. They are our greatest added value and, without a doubt, our most legitimate source of pride.

PATRICK AEBISCHER
EPFL PRESIDENT



TEACHING

VIRTUAL CAMPUS, REAL CAMPUS

The challenge facing universities today is this: to find a balance between the physical world and the virtual world. The Internet offers amazing possibilities for sharing knowledge and building networks between students, researchers and professors. But for all that, the university will never overcome the necessity for a physical place where knowledge and know-how can be exchanged, for laboratories, for adequate infrastructure where students can get hands-on experience. This reality is even more important for an institute of technology like ours. • Online courses – more commonly known as MOOCs – exploded in 2013 (p. 8). EPFL is the first European university to join the movement, and on the continent we are now the standard-bearer. Tens of thousands of students from around the world have taken our courses all the way through the final exams. We have given ourselves the means with which to meet our ambitions, setting up a recording studio and a support team for professors who are creating online courses. • This movement is a unique opportunity. Our goal is not to switch university education into MOOCs mode, but to redefine the usages and frontiers between the real and the virtual. On the one hand, we have successfully experimented with MOOCs for our own students – online education is a very convincing alternative for certain lecture courses, given to hundreds of students in large, impersonal auditoriums. On the other hand, this revolution gives us the opportunity to redeploy our strengths towards improving laboratory classes and smaller seminar courses; this is where the physical campus will always continue to make a real difference. • Our students' amazing Master's research (p. 12) and our mentoring program (p. 11) are among the initiatives that can only take place on a physical campus. The paradox is resolved when we take into account all the factors in the equation: far from competing with each other, the real and the virtual combine to provide a whole educational experience whose quality is better than ever.

PHILIPPE GILLET
VICE PRESIDENT
FOR ACADEMIC AFFAIRS

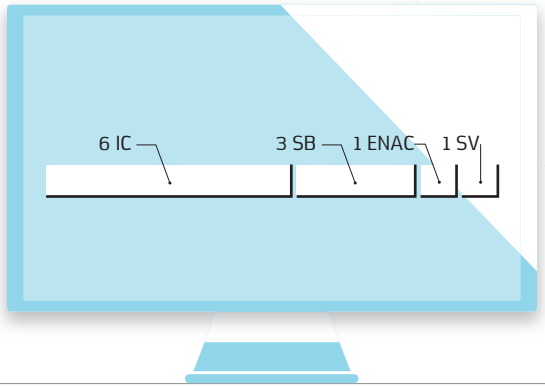
KARL ABERER
VICE PRESIDENT
FOR INFORMATION SYSTEMS

EPFL OFFERS MORE MOOCS

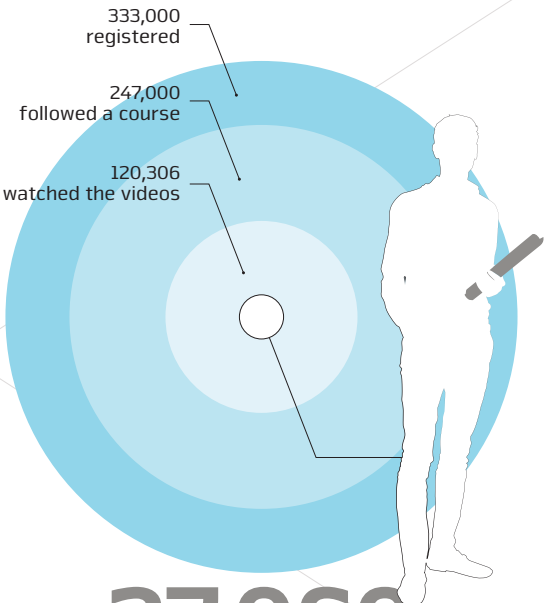
FOLLOWING THE SUCCESS OF ITS FIRST MASSIVE OPEN ONLINE COURSE (MOOC) IN 2012, EPFL HAS JUMPED IN WITH BOTH FEET, PUTTING TOGETHER MORE COURSES AND CREATING THE CENTER FOR DIGITAL EDUCATION.

• The year 2013 was a critical turning point in the establishment of MOOCs at EPFL. In the spring semester, the School's Center for Digital Education was inaugurated, along with its core project, the "MOOCs factory." The goal of these structures is to encourage the development of courses and provide support to professors who are interested in joining the online adventure. • The first course, which was offered on the Coursera platform in fall 2012, had more than 50,000 students. The following year, no fewer than 11 different courses were offered (ten on Coursera and one on edX). Six of these were in the School of Computer and Communication Sciences (IC), three from Basic Sciences (SB), one from the School of Architecture, Civil and Environmental Engineering (ENAC) and one from the School of Life Sciences (SV). They were taught by 16 professors, lecturers and outside participants. • About 330,000 people signed up for the courses; of these, 247,000 followed at least one course. Nearly half of these, 120,306 students, watched the videos but didn't do the homework. Ultimately 27,060 individuals out of the 69,185 most active participants obtained a certificate of completion. • Although this educational model is primarily designed for international students, it is clearly also attractive for EPFL students. The MOOCs are envisaged as complementary to existing courses or as a course to take at home, followed by scheduled campus meetings to discuss and study particular topics in more detail.

2013 QUICK FACTS



11 COURSES
ONLINE TEACHING



27,060
ONLINE CERTIFICATES

FUTURE ARCHITECTS AND ENGINEERS JOIN FORCES FOR SUSTAINABLE BUILDING

THE NEW "IDEAS" MINOR PROGRAM PREPARES ARCHITECTS AND ENGINEERS FOR A COLLABORATIVE AND INTERDISCIPLINARY PROFESSIONAL FUTURE IN A WORKPLACE WHERE TECHNOLOGY IS BECOMING INCREASINGLY SOPHISTICATED. • In 2013 EPFL launched a new minor in the School of Architecture, Civil, and Environmental Engineering (ENAC). The interdisciplinary program, called IDEAS, pushes architecture and engineering students out of their comfort zones, instilling in them a common culture. • "Today, solutions often lie beyond the scope of any single specialization, making it increasingly important for architects and engineers to speak a common language," says Marilyne Andersen, Professor of Architecture and Dean of ENAC. "The IDEAS program builds a new bridge between them and promotes research in integrated design and sustainable architecture." • "We aspire to prepare our graduates for today's societal challenges, such as drastically reducing energy consumption while preserving the quality and comfort of buildings. Translating these challenges to solutions at the level of a single building or neighborhood is no simple task. Our program aims to give students the background they need to do so," says Emmanuel Rey, Assistant Professor of Architecture and partner at Bauart, an architectural firm based in Bern, Neuchâtel and Zurich.

ALL FIRST-YEAR STUDENTS TO TAKE "INFORMATION, CALCUL ET COMMUNICATION"

> 11 professors
> 16 doctoral assistants
> 65 student assistants
> 1400 students

STARTING IN SEPTEMBER 2013, THE SCHOOL OF COMPUTER AND COMMUNICATION SCIENCES IS OFFERING A COURSE IN THE FUNDAMENTALS OF COMPUTER SCIENCE, NUMERICS AND COMMUNICATION (ICC) TO THE MAJORITY OF EPFL'S FIRST YEAR STUDENTS. • The experts agree: a basic scientific understanding of the fundamentals of computer science and communications systems is essential for students in all fields of science that use these tools and methods of information technology. EPFL has risen to the challenge by launching a new course, "Information, Calcul et Communication" (ICC), which covers the basics of computer science, numerical methods and communication systems. This broad-based project involves 11 professors, 16 PhD students and 65 student assistants. • The course is geared for all first-year students, independent of their specialization, with the exception of architecture students. It consists of three modules. The first introduces the concepts of algorithms and the representation of information. The second deals with signal sampling and data compression. The third module covers aspects related to systems: processors, memory, communication and security. • An evaluation by 1400 students who took the first semester of the course was very positive. "I discovered a new world; it's fascinating to learn how computers work and all the things you can do with them. It's essential knowledge for the world of tomorrow, and useful for the world of today," said one student.

EPFL SUPPORTS TEACHING IN THE CLASSROOM AND IN THE LABORATORY

A NEW PROJECT TO SUPPORT TEACHING WILL MAKE IT POSSIBLE TO CONTINUE OFFERING EXISTING LABORATORY PRACTICAL SESSIONS AS WELL AS DEVELOP NEW ONES. MORE THAN 80 LAB DESKS WERE EQUIPPED WITH NEW MATERIAL. • Laboratory practicals are an important component of scientific training and one of EPFL's educational pillars. The increasing number of students and the growing complexity of the challenges they will encounter in their professional careers motivated EPFL's management to reflect on the support that is provided for teaching in the School. Drawing from this and as part of a curriculum review process, a project was initiated that includes support for discipline-specific laboratory practicals and an interdisciplinary approach to the laboratory teaching programs in the Bachelor's and Master's studies programs. • The project involves all the teaching sections in the School and will be deployed over a period of several years so as to accompany and support the curriculum revisions that are currently underway. The project was initiated in 2013 in the School of Engineering. More than 80 additional lab benches were equipped with new material, making it possible to continue existing lab sessions as well as offer new ones in the following areas: electronics, sensors and actuators, information technology, embedded systems, control and regulation. Ultimately this equipment will be brought together in a new space dedicated to lab sessions that will offer new synergies between courses.

A NEW MASTER'S DEGREE FOR MANAGING A POST-NUCLEAR WORLD

> renewable energy
> smart grids

THE INSTITUTE OF ELECTRICAL ENGINEERING IS OFFERING A NEW DEGREE PROGRAM. IT WILL ALLOW FUTURE ENGINEERS TO CREATE THE SMART GRIDS OF THE FUTURE. • In the near future, it will be necessary to completely rethink our electricity infrastructure. With the abandonment of nuclear power and an increasing number of electricity consumers, systems will become more and more complex. It will be particularly important to integrate renewables such as solar, hydropower, and wind power on a large scale into the grid, while still taking into account market fluctuations and the intermittent and decentralized nature of these energy sources. This shift will necessitate the development of smart grids. • In 2013, the Institute of Electrical Engineering added a Master's in Smart Grids Science and Technology to its pallette of degree programs. This multidisciplinary approach, unique in Europe, teaches students to develop and manage complex smart grids. • "We have to get past the idea that power plant "x" can produce a quantity of energy "y" at any given moment," says Professor Mario Paolone, who is in charge of the new program.

INDUSTRY MENTORS SHOW STUDENTS THE ROPES

SINCE 2010, MASTER'S STUDENTS IN MANAGEMENT, TECHNOLOGY AND ENTREPRENEURSHIP HAVE BENEFITTED FROM A UNIQUE MENTORING PROGRAM PUT IN PLACE BY THE SECTION. • The main goal of the program is to put students into contact with highly placed industry professionals, so they can benefit from their mentors' experience and networks. The students thus have a better chance of finding job opportunities and contributing to the regional economy. The mentors, often EPFL alumni, benefit from the students' energy and talent, while maintaining ties with the School. • The program perfectly complements the research internship program, which has become mandatory in the EPFL Master's curriculum. Internship supervisors, who often work in well-known companies, are increasingly showing interest in participating in the program. Future students could thus benefit from even more coaching opportunities during their Master's studies. The program gives added value to the university degree, while also bringing the academic and business worlds closer together.

SIMULATING A SUPERNOVA

When a star dies, a spectacular explosion called a supernova occurs, providing valuable information about the birth of the universe. Alexis Arnaudon's Master's research focused on improving the way that supernovae are simulated, in order to gain insight into as yet unanswered questions. Alexis began by reproducing the explosion of an isolated star. His results are a first step in obtaining more precise models.

A FATIGUE DETECTOR: KEEPING AN EYE ON THE DRIVER

In her Master's project in Electrical Engineering, Marina Zimmermann developed a video algorithm for detecting fatigue based on eye closure. Her algorithm makes it possible to cancel out the effects of varying light conditions and eye morphologies. She also built a 3D profile of the eye and eyelids. PSA Peugeot Citroën, who was a partner in the project, has integrated her program into a prototype.

SMART ENERGY FOR REFUGEE CAMPS

During his Master's thesis project – in collaboration with the United Nations High Commission for Refugees (UNHCR) – Hamde Ziade developed an energy consumption model adapted to refugee camps all over the world, in an effort to battle nighttime darkness in the camps. He outlined a plan for replacing diesel generators by a network of smart solar streetlights that can store the energy needed to provide the essential light.

LIGHTER AIRCRAFT HAS AN UNUSUAL SHAPE

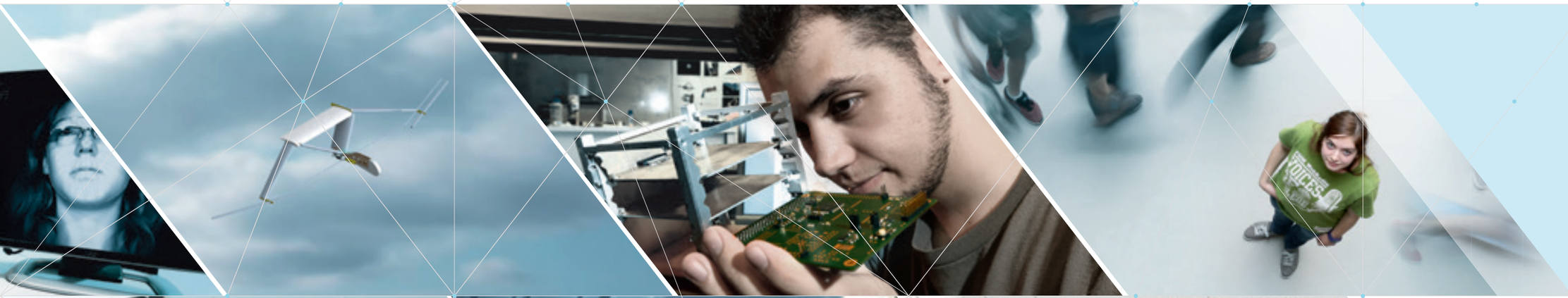
Bachelor's students in the Laboratory of Applied Mechanics and Reliability Analysis have created a new kind of drone. It is larger than traditional drones, but lighter in weight and just as solid. The students used a truss between the two wings to distribute the load across the entire device, rather than just in the center. The aircraft, built out of polystyrene and carbon fibers, has a wingspan of four meters and only weighs five kilos.

A BRAIN FOR PICO-SATELLITES

Invented in the early 2000s by researchers at Caltech and Stanford University, the pico-satellite, a cube measuring only 10 cm on a side, was designed to serve scientists as a platform for conducting low-cost space experiments. Louis Masson, a Master's student in Microengineering, designed a new kind of microcomputer for these pico-satellites that improves their performance. His invention will ride aboard the successor to Swisscube, which was designed by students and launched in 2009.

USING BLUETOOTH TO STUDY CROWD DYNAMICS AT THE PALÉO MUSIC FESTIVAL

Every year more than 40,000 music fans flock to the Paléo music festival in Nyon. Many of them carry cellphones with activated Bluetooth devices. For a semester project, Elisaveta Kondratieva studied the dynamics of the crowd by statistically evaluating an extensive data set of signals collected from cellphones during the 2010 edition of the festival. She analyzed both the potential and the pitfalls of this approach.



TURNING BACK THE CLOCK IN VENICE

Two students from the College of Humanities developed an interface that lets tourists see what buildings in Venice looked like long ago. They identified the represented sites in a book of prints, and created a database cataloguing the transformation of the buildings. Using the GPS in their smartphones and tablets, tourists can obtain historical and visual information on the buildings and monuments as they tour the city.

THE ROBOT AND ITS VIRTUAL TWIN

DARwIn-OP is a small humanoid robot developed by a Korean company and three US universities as a research tool. Master's student David Mansolino has given it a digital twin, which is used, via a simulation platform developed by EPFL spin-off Cyberbotics, to help DARwin-OP rapidly learn new tasks. Mansolino also developed a window that makes it possible – in a single click – to go directly from the simulated task to the actual robot and to monitor the status of all its sensors and actuators in real time.

STUDYING ACCESS TO CLEAN WATER IN VIETNAM'S HOSPITALS

Instead of lounging on a beach last summer, three Master's students headed for Ho-Chi-Minh City and its slums to look at hospitals. The trip was the first step in a project whose objective is to develop a water purification kit adapted for hospitals in developing countries. The internship was funded by Ingénieurs du Monde and is part of EPFL's EssentialTech program.

SOFTWARE TO GUIDE YOU THROUGH THE MAZE OF A CONFERENCE

Imagine you're in the plane the day before a huge conference, trying to navigate through hundreds of abstracts in order to choose which talks you want to attend. How can you make sure you don't miss any that are related to your field? Three Computer and Communications Science students developed a program they named TrailHead that uses a visualization system to filter information. Jonas Arnfred, Amine Mansour and Yannik Messerli's software pinpoints talks based on the scientific interests of the user.

SENSATIONAL STUDENT PROJECTS IN THE SPOTLIGHT

ASTRONOMY, AUTOMOBILE ENGINEERING, COMPUTER SCIENCE, ENVIRONMENTAL ENGINEERING... STUDENTS AREN'T WAITING TO RECEIVE THEIR DEGREES TO EXPLORE NEW POSSIBILITIES AND UNDERTAKE AMBITIOUS RESEARCH. WE MEET SOME REMARKABLE YOUNG SCIENTISTS.

RESEARCH

A MULTIFACETED SCIENCE FOR THE 21st CENTURY

At EPFL, the Human Brain Project garnered the lion's share of attention in 2013 (p. 26–29). It's a project of superlatives, with an estimated budget of €1.2 billion and more than 120 research teams, it will tackle the most complex mission of all: understanding how the human brain works. Selected by the European Commission it is clearly a source of intense pride for both EPFL and Swiss science. • The scope of a project like this is impressive indeed. But even so, the Human Brain Project is interesting from another point of view. It is emblematic of 21st century science, which must come out from its separate disciplines and meet around the same table in order to take on society's pressing challenges. Computer scientists, physicists, medical doctors, electrical engineers, and roboticists must join forces to tackle the problems we're facing, because they are too complex to be solved by any single specialty. • Many other research projects, described in this report, are heading in this same direction. Without a dialog between biologists and computer scientists, we could not have mapped human resistance to AIDS, a necessary precursor to identifying the virus' weaknesses (p. 25). The same is true in energy and environmental engineering: interdisciplinary research in hydropower (p. 19), promising photovoltaic nanowires (p. 32) and the issue of nuclear waste storage (p. 30) are just three examples of critical problems that are being solved by combining extremely diverse areas of expertise. • We have tried to give you as complete a picture as possible of the research being done at EPFL. But these few pages only give a glimpse of the extraordinary work done in the more than 300 laboratories that make up our School. These research teams, in sharing their expertise and their extremely varied scientific cultures, have set the tone and shaped the internationally recognized force that our School has become.

PHILIPPE GILLET
VICE PRESIDENT
OF ACADEMIC AFFAIRS


ALPINE VALLEYS


HYDROPOWER

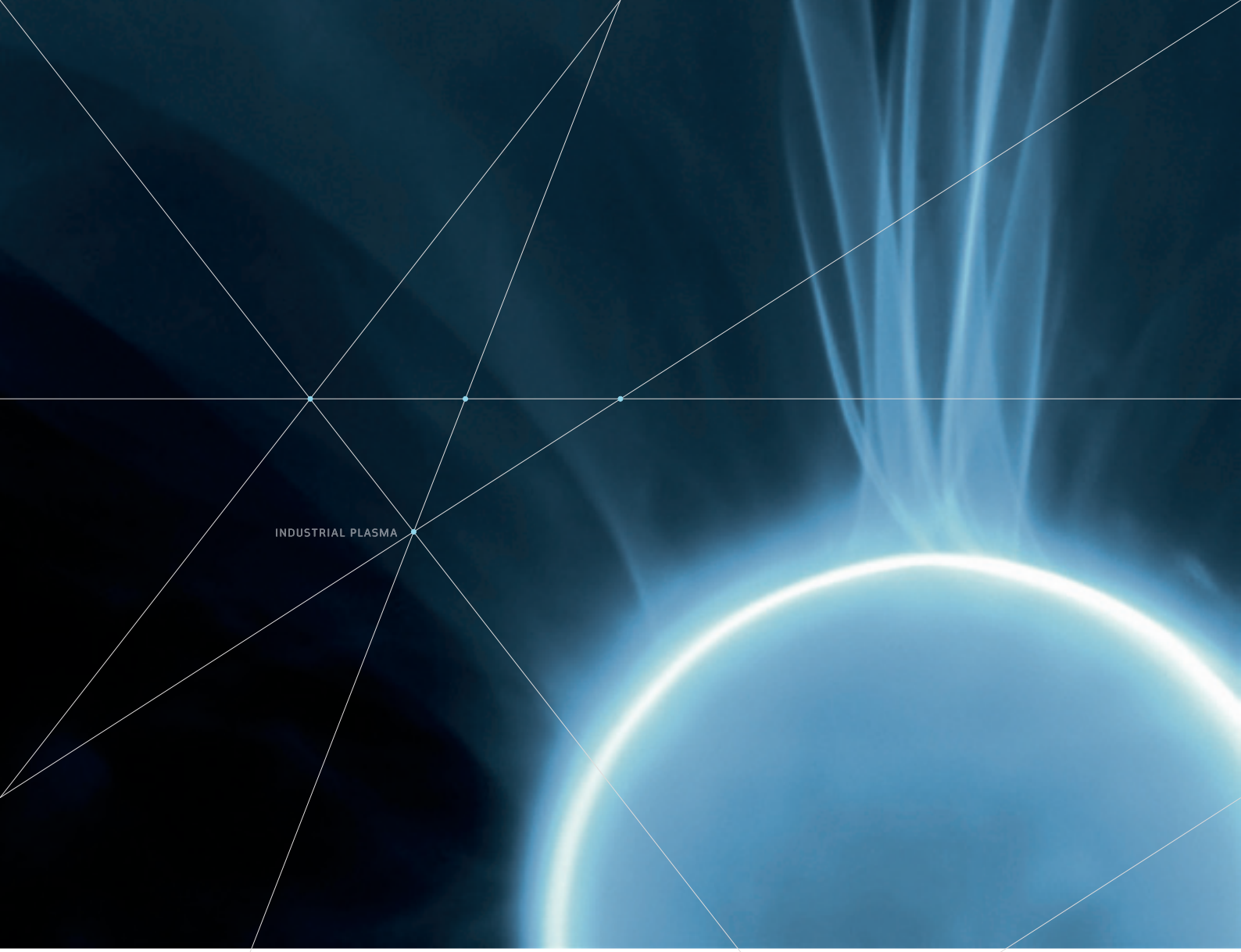
VAL FERRET USED TO MODEL EXTREME GLOBAL RAINFALL

> 24 weather stations

EPFL SCIENTISTS DEVELOPED A NEW STATISTICAL MODEL OF EXTREME RAINFALL IN THE SWISS VAL FERRET REGION, WHICH CAN BE USED ACROSS THE GLOBE. • Extreme rainfall events are linked to hurricanes and floods, which can threaten human lives, severely damage infrastructure, and impact a country's economy. To more accurately predict the risk associated with these events, it is necessary to develop models of extreme rainfall. • A Chair of Statistics team used rainfall data from Val Ferret to build a statistical model of extreme rainfall. They used data from 24 weather stations distributed around the Great St Bernard Pass, including a Météo-Suisse weather station that had collected rainfall data over a 31-year period. • The idea was to learn how extreme rainfall events are distributed over time and space. The researchers used a statistical method called Extreme Value Theory (EVT), which focuses on data that fall far from the average. The team fit existing extreme rainfall models to the Val Ferret data and compared how well each model matched the data. They selected the best models, and then compared how they predicted future daily rainfall. • The study found that a model based on EVT would be the most accurate in predicting extreme rainfall events in Val Ferret. They argue that the method could also be generalized and used to simulate extreme rainfall events on a global scale, for providing risk analyses for use in insurance, flood mitigation, and infrastructure design.

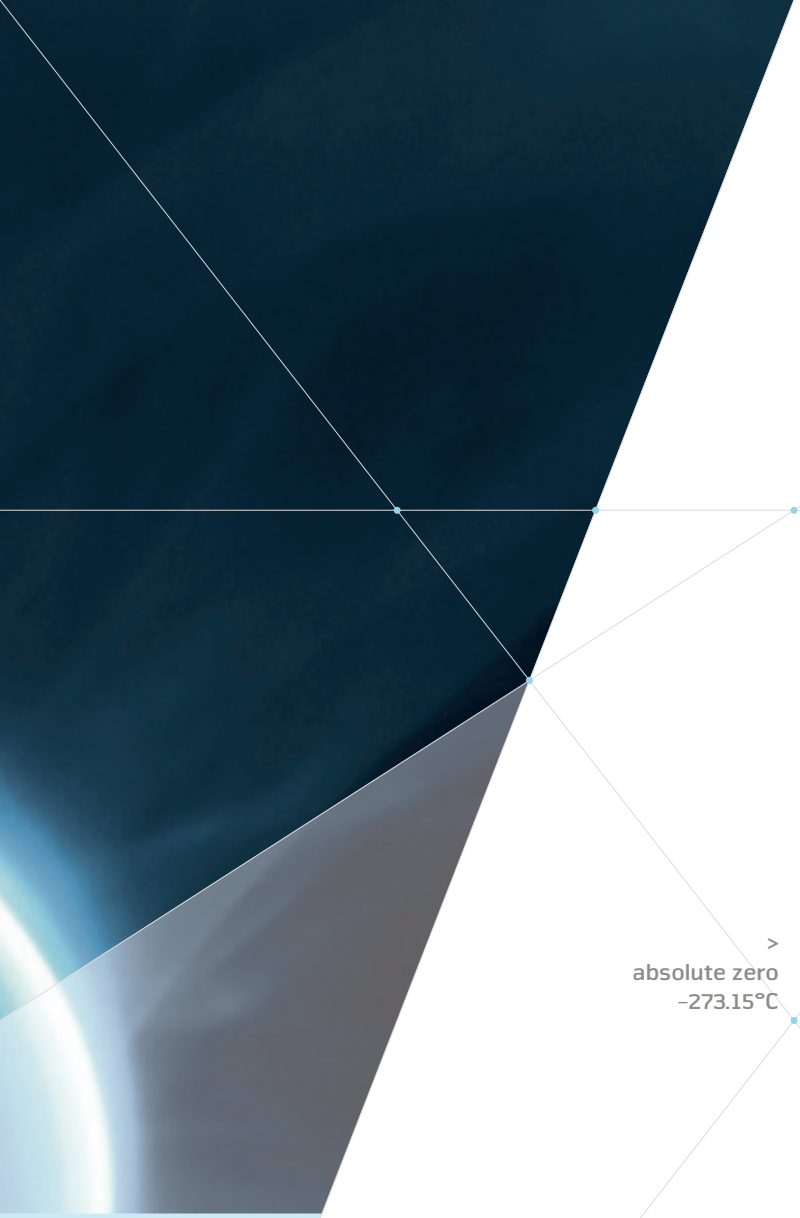
INCREASING HYDROPOWER CAPACITY WITHOUT ENDANGERING THE ENVIRONMENT

HUNDREDS OF MINI-HYDROELECTRIC PLANTS AWAITING APPROVAL IN SWITZERLAND COULD THREATEN THE BIODIVERSITY OF OUR RIVER ECOSYSTEMS. MORE ENLIGHTENED POLICIES COULD HELP PRESERVE THE ENVIRONMENT, SAYS PROFESSOR PAOLO PERONA. • Following the Fukushima accident and Switzerland's decision to abandon nuclear power, renewable energy – particularly hydropower – is expected to pick up much of the slack. But what does this mean for the country's river ecosystems? Under current policy it could lead to dramatic changes in biodiversity, argues Paolo Perona, Professor in Applied Hydro-economics and Fluvial Morphodynamics. • In two recent papers, Perona presented an innovative approach for river management that reconciles both the ecological and the economic point of view. "Measures have been put in place to ensure that rivers never dry out. But these measures kill the natural variability of the river," he says. This comes at a cost to the environment. "Many river processes are dictated by flow variability. Floods, for example, connect rivers to their floodplains, renew soil moisture, deliver nutrients, and remove debris." • Guaranteeing the long-term sustainability of hydropower will require rethinking the way that rivers are managed. Drawing on economic theory, Perona proposes allocating water to hydropower plants and the environment in such a way that both have the same marginal benefit, while preserving the variability of the river flow that is essential to biodiversity.



MAKING INDUSTRIAL PLASMA SAFER

EPFL SCIENTISTS HAVE UNRAVELED THE PHYSICS BEHIND PLASMOIDS, WHICH CAN SEVERELY DAMAGE INDUSTRIAL PLASMA REACTORS. • Plasma is a heated gas with ionized molecules. On Earth, plasma exists naturally in lightning and auroras. In industry, special reactors are used to create plasmas which are then used to manufacture solar cells, fluorescent lights, display screens, and even food packaging. One common problem with industrial plasma is the formation of plasmoids: intense, localized plasmas that can ignite spontaneously and destroy reactor components. Plasmoid damage can result in expensive repairs and costly losses in production. • Scientists in EPFL's Center for Plasma Physics Research (CRPP) have discovered how these plasmoids form, and have suggested ways to stop them. They found that plasmoids act like a funnel for an intense electrical current, transporting electrons through the reactor's grid, which is supposed to contain the plasma. The researchers found that plasmoids are actually sustained by the same power supply that creates the plasma in the first place, and form a positive potential on both sides of the grid. This funneling of electrical current is what causes the plasmoid's intense heat. • "By discovering the physics behind plasmoid formation, we can propose strategies for how the plasma industry can suppress them," says team member Alan Howling. "By regulating the plasmoid-forming mechanisms of their reactors, manufacturers can minimize or prevent plasmoids altogether."



UNDERSTANDING HIGH-TEMPERATURE SUPERCONDUCTIVITY

> absolute zero
–273.15°C

SUPERCONDUCTORS COULD POTENTIALLY REVOLUTIONIZE ENERGY MANAGEMENT, BUT MOST ARE COMMERCIALLY UNUSABLE BECAUSE THEY ONLY WORK IN EXTREME COLD, CLOSE TO ABSOLUTE ZERO. EPFL SCIENTISTS HAVE DEVELOPED AN INNOVATIVE APPROACH THAT MAY HELP US UNDERSTAND AND USE SUPERCONDUCTIVITY AT HIGHER TEMPERATURES. • Superconductors are materials in which electrical current can flow with no energy loss, a phenomenon that, if harnessed, could usher in a vastly more energy-efficient future. Most superconductors work only in extreme cold, however, at temperatures close to absolute zero (–273.15°C). There are some that operate at higher temperatures, around –135°C , but how they do so remains something of a mystery. Scientists in the Laboratory for Ultrafast Microscopy and Electron Scattering have now developed a method that can shed light on these "high-temperature" superconductors (HTS). • Below a certain temperature, the atoms in a superconductor "nudge" electrons together to form new particles called Cooper pairs. These electron pairs observe quantum physics and form an unusual state of matter known as a Bose-Einstein Condensate, which is not affected by electrical resistance. • The researchers cooled an HTS to its superconducting temperature and then repeatedly fired laser pulses on it to break the Cooper pairs up into single electrons, which changed the superconductor's color spectrum. By measuring this change, they discovered that Cooper pair formation in an HTS follows a completely different path than in conventional superconductors. • This study is the first direct observation of Cooper pair formation in a HTS, and provides scientists with a powerful tool to gain further insight into how high-temperature superconductors operate.

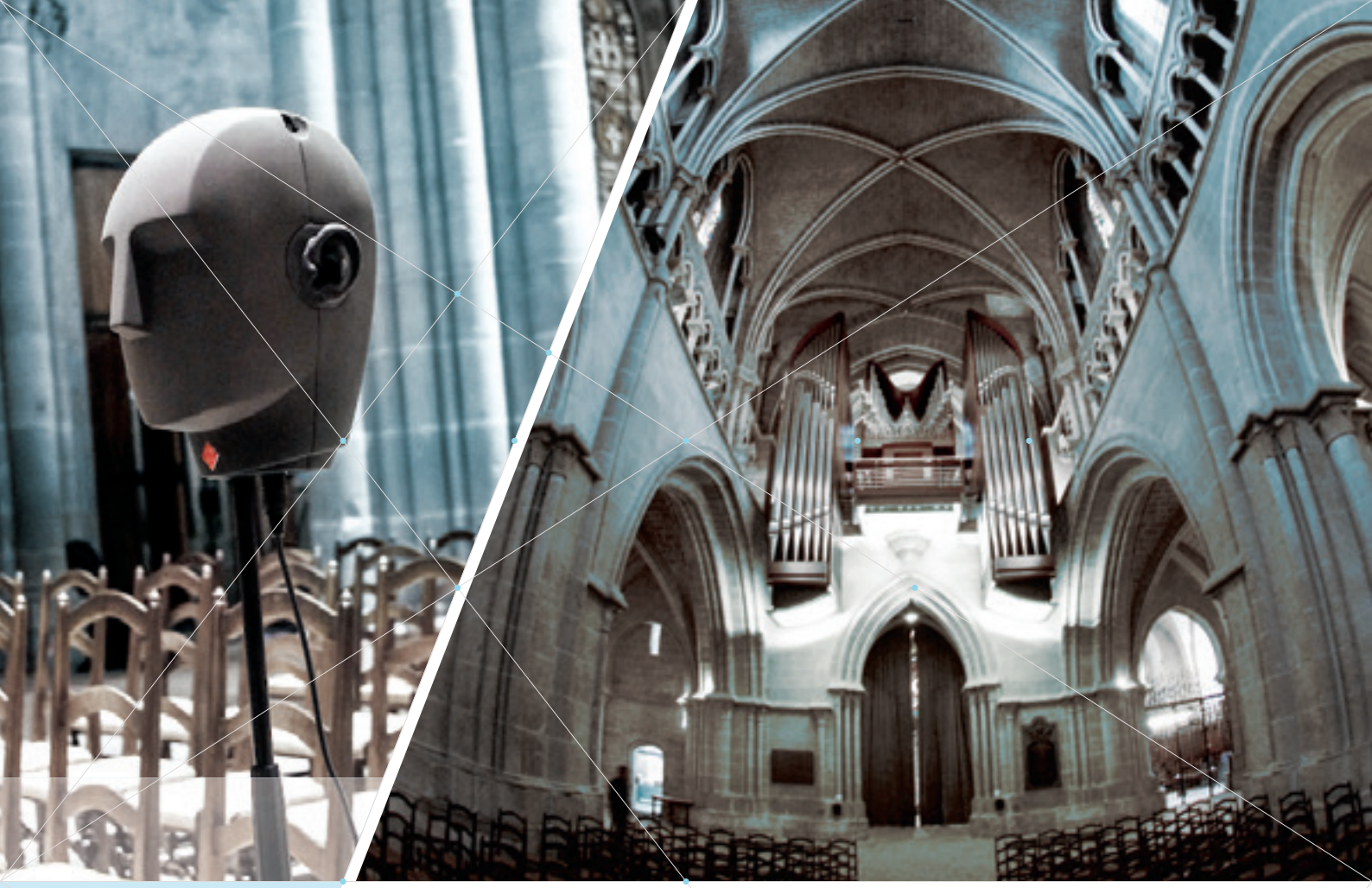
RESEARCHERS UNVEIL A BACTERIAL BATTLE SECRET

SOME PATHOGENIC BACTERIA, INCLUDING THE INFAMOUS *STAPHYLOCOCCUS AUREUS*, ARE VERITABLE WAR MACHINES. EPFL SCIENTISTS HAVE DISCOVERED THAT THEY DEPLOY TINY DARTS TO PENETRATE THEIR VICTIMS' CELL MEMBRANES. • Some bacteria are equipped with a formidable weapon: miniature darts that penetrate the host cell membrane, killing the cell in the process. Scientists in the Global Health Institute have identified the mechanism behind this mayhem: it's an assemblage of proteins that take the form of a spur when they unfold and reassemble. The group's research opens up new avenues for fighting pathogenic bacteria, in particular the highly antibiotic-resistant *Staphylococcus aureus*, the culprit at the root of often-lethal hospital "staph" infections. • In order to invade a host cell, a bacterium must first latch onto it. This is accomplished thanks to seven proteins on the bacterium's surface that are organized in a ringlike shape. In the presence of enzymes from the host cell, a small organic molecule called a peptide detaches from this group, triggering the protein assembly to unfold. The proteins spread out in a circular movement, forming a spur, which then pierces the membrane of the host cell. • One possible strategy to neutralize invading bacteria would be to block the deployment of the protein spur, depriving the bacteria of their lethal weapon. The concept of attacking the bacteria's weapons rather than the bacterium itself is particularly attractive at a time when multiple antibiotic resistances are becoming increasingly common, such as in cases of nosocomial infection involving *staphylococci*.

SLOWING DOWN THE AGING PROCESS WITH SIMPLE ANTIBIOTICS

EPFL SCIENTISTS HAVE FOUND A MECHANISM INVOLVED IN THE AGING PROCESS. NEMATODES THAT WERE TREATED TO BLOCK THIS MECHANISM LIVED BETTER AND LONGER THAN THEIR UNTREATED PEERS. • Why, in an otherwise homogeneous population of the same species, do some individuals live up to three times longer than others? • Now, scientists in the Laboratory for Integrative and Systemic Physiology have uncovered a mechanism that could be responsible for longevity. This takes place in the mitochondria, the so-called powerhouses of the cell. Located in the heart of the cell, these organelles play a role in how organisms age. The new research has pinpointed exactly which gene is involved in that process, and shown what happens with longevity when there is a variation in the protein it expresses. • The team reproduced these variations in nematodes, using antibiotics. "By artificially reducing the manufacture of these proteins during the worms' growth phase, we significantly augmented their longevity," explains lab director Johan Auwerx. Their average life expectancy increased from 19 to more than 30 days. And, notes Auwerx, not only did they live longer, but they were healthier as well.

> worm life expectancy increased from 19 to more than 30 days



MAPPING A ROOM IN A SNAP

AN ALGORITHM DEVELOPED IN THE SCHOOL OF COMPUTER AND COMMUNICATIONS SCIENCES MAKES IT POSSIBLE TO MEASURE THE DIMENSIONS OF A ROOM USING JUST A FEW MICROPHONES AND A SNAP OF YOUR FINGERS. MANY PROMISING APPLICATIONS ARE ON THE HORIZON. • Some blind individuals develop the extraordinary ability to perceive the contours of the room they are in based uniquely on auditory information. Bats and dolphins also use sound to orient themselves in their environment. • A team from EPFL's Audiovisual Communications Laboratory (LCAV), led by professor Martin Vetterli, has developed a computer algorithm that can do the same job based on sound input from four microphones. "Each microphone hears the sound it receives directy, as well as the echoes bouncing off the various walls," explains PhD student Ivan Dokmanić. "The algorithm compares the signals from each microphone. Tiny lags make it possible to calculate not only the distance between the microphones, but also the distance of each with respect to the walls and the sound source." • This ability to "filter" the various echoes recorded by each microphone is in itself an accomplishment. An analysis of each microphone's signal lets the system determine if it is coming from a first or second rebound and to identify the unique "signature" of each of the walls. • The researchers first tested the algorithm in an empty room, where they moved an adjustable wall. Then, based on the encouraging results, they did a second experiment in a much more complex setting – an alcove in Lausanne's Cathedral – which also gave good results.

To the naked eye, the structure resembles a geometric shape.

When a lens is superimposed and gently moved, the design appears.

A NEW METHOD TO THWART COUNTERFEITERS

TO COMBAT COUNTERFEITING, SCIENTISTS HAVE DEVELOPED A MINIATURIZED AUTHENTICATION SYSTEM THAT COMBINES MOIRÉ AND MICROLITHOGRAPHY TECHNIQUES. DOCUMENTS ARE EASILY VERIFIED WITH THE NAKED EYE AND IMPOSSIBLE TO REPRODUCE USING CURRENT PRINTER TECHNOLOGY. • EPFL scientists have introduced a new weapon in the fight against forgery and counterfeiting. They have developed an authentication system that combines two complex techniques and produces images that are virtually impossible to reproduce. These images could be used to help protect currency notes, passports, electronic devices, valuable watches and drugs from being forged. • Two teams were involved: one, led by Roger D. Hersch, provided expertise on the moiré technique, an optical phenomenon resulting from the superposition of two structures that are each made up of dark and light sections; and a second, led by Jürgen Brugger, provided expertise in microlithography. Their joint work resulted in a dynamic, miniaturized image that provides an alternative to holograms, which have become relatively easy to fake. • This invention has numerous security advantages. The moiré patterns are easily recognizable to the naked eye; infrared lamps or microscopes are not needed to verify their authenticity. In addition, the microlithography process makes it possible to obtain complex, high-resolution images of nearly 10,000 dpi; current printers can only manage up to 1200 dpi. A variation of only a few microns in in the superposition of the two layers making up the moiré will result in a noticeable deformation. Attempts at forgery are thus easy to identify.

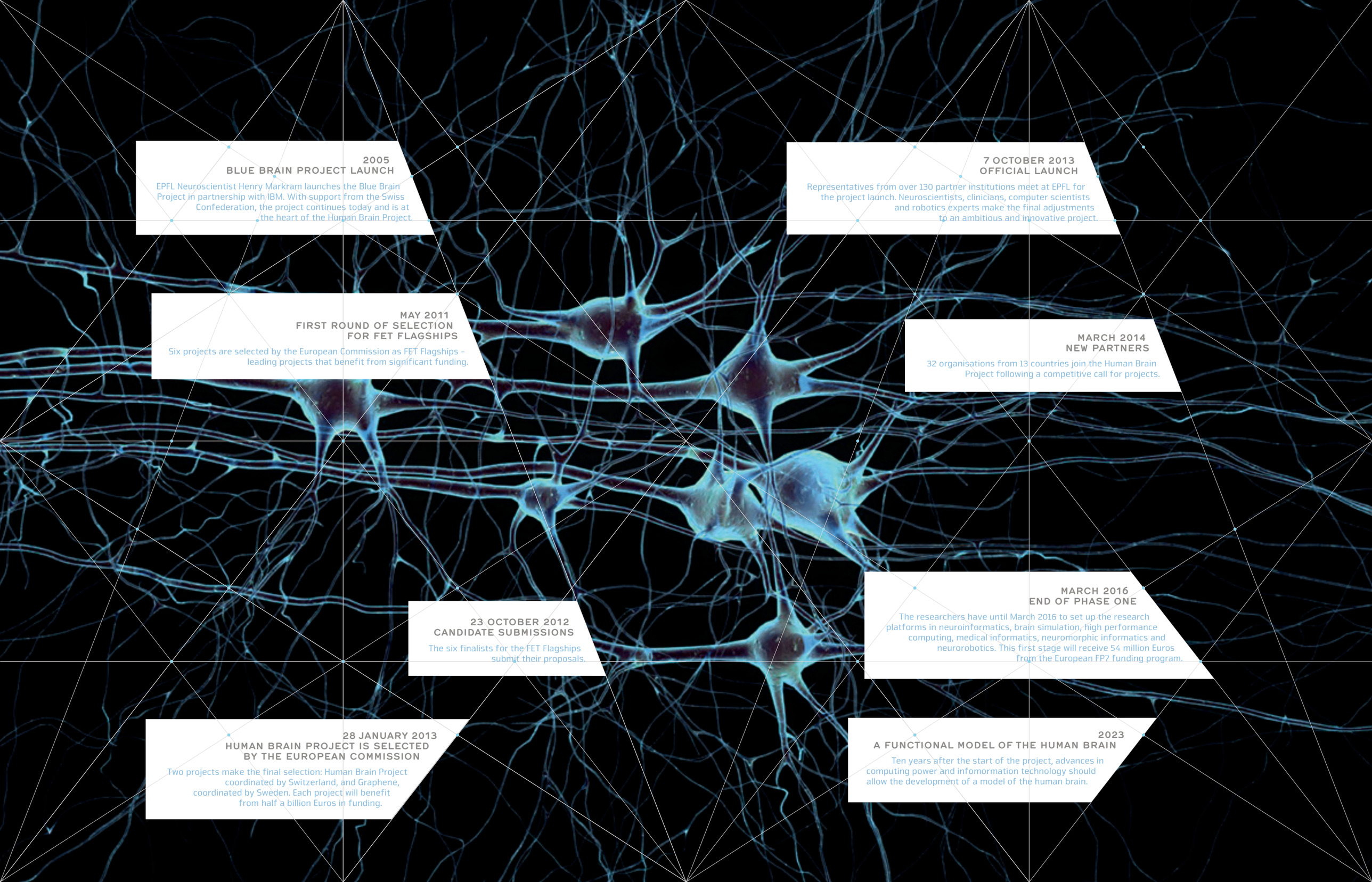
COPPER INTAKE HELPS TUMORS BREATHE

EPFL RESEARCHERS HAVE SHOWN THAT COPPER IS ESSENTIAL FOR THE ENERGY PRODUCTION OF MALIGNANT CANCER CELLS, AND THAT REDUCING COPPER INTAKE VIA FOOD AND WATER CAN SLOW DOWN TUMOR GROWTH. • Copper imbalances have been associated with a number of pathological conditions, including cancer. Led by Professor Douglas Hanahan, holder of the Merck Serono Chair in Oncology, scientists studied the role of copper in cancer using genetically engineered mice with pancreatic neuroendocrine tumors. Their results, published in *PNAS*, show that copper in drinking water – given at the maximum levels permitted in public water supplies – accelerated the growth of tumors in the mice. The study strongly suggests that copper is an essential factor for the growth of tumors in humans as well. The researchers propose that cancer victims should minimize copper intake as part of their cancer therapy. • "The biggest surprise was that a small amount of copper added to drinking water accelerated the growth of tumors, indicating that copper is an essential nutrient for them," said Seiko Ishida, lead author on the paper. • The study does not suggest that copper causes cancer; in fact, exposing healthy mice to the same amount of copper via drinking water for up to two years did not result in an increased incidence of cancer.

GENETICISTS MAP HUMAN HIV RESISTANCE

DO OUR GENES HOLD THE KEY TO FUTURE AIDS THERAPIES? USING A SUPERCOMPUTER, SCIENTISTS ANALYZED THE GENOMES OF THOUSANDS OF STRAINS OF THE HIV VIRUS AND PRODUCED THE FIRST MAP OF HUMAN RESISTANCE. • The key to future HIV treatment may be hidden right in our own genes. Everyone who becomes infected deploys defense strategies. Some even manage to hold the virus at bay without any therapy at all. This immune response leaves its genetic mark within the pathogen itself. Scientists from EPFL and the CHUV-UNIL retraced the chain of events in these battles, from the genome of the virus to the genome of the victim. They have created the first map of human HIV resistance. The goal of their research is to find new therapeutic targets and to enable individualized treatment strategies. • To draw up this resistance map, the researchers analyzed an enormous amount of data going back to the 1980s. They studied HIV strains from 1071 seropositive individuals, comparing over 3000 potential mutations in the viral genome with over six million variations in the patients' genomes. Using supercomputers, they studied all these possible combinations and identified correlations between patients. This novel, indirect method made it possible to obtain the most complete global overview to date of human genes and its implications for HIV resistance.

THE HUMAN BRAIN PROJECT IS ONE OF THE EUROPEAN COMMISSION'S TWO FLAGSHIP PROJECTS. SELECTED AFTER A PROCESS OF INTENSE COMPETITION, THIS PROJECT TO MODEL THE BRAIN HAS BEEN AWARDED €1.2 BILLION IN FUNDING AND IS BEING COORDINATED BY EPFL. • For the next ten years, the Human Brain Project will bring together scientists from more than 100 European research institutions. Its budget is estimated at €1.19 billion. Along with the Graphene Initiative, headquartered in Sweden, the Human Brain Project was selected by the European Commission as a FET Flagship – a program to boost the emergence of very large scale projects in the area of technology. It will be directed at EPFL by Professor Henry Markram, and co-directed by Richard Frackowiak of the Lausanne University Hospital (CHUV) and Karlheinz Meier of the Unviersity of Heidleberg in Germany. • The goal of the Human Brain Project is to bring together all the current knowledge about the human brain for the purpose of modeling it on a computer. These models will be used to better understand the brain and neurological diseases. The project will also involve developing new technologies in computer science and robotics. • Switzerland is playing a pivotal role in the Human Brain Project. At EPFL, Markram and his team are responsible for coordinating the project as well as developing a brain simulation platform. At the CHUV, Frackowiak and his colleagues are creating a medical informatics platform. In Lugano, the Swiss Supercomputing Centre will provide the computer infrastructure needed. Many other Swiss groups are also participating in the project. • The federal government is also participating financially, to the tune of CHF 75 million for the 2013-2017 period, to support Markram's laboratory and the Swiss Supercomputing Centre. Eventually EPFL scientists will do their research in Geneva, on the former site of Merck Serono's laboratories. • Other European countries are not sitting on the sidelines. Germany, in particular, is heavily involved in the project, notably the Jülich Research Centre, which will provide a large part of the required computing resources, and the University of Heidelberg, which is taking on the responsibility of developing new brain-inspired, or "neuromorphic" information technologies.



2005
BLUE BRAIN PROJECT LAUNCH

EPFL Neuroscientist Henry Markram launches the Blue Brain Project in partnership with IBM. With support from the Swiss Confederation, the project continues today and is at the heart of the Human Brain Project.

MAY 2011
FIRST ROUND OF SELECTION FOR FET FLAGSHIPS

Six projects are selected by the European Commission as FET Flagships – leading projects that benefit from significant funding.

23 OCTOBER 2012
CANDIDATE SUBMISSIONS

The six finalists for the FET Flagships submit their proposals.

28 JANUARY 2013
HUMAN BRAIN PROJECT IS SELECTED BY THE EUROPEAN COMMISSION

Two projects make the final selection: Human Brain Project coordinated by Switzerland, and Graphene, coordinated by Sweden. Each project will benefit from half a billion Euros in funding.

7 OCTOBER 2013
OFFICIAL LAUNCH

Representatives from over 130 partner institutions meet at EPFL for the project launch. Neuroscientists, clinicians, computer scientists and robotics experts make the final adjustments to an ambitious and innovative project.

MARCH 2014
NEW PARTNERS

32 organisations from 13 countries join the Human Brain Project following a competitive call for projects.

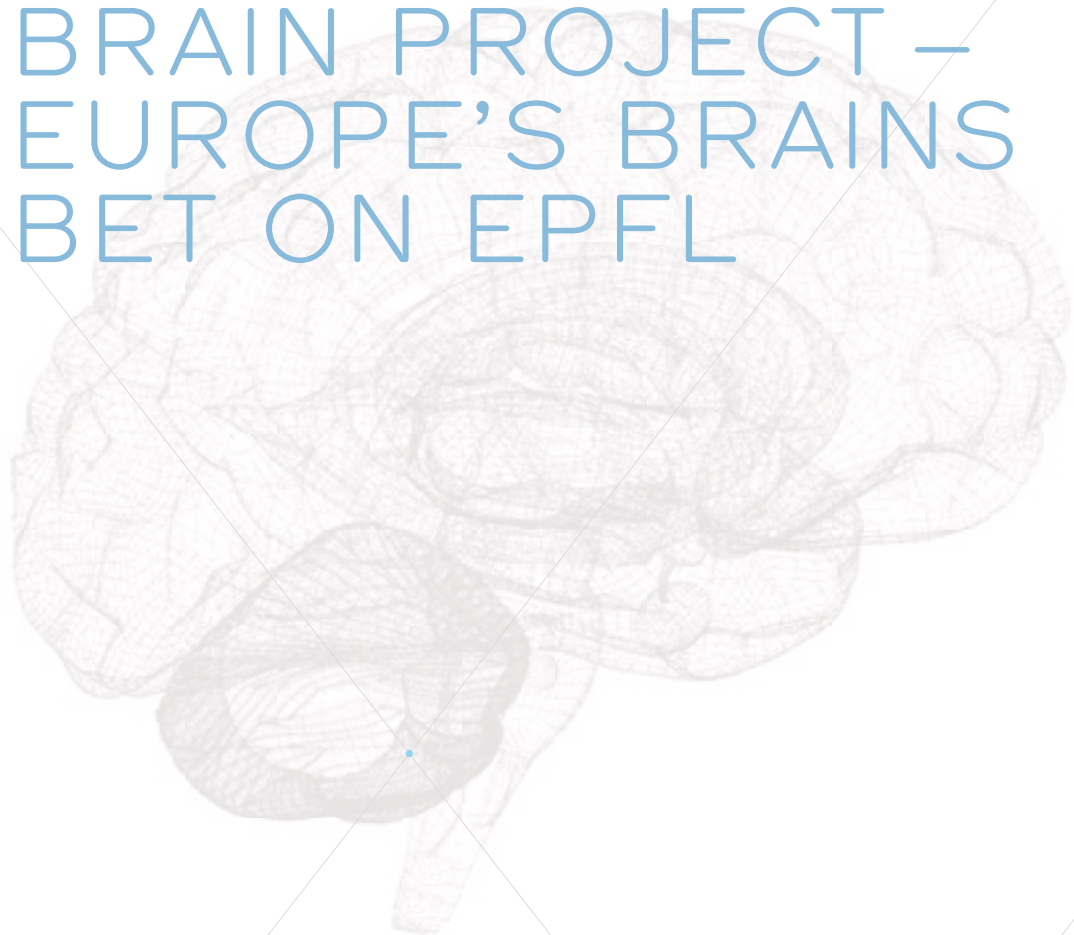
MARCH 2016
END OF PHASE ONE

The researchers have until March 2016 to set up the research platforms in neuroinformatics, brain simulation, high performance computing, medical informatics, neuromorphic informatics and neurorobotics. This first stage will receive 54 million Euros from the European FP7 funding program.

2023
A FUNCTIONAL MODEL OF THE HUMAN BRAIN

Ten years after the start of the project, advances in computing power and infomormation technology should allow the development of a model of the human brain.

THE HUMAN BRAIN PROJECT – EUROPE'S BRAINS BET ON EPFL



OBJECTIVE: MODELING THE HUMAN BRAIN • The Human Brain Project will develop neuroinformatics, brain simulation and high-performance computing platforms. These will make it possible to collect and unify the enormous quantity of neuroscience data available from around the world – more than 50,000 journal articles every year. These data will be integrated into models and simulations. The models will be verified in the light of current knowledge in biology and made available to the scientific community. The ultimate goal is for neuroscientists to understand on the one hand the genetic, molecular and cellular components, and on the other, the cognitive and behavioral dimension.

UNDERSTAND AND DIAGNOSE NEUROLOGICAL DISEASE • A new medical informatics platform will handle clinical data from around the world. Medical researchers will thus have access to valuable information and integrate this into models of disease. The idea is to be able to develop objective diagnostic techniques for neurological illness, to understand their underlying causes, and to provide a tool that could ultimately accelerate the development of new treatments.

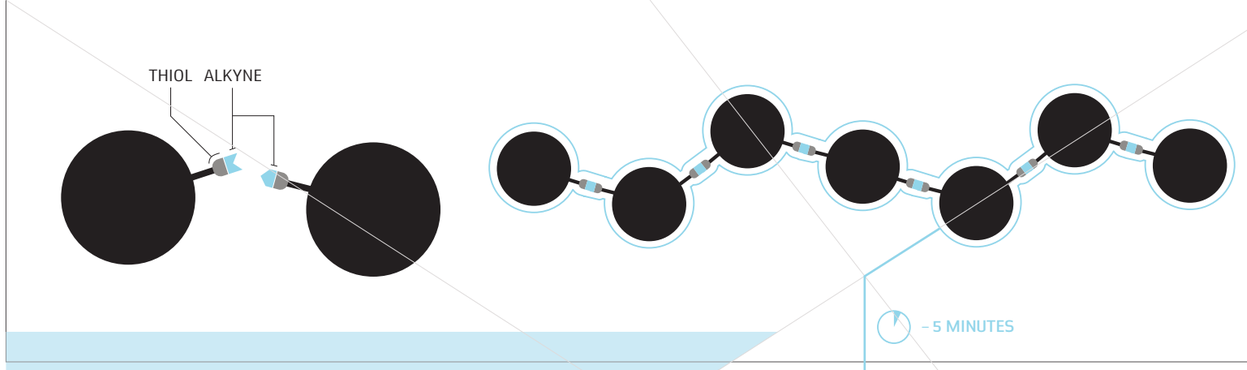
NEW NEURON-INSPIRED TECHNOLOGY • Electronic chips currently work on principles that are completely different from those that govern neurons. Yet we have often found that there is much to be gained from taking a closer look at nature. The brain consumes a meager 20 watts and yet presents modes of learning and resilience that are far beyond the capabilities of even the most powerful supercomputer. That's why many scientific teams around the world are currently developing artificial neuronal circuits on silicon substrates. The University of Heidelberg, a key partner in the Human Brain Project, is on the cutting edge of this field that is extremely promising for the future of computing.

THE FIRST ADVANCE WARNING SYSTEM FOR LANDSLIDES

EPFL SCIENTISTS HAVE DEVELOPED AN EARLY WARNING SYSTEM FOR LANDSLIDES. THIS COULD BE AN INVALUABLE TOOL IN SWITZERLAND; UP TO 6% OF ITS MOUNTAIN SLOPES ARE CHARACTERIZED AS UNSTABLE AND POTENTIALLY DANGEROUS. • There are two basic types of landslide: deep, slow-moving slides that move only a few millimeters per year or per century, and are generally well known and monitored; and surface slides, which are unexpected and move at speeds of up to a meter or more per second. These surface slides are much more difficult to predict. • This is the problem tackled by John Eichenberger, a PhD student in the Laboratory of Soil Mechanics. He worked for four years to develop a numerical model that could reproduce the behavior of steep slopes under the effects of heavy precipitation. Studies were done both in the laboratory and in the field, notably on the slopes of the Rhine River where he coupled sensors with a computer model. The model detects exactly when the soil saturation reaches a critical level, making it possible to launch an early warning. The system is now being applied in Costa Rica to protect laborers working on a mine on the slopes of the Irazu volcano.

URANIUM FOUND TO LEAK OUT OF NATURAL WETLANDS

EPFL RESEARCHERS STUDYING A NATURAL WETLAND NEAR A DECOMISSIONED URANIUM MINE IN FRANCE HAVE SHOWN THAT UNDER CERTAIN CIRCUMSTANCES, THE URANIUM PRESENT IN THE WETLAND IS LESS EFFECTIVELY SEQUESTERED THAN PREVIOUSLY BELIEVED. • Because they are known to mop up pollutants, artificial wetlands are considered to be an efficient strategy to contain waterborne uranium. But studying a natural wetland near a former uranium mine in Limousin, France, Professor Rizlan Bernier-Latmani and her colleagues have found that under certain circumstances the uranium leaks out of the wetland and into the surrounding water. The contaminant escapes by binding to tiny metallic and organic compounds with a little help from ambient bacteria. • Their findings provide important insights into the management of radioactively contaminated sites. A very specific set of circumstances must exist for uranium to escape from the wetland. "We found that uranium has to be present in a specific mobile form, in the presence of large quantities of organic matter, iron, and relatively little sulfate," explains Bernier-Latmani. When these conditions are met, the mobility of uranium withheld in wetlands could be underestimated. • The research also points to a potential strategy that would help improve the wetlands' ability to capture waterborne uranium: by providing the bacteria with enough sulfate, the chain of events could be stopped well before the uranium can escape.



Thiols are ideal for connecting molecules like drugs or polymers together. When coupled with "adaptor" molecules such as alkynes, they offer new commercial, medical and industrial applications.

A new chemical method enables alkynes and thiols to be "clicked" together in less than five minutes, at room temperature and without additional catalysts.

CLICKING MOLECULES TOGETHER TO CREATE NEW COMPOUNDS

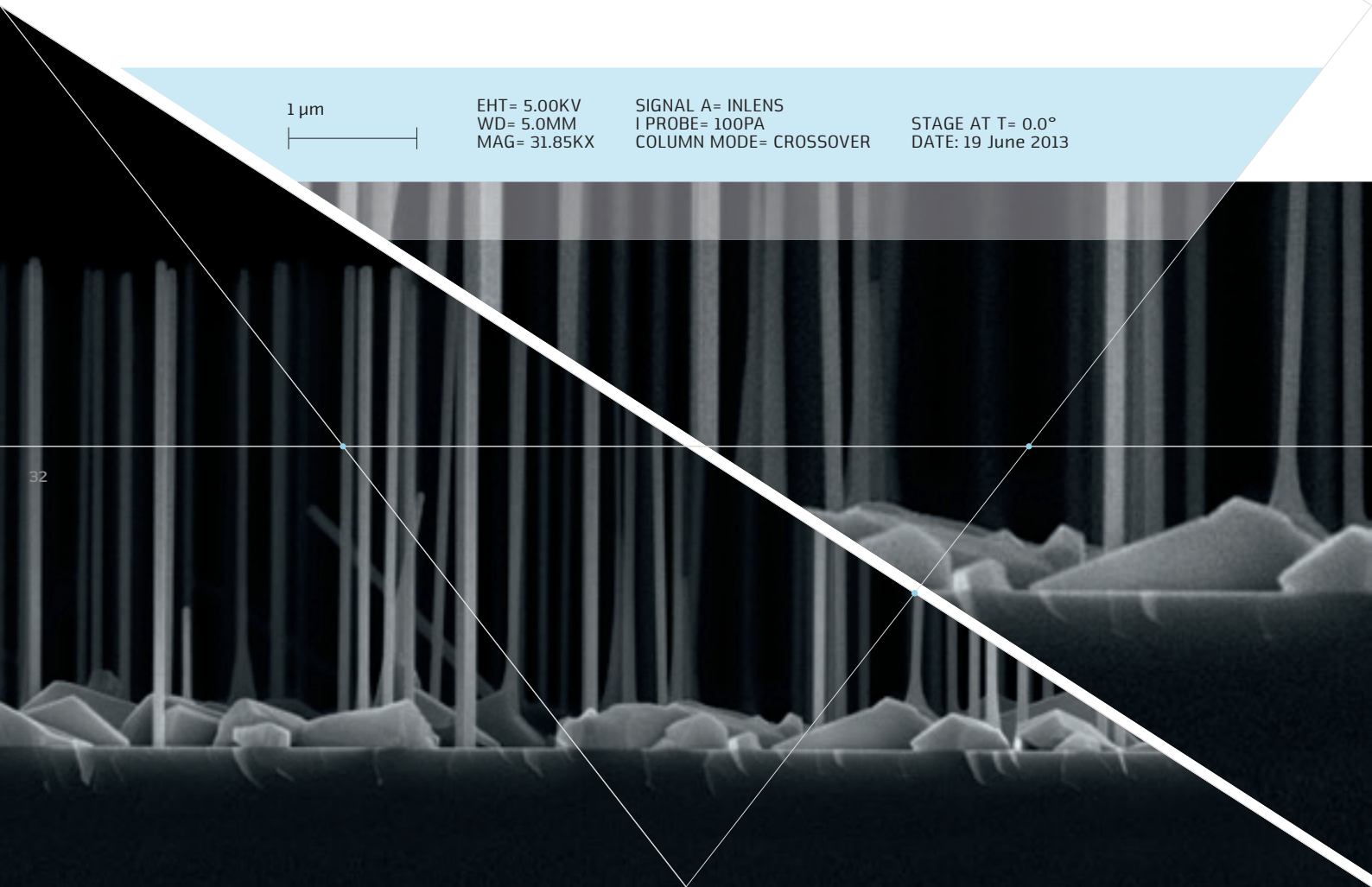
SCIENTISTS AT EPFL HAVE DEVELOPED A QUICK AND SIMPLE METHOD FOR CONNECTING AND ASSEMBLING NEW MOLECULES, OPENING NEW HORIZONS IN SYNTHETIC CHEMISTRY, MATERIALS SCIENCE, CHEMICAL BIOLOGY, AND EVEN DRUG DISCOVERY. • "Click" chemistry is a way to synthesize large molecules by quickly "clicking together" smaller ones, allowing chemists to change previously immutable complex molecules. Thiols, molecules found in most proteins of the human body, are ideal for connecting molecules like drugs or polymers together. But in order for them to do this, thiols must first be fitted with another chemical group that acts like an adaptor. Some of the best "adaptors" are the alkynes, but adding them to thiols is an extremely difficult laboratory procedure. • Scientists in the Laboratory of Catalysis and Organic Synthesis developed a new chemical method that can "click" alkynes to thiols in less than five minutes, at room temperature and without additional catalysts, thus opening up the possibility for many new commercial, medical and industrial applications. • To confirm their new method, the group tested it on a range of thiols that contained the most common and reactive chemical groups present in bioactive molecules. "Introducing an alkyne into thiol-containing molecules allows us to further modify them in order to make future bioconjugates," notes Professor Jérôme Waser.

A NEW METHOD FOR DETECTING FAKE PERFUMES

EPFL SCIENTISTS HAVE DESIGNED A QUICK METHOD FOR DETECTING COUNTERFEIT PERFUMES, AND HAVE TESTED IT ON MAJOR BRANDS LIKE GIVENCHY, HERMES AND D&G. • Identifying imitation perfumes can be a difficult and time-consuming task. Researchers from the Laboratory of Physical and Analytical Electrochemistry have developed a new method for identifying counterfeit perfumes that's faster than conventional methods. • The unknown perfume is charged like a battery until it breaks into fragments that are then sprayed onto a detector. The detector sorts the perfume's fragments by mass, and a computer identifies the whole molecule. The benefit is that the tested sample requires minimal or no chemical preparation beforehand, making the whole process faster, real-time and more informative. • The team tested their method on six perfumes from Givenchy, Hermes and D&G, which were compared to a "model counterfeit" perfume made from ten compounds. The new method was able to quickly distinguish between authentic perfumes and the counterfeit, and without any previous chemical processing. • This method could be used in both quality control and in the development of new compounds upon which perfumes are based, thereby increasing the productivity of the perfume and cosmetic industry.

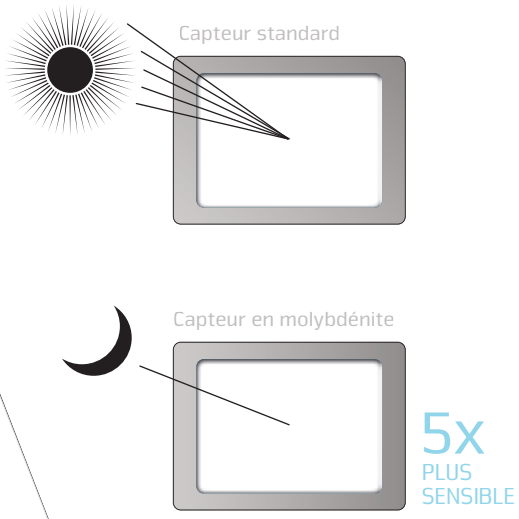
NANOWIRES: A REVOLUTION FOR SOLAR ENERGY

NANOWIRES CAN CAPTURE UP TO TWELVE TIMES MORE LIGHT THAN TRADITIONAL SOLAR TECHNOLOGY, GIVING THEM THE POTENTIAL TO REVOLUTIONIZE SOLAR ENERGY PRODUCTION. • Imagine a solar panel more efficient than today's best solar panels, but using 10,000 times less material. This is what researchers expect given recent findings on the tiny filaments called nanowires. Solar technology integrating nanowires could capture large quantities of light and produce energy with incredible efficiency at a much lower cost than traditional solar technology. Nanowire-based solar technology could one day be used to power microchips and in a new generation of solar panels. • ''These nanowires capture much more light than expected,'' says Professor Anna Fontcuberta i Morral. • Fontcuberta's research was published in the journal *Nature Photonics*. A prototype is already almost 10% more efficient at transforming light into power than the most theoretically efficient conventional single material solar panels. The study suggests that an array of nanowires may attain 33% efficiency in practice. Commercial (flat) solar panels are now only up to ~20% efficient. Arrays of nanowires would use at least 10,000 times less gallium arsenide than conventional solar panels, making large-scale industrial production feasible.



A MOLYBDENITE-BASED ULTRASENSITIVE PHOTOGRAPHIC SENSOR

SCIENTISTS HAVE DEVELOPED A PROTOTYPE OF AN IMAGE SENSOR THAT PUSHES BACK THE LIMITS OF CURRENT TECHNOLOGY. IT COULD EVENTUALLY LEAD TO CAMERAS THAT ARE FIVE TIMES MORE SENSITIVE THAN THOSE CURRENTLY ON THE MARKET AND OPEN UP POSSIBILITIES FOR NIGHT-TIME PHOTOGRAPHY. • A new material could impressively multiply the sensitivity of photographic sensors. After having discovered the powerful semi-conducting properties of molybdenite (MoS_2), Professor Andras Kis and his team are continuing to explore its potential in a variety of applications. MoS_2, an increasingly serious candidate to replace silicon, was integrated into an image sensor prototype whose light sensitivity is five times greater than image sensors currently on the market. • This achievement opens up the possibility of night-time photography without having to use noise-generating amplification processes, slow down the shutter speed or use a flash. For some specific areas in which light conditions are often less than ideal, such as astrophotography or biological imaging, the advantage is even more evident, notes Kis.



Sensitive molybdenite photographic sensors could open up the possibility of night-time photography.

AVOIDING THE PITFALLS OF URBAN DENSIFICATION

THE SWISS POPULATION RECENTLY VOTED TO PUT A HALT TO URBAN SPRAWL. THANKS TO RESEARCH IN URBAN PLANNING, TODAY WE HAVE WHAT IT TAKES TO DESIGN DENSE, YET PLEASANT URBAN SPACES. • Following the Swiss population's decision to contain urban sprawl, villages and cities are under pressure to accommodate growing numbers of residents without spilling over their perimeters. But what does this mean for people living in cities? History reveals no shortage of urban densification projects gone awry. But they were mainly the result of a lack of experience in dealing with such high population densities, says EPFL Professor Andrea Bassi, Director of a Geneva-based architectural firm. • Once an enabler for urban development, personal mobility has now become a bottleneck. ''By promoting urban mixity, or the coexistence of residential, commercial and recreational spaces, we can reduce the reliance on motorized transport.'' Says Bassi. In Switzerland, this transition is already underway. ''The master plan for the Praille neighborhood in Geneva is based on a mixed, dense program. And a national construction program outlining these themes is already in place,'' he concludes.

Targeting medication to the right place, at the right time, could help regenerate cartilage

A NEW METHOD FOR REGENERATING CARTILAGE

EPFL SCIENTISTS HAVE DEVELOPED AN INTELLIGENT HYDROGEL THAT CAN PROMOTE CARTILAGE REGENERATION. THEIR METHOD INVOLVES RELEASING MEDICATION IN THE RIGHT PLACE AT THE RIGHT TIME. • Unlike our bones, cartilage is not vascularized, in other words, it does not have its own blood supply, and this is why it does not regenerate well after an injury. Joint injuries, which are common in competitive sports, often lead to cartilage degeneration and arthritis. This condition becomes chronic and irreversible. No effective treatments are available. • The cells that produce cartilage in a joint will only do their work when they are subjected to a repeated mechanical load. As part of the Swiss National Research Program in Intelligent Materials (PNR62), Professors Dominique Pioletti and Harm-Anton Klok developed a hydrogel that can deliver a growth factor to cartilage-producing cells only during repetitive movement, such as walking. Their results were published in the journal *Biomaterials*. For the time being, the scientists have only demonstrated the mechanical concept, using colored dyes instead of growth factors. This innovative method is now undergoing fine tuning to be ready for the market.

SPEEDING UP TRAFFIC ON THE OPTICAL FIBER SUPERHIGHWAY

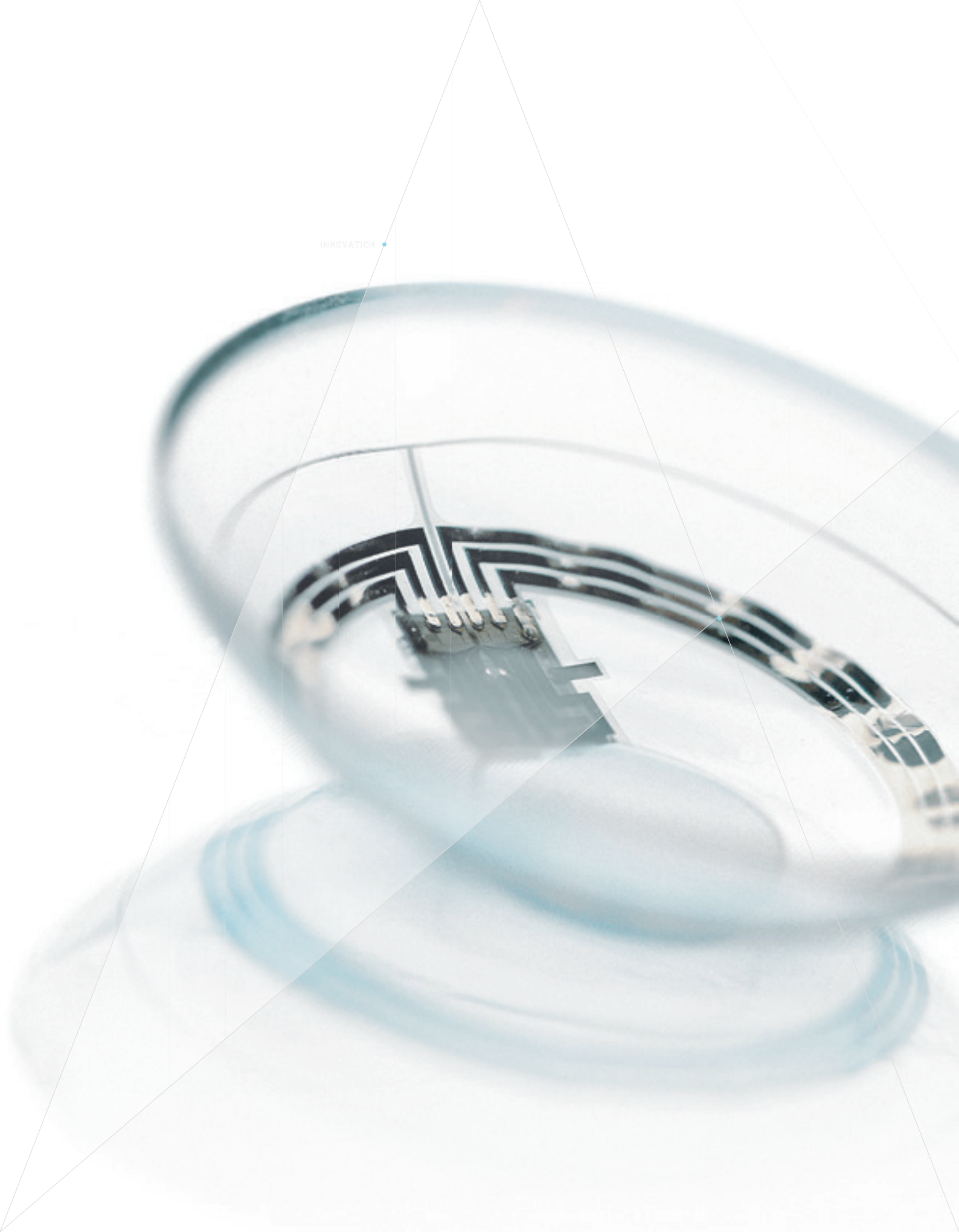
A NOVEL BUT SIMPLE METHOD TO REDUCE THE SPACE BETWEEN PULSES OF DATA TRAVELING DOWN OPTICAL FIBERS COULD INCREASE THROUGHPUT IN TELECOMMUNICATIONS SYSTEMS BY A FACTOR OF TEN. • Optical fibers use light pulses to transport information over thousands of kilometers at astronomical speeds. The flow rate, however, is limited because the pulses cannot travel too closely together. • To prevent data traveling along the fibers from interfering with one another, the light pulses must be lined up in "Indian file," one after the other, keeping a specific distance between them. This leaves unused empty space in the fiber. • Camille Brès and Luc Thévenaz presented a method for generating light pulses that can be fitted together within the fiber, thus eliminating the space between the pulses. This approach, which was published in the journal *Nature Communications*, makes it possible to use all the capacity in an optical fiber and opens the door to a ten-fold increase in throughput in our telecommunications systems. The technology is already mature, as well as 100% optic and relatively cheap, and the new transmitter could fit on a simple chip.

GENEZIK BEATS A PATH THROUGH YOUR MUSICAL JUNGLE

NEW SOFTWARE DEVELOPED FROM EPFL RESEARCH HELPS USERS BUILD NEW PLAYLISTS AND FIND LOST FAVORITES. IT COMBINES A THOROUGH COMPUTER ANALYSIS OF MUSICAL STRUCTURE WITH EACH USER'S UNIQUE MUSICAL "DNA." • As the years go by and you download thousands of songs, your digital music library can quickly become a jungle. Genezik, a software program developed in the Signal Processing Laboratory by Kirell Benzi and Florian Carrere, gives you a new way to navigate this jungle, so you can rediscover your own musical collection and explore new musical possibilities. • What makes this program original is its "musical paths" approach. It determines a list of songs that, played one after the other, can gently take a listener from, say, a classic Aretha Franklin tune to a Daft Punk hit, or from Mozart to Metallica. If you only choose a single song, it will create a coherent path of songs whose properties are considered scientifically similar. • Genezik analyzes each song's rhythmic structure, timbre, harmonic structure and progression, dissonance, and so on. The program uses graph theory to represent each piece as a node in a graph. Similar nodes are connected, forming clouds like "rock," "pop," and "jazz." The system also takes into account the listener's musical preferences, since at any time you can tell it you like or don't like a song or a transition. Automatic learning algorithms take this information and use it to refine and personalize the program, adjusting the results to your "musical DNA."

A CHIP THAT HOLDS A MICROWAVE FOR A MOMENT

SCIENTISTS CAPTURED A MICROWAVE AND HELD IT IN A CHIP FOR SEVERAL MILLISECONDS, AND THEN RELEASED IT VIRTUALLY UNCHANGED. THIS PROCESS, WHICH IS CRITICAL IN TELECOMMUNICATIONS, NORMALLY REQUIRES HUNDREDS OF KILOMETERS OF ELECTRICAL CABLES. • Microwave radiation is everywhere: in cell phones, airplane navigational systems, and wifi routers. But it is difficult to control their propagation. Hundreds of kilometers of electrical cables are needed to store a signal for several milliseconds, for example. As it propagates through this cable waveguide, however, the signal deteriorates to such a degree that the wave must be regularly amplified. • Scientists in the Laboratory of Photonics and Quantum Measurements, in collaboration with the Walther-Meissner-Institute in Garching, Germany, have developed a new method to control this wave propagation that can block, delay, accelerate or switch microwave pulses. • The team, led by Professor Tobias Kippenberg, combined two devices on a chip in a hybrid technology: a microwave cavity and a mechanical nanooscillator, a sort of tiny vibrating bridge placed inside the cavity. When a microwave signal arrives it is reflected along the interior boundaries of the cavity thousands of times. The tiny mechanical oscillator preserves the signal quality. The two technologies, when combined, allow the microwave signal to be stored for several milliseconds.


INNOVATION

TECH TRANSFER

INNOVATION THAT TAKES LOCAL COMPANIES INTO ACCOUNT

In 2013, start-up companies in EPFL's Innovation Park managed to raise more than CHF 100 million in private capital. Some of these young companies came from the outside and chose our campus as an ideal ecosystem in which to continue their development. Others were formed to further develop research that originated in EPFL laboratories – there were 12 of these in 2013. Indeed, one of the School's basic missions is to ensure that what is discovered in our laboratories can be transferred to industry and, in the end, work to benefit both future employees and consumers. • A particularly impressive example of this can be seen in our many medical technology start-ups (pp. 40–42). These young companies are developing novel technologies in diagnostics, assisted surgery and drug therapies. • These medical technologies are not only growth areas for their own sake, but they are particularly suited to the Swiss industrial landscape and, dare I say it, to the country's DNA. This is a domain in which quality cannot be compromised and high precision is essential. This is why young medtech companies find in Switzerland the ideal cultural soil in which to grow and thrive, along with a highly qualified work force that is a necessary part of their success. • In this year as well, our company creation chain received an important new link. With "the Forge" we have established a structure that can help our young entrepreneurs at the critical phase in which their idea is ready and they are preparing to launch into the adventure (p. 39). We provide advice from experts along with office space and technical infrastructure. The new entity's doors have just opened and it already houses more than 15 young companies. And the future looks even more promising.

ADRIENNE CORBOUD FUMAGALLI
VICE PRESIDENT FOR INNOVATION
AND TECHNOLOGY TRANSFER

TWO NEW COMPANIES COME TO CAMPUS IN 2013

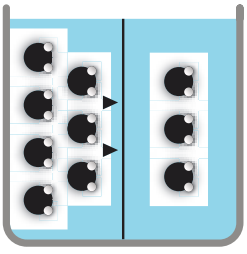
THE INNOVATION PARK IS THE INTERFACE BETWEEN CUTTING EDGE CORPORATE RESEARCH CENTERS AND EPFL. TWO ADDITIONAL COMPANIES CAME ON BOARD IN 2013: MERCK SERONO AND VIASAT. • In order to be closer to the numerous collaborative possibilities with EPFL's laboratories and the stimulating campus environment of the Innovation Park, two large companies opened research satellites on campus in 2013, joining other multinationals such as Nestlé, Logitech, Nitto Denko, and Credit Suisse. • Merck Serono inaugurated its offices on November 22. The pharmaceutical group is planning to develop academic and research collaborations with several EPFL laboratories by bringing its expertise in pharmacometrics to the table. Scientists at the satellite in the EPFL Innovation Park will do research in the quantitative analysis of relations between patients, their diseases, and drugs that are being developed to treat them. Pharmacology, physiology and disease progression models will be used along with simulation tools. Cancer, neurodegenerative diease, immunotherapies and bioengineering are among the areas in which fruitful and wide-ranging collaborations could be developed. • ViaSat, a large American telecommunications company, opened offices in EPFL's Innovation Park after having acquired a spin-off from EPFL's Laboratory of Electromagnetism and Acoustics in 2007. This satellite will develop high-performance antennas and new applications for terminals that could extend high value-added services for satellite communications.

EPFL GETS A HUB FOR FUTURE ENTREPRENEURS

LOCATED IN THE INNOVATION PARK, THE FORGE PROVIDES AN AREA FOR FUTURE ENTREPRENEURS TO DRAW UP A PLAN FOR THEIR START-UPS, EXCHANGE IDEAS WITH OTHER ENTREPRENEURS AND TAKE ADVANTAGE OF EXPERT COACHING. • Up until recently, the EPFL campus did not have a place where sprouting start-ups could get themselves going and interact with one another. Now the Forge, located in Innovation Park, has met this need; it provides future entrepreneurs with desk space in an open area, a conference room and meeting rooms. It was inaugurated on November 19, 2013. It also serves as a networking and consulting area. • The Forge is a true platform for the exchange of ideas. Here, coaches help guide new entrepreneurs, and informal meetings are organized with seasoned entrepreneurs, venture capitalists, and other actors in the start-up world. These discussions lead to new directions, new ideas, inspiration and visibility. • Future start-ups have space for a six-month period that can be renewed once. This is enough time to evaluate whether or not the spark will catch and a concrete project is possible, and whether sufficient funding can be raised to pass to the next stage, in the "Garage" in the Innovation Park or elsewhere.

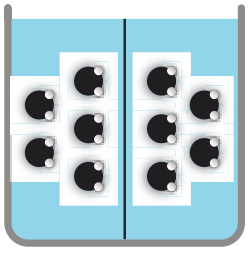
CONVERTING HEAT INTO ELECTRICITY

START-UP COMPANY OSMOBLUE RECENTLY VALIDATED THE FEASIBILITY OF PRODUCING ELECTRICITY FROM HEAT EMITTED BY WASTE INCINERATORS, REFINERIES AND DATA CENTERS. • A large proportion of the energy we consume – between 20% to 50%, according to some studies – is dissipated as heat. Although it is already possible to recycle heat at temperatures over 150 degrees to produce electricity or heat homes, the rest is simply released into the environment. OsmoBlue, a start-up company that originated from research in the Laboratory for Microsystems, has developed an osmosis-based process for transforming heat over 30 degrees into electricity. • Osmosis occurs naturally when two solutions separated by a permeable membrane have different concentrations, for example salt water and fresh water. A flow develops from the less concentrated side to the more concentrated side of the membrane, until the solutions reach equilibrium. The mechanical energy generated by this flow can be converted into electricity using a turbine and an alternator. Heat is used to separate the fluid once again into two solutions with different concentrations. Thus a closed circuit is formed that does not consume water. • The main advantage of OsmoBlue's technology is that it can be used with any heat source: air, gas, or liquid. The young company has created a digital demonstrator and a computer model that evaluates the product's performance, and a prototype machine is being manufactured at EPFL.



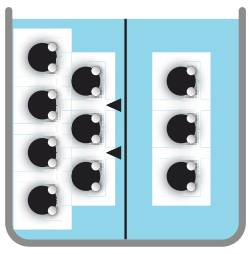
OSMOSE

L'osmose se produit naturellement lorsque la concentration entre deux solutions est différente. L'énergie mécanique de ce flux peut être transformée en énergie électrique.



CHALEUR INDUSTRIELLE

La chaleur est utilisée pour séparer à nouveau le fluide en deux solutions avec une concentration différente. Il s'agit donc d'un circuit fermé ne consommant pas d'eau.



DIAGNOSTICS AND IMAGING

SMARTPHONE BLOOD ANALYSIS

Thanks to Qloudlab, an EPFL-based start-up, patients on anticoagulant medications can do a blood test at home in only a few seconds. Qloudlab's device analyzes the sample and then displays results directly on patients' smartphone screens. The data can then be sent directly to their doctor using a mobile app. Patients on anticoagulants are required to undergo frequent hospital blood tests; this invention could make life a lot easier for them.

BACTERIA: DEAD OR ALIVE?

How can you tell if a microbe is truly dead? This question is critical, confronted as we are with an increasing incidence of antibiotic-resistant stratins of bacteria. EPFL physicists have developed an ingenious and almost instantaneous diagnostic test to answer it: a minuscule silicon lever that reveals the tiniest signs of life in a microorganism through vibrations. The method is easy to use in a clinical setting and could also be used to test chemotherapy medications.

A MINI-LAB UNDER THE SKIN

A tiny implant developed at EPFL can analyze the concentration of substances present in our bodies, some of which act as health status indicators. Implanted under the skin, the devive can simultaneously detect up to five proteins or organic acids. A radio module in it can then send results to a doctor over a cellphone network. This feat of miniaturization could be particularly useful for monitoring chemotherapy patients.

A CANCER ID CARD IN MINUTES

Scientists have discovered a way to rapidly identify the type of breast cancer a patient is suffering from, and in only a few minutes. This extremely rapid and reliable *in vitro* system identifies the presence of a protein that's correlated with an elevated risk of developing metastases. This method is an important advance, because it allows caregivers to quickly prescribe a targeted treatment which, coupled with chemotherapy, has been shown to be very effective.

KEEPING TABS ON YOUR HEART

Thanks to a portable ECG device developed in EPFL's Embedded Systems Laboratory, patients and doctors can be immediately alerted in the event of heart rate anomalies. By detecting arrhythmia early, medical intervention can occur more rapidly, giving the patient a much better chance of survival. The device is small, not cumbersome, and its batteries have a large degree of autonomy. The invention led to the creation of the start-up company SmartCardia.

BETTER, SAFER MRI SCANS

EPFL scientists have developed a method for reducing the risks and costs of magnetic resonance imaging (MRI). Although this technology is very useful, it is not very sensitive. The only solution up to this point has been to inject patients with potentially toxic tracers, called persistant radicals. The researchers discovered that it was possible to conduct high-resolution MRI tests using pyruvic acid, a non-toxic organic substance that the body produces naturally.

ONE-HOUR CELL ANALYSIS

A PhD student in EPFL's Laboratory of Biomedical Imaging has designed a new virtual tool that could change biologists' lives. Microscopes are continually improving and today, they can provide 3D images of thousands of cells. But because they're all piled up on top of each other, it is difficult to get data such as size, shape and density in a short amount of time. Using the new tool, called "Active Cells," or "Snake," it only takes an hour to analyze dozens of images of cells on a simple desktop computer.

MEDICINE

NEW DRUGS TO FIGHT CANCER AND AUTOIMMUNE DISEASE

Bicycle Therapeutics, an EPFL start-up, has come up with a new class of drugs that can fight cancer and autoimmune disease. It's based on peptides, amino acid polymers that have several advantages over the monoclonal antibodies that are commonly used in current medications. The peptides are smaller and can thus spread more easily thoughout tissues. They can also be attached to proteins involved in specific diseases and disrupt their functioning, without affecting other proteins.

ON-COMMAND TARGETED DRUG DELIVERY

Scientists have succeeded in controlling a drugs' active component with a magnetic nanovector. This makes it possible to deliver a drug specifically to a diseased area. Chemotherapy drugs have the disadvantage of affecting healthy tissues as well as cancerous ones; this advance will provide a solution to that drawback. The research was done in collaboration with the University of Fribourg and the Geneva University Hospitals.

GOOD NEWS IN THE FIGHT AGAINST ALZHEIMER'S

AC Immune, a company headquartered on the EPFL campus and a key player in the development of new therapeutic agents to fight Alzheimer's disease, has made significant progress in 2013. It was selected from among 25 candidates by the U.S. National Institute of Health to conduct clinical trials involving the injection of antibodies. The company is also conducting clinical trials exploring the possibility of vaccination.

SURGICAL AND MEDICAL DEVICES

A MICRO-TAP TO TREAT GLAUCOMA

A tiny implant developed in EPFL laboratories could revolutionize glaucoma treatment. This disease is the second most common cause of blindness, after cataracts, and is characterized by a buildup of fluid between the cornea and the iris, which destroys the optic nerve. The device, a kind of controllable mini-drain, removes the excess fluid. It will be commercialized by Rheon Medical, an EPFL spin-off, sometime in 2014.

GETTING A GLIMPSE OF CANCER CELLS ON THE OPERATING TABLE

A new generation surgical microscope will allow surgeons to see the cellular and micro-vascular structure of human tissues during the course of an operation. This device, called HistoScope, was developed by EPFL spin-off Samantree. It provides a significant benefit in both time and cost; suspicious lesions can be identified immediately, and surgeons can verify that all cancerous cells have been removed during an operation to remove a tumor.

A MASTER OF PRECISION

Neuroglide, a robot developed by EPFL's Laboratory of Robotic Systems, was designed to be a master of precision: it can place a screw with a 4 mm diameter into a bone that's only an average of 6mm wide, avoiding cerebral arteries on one side and the spinal cord on the other. This operation is delicate, even for the best surgeons in the world. A start-up company, KB Medical, was launched to commercialize the robot.

DEVELOPING TECHNOLOGIES FOR HEALTH

MEDICAL TECHNOLOGY IS BOOMING THESE DAYS. FROM DIAGNOSING DISEASE TO MONITORING PATIENTS REMOTELY TO ASSISTING SURGEONS IN DELICATE PROCEDURES, MANY PROMISING COMPANIES ARE BEING CREATED AT EPFL. THE MEDTECH INDUSTRY IS PARTICULARLY WELL ADAPTED TO SWITZERLAND'S EXPERTISE AND ECONOMIC ENVIRONMENT, FOR THE CREATION OF SMALL AND MEDIUM-SIZED BUSINESSES. MEDTECH MADE HEADLINES ON CAMPUS SEVERAL TIMES IN 2013.

OPEN ACCESS "MADE IN EPFL" HAS CAUGHT NATURE'S EYE

NATURE PUBLISHING GROUP, PRODUCER OF THE PRESTIGIOUS, EPONYMOUS JOURNAL, HAS INVESTED IN FRONTIERS, AN EPFL GROUP THAT HAS PUBLISHED A SERIES OF SCIENTIFIC JOURNALS USING AN OPEN-ACCESS MODEL. • In March 2013, Nature Publishing Group, publisher of the prestigious academic journal *Nature*, announced a majority investment in EPFL-based Frontiers. Created by EPFL scientists, Frontiers has gradually become one of the most prominent open access (OA) publishing companies in the world. Since its inception in 2007, the number of articles has more than doubled, reaching 5000 in 2012. It currently has a portfolio of 14 open access journals in 14 scientific fields. • Frontiers will continue to use its own platform, brand and policies. The two groups will work together to develop new tools for open science and streamlining editing and publication procedures. Philip Cambell, editor in chief of *Nature*, was impressed by the refereeing process put in place by Frontiers, particularly the fact that reviewers' and editors' names appear in published articles. This aspect was also emphasized by Kamila Markram, who wants to "innovate not only in the field of open access, but also to offer a more transparent and constructive peer review process."

A NEW TOOL FOR CLEANING UP CODE

BUGBUSTER, AN EPFL START-UP, HAS DEVELOPED A SMART BOT THAT CAN TRAWL A WEB APPLICATION CODE, REVEAL ANY BUGS IT FINDS, AND PINPOINT THEIR LOCATIONS USING SCREEN SHOTS. IT'S A BOON FOR DEVELOPERS SINCE IT COULD SIGNIFICANTLY REDUCE TESTING TIME AND COST. • To combat user problems in websites, which can have serious financial consequences for large companies, BugBuster has developed an intelligent, autonomous bot. It figures out how to interact with a web application, and then executes the code in a variety of scenarios. It gives developers feedback on bugs in the code via screen shots. This robot, now available in beta version, will save developers significant time and cost and result in more reliable websites. • BugBuster's initial product uses software dynamic analysis techniques coupled with an expressive API to let software developers direct the tool precisely and find functional issues. The user simply enters the website's URL and hits start. The bot automatically analyzes the source code and figures out what link to follow, where to click and what values to enter. It then highlights bugs and gives specific information to facilitate debugging. "False positives are impossible," says Olivier Crameri, cofounder of the start-up with Renault John Lecoultre. "This dependability in itself will save developers a huge amount of time."

MORE EFFICIENT •

DYE-SENSITIZED SOLAR CELLS RIVAL CONVENTIONAL CELL EFFICIENCY

DYE-SENSITIZED SOLAR CELL EFFICIENCY HAS BEEN RAISED TO A RECORD 15%, THANKS TO A NEW FABRICATION PROCESS DEVELOPED BY EPFL SCIENTISTS. • Dye-sensitized solar cells (DSSCs) have many advantages, including transparency, low cost, and high power-conversion efficiencies in low-light conditions. Developped at EPFL by Michael Grätzel, this technology is currently considered one of the most promising in its field. But so far, DSSC efficiency has been lower than conventional solar cells. • Grätzel's team has now developed a two-step method of making DSSCs that raises their efficiency up to a record 15%. The new DSSC is made from a light-harvesting perovskite and an organic hole transport material. A part of the perovskite is deposited into the pores of a metal-oxide scaffold. Then it is exposed to a solution that contains the other part of the perovskite. When the two parts come into contact, they react and turn into a light-sensitive pigment. • The new method allows DSSCs to exceed the power conversion efficiencies of conventional, amorphous silicon-based solar cells. This will usher in a new era of DSSC development, featuring stability and efficiencies that equal or even surpass today's best thin-film photovoltaic devices.

THE MATTERHORN LIKE YOU'VE NEVER SEEN IT

TWO EPFL SPIN-OFFS, SENSEFLY AND PIX4D, HAVE MADE A 3D MODEL OF THE MATTERHORN AT A LEVEL OF PRECISION NEVER BEFORE ACHIEVED. IT TOOK SENSEFLY'S ULTRALIGHT DRONES JUST SIX HOURS TO SNAP THE HIGH ALTITUDE PHOTOGRAPHS THAT WERE NEEDED TO BUILD THE MODEL. • In mid-September 2013, four "ebees," each weighing less than a kilo but as agile as eagles, took off from the Matterhorn on a mission to photograph the mountain's contours. These flying robots, developed by senseFly, a spin-off of the Intelligent Systems Laboratory, are completely autonomous, requiring nothing more than a computer-conceived flight plan before being launched by hand into the air. • Three of them were launched from a "base camp" located at an altitude of more than 3000 meters, and the fourth took off from the summit of the iconic Swiss mountain, at 4478 meters above sea level. During their six-hour flight, the completely autonomous drones took some 3000 high-resolution photographs. The only remaining task was for software developed by Pix4D, another EPFL spin-off from the Computer Vision Lab (CVLab), to assemble them into an impressive 300-million-point 3D model. • "We want above all to demonstrate what our devices are capable of achieving in the extreme conditions that are found at high altitudes," explains Jean-Christophe Zufferey, head of senseFly. In 2012, the French company Parrot invested more than CHF 7 million in the two EPFL start-up companies. Their technology will be applicable in many sectors, from construction to geographical information systems.

ATTOLIGHT SETS ITS SIGHTS ON ASIA

A SINGAPORE-BASED RESEARCH INSTITUTE HAS PLACED THE FIRST ORDER WITH ATTOLIGHT, AN EPFL SPIN-OFF. ADDITIONAL SALES HAVE BEEN AGREED UPON IN CHINA AND A CONTRACT WITH A JAPANESE DISTRIBUTOR IS UNDER NEGOTIATION. • The device developed by Attolight is ushering in a small revolution in the nanoworld. Using a combination of an ultrafast laser and a scanning electron microscope, it can film moving electrons. It can be used for conducting quality control tests on chips, LEDs and solar cells. Asia, where the majority of these products are manufactured, has shown marked interest for the novel tool that originated in EPFL's laboratories. • Attolight's device can be used to test miniaturized integrated components that are commonplace in the semi-conductor market. It provides information on a material's structure as well as problems that could reduce its longevity or influence its efficiency over the long term. "We have a big edge over our competitors in terms of ease of use and on-screen image quality," says Attolight CEO Samuel Sonderegger.

EPFL START-UPS ATTRACT VENTURE CAPITAL

12 starts-ups per year
25% internet & IT
25% med tech
20% energy
10% micro-engineering
20% electronics & sensors

EPFL has helped in the creation of 12 start-ups in 2013 and between 10 and 15 start-ups per year since 2007. These companies raised more than CHF 100 million last year and more than CHF 600 million since 1999. They cover a wide range of product applications, with about 25% in information technologies and the Internet, and another 25% in medical devices and biotechnology. The remaining 50% are in electronics and sensors (20%), cleantech and energy (20%) and micro-engineering (10%). Even though the main challenge of EPFL start-ups is recognized as growth, about 10% of these start-ups manage to raise venture capital. The most talked-about are Typesafe, which developed the Scala language, and Aleva Neurotherapeutics, which provides electrodes for neurosurgery. Each raised more than CHF 15 million. Kandou, Distalmotion, and Abionic are other recent examples. • Innovation is made possible through the combination of ideas developed by entrepreneurs and financial resources provided by investors, but this would remain a daunting task without a friendly ecosystem. From the early protection of these ideas with patent applications or copyrights to the pre-seed funding of the projects through the Enable and Innogrant programs, EPFL is doing its best to encourage and support entrepreneurship. External supporters are also very critical in that process. They include the on-campus EPFL Innovation Park which provides office space, including its new Forge, and many other value-added services; the IFJ programs (venturelab, ventureideas, ventureleaders, ventureKick); the recent cantonal Innovaud; as well as the federal support of CTI, the Swiss Innovation Agency; and the Swiss National Science Foundation's "spin funds." In addition, EPFL alumni have created their own mentor programs. • Success stories similar to those of Logitech and Endoart are beginning to emerge again from these efforts. Pix4D and Sensefly have partnered with Parrot, and in 2013, Jilion was acquired by Dailymotion. EPFL alumni also export their talent abroad, including Synopsys, founded in Silicon Valley in the 80s. Apple's Siri is another start-up with a few roots from EPFL.


SUSTAINABLE BULDING

OUTLOOK

EPFL MUST PLAY A REGIONAL ROLE

In the era of the global economy, focus must still be kept on local developments. The Internet will not replace the physical world – I'm happy to say – and it's in the various regions of our own country that we are building the future, in direct contact with decision-makers, entrepreneurs and actors in the social and cultural mileu. ''Think global, act local'' – this oft-repeated adage is something we have tried to put into practice in Neuchâtel, Valais, Geneva and Fribourg. • In Geneva (p. 50), we created the Campus Biotech in collaboration with the Canton, the University and the Wyss and Bertarelli Foundations. We plan to relaunch activity in the life sciences which was cut short by the departure of Merck Serono, and it's in the former offices of the pharmaceutical giant that we have set up shop. The Human Brain Project, selected by the European Commission to receive € 500 million, will soon be headquartered here. • In Valais (p. 51), our campus will focus the majority of its activity on renewable energy and hydropower – what could be more logical for the Swiss canton known for its large resources of water and sunlight? In addition, an important research initiative will focus on rehabilitiation for individuals with limited mobility, in collaboration with the Clinique Romande de Réhabilitation in Sion. . In Neuchâtel, we have tapped in to the local high-precision industry. In accordance with our commitments, we have more than doubled the number of laboratories in the Microengineering Institute, which we took on board in 2009. More than half of these new chairs are sponsored by major companies in the region. In Fribourg, we have put the accent on sustainable construction in collaboration with the School of Engineering and Architecture on the former site of the Cardinal Brewery. Our main campus is still in Lausanne – and it's still the most international campus in the world, according to the well-known ranking in the Times Higher Education supplement. But even though we owe much of our dynamism to our open approach to the world, we must share the benefit with our neighboring regions. In 2013 more than ever before, we gave ourselves the means with which to built important bridges between global and local.

ANDRÉ SCHNEIDER
VICE PRESIDENT FOR
PLANNING AND LOGISTICS

CAMPUS BIOTECH: SEIZING AN EXTRAORDINARY OPPORTUNITY IN GENEVA

Thanks to the support of Hansjörg Wyss and the Bertarelli family, the former headquarters of Merck Serono in Geneva's Secheron district is being transformed into a complex for neuroscience and biotechnology research. Together with these dedicated partners, EPFL and the University of Geneva are working together to launch the new "Campus Biotech". Once fully operational, the facility will house more than 1200 people: research groups and laboratory technicians, as well as research and development teams from start-up companies who can open offices and labs in order to facilitate interactions with academic groups. • The site will be the headquarters of the Human Brain Project, an EPFL-directed European project. Several labs involved in the project moved into their new quarters in autumn 2013, along with Chairs from the EPFL Center for Neuroprosthetics. • It will also be home to the new "Wyss Center for Bio- and Neuroengineering," designed on the model of the existing center at Harvard University, whose objectives are to stimulate the discovery of disruptive innovations and encourage – by accelerating – their transfer to clinical applications and the commercialization of new solutions. Groups from the University of Geneva Hospitals (HUG) are working towards this same objective. • Campus Biotech is far more than just a simple research center being developed here on the edge of the city of Geneva; it's a whole new ecosystem.

FRANÇOIS AVELLAN
Full Professor of
Hydraulic Machines (STI)

BERND SMIT
Full Professor (SB)

DANIEL KUHN
Associate Professor of Risk
Analytics and Optimization (CdM)

FRANÇOIS MARÉCHAL
Adjunct Professor (STI)

JAN VAN HERLE
Senior Scientist (STI)

ANTON SCHLEISS
Full Professor of
Hydraulic Constructions

MOHAMMAD KHAJA NAZEERUDIN
Senior Scientist (SB)

HUBERT GIRAULT
Full Professor of Physical and
Analytical Electrochemistry (SB)

BUILDINGS, RESEARCHERS AND A DIRECTOR IN THE VALAIS

The development of the specialized EPFL branch in the canton Valais was largely completed in 2013. In February, Marc-André Berclaz was nominated as director. Then, in August, the project that was selected from the architectural contest for the joint Swiss University of Applied Science Valais Wallis – EPFL campus south of the Sion train station was presented. • Things also advanced on the academic front; a team of five researchers began work in the Clinique romande de réadaptation (CRR), in Sion. Additional details, such as fields of study and research and chair holders who will be involved in the new campus, were laid out. Green chemistry and energy engineering researchers Hubert Girault, Daniel Kuhn, Berend Smit, François Maréchal, Jan van Herle and Mohammad Khaja Nazeerudin will be relocating their labs from EPFL to the new campus along with Andreas Züttel from EMPA. For hydraulic engineering, François Avellan and Anton Schleiss will be contributing. In the medical and health arena, Olaf Blanke, Silvestro Micera, José del R. Millán and Grégoire Courtine from the Center for Neuroprosthetics will split their research activities between Geneva (Campus Biotech) and Sion. • In each of these fields, professors and senior scientists from EPFL will collaborate with their colleagues from the Swiss University of Applied Science Valais Wallis.

EPFL AND AFRICA JOIN FORCES FOR TECHNOLOGICAL DEVELOPMENT

EPFL IS INTENSIFYING ITS CONNECTIONS WITH THE AFRICAN CONTINENT VIA MOOCS (MASSIVE OPEN ONLINE COURSES) AND ITS CENTER FOR COOPERATION AND DEVELOPMENT (CODEV). As a technological university with French as its main language, EPFL is currently a leader in offering MOOCs to audiences in french-speaking Africa. In 2013, not only were students showing marked interest in this new form of education, but EPFL professors and partner countries were also showing real commitment to meeting that need. In addition to remote learning, EPFL launched EssentialTech, a cooperation program that primarily targets Africa. It was set up by EPFL's Center for Cooperation and Development to develop and launch essential technologies adapted for the needs of developing countries.

STUDENTS BEYOND THE SAHARA

In Africa, MOOCs respond to the need for high quality education while allowing an increasing number of students to gain access to higher education. The experiment began in Lausanne; ten African instructors were trained to serve as advisors in their own institutions. Twenty African universities responded to the call and included the five online EPFL courses (in French) into their curricula. EPFL is primarily offering courses based on mathematics, physics and computer science, but specific subjects, such as microcontrollers, are also possible. These MOOCs attracted 7000 individuals on the African continent, 3000 of which were students. Now, the challenge is to diversify the platforms on which the courses can be offered, given the often significant connecitivity problems that many African countries have. This project is part of the RESCIF program that brings 14 french-speaking technology universities from north and south together.

BLACKOUT RELIEF IN CAMEROON

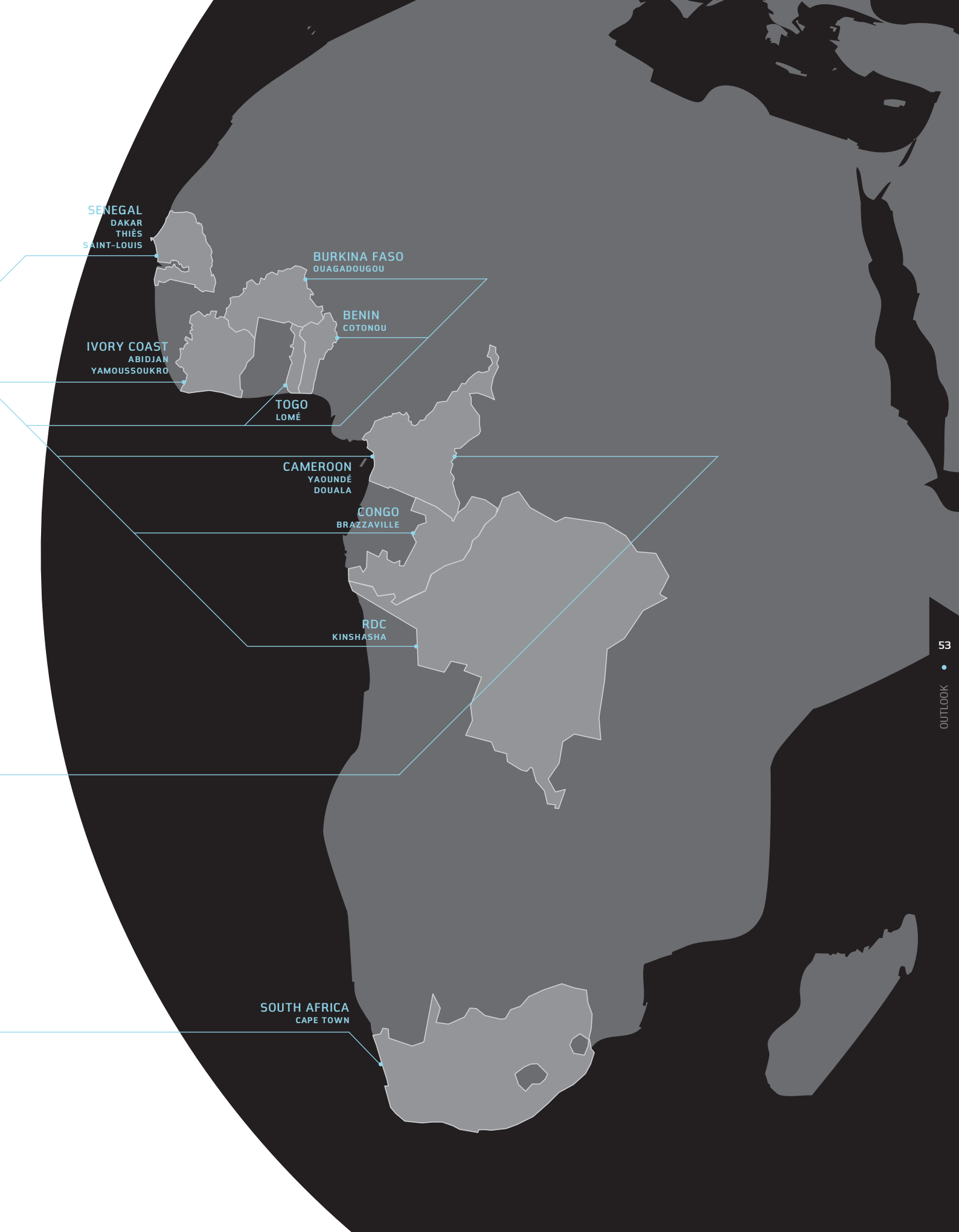
The Ecole Nationale Supérieure Polytechnique de Yaoundé and EPFL have opened a joint laboratory in Cameroon's capital, Yaoundé, to develop technologies for stabilizing and improving the country's electricity grid. Problems associated with electricity grids are critical in sub-Saharan Africa, particularly in hospitals. The new laboratory will eventually include ten researchers, most of them from Cameroon. This project is also part of the RESCIF program.

ADAPTING ESSENTIAL MEDICAL TECHNOLOGIES

Some technologies have the potential to change millions of lives in disadvantaged regions of the world. But due to lack of adequate infrastructure and personnel, more than 70% of the medical devices that are sent to Africa are never used. The projects run by the EssentialTech program are changing this statistic by rethinking how materials are designed. The first and most advanced of these is GlobalDiagnostiX, which, in collaboration with Cameroon, is rethinking the medical imaging system. GlobalNeoNat is designing neonatal incubators and H2Ospital is working on supplying clean drinking water to hospitals. EssentialTech's strength lies in its ability to integrate technology into a complete value chain, from analyzing needs and limitations to monitoring the real impact of the technologies and their long-term viability. It requires a collaborative, interdisciplinary and multicultural approach, along with a partnership between the private sector, public authorities and the population.

MATHUMANITARIAN GAMES IN SOUTH AFRICA

Twenty-four undergrads spent two weeks spreading their love of math in South African townships. EPFL's Mathematical Humanitarian Project aimed at communicating a playful approach to elementary school math. EPFL students performed skits that covered nine major fundamental concepts, such as understanding complex algorithms using origami and going from 2D to 3D using an envelope. EPFL's alumni association (A3), professors from the School of Basic Sciences and five Chairs provided financial support for the adventure.


SENEGAL
DAKAR
THIÈS
SAINT-LOUIS
BURKINA FASO
OUAGADOUGOU
BENIN
COTONOU
IVORY COAST
ABIDJAN
YAMOUSSOUKRO
TOGO
LOMÉ
CAMEROON
YAOUNDÉ
DOUALA
CONGO
BRAZZAVILLE
RDC
KINSHASHA
SOUTH AFRICA
CAPE TOWN

THE VENICE TIME MACHINE

EPFL AND THE UNIVERSITY CA' FOSCARI IN VENICE HAVE CREATED A TRANSDISCIPLINARY EDUCATIONAL AND RESEARCH PROGRAM, IN WHICH THE CITY OF VENICE ITSELF IS THE SUBJECT OF STUDY. • The agreement signed in February 2013 by Patrick Aebischer and Carlo Carraro, Rector of Ca' Foscari University, announces the first step in a long-term research center in Venice dedicated to digital humanities and future cities, Digital Humanities Venice (DHV). On the same occasion the two universities also signed a corporate partnership agreement with Telecom Italia. • DHV will begin with a research program, the Venice Time Machine, a historical, geographical and comprehensive simulation of Venice that will enable us to reconstruct its past, provide a better understanding of its present, and help anticipate its future. The ambitious program will focus on digitizing and preserving the cities' archives – Venice is one of the world's most documented cities. Massive amounts of data will be organized with the aim of designing visualization techniques such as interactive 3D maps and novel museographical experiences. The first Master's students will start work in 2014.

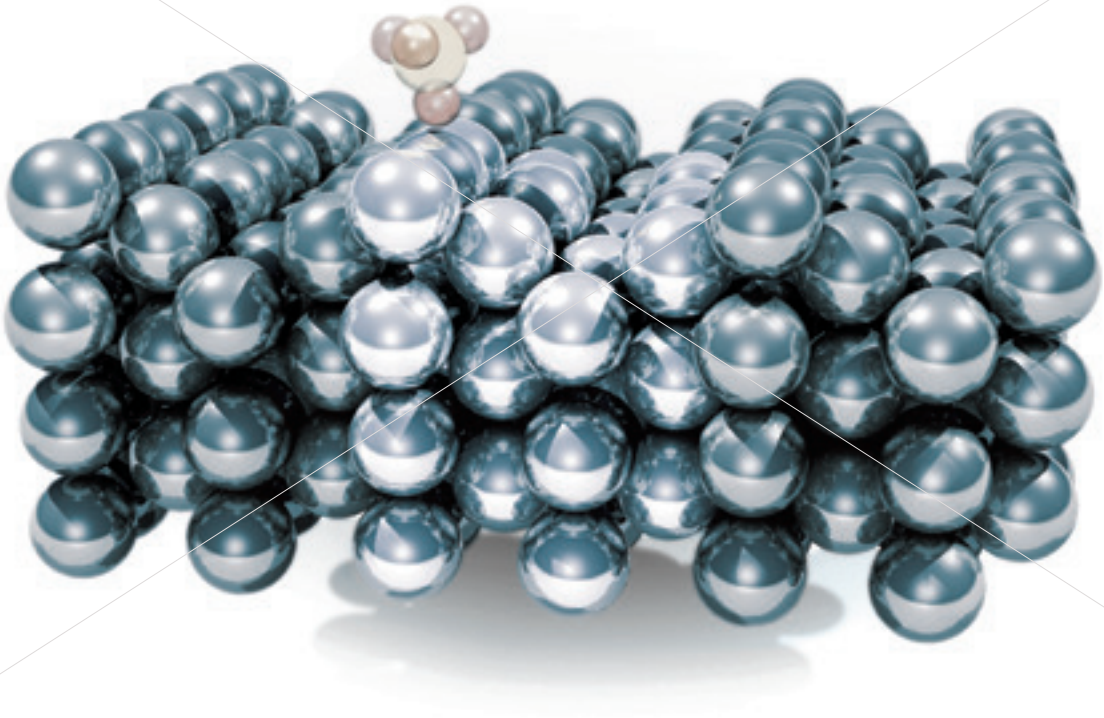
ARCHITECTURE FOR THE ELDERLY

> Switzerland prioritizes the wellbeing of the elderly

A STUDY BY BRUNO MARCHAND AND MARIELLE SAVOYAT LOOKS INTO THE ARCHITECTURE OF NURSING HOMES, FOCUSING ON A DOZEN RECENT PROJECTS IN THE SWISS CANTON OF VAUD. • Under a mandate by the canton of Vaud's Public Health Department, Bruno Marchand and Marielle Savoyat analyzed a dozen nursing homes recently built in Vaud through the eyes of an architect. Their results give an overview of the history and current trends in the field of nursing home architecture. • "Nursing homes are complex hybrid organisms, where areas for medical care are intimately linked to living spaces," says Marchand. One of the main challenges architects are confronted with in desiging these homes is concealing their medical component in favor of a strongly humane character. "The residents should feel like they are at home, not in a hospital," he explains. • By analyzing hundreds of submissions to recent architectural competitions for nursing homes, the researchers compiled a catalogue of practical solutions that architects will be able to draw on for future projects. • According to Marchand, Switzerland has a history of caring for the wellbeing of its elderly population, making it one of the most advanced countries in this area. "As is often the case, Switzerland stands out for its very high quality of living and its high quality infrastructure; the same is true for its nursing homes," he says.

EPFL BECOMES A HUB FOR SWISS MATERIALS SCIENCE RESEARCH

MARVEL, DIRECTED BY EPFL, IS ONE OF SWITZERLAND'S NEW NATIONAL CENTERS FOR COMPETENCE IN RESEARCH (PRN/NCCR). IT IS DEDICATED TO DEVELOPING INNOVATIVE NEW MATERIALS USING COMPUTER SIMULATION. • Led by Professor Nicola Marzari, the new NCCR has its sights on revolutionizing materials design and discovery. ''The power of supercomputers combined with our understanding of quantum mechanics now enables us to come up with innovative materials and to simulate their characateristics and behavior without having to create them in the laboratory,'' he explains. ''This allows us to advance much more rapidly than we used to when we were dependent on costly trial and error process.'' • Developing new materials is important in several areas, including energy. ''We need to make significant progress in special materials in order to harvest energy from the environment, transform it and store it in an efficient and economically viable manner,'' says Marzari. • But that's not all: electronics, basic theoretical and experimental research, quantum computing and even the pharmaceutical industry all take advantage of specific properties of certain materials. The Nobel Prizes awarded for research on graphene and high temperature superconductivity are good examples of scientific progress associated with newly discovered materials. • To go beyond the simulation stage and move research in the direction of practical applications, MARVEL has assembled the best expertise from around the country. In addition to EPFL, the consortium includes researchers from ETH Zurich, the universities of Geneva, Basel, Fribourg, Zurich and the Ticino, along with IBM and the Swiss National Supercomputing Centre (CSCS). Experimental synthesis and materials characterization will be the responsibility of the Paul Scherrer Institute and the Swiss Federal Laboratory for Materials Science and Technology (EMPA).



"CURIOUS AND INVENTIVE" – A CONTEST FOR 8-13 YEAR-OLDS

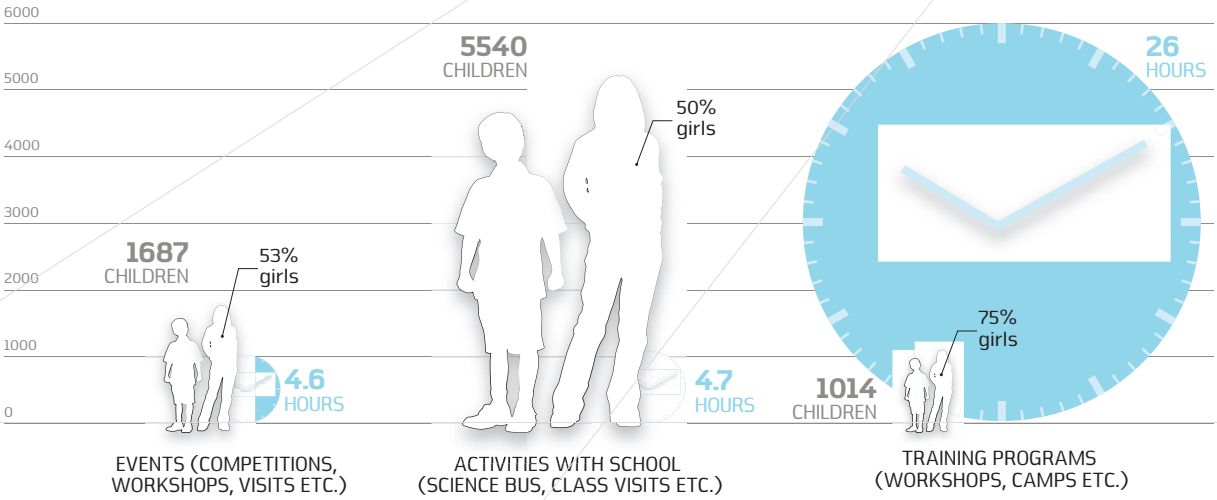
> 32 teams of 8 – 13 year old girls and boys

On March 28 and 29, 2013, 32 teams of 8-13 year-old boys and girls participated in a science competition, entitled "Curious and Inventive," whose goal was to give these kids a taste for science and to encourage scientific thinking and collaborative work. This first edition took place on the EPFL campus, organized by EPFL's Equal Opportunity Office. • There were several challenges on the menu: a random drawing of a problem, an experimental challenge, a contest to put team spirit to the test, and a team quiz. This event, initially planned for 18 teams during one day, was so successful that it was extended to two days so that all the interested teams would be able to participate.

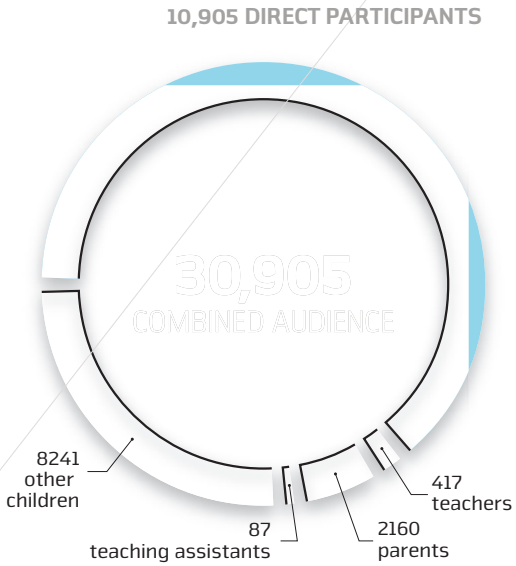
EPFL OUTREACH 2013

CONTACT TIME AND PARTICIPATION OF GIRLS BY TYPE OF ACTIVITY

EPFL's outreach strategy targets girls in particular. For the longer courses, girls represent 75% of the participants with a contact time of 26 hours per child on average.



COMBINED AUDIENCE

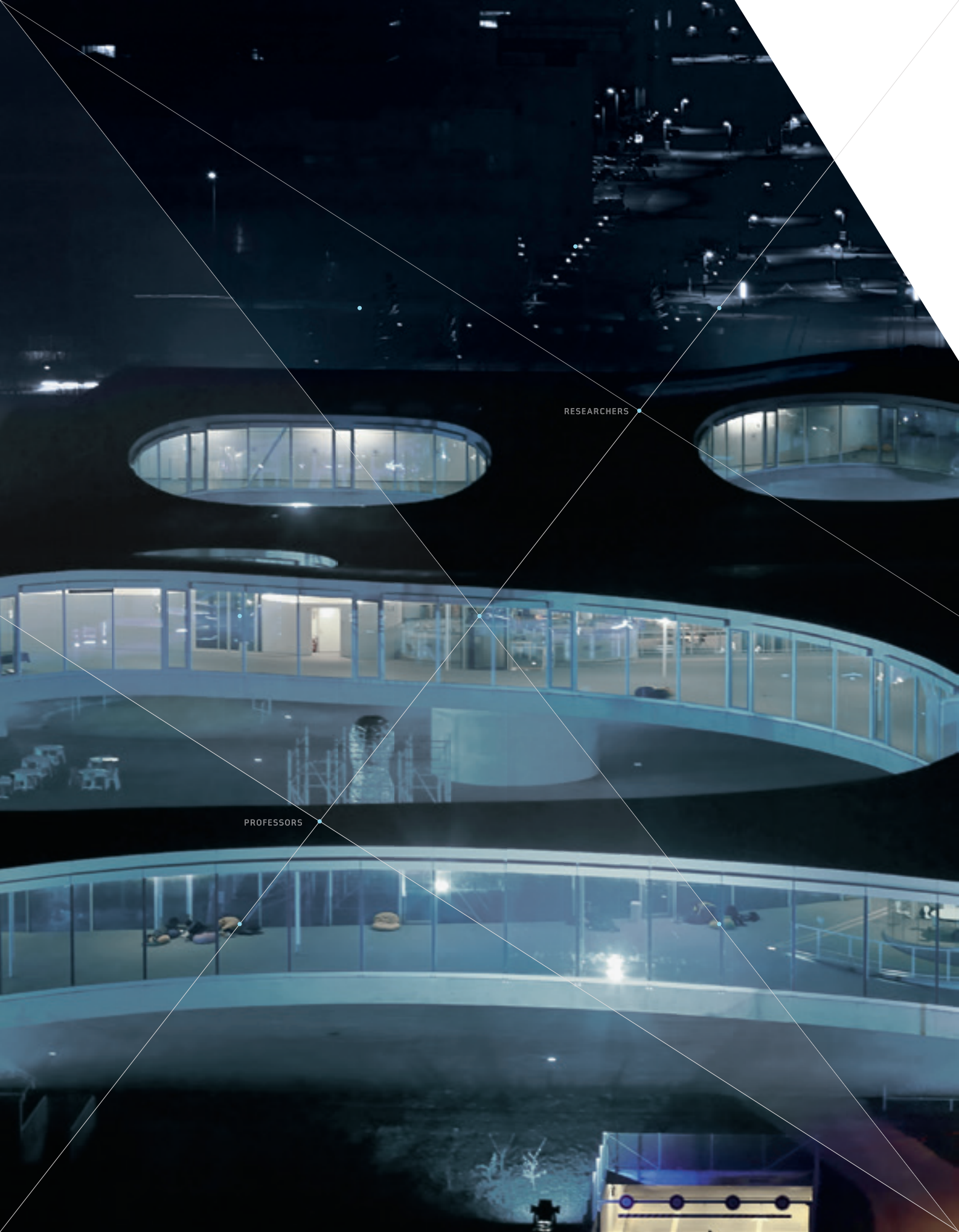


QUICK FACTS

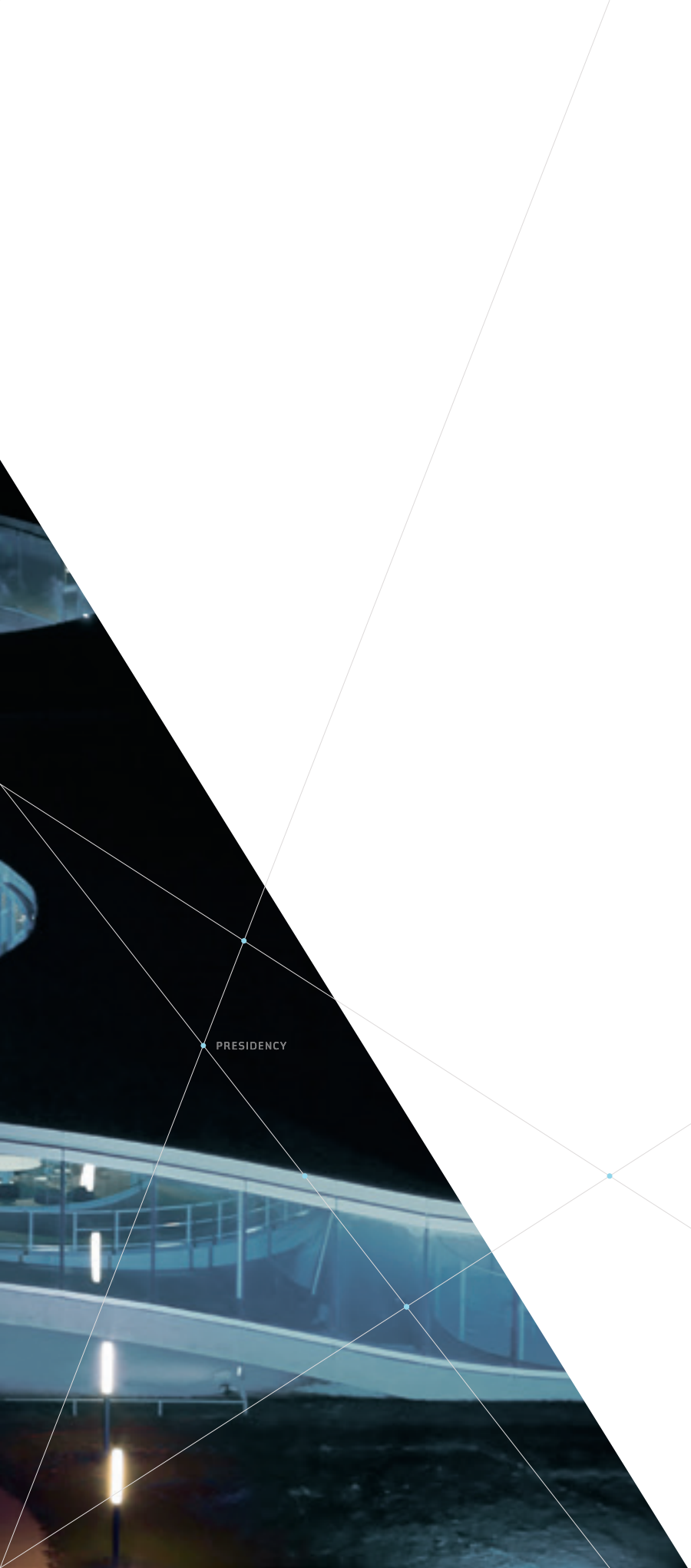
110 TEACHERS
TOOK PART IN SPECIALIZED WORKSHOPS ON NEUROSCIENCE AND ROBOTICS

8241 CHILDREN
OF WHOM 54% WERE GIRLS TOOK PART IN OVER 40 ACTIVITIES IN 2013

277 CLASSES
BENEFITED FROM DEMONSTRATIONS AND WORKSHOPS IN THE SCIENCE BUS OR ON EPFL'S CAMPUS


RESEARCHERS
PROFESSORS

PERSONALIA



PROFESSORS NOMINATED OR PROMOTED IN 2013

BERNARD CACHE
Associate Professor,
Digital Culture for Architectural Projects (ENAC)

THOMAS DAVID
Full Professor, humanities and social sciences and Director of the College of Humanities (CdH)

PASCAL FROSSARD
Assistant Professor,
electrical engineering (STI)

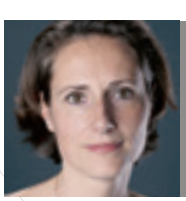
OLIVER KRÖCHER
Adjunct Professor,
life sciences (SB)

DANIEL KUHN
Associate Professor,
operations research (CdM)

FRANCESCO MONDADA
Adjunct Professor,
robotics (STI)

PAOLA VIGANÒ
Full Professor,
urbanism (ENAC)

ESTHER AMSTAD
Assistant Professor,
materials science (STI)



MARILYNE ANDERSEN
Full Professor, sustainable construction technologies (ENAC)
Dean of ENAC
from September 1, 2013

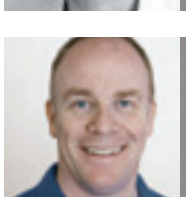
ARDEMIS BOGHOSSIAN
Assistant Professor,
chemical engineering (SB)

ANJA FRÖHLICH
Associate Professor,
architecture (ENAC)

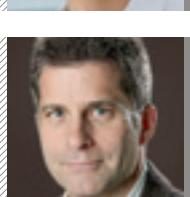
MARTIN FRÖHLICH
Associate Professor,
architecture (ENAC)

KERSTEN GEERS
Associate Professor,
architecture (ENAC)

JOHANNES GRÄFF
Assistant Professor,
life sciences (SV)
Nestlé Chair in Neurodevelopment



ANDERS HAGFELDT
Full Professor,
physical chemistry (SB)



CHRISTOF HOLLIGER
Full Professor,
environmental biotechnology (ENAC)

SB: BASIC SCIENCES

SV: LIFE SCIENCES | IC: COMPUTER AND COMMUNICATION SCIENCES

MES: ENERGY MANAGEMENT AND SUSTAINABILITY | ENAC: ARCHITECTURE, CIVIL & ENVIRONMENTAL ENGINEERING

STI: ENGINEERING | CDM: MANAGEMENT OF TECHNOLOGY

JAMES LARUS
Full Professor, computer and communication sciences (IC)
Dean of the School of Computer and Communication Sciences from October 15, 2013

JEREMY LUTERBACHER
Assistant Professor, chemical engineering (SB)

DOMINIQUE PIOLETTI
Associate Professor, translational biomechanics (STI)

DAVID SUTER
Assistant Professor, life sciences (SV)
Carigest Chair in embryonic stem cells

ALEXIS BERNE
Associate Professor, environmental remote sensing (ENAC)

RIZLAN BERNIER-LATMANI
Associate Professor, environmental microbiology (ENAC)

NICOLAI CRAMER
Associate Professor, environmental microbiology (ENAC)

VICTOR PANARETOS
Associate Professor, statistics (SB)

BEREND SMIT
Full Professor, chemical engineering (SB)

DRAZEN DUJIC
Assistant Professor, electrical engineering (STI)

JOACHIM KRIEGER
Full Professor, mathematics (SB)

ROLAND LOGÉ
Associate Professor, materials science (STI)

CARL PETERSEN
Full Professor, life sciences (SV)

NISHEETH VISHNOI
Associate Professor, computer and communication sciences (IC)

RICHARD FRACKOWIAK
External Adjunct Professor (SV)

KEI SAKAMOTO
External Adjunct Professor (SV)


FABIOLA GIANOTTI


CHRISTOS PAPADIMITRIOU


JOHN A. ROGERS

DR HONORIS CAUSA 2013

> expertise:
> particle physics
> soft materials
> computational complexity

THE 2013 MAGISTRALE BESTOWED HONORARY DEGREES ON THREE SCIENTISTS • **Fabiola Gianotti** is a particle physicist. She is the head of the "ATLAS" project, which brings more than 3,000 physicists from around the world together at CERN's Large Hadron Collider. She played a key role in the discovery of the Higgs boson. • **John A. Rogers** is a physical chemist and materials scientist at the University of Illinois in Urbana-Champaign. With his team of researchers, he seeks to understand and exploit the unique properties of soft materials, such as polymers, liquid crystals, and biological tissues, and to develop hybrid combinations of them. • **Christos Papadimitriou** is a professor in computer science and became renowned for his contributions in the field of algorithmic complexity, databases, and combinatorial optimization. Currently a teacher and researcher at the University of Berkeley, California, he is the author of several books, most prominently of *Computational Complexity*, and arguably most intriguingly, of *Turing,* a modern love story centered around computation. He is also the author of non-scientific novels.

ORGANIZATION EPFL PRESIDENCY

Patrick Aebischer
President

André Schneider
Vice-President
of Planning and Logistics

Philippe Gillet
Vice-President
of Academic Affairs

Adrienne Corboud Fumagalli
Vice-President of Innovation
and Technology Transfer

Karl Aberer
Vice-President
of Information Systems

SCHOOLS

SB
Basic Sciences

- Mathematics
- Physics
- Chemistry

SV
Life Sciences

- Bioengineering
- Neuroscience
- Global Health
- Cancer

STI
Engineering

- Electrical Engineering
- Mechanical Engineering
- Materials Science
- Microengineering
- Bioengineering

IC
Computer & Communication Sciences

- Computer Science
- Communication Systems

ENAC
Architecture, Civil & Environmental Engineering

- Architecture
- Civil Engineering
- Environmental Engineering
- Urban Planning

COLLEGES

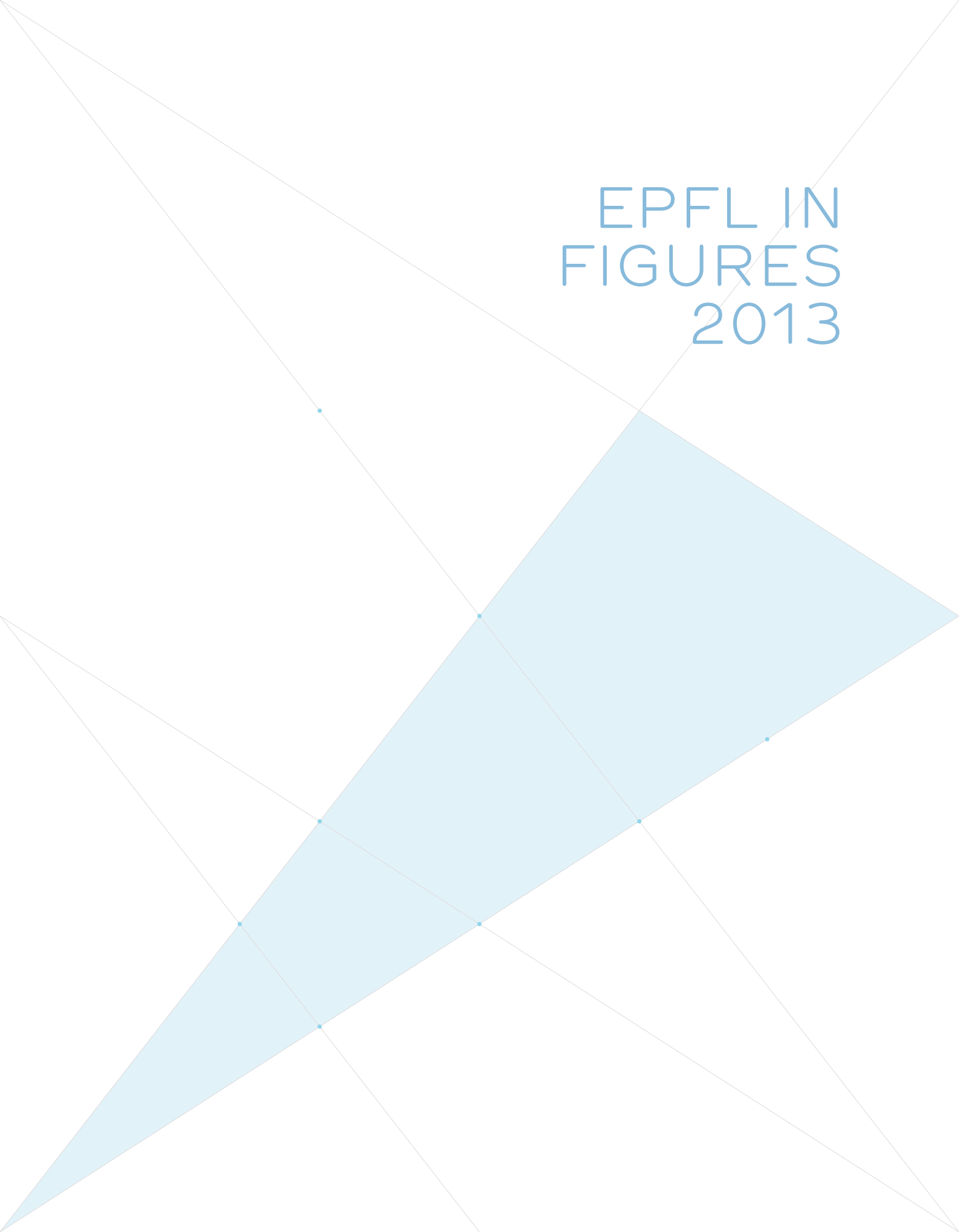
CdH
College of Humanities

- Human and Social Science
- Area & Cultural Studies
- Digital Humanities

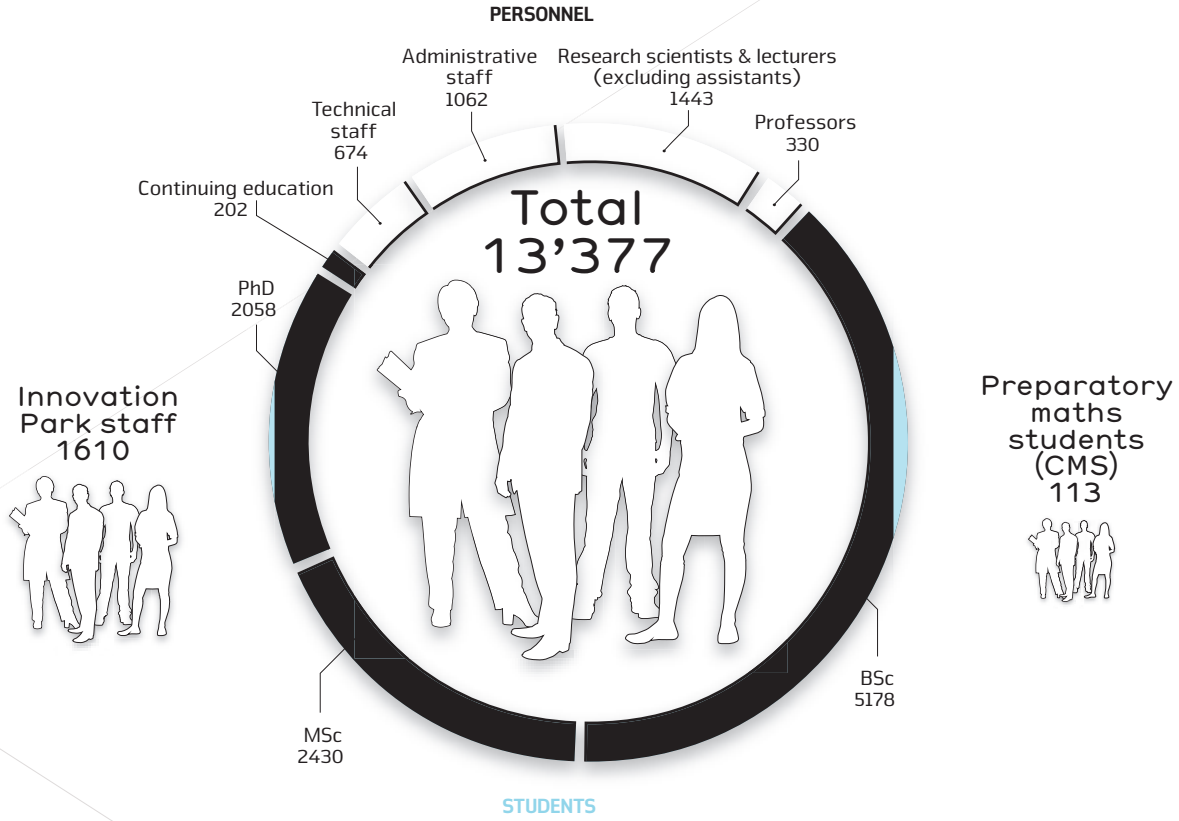
CdM
Management of Technology

- Management of Technology
- Technology and Public Policy
- Financial Engineering

EPFL IN FIGURES 2013



CAMPUS POPULATION



QUICK FACTS

RESEARCH

339 LABORATORIES
2962 SCIENTIFIC PUBLICATIONS
(ISI WEB OF SCIENCE REFERENCED)
76 ERC GRANTS (2007 TO 2013)

TEACHING

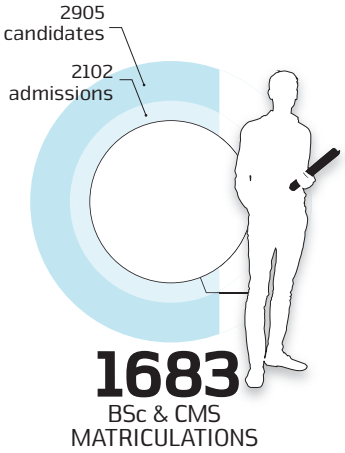
1 PROFESSOR: 31 STUDENTS (BSC & MSC)
15 BACHELOR PROGRAMS
35 MASTER PROGRAMS

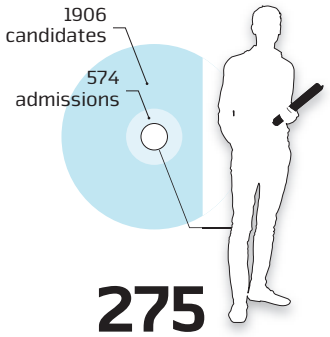
TECH TRANSFER

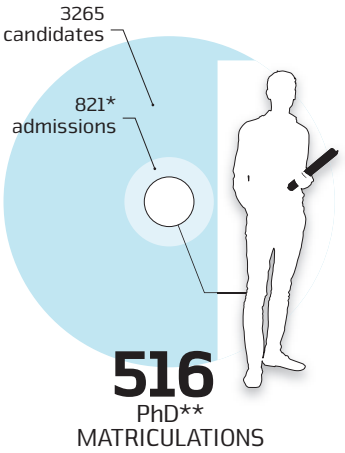
15 R&D UNITS IN THE INNOVATION PARK
105 MILLION CHF START-UP FUNDING IN 2013
12 START-UPS PER YEAR SINCE 1997 (AVERAGE)

STUDENT BODY

OVERVIEW OF BACHELORS, MASTERS AND DOCTORAL CANDIDATES

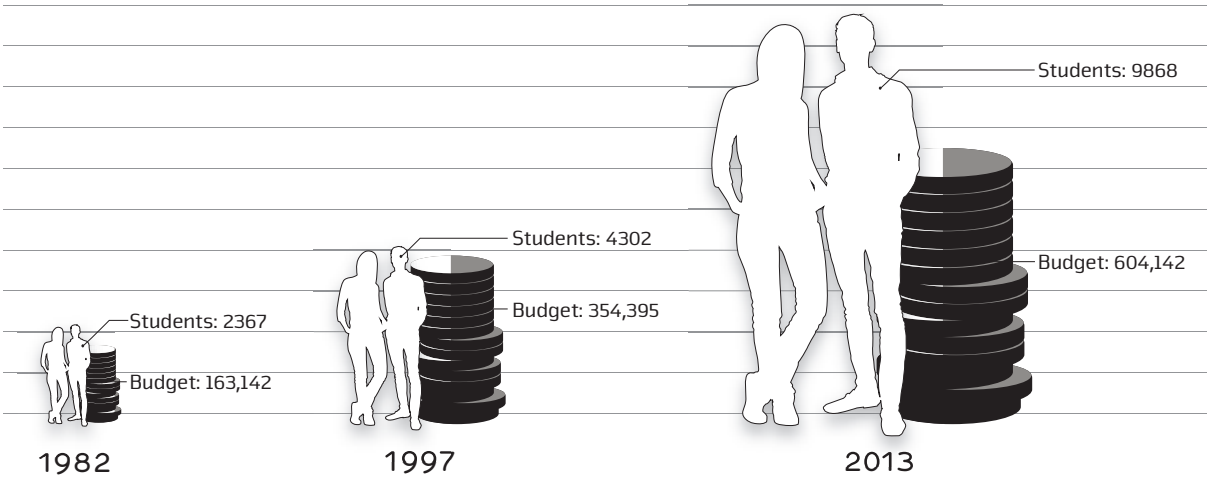






* Jan – Nov 2013
** Includes PhD students admitted but currently without a thesis director

GROWTH IN BUDGET (KCHF) AND STUDENT NUMBERS



STUDENTS BY FIELD AND STUDY LEVEL

	BACHELOR	MASTER	DOCTORAL	CONTINUING EDUCATION	TOTAL
Basic Sciences (SB)	1031	406	474		**1911**
Mathematics	337	116	74		**527**
Physics	404	136	210		**750**
Chemistry and Chemical Engineering	290	154	190		**634**
Life Sciences (SV)	484	217	255		**956**
Engineering (STI)	1365	644	687		**2696**
Materials Science & Engineering	186	89	121		**396**
Mechanical Engineering	560	206	109		**875**
Microengineering	434	184	197		**815**
Electrical Engineering	185	165	260		**610**
Computer and Communication Sciences (IC)	711	371	296		**1378**
Communication Systems	253	138	101		**492**
Computer Science	458	233	195		**886**
Architecture, Civil and Environmental Engineering (ENAC)	1587	602	290	61	**2540**
Environmental Engineering	232	158	88		**478**
Civil Engineering	503	188	112	14	**817**
Architecture	852	256	90	47	**1245**
Management of Technology (CdM)		151	56	141	**348**
Management of Technology		66	37	141	**244**
Financial Engineering		85	19		**104**
Energy Management and Sustainability (MES)		39			**39**
Total	5178	2430	2058	202	**9868**

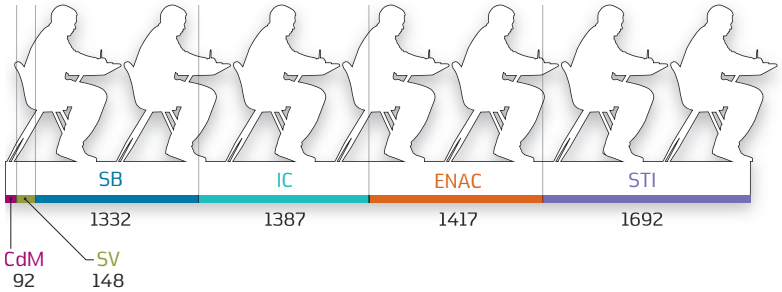
Bachelors & Masters students

7608

STUDENT BODY

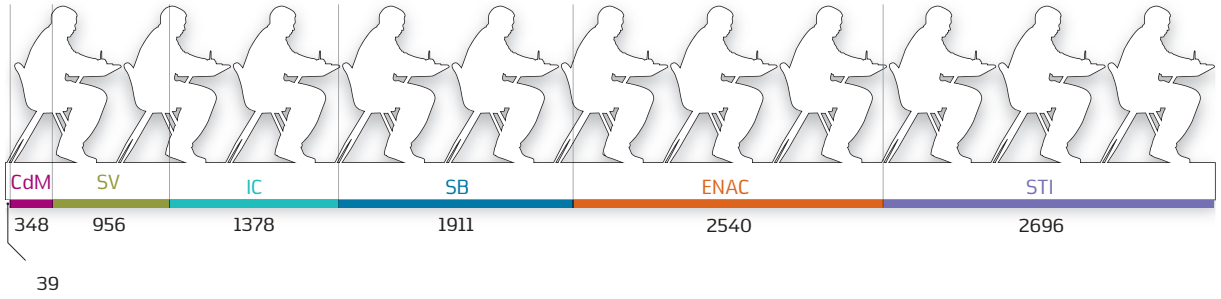
A DECADE OF GROWTH BY FACULTY*

6068 students in 2003



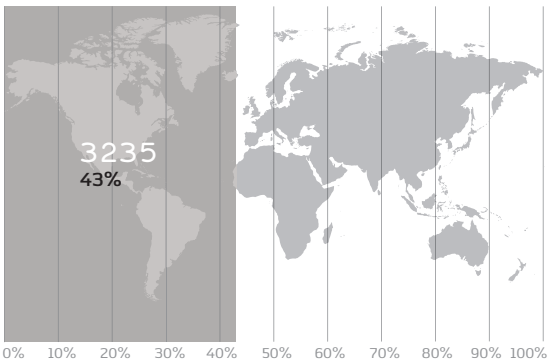
*SB: Basic Sciences
SV: Life Sciences
STI: Engineering
IC: Computer and Communication Sciences
ENAC: Architecture, Civil & Environmental Engineering
CdM: Management of Technology
MES: Energy Management and Sustainability

9868 students in 2013



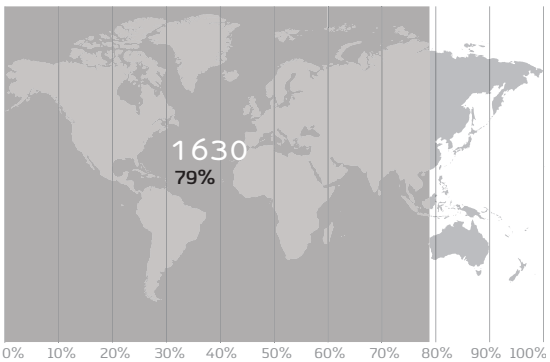
OVERSEAS STUDENTS (EXCLUDING SWISS RESIDENTS)

Bachelor + Master



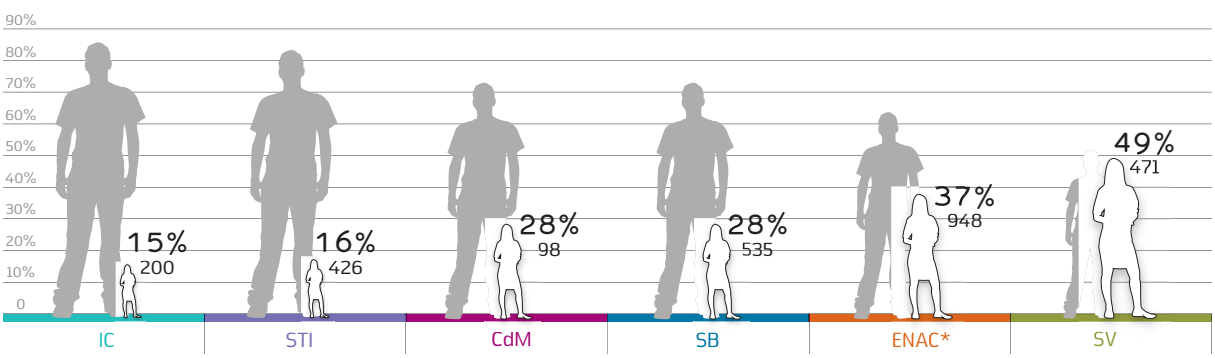
Bachelor : 2089 – 40%
Master : 1146 – 47%

Doctoral



WOMEN AT STUDY

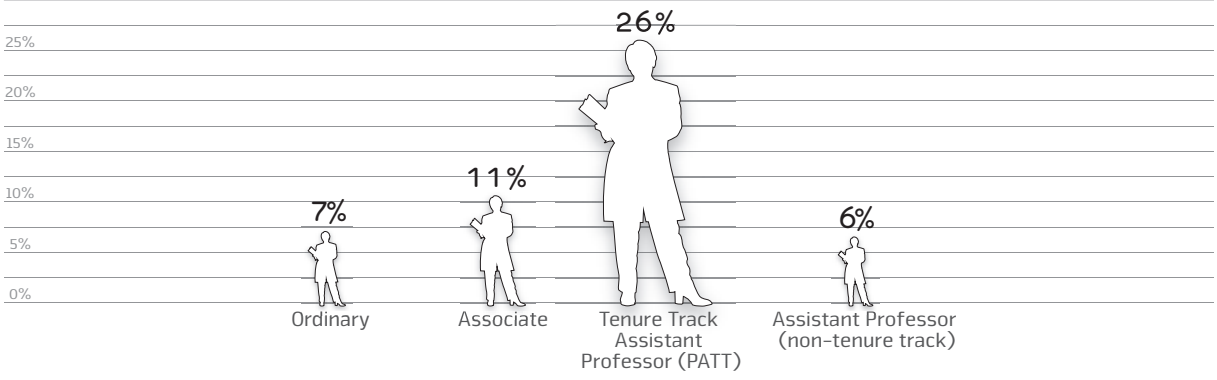
Proportion of Women Students by Faculty*



* Including MES

Growth in the Percentage of Women Students

Women Professors FTE



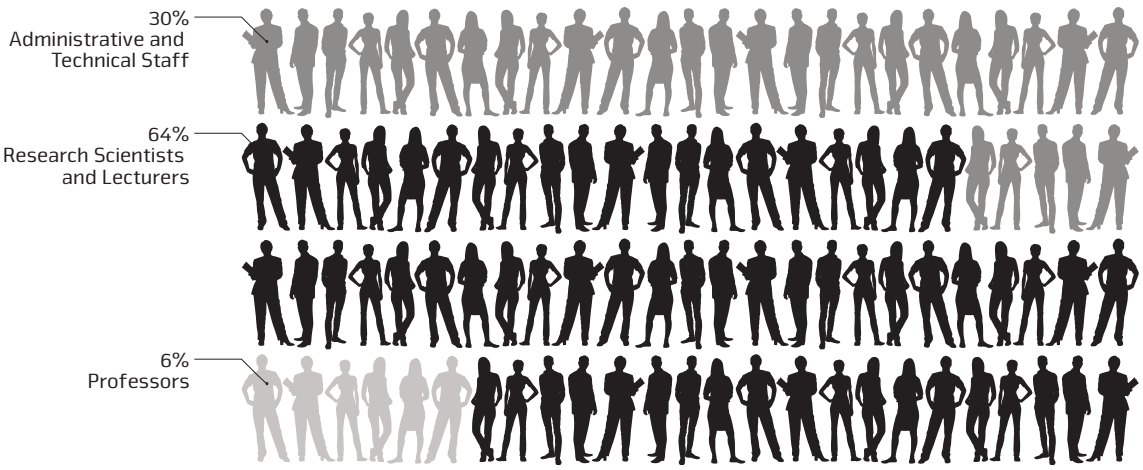
PERSONNEL

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

	TOTAL
Transdisciplinary Units (ENT)	**80.6**
Basic Sciences (SB)	**1172.9**
Mathematics	200.7
Physics	541.4
Chemistry	430.8
Life Sciences (SV)	**714.7**
Engineering (STI)	**1277.3**
Materials Science	233.6
Mechanical Engineering	337.4
Microengineering	409.4
Electrical Engineering	296.9
Computer and Communication Sciences (IC)	**484.1**
Communication Systems	175.5
Computer Science	308.6
Architecture, Civil and Environmental Engineering (ENAC)	**605.5**
Environmental Engineering	194.4
Civil Engineering	204.3
Architecture	206.8
Management of Technology (CdM)	**96.0**
Management of Technology	54.5
Financial Engineering	41.4
Central services	**665.0**
Total	5096.1

PERSONNEL BY CATEGORY (FULL-TIME EQUIVALENTS)

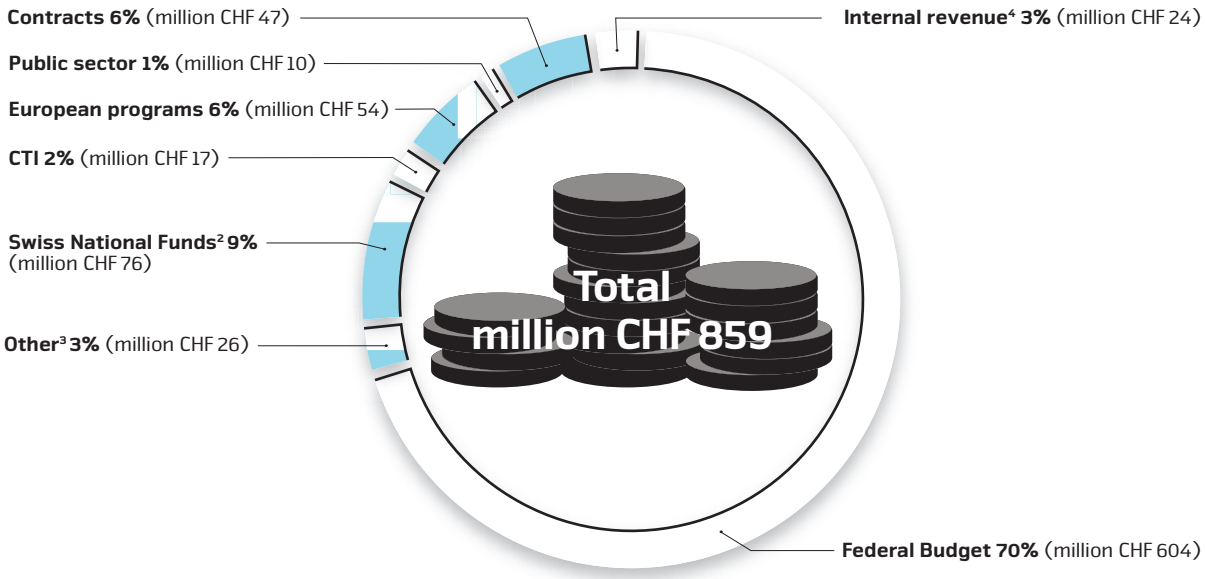
	TOTAL	GOVERNMENT FUNDED	THIRD PARTY FUNDED (PUBLIC & PRIVATE)
Professors	**301.1**	282.0	19.1
Professors	**171.1**	168.1	3.0
Associate Professors	**58.4**	58.4	0.0
Tenure-track Assistant Professors	**60.7**	54.8	5.9
Swiss National Fund Assistant Professors	**10.9**	0.7	10.2
Research Scientists and Lecturers	**3272.2**	1470.5	1801.7
Adjunct Professors	**46.4**	44.4	2.0
Senior Scientists	**75.8**	72.9	2.9
Assistants (incl. doctoral students)	**1945.9**	741.9	1204.1
Scientific Collaborators (incl. Postdoctorates)	**1204.1**	611.3	592.7
Administrative and Technical Staff	**1522.8**	1343.2	179.6
Administrative Staff	**886.7**	809.5	77.2
Technical Staff	**636.1**	533.6	102.4
Total	**5096.1**	3095.7	2000.4
		61%	39%



FINANCES*

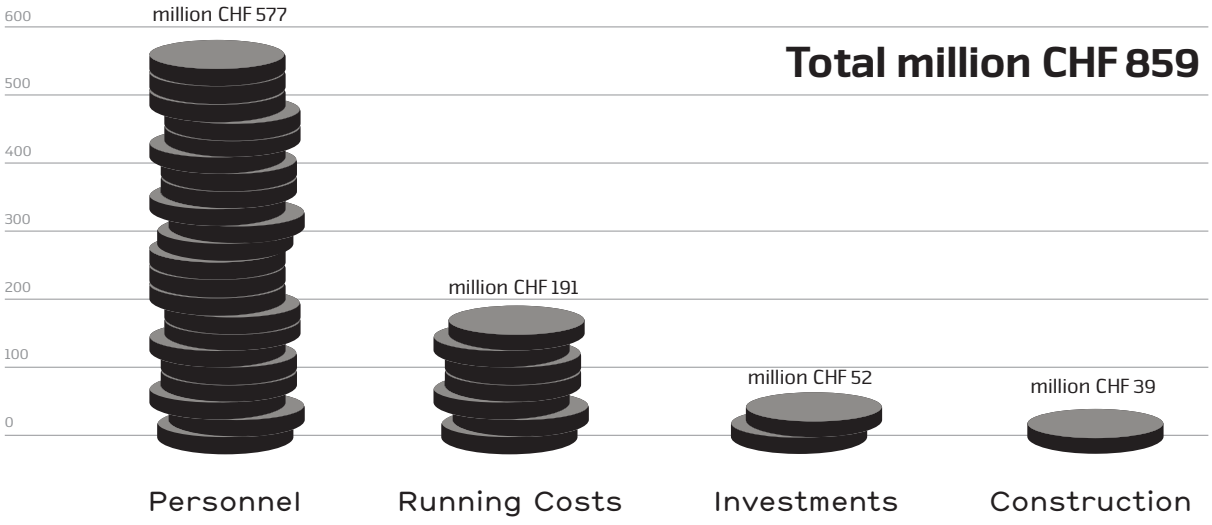
ANNUAL EXPENDITURE BY FUNDING SOURCE[1]

THIRD PARTY FUNDING



[1] Total expenditure including construction (including Federal Office for Buildings and Logistics [FOBL] allocation)
[2] Including NCCR and NanoTera/SystemsX project funding
[3] Sponsoring, foundations, commited and reserved funds, congresses, continuing education etc.
[4] Tuition fees, services, financial revenue etc.

EXPENDITURE BY SECTOR



* 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	IINVEST-MENTS	**TOTAL**	THIRD-PARTY FUNDING
Basic Sciences (SB)	134,636	20,692	9964	**165,292**	55,009
Mathematics	24,541	2643	133	**27,317**	6316
Physics	67,769	10,554	5686	**84,009**	27,418
Chemistry	42,326	7496	4144	**53,966**	21,276
Life Sciences (SV)	75,958	22,872	19,554	**118,670**	39,537
Engineering (STI)	133,330	24,584	11,053	**168,968**	72,900
Materials Science	25,309	5199	2184	**32,691**	13,989
Mechanical Engineering	34'865	4717	1860	**42,783**	15,814
Microengineering	44,333	8543	5821	**57,663**	25'486
Electrical Engineering	28'824	6125	1188	**35,831**	17,610
Computer and Communication Sciences (IC)	49,596	5979	666	**56,241**	17,977
Communication Systems	18,671	2198	194	**21,062**	5302
Computer Science	30,925	3781	472	**35,178**	12,675
Architecture, Civil and Environmental Engineering (ENAC)	67,770	10,928	4415	**83,114**	20,534
Environmental Engineering	22'180	3474	3538	**29,191**	6877
Civil Engineering	21,431	3531	794	**25,755**	8260
Architecture	24,160	3923	84	**28,167**	5397
Management of Technology (CdM)	12,390	1898	43	**14,330**	4043
Management of Technology	7285	1423	11	**8719**	2929
Financial Engineering	5105	474	32	**5611**	1113
EPFL Middle East	445	990	17	**1452**	1452
Central services	95,666	95,583	5848	**198,085**	15,852
Transdisciplinary Units	7362	7609	537	**14,235**	3927
Construction (BBL)	0	0	39,000	**39,000**	0
Total	577,155	191,135	91,097	**859,386**	231,232

RESEARCH

INTERNATIONAL RANKING

Europe

1st Leiden

2nd AWRU/Shanghai (Engineering)

4th QS (Engineering)

5th THE (Engineering)

7th Times Higher Education (THE)

7th QS Global

World

8th QS (Engineering)

13th Leiden

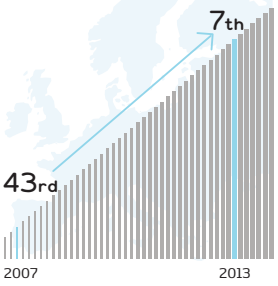
15th THE (Engineering)

15th AWRU/Shanghai (Engineering)

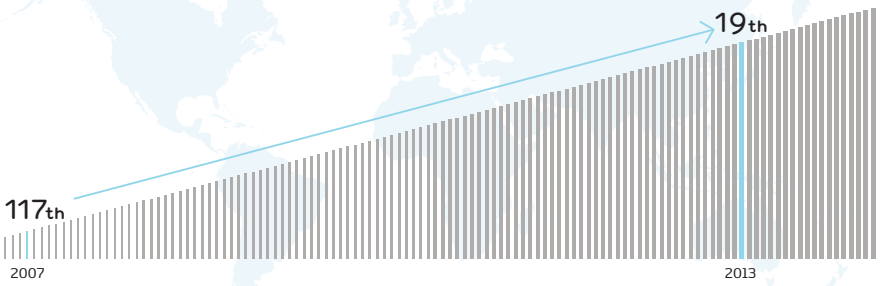
19th QS Global

37th Times Higher Education (THE)

PROGESSION IN QS GLOBAL RANKING



Europe



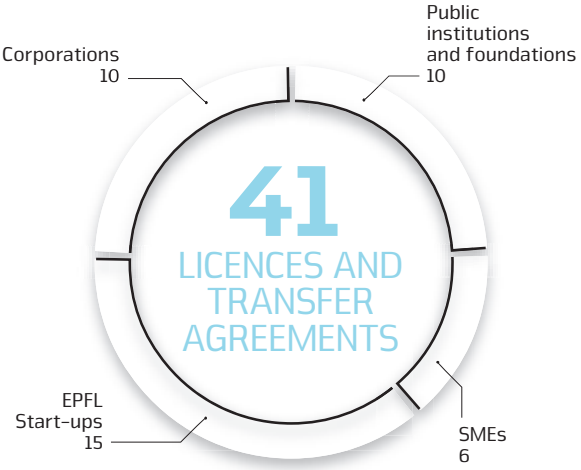
World

TECH TRANSFER

TECHNOLOGY TRANSFER BY FACULTY

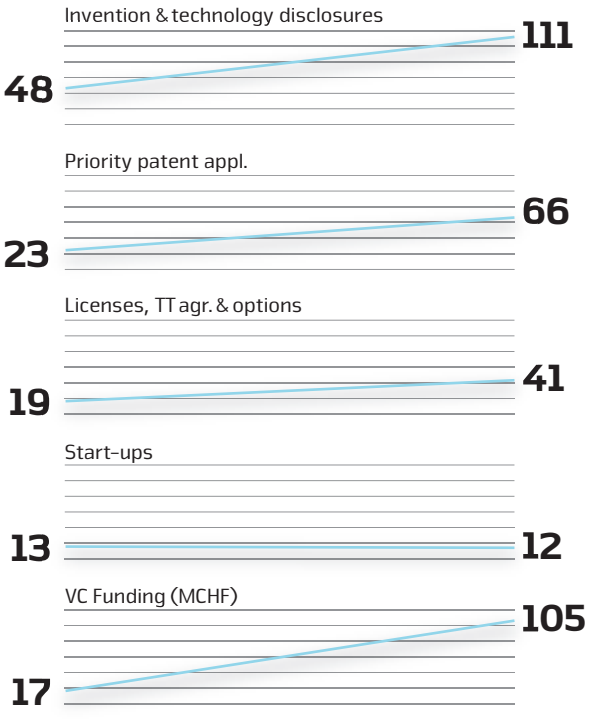
	INVENTION & TECHNOLOGY DISCLOSURES	PATENT REGISTRATION[1]	LICENSING	START-UPS CREATED
Basic Sciences (SB)	**32**	**19**	**8**	**0**
Life Sciences (SV)	**9**	**8**	**5**	**1**
Engineering Sciences and Techniques (STI)	**51**	**29**	**14**	**7**
Computer and Communication Sciences (IC)	**16**	**9**	**7**	**3**
Architecture, Civil and Environmental Engineering (ENAC)	**3**	**1**	**5**	**0**
Other (CdM and Admin)	**0**	**0**	**2**	**1**
Total	111	66	41	12

[1] priority applications



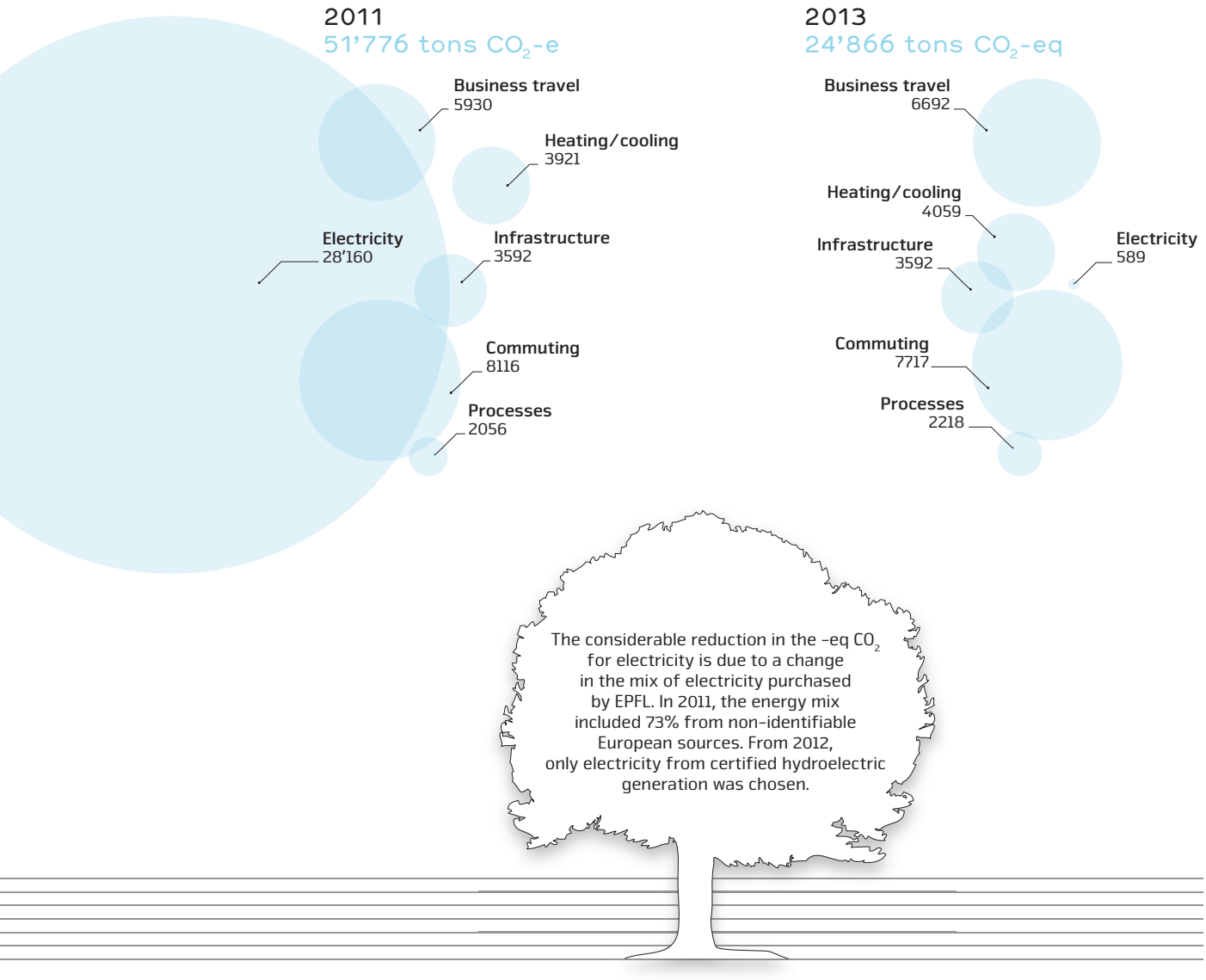
INDUSTRIAL CONTRACTS MANAGED BY THE TTO IN 2013

GROWTH IN TECH TRANSFER (1999-2013)



SUSTAINABILITY

TOTAL CO_2-EQ EMISSIONS* (CAMPUS)



*CO_2 balance based on a Life Cycle approach established with the EPFL spinoff Quantis. Elements not considered: Student exchanges, food, water, material and equipment.

ENERGY CONSUMPTION

	2011	2013
ELECTRICITY (MWh)		
Total electricity purchased EPFL	**72,794**	**77,024**
Total electricity purchased EPFL Vaud	80,987	80,764
Total electricity purchased EPFL Neuchâtel	–	356
Electricity sold to third parties	-8194	-4096
HEATING/COOLING (MWh)		
Total energy purchased	**13,633**	**13,918**
Oil	6624	7363
Oil distributed to third parties	-249	-299
Gas	7258	6854
PROCESSES (MWh)		
Total energy purchased	**8532**	**9206**

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

WWW.EPFL.CH

PROJECT: MEDIACOM EPFL
DESIGN & ILLUSTRATIONS: ALTERNATIVE COMMUNICATION SA, GENEVA-SWITZERLAND
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