PANORAMA 017

ANNUAL REPORT

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

PANORAMA 2017

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FÉDÉRALE DE LAUSANNE

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EDITORIAL

Welcome day: 1,955 new Bachelor's students and 223 students taking the Special Mathematics Course gathered at the SwissTech Convention Center.

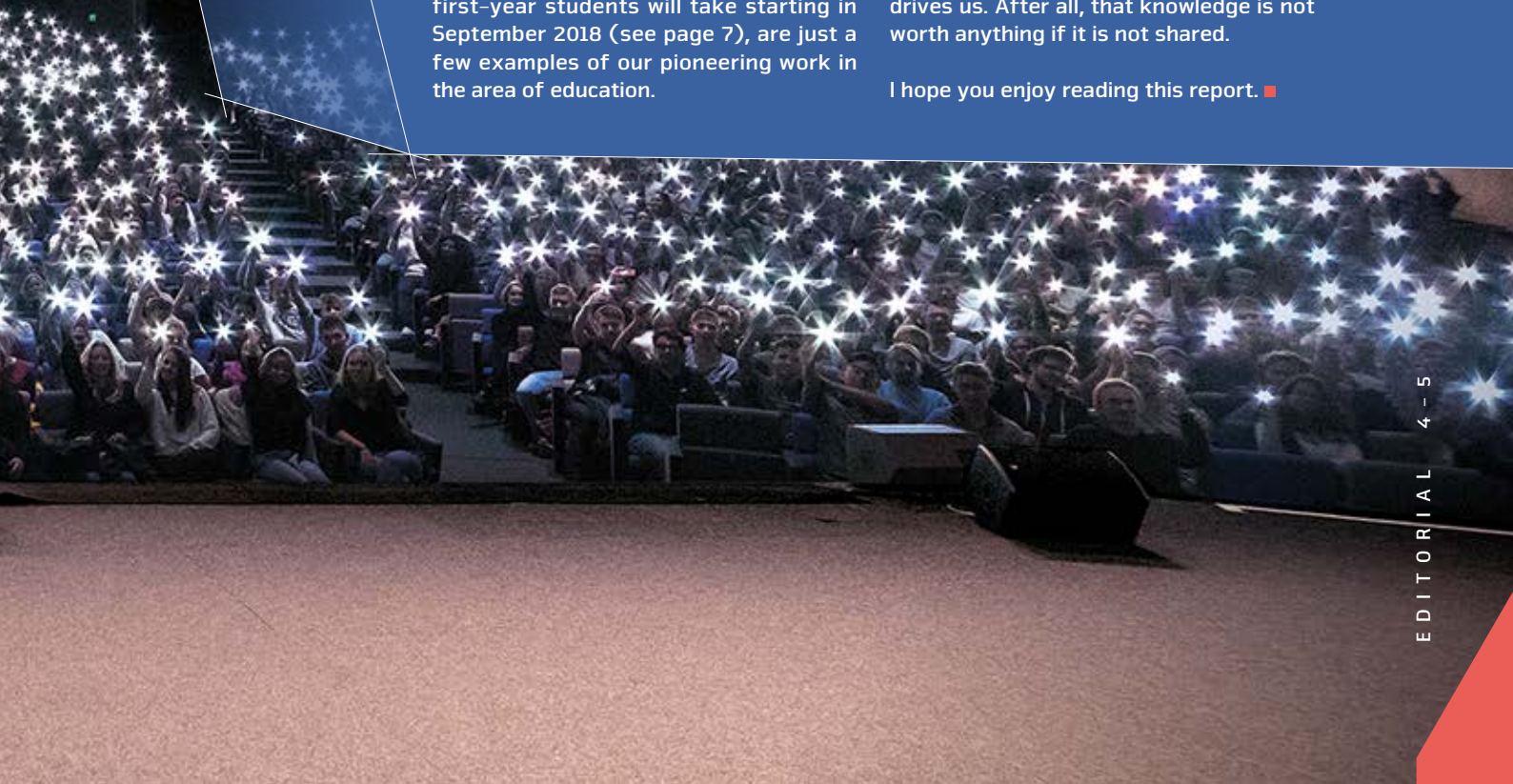
''Among EPFL's many projects, digital technology clearly illustrates the key role played by Switzerland's federal institutes of technology.''

MARTIN VETTERLI
President —

It was with great pride that the new management team took up office in 2017, ready to lead a highly dynamic school that never ceases to amaze us. This annual report provides a glimpse of some of the groundbreaking new research, cutting-edge training programs and innovation in everything from teaching to knowledge transfer that came out of EPFL last year. I'd like to highlight the innovation in teaching in particular. In 2017, some 1,000 students graduated from our school and another 2,000 joined us. While these students are here with us, our mission is to provide them with the highest possible standard of education, giving them the tools they need to meet the challenges they will face as they contribute to the betterment of society. Our massive open online courses (MOOCs) and the Discovery Learning Laboratories, not to mention the computational thinking course that all first-year students will take starting in September 2018 (see page 7), are just a few examples of our pioneering work in the area of education.

Among EPFL's many projects, digital technology clearly illustrates the key role played by Switzerland's federal institutes of technology in bringing informed solutions to the major challenges facing our society and in fostering dialogue and cooperation across scientific disciplines. On Switzerland's first-ever Digital Day, which was held on 21 November 2017, the Swiss government set digitization and the fourth industrial revolution as priorities for the country (see page 49). And these are priorities for EPFL, too. The task ahead of us is huge, but the Swiss Data Science Center has already made headway, launching eight projects in fields as varied as personalized medicine, the environment and open science (see pages 22–23). And last December, we unveiled plans to create a Center for Digital Trust together with several institutional and industrial partners. This center will lay the groundwork for a new form of trust in a digital and dematerialized world. This is one of the major challenges for both digital technologies and our increasingly digitized society (see page 49).
The following pages will take you on a tour through each of our missions and give you a taste of the knowledge that drives us. After all, that knowledge is not worth anything if it is not shared.

I hope you enjoy reading this report. ■



TEACHING

Some of the students who took part in the Solar Decathlon 2017, together with Marilyne Andersen, the dean of ENAC, and Claude-Alain Jacot, the construction manager, at the open-house event in Fribourg in spring 2017.

At EPFL, we are constantly updating our curriculum to ensure our courses continue to meet the changing needs of industry and emerging fields. We even create new degree programs, like we did last September when we began offering a Master's in Data Science. But today, in order to keep pace with the digital transformation of society, we need to reassess the very foundations of the education we offer.

For us, those foundations are mathematics and physics. These are the building blocks our future scientists and engineers need to master the tools of their trade and, more importantly, to think differently. Yet breakthroughs in computational methods and, more recently, big-data and machine-learning applications are shaking the very bedrock on which science and engineering are built.

"Going forward, EPFL graduates will need to know how to formulate problems so that they can be solved by a computer or another intelligent system."

Going forward, EPFL graduates will need to know how to formulate problems so that they can be solved by a computer or another intelligent system. They will have to come up with new ways of asking questions and getting answers – and understand the limits of this technology. In other words, they will have to acquire a whole new way of thinking, computational thinking. That's why, in 2018, EPFL will launch a new core course on this topic for all first-year students. This course will be tailored to each department within EPFL, with the ambitious aim of making our school a pioneer in this essential, cutting-edge field of engineering. ■

PIERRE VANDERGHEYNST
Vice President for Education

EPFL's Industry Day is a chance for students to make their first contact with the business world.

FOR BUSINESSES, INTERNS ARE WORTH THEIR WEIGHT IN GOLD

EPFL students have to spend several months outside the academic world doing a work placement or their Master's project. This experience can be extremely rewarding for the businesses concerned – as well as a valuable source of innovation. —

Making a foray into the business world for two to six months is an essential rite of passage for EPFL students. Each year, around 1,000 students choose from among the more than 2,000 placements on offer. Our future engineers are known for delivering concrete results, which is what makes businesses so keen to have them. "Students look at the challenges we face in a different way, leveraging new skills and taking a different approach," says Jean-Michel Chardon, senior director at Logitech and an EPFL alumnus. He finds that his company clearly comes out on top with this kind of exchange. "They are brimming with ideas. It's a rewarding program that enables us to innovate in so many different areas."
As delighted as businesses are by their interns, the feeling goes both ways. Eve Carletti, an electrical engineering student, completed both a six-month work placement and a Master's project at Microchip Technology. "I had the supervision I needed but was still encouraged to take the initiative," she says. And it was clearly a positive experience on both sides, because the firm hired her as soon as she graduated. Indeed, many students go on to work for the company where they did their placement. ■

ENHANCED LEARNING THROUGH FLIPPED CLASSROOMS

A small revolution in teaching methodology has been under way at EPFL in recent months: rather than sitting and listening to their professor in a lecture hall, some students have found themselves in a flipped classroom. This approach upends conventional teaching in an effort to enhance the learning process. —

Around one hundred students volunteered to try out Simone Deparis' linear algebra course, which has been testing the flipped classroom concept this year. This teaching technique was developed in English-speaking universities and totally revolutionizes the approach to learning. Instead of being taught new material by the professor in class, students in a flipped classroom first learn the basics themselves online through a video course. They then come to class to deepen their knowledge and ask the professor questions.
Surprisingly, this approach has proven to enhance learning and improve student participation. "The students are extremely motivated and very demanding. In class, we have the time to really delve into certain areas. It means I can basically offer a tailor-made course," says Deparis. Even though the flipped classroom is a promising strategy, not all EPFL students will find themselves in this type of course in the future. "The goal is by no means for this technique to be adopted in all courses. It's just one of many options," explains Deparis. ■

OUR BEST TEACHER

Fabien Sorin is unstinting in the time and energy he devotes to his classes, with the perfect blend of demonstrations, theory and experiments. That's why he received the Award for Best Teaching at EPFL in 2017. —

Fabien Sorin has only been at EPFL for four years, but he's already made his mark. The assistant professor in the Materials Science and Engineering section took over teaching an introductory course for around 300 first-year students. Professor Sorin has poured his heart into the course, and in recognition he received the Credit Suisse Award for Best Teaching, which is bestowed every year by a panel of EPFL judges.

How does Professor Sorin engage his students? Through a curriculum that combines demonstrations, scientific concepts and experiments. "Getting certain points across to a lecture hall full of 300 students through experiments is challenging," says Sorin. "Over the past few years, I have come up with a three-pronged approach so that I can teach the theoretical and practical sides together." Sorin begins his classes with often-spectacular demonstrations, not hesitating to break dishes, for example, in order to reveal the properties of a given material. He then introduces the theoretical elements of that day's lesson and ends the class with experiments. "What I find so rewarding is not only that the students like the class, but that the second-year professors have seen the students' level of understanding increase noticeably since I changed my way of teaching," says Sorin. ■

Fabien Sorin often conducts spectacular demonstrations during his lectures.

TURNING PhD STUDENTS INTO ENTREPRENEURS

In 2017, we launched EPFLinnovators, an initiative designed to hone our PhD students' business skills and unlock their potential for innovation. —

One of EPFL's three missions is to promote the transfer of knowledge from research to industry. However, too many PhD students wait until the end of their studies to start considering career opportunities or the possibility of creating a startup. That's why we launched EPFLinnovators, a program that will provide our best new PhD students with the training, experience and advice they need to become successful entrepreneurs.

EPFLinnovators selects 36 participants from among the PhD candidates in our 19 doctoral programs. These students take additional classes and do a six-month to two-year work placement in industry. This gives them the research and entrepreneurial skills they need to get ahead in the business world.

After completing the program, the PhD students will continue to receive startup-related support from EPFL, including contacts with investors and personalized guidance at EPFL Innovation Park. The program aims not only to kindle the PhD students' entrepreneurial spirit, but also to provide them with the tools they need to create successful startups after completing their studies. ■

EARNING AN EPFL CERTIFICATE THROUGH CONTINUING EDUCATION

The EPFL Extension School, launched last autumn, offers online programs in which participants can obtain a Certificate of Open Studies with no prerequisites. —

The EPFL Extension School gives people the chance to get an EPFL qualification even if they do not hold a university degree. Students who successfully complete one of the school's continuing education programs will get a Certificate of Open Studies, a new type of academic qualification that is currently offered only by EPFL. The EPFL Extension School is particularly well suited to working professionals, as it offers programs on topics of immediate use on the job market.

Given the impact that digitization now has on almost every profession, the aim is to give anyone who is interested the chance to learn more about new technologies. "The only way to be ready for the digital transformation is to be part of it, and this requires practical skills," says Professor Marcel Salathé, the school's academic director. The EPFL Extension School allows learners to acquire these skills without interfering with their professional or family obligations. People who complete these continuing education courses do not automatically gain entry into an EPFL degree program, but the ECTS credits obtained are recognized by several European universities. ■

A NEW EPFL INCUBATOR FOR EDUCATION TECHNOLOGY

In spring 2017, we opened the Swiss EdTech Collider, which provides a home for around 30 startups focused on transforming education through technology. The startups also have the opportunity to become involved in the cutting-edge research conducted at EPFL in this field. —

For several years now, we have played a leading role in developing digital education, particularly through our online courses, which more than 1.5 million users have signed up for since they were launched in 2012. And then last spring we took a decisive step towards developing an international Swiss-based hub for digital education when we opened our new Swiss EdTech Collider.

This 300 m^2 coworking space will bring together entrepreneurs active in educational technologies and EPFL professors conducting cutting-edge research. Thanks to its location at EPFL Innovation Park, this unique ecosystem also benefits from being close to the EPFL campus and to the current Center for Digital Education and several research laboratories. The main aim of the Swiss EdTech Collider is to contribute to the development of the education technology sector in Switzerland, from nursery school all the way up to continuing education for adults and corporate training. ■

Cristina Riesen and Pierre Dillenbourg coordinated the launch of the Swiss EdTech Collider.

250 people from 24 countries, including 90 EPFL students, took part in the second LauzHack.

MORE THAN 250 PEOPLE JOIN IN THE HACKATHON RUN BY EPFL STUDENTS

The second LauzHack, held in 2017, drew participants from around the world intent on solving new-technology challenges. —

The teams worked on a challenge of their own making or chose from the ones provided by the event sponsors. A panel of judges awarded prizes to the best projects, which included an easy way of drawing on a computer with gestures, an everyday application for augmented reality and artificial intelligence to make summaries of articles. The hackathon was organized and run entirely by EPFL students. ■

NEW MASTER'S PROGRAMS IN DATA SCIENCE AND DIGITAL HUMANITIES

EPFL keeps pace with a changing society and the challenges of an increasingly digitized world by launching two new Master's programs. —

The Master's in Data Science offers training in all areas of this cutting-edge field, from algorithms and database architecture to information theory and machine learning. Students are given access to different types of real-time data, which they then use to make complex forecasts and conduct large-scale calculations. The Master's in Digital Humanities offers a curriculum at the intersection of engineering and the social sciences. In addition to extracting information from big data and machine learning, students learn how to interpret data from the humanities and the social sciences, two vast fields. ■

ENSURING A SEAMLESS TRANSITION FROM HIGH SCHOOL TO EPFL

Two years ago, we began offering training opportunities to local high school teachers to help them ease their students' transition to EPFL. —

The training program gives math, physics, chemistry, biology and IT teachers the chance to spend one day per week at EPFL for one or two semesters. During this time, the teachers gain insight into what EPFL expects from students, the difficulties that students experience and the workload they face. By teaming up with high schools in the cantons of Vaud, Valais and, more recently, Geneva, EPFL aims to make sure its incoming students are well prepared. The first year at EPFL can be particularly tough, but with this program teachers can find out how to gear their teaching towards ensuring students have the right approach to learning and the knowledge they need to be successful here. ■

STUDENTS' SEMESTER PROJECTS

A ROBOT THAT HELPS VISUALLY IMPAIRED SCHOOLCHILDREN FIND THEIR WAY

Alexandre Foucqueteau with Cellulo.

Cellulo, a little hand-held robot created by Alexandre Foucqueteau for his semester project, can help visually impaired children get around their classroom. The children simply move the robot around a 2D map of the room, and a tablet tells them where the objects in the classroom – like cupboards, chairs and desks – are located. ■

THE FUNDAMENTALS OF LIFE

Sarah Herrman at work in the Pierre Gönczy laboratory.

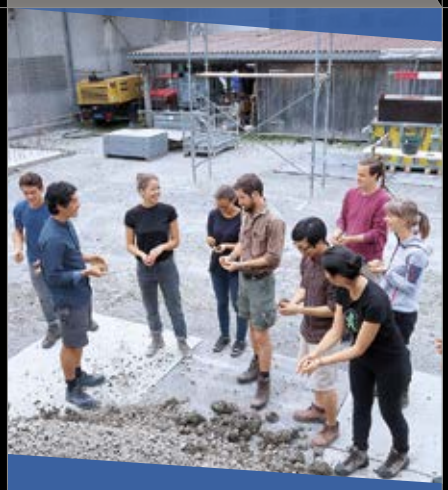
Sarah Herrman has looked at how centrosomes, which are involved in the splitting of cells, help to organize a developing embryo. Her work consists of analyzing the early stages of life using the roundworm C. elegans as a model organism. Herrman, who wants to go to medical school, came to EPFL from the University of California as part of the Summer Research Program run by EPFL's School of Life Sciences. ■

THE APP THAT MAKES EATING OUT A PIECE OF CAKE

Two of the seven students who designed Apety: Louis Comte and Teo Stocco.

Students from EPFL and HEC have launched an app that can help you organize a meal out with friends. Users can select what they want to eat in one of the partner restaurants, invite friends to join them and then pay for their share of the meal at the end. The app, which is now available on the App Store, saves time and is a good way to discover new places to eat. Around 40 restaurants in Geneva and ten in Lausanne have already signed on. ■

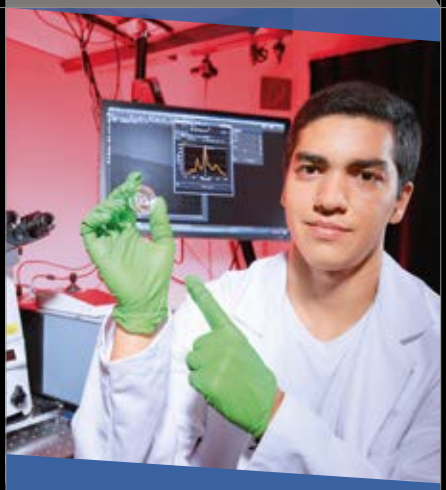
A RAMMED-EARTH PAVILION IN ST. GALLEN



The architecture students built a mock-up pavilion out of rammed earth.

A group of around 30 Master's students in architecture from EPFL and other Swiss universities spent the summer building a rammed-earth "mock-up" pavilion in St. Gallen. The structure mainly consists of rammed-earth pillars, an age-old building technique that uses earth that has been compacted in formworks. The project serves as a prototype for a six-meter-high arts pavilion to be completed in 2018. ■

BUILDING A NANOTUBE BIOSENSOR



Edward Honein holding a microfluidic nanotube biosensor.

Biosensors detect biological molecules in air, water or blood and are used widely in drug development, medical diagnostics, biological research and even security. Edward Honein has developed a biosensor made up of carbon nanotubes that can detect single biomolecules using a scalable, high-throughput approach. His device could prove extremely useful for diseases that need to be monitored continuously, like diabetes. ■

A DRONE TO RESCUE FAWNS

Simon Jobin is an aerial photography specialist.

Simon Jobin, an architecture student with expertise in aerial photography, has found a way to put his drone skills to good use. Using a thermal camera mounted on a drone, he searches for fawns hidden in the long grass before the harvester passes through. He does not charge for this service, which, if he can build up a big enough network of volunteer drone pilots, could eliminate the risk of animals being accidentally killed in the fields. ■

RESEARCH

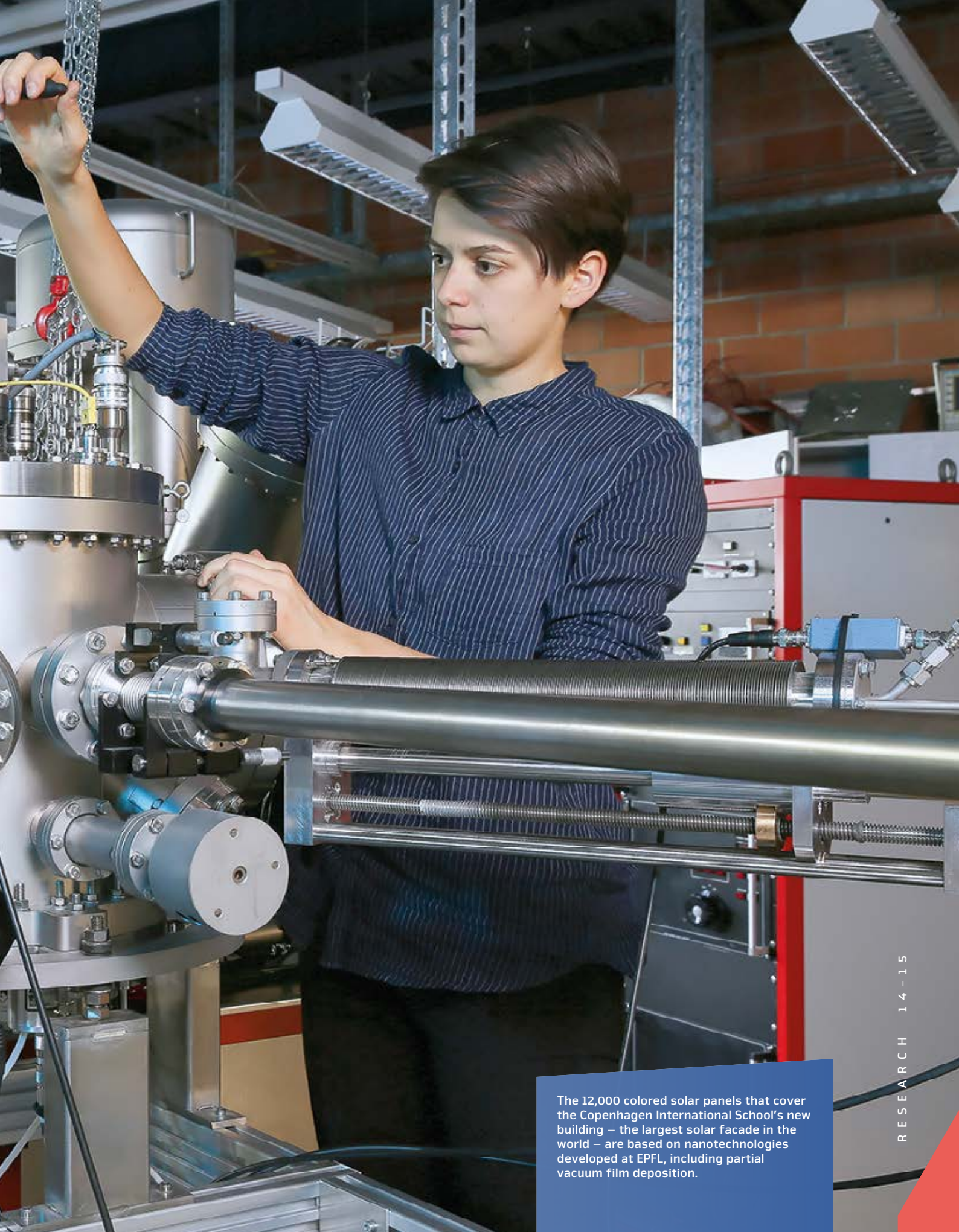
Research is EPFL's second mission and perhaps the one most visible to the outside world. Not a week goes by without our researchers publishing the findings and discoveries they make, the world over, on a broad spectrum of topics. We are making their work more accessible for both the global scientific community, in the name of open science, and the general public, particularly in Switzerland. People are increasingly aware of the enormous challenges that our society is facing. These include the impact of climate change; our growing need for energy, raw materials and food; the digitization of almost everything around us; and advances in life sciences and subsequently in health and well-being. The research conducted in our laboratories seeks to respond to people's questions and concerns surrounding these issues – and to leverage opportunities that arise.

"Not a week goes by without our researchers publishing the findings and discoveries they make, the world over, on a broad spectrum of topics."

The following pages offer a glimpse at our researchers' achievements. As you will see, the research conducted at EPFL is often fundamental in nature. While such work seeks to advance knowledge over the long term, it still fully reflects our drive to meet the concerns and challenges of today's society. You'll also find examples of applied research, which aims to have a more direct and clear-cut impact on society. EPFL's scientific community thus goes full circle, from curiosity and discovery to application and inspiration – and back to curiosity. Our researchers address the current and future concerns of each and every one of us with ambition and determination.

By explaining the findings and challenges of the research conducted at EPFL to the general public, we also hope to connect with the next generation. Sparking the interest of young people and motivating them to get involved in the research we do are essential to our shared future. ■

ANDREAS MORTENSEN
Vice President for Research —



The 12,000 colored solar panels that cover the Copenhagen International School's new building – the largest solar facade in the world – are based on nanotechnologies developed at EPFL, including partial vacuum film deposition.

GREEN CHRISTMASES AND RISING CO_2 EMISSIONS IN THE ALPS

Climate change will shorten the ski season and alter the CO_2 emissions of Alpine streams. —

A study by the Laboratory of Cryospheric Sciences and the Institute for Snow and Avalanche Research has shown that mountain regions will have to prepare for dwindling amounts of snow in the winter. According to the research, the Alps could lose as much as 70% of their snow cover by the end of the century. Areas below an altitude of 1,200 meters will be hit hardest. In addition to the changes in snow cover, the research revealed that the Alpine winter season – the period when natural snow is deep enough for winter sports – is becoming shorter. As temperatures rise, the ski season could start half a month to a month later than it does now. If we don't take action, there may only be enough snow to do winter sports above 2,500 meters by the end of the century.
Another study, by the Stream Biofilm and Ecosystem Research Laboratory, has shown that warmer winters and the lack of snowfall are already taking their toll on the Alps: in the springtime, Alpine streams now release more carbon dioxide than they absorb. Further research in this area is being conducted in Switzerland, mainly through the METALP research project run by the Swiss National Science Foundation with support from EPFL Valais Wallis. ■

NEW INSIGHTS INTO OUR OCEANS AND CORAL REEFS

Two studies have added to our understanding of the oceans, coral reefs and climate change. —

Studying the world's oceans can still produce some surprises. A publication by the Laboratory for Biological Geochemistry has revealed a flaw in the way past ocean temperatures were estimated up to now. According to the methodology widely used by the scientific community, the temperature of the ocean depths 100 million years ago was around 15 degrees higher than current readings. But ocean temperatures may in fact have remained relatively stable throughout this period. This discovery puts current global warming in a very different light, suggesting it could well be completely unprecedented. In another recent article, researchers from the same lab, which also specializes in coral studies, showed that corals in the Gulf of Aqaba are particularly resistant to the effects of global warming and ocean acidification. The researchers called on countries in the region – Saudi Arabia, Egypt, Jordan and Israel – to come together to create a strong environmental protection program. While these corals may stand up to rising water temperatures, they are still vulnerable to local pollution and overfishing. ■

MONITORING THE BIODIVERSITY OF SWISS LIVESTOCK

GenMon is a web platform that maps out the biodiversity of breeds farmed in Switzerland in order to estimate how sustainable they are. This information will be useful for livestock associations. —

GenMon was designed to maintain the genetic biodiversity of Swiss livestock breeds and prepare for climate change through the automated monitoring of livestock. This web platform was developed by the Laboratory of Geographic Information Systems in partnership with the Swiss Federal Office for Agriculture. GenMon looks at geographical, environmental, genetic and socio-economic data simultaneously and estimates how sustainable it is to farm each breed. The platform displays a map of Switzerland with a score for each breed of various types of livestock. The score is based on five criteria: pedigree, geographical concentration within a region, introgression (the process of uncontrolled entrance of genes from another gene pool through mating with another breed), cryo-conservation plans, and the sustainability of farming each breed in Switzerland. The platform was created to meet one of the recommendations of the United Nations Food and Agriculture Organization. Its designers say that the app, which is the only one of its kind in Europe, could be easily adapted to other countries. ■

Researchers took millions of pictures of snowflakes in Davos.

UNRAVELING THE MYSTERY OF SNOWFLAKES

By studying the structure of snowflakes, EPFL researchers aim to improve winter weather forecasts and more accurately estimate the water content stored in the snowpack. —

Researchers from the Environmental Remote Sensing Laboratory used a device with three synchronized cameras to observe snowflakes from several different angles. Their goal is to improve snowfall forecasts at high altitudes and more accurately estimate the water content of the snowpack. This information could prove extremely useful for managing water resources, irrigation and hydropower. In partnership with MeteoSwiss and the Institute for Snow and Avalanche Research, the researchers installed their equipment at an altitude of 2,500 meters near Davos during the winter months and at a site in Antarctica during the southern hemisphere's summer. Millions of images of snowflakes were taken. They then trained an algorithm to recognize six different categories of snowflake in order to determine their respective frequency, and they observed the degree of riming of each snowflake. It was the first time such robust statistics had been obtained. The data collected at Davos and in Antarctica will enable the researchers to test various hypotheses on the liquid water content of snowflakes, which remains an enigma for atmospheric scientists. In early 2018, the researchers installed their equipment in the mountains of South Korea for the PyeongChang Winter Olympics. ■

AN ANTARCTIC EXPEDITION TO STUDY THE EFFECTS OF CLIMATE CHANGE

From December 2016 to March 2017, the Antarctic Circumnavigation Expedition (ACE) made its way around the great white continent. Scientists on board conducted 22 research projects in order to gauge the impact of global warming on the Southern Ocean and the planet as a whole. —

The three-month Antarctic Circumnavigation Expedition (ACE) was organized by the EPFL-based Swiss Polar Institute. It involved 150 researchers from 23 different countries, who took part in at least one leg of the expedition on board the Akademik Treshnikov, a Russian research ship. The researchers conducted 22 projects, taking close to 30,000 samples on a number of islands and mainland sites as well as from the air and the ocean. All the data is now being analyzed in the laboratories of the 70 international research institutions associated with the expedition.

The research covered fields as varied as oceanography, climatology and biology. The aim was to gather data on the effects of global warming in order to better understand its impact on the Southern Ocean and the broader implications for our planet. The Antarctic region is crucial to the planet's health for a number of reasons. First, it serves as a major carbon sink. And in addition to influencing weather conditions in the southern hemisphere, the Antarctic continent plays a key role in how the oceans circulate around the world.

"This expedition is a first in several respects," explained David Walton, the chief scientist on board. "Until now, no one had ever gathered data over an entire season on one expedition or simultaneously conducted land, ocean and atmospheric research. Taken together, these projects will give us a fuller picture of Antarctica and the Southern Ocean." ■

Chemical traces in the ice contain detailed information on our climate history. That's why researchers took so many ice cores on the islands they visited and on Mertz Glacier (shown here).

The researchers visited around a dozen islands. Here, they have just crossed St. Andrews Bay to reach South Georgia Island, which is home to one of the largest colonies of king penguins in the region.

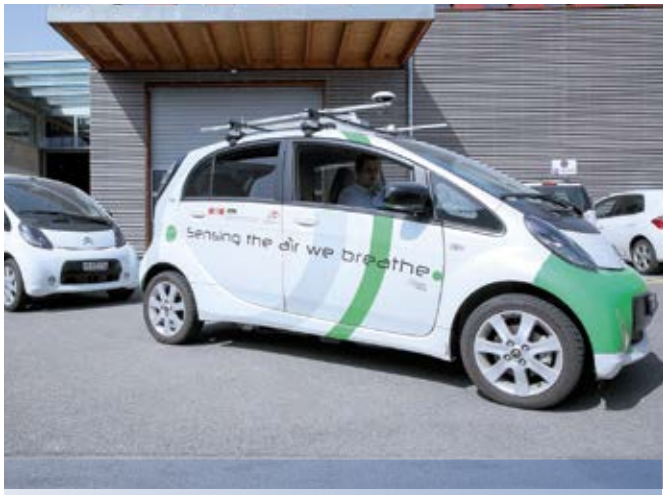
MAPPING THE URBAN UNDERGROUND

Thanks to an EPFL study, it is now possible to map out the potential of each natural resource found underneath a city and ensure that underground urban development is a success. —

For his thesis project, Michael Doyle, from the Laboratory of Environmental and Urban Economics, mapped out the ground below three cities with very different political, economic and geological characteristics: San Antonio (Texas, USA), Hong Kong (China) and Dakar (Senegal). To do this, he applied the Deep City methodology developed at EPFL. The Deep City approach simplifies complex geological maps so that cities can use them to plan their underground development while also protecting the natural resources found there. By fine-tuning this methodology, Hoyle was able to develop a coefficient system to assess the potential of each underground resource. His aim was to provide decision-makers with a useful metric that they could apply in their underground urban planning. Hoyle also looked at Montreal's underground. Why? To see the extent to which large underground structures can contribute to a city's economic success, and to gain insight into the interaction between commercial spaces above and below ground. ■

TWO SMART VEHICLES ARE BETTER THAN ONE

When EPFL researchers merged the data from two smart vehicles, they improved each car's field of vision and enhanced their situational awareness. —



The vehicles need to know their position relative to each other very accurately.

Smart vehicles get their intelligence from cameras, light-detection and ranging sensors (known as lidars), and navigation and mapping systems. But there are ways to make them even smarter. Researchers at the Distributed Intelligent Systems and Algorithms Laboratory are working to improve the reliability and error tolerance of these systems by combining the data gathered from several vehicles. This would allow the researchers to extend the field of vision of a trailing car, for example. Using simulators and road tests, the team developed software to create a network among intelligent vehicles so that they can interact. With help from Groupe PSA, two Citroen C-Zero electric cars were retrofitted with lidars, a Mobileye camera, an accurate localization system, a router to enable Wi-Fi communications, a computer to run the software and an external battery to power it all. The longer-term goal is to create a network among multiple vehicles and with the highway infrastructure. In addition to enhancing safety and comfort, cooperative networks of this sort could eventually be used to optimize a vehicle's trajectory, save energy and improve traffic flows. ■

AN ALGORITHM DESIGNED TO EXPAND WIKIPEDIA IN ALL LANGUAGES

An EPFL researcher has created an algorithm that scans Wikipedia for important articles that are missing in certain languages. This project could help expand the online encyclopedia's coverage in minority languages, such as Romansh. —

With 40 million articles in 293 languages, Wikipedia is the largest encyclopedia ever made. The 5.4 million pages in English are extremely varied, but not all languages enjoy such depth of coverage. "Information that some language groups need has not been translated," says Robert West, a researcher at EPFL's Data Science Lab. "For example, global warming is a crucial issue in Madagascar, yet there are no articles on this topic in Malagasy."
Closer to home, only 3,400 articles are available in Romansh versus 1.8 million in French and over two million in German. And it's hard for Wikipedia editors to know which of the millions of pages they should translate in order to really make a difference. That's where West comes in: he used machine learning to identify the most important articles missing in each language. Once the algorithm has come up with a ranking, lists of missing topics are displayed on the Wikimedia GapFinder platform for volunteer editors to translate. The platform, which was developed together with Stanford University and the Wikimedia Foundation, has been publishing 200 new articles per week. ■

USING ARTIFICIAL INTELLIGENCE TO COMPOSE ORIGINAL MUSIC

The artificial composer developed by Florian Colombo and Wulfram Gerstner can produce entire, convincing melodies. It can also assess the originality of a piece of music.

A new algorithm developed by EPFL researchers can generate melodies in a given style of music. This deep artificial composer could one day be used in video games or to help composers during the creative process. —

Thanks to the processing power of modern computers and the sheer amount of digitized musical scores available, automatic music composition is now a reality. Indeed, researchers from the Computational Neuroscience Laboratory have developed artificial intelligence that can produce original melodies. The deep artificial composer – or DAC for short – generates brand-new melodies that imitate a given style of music. For now that style is either traditional Irish folk music or Klezmer music from Eastern Europe. And it does this without plagiarizing already existing music, since the melodies it produces are as original as those written by a human composer.
Artificial intelligence was already capable of composing musical scores using music theory. What's new with the DAC is that the artificial intelligence learns to compose complete melodies from start to finish without any music theory. Instead, it uses only a large database of existing music. No human post-production is required. ■

A CUTTING-EDGE PAVILION MADE FROM WOOD

The Vidy Theater in Lausanne opened its new auditorium, the Pavilion, in 2017. The design combines a wooden structure with an innovative digital construction approach developed at EPFL. —

Yves Weinand, the director of the Laboratory for Timber Constructions, was at the heart of this project. For over ten years, he has supported the building of ecological – primarily wooden – structures. The Vidy Pavilion's wood panels were assembled using tenon joints, a novel method developed in Weinand's lab. Fewer metal joints and less glue were needed to build the Pavilion thanks to this technique, which fits the panels together like a jigsaw. This approach also reduces the cost of sorting materials in the event the building is dismantled or recycled. During the construction phase, over 60 companies came to visit the site. Weinand happily made his digital panel-cutting model available to the companies, along with his method for manufacturing wood-wood joints for this type of building. The Vidy Pavilion cost just 2.8 million Swiss francs, including all the stage equipment but excluding research costs. While high-profile buildings help highlight the value of his technique, Weinand underscores the fact it can also be applied to standard structures. The project received support from the Swiss Federal Office for the Environment's wood action plan. ■

The origami-looking building can seat 250 theatergoers.

SWITZERLAND LAUNCHES A NATIONAL CENTER FOR DATA SCIENCE

The Swiss Data Science Center (SDSC) is a joint venture between EPFL and ETH Zurich. Its mission is to foster innovation in data science and promote multidisciplinary research and open science. —

The SDSC, which was launched in February 2017, is being implemented jointly by EPFL and ETH Zurich, with offices in both Lausanne and Zurich. The SDSC works to leverage and recycle existing data, making it more than just a simple data center that gathers and stores information. In fact, it is designed to foster innovation in data and computer science and to provide the necessary infrastructure for promoting cross-disciplinary research and open science, with applications ranging from personalized health to environmental issues. The initiative will enable Switzerland to develop expertise in data science and become a center of excellence with global standing.

The presidents of ETH Zurich and EPFL, Lino Guzzella and Martin Vetterli, have a common vision.

A TWO-PRONGED APPROACH

One of the main challenges facing the field of data science is making sure that data providers, computer and data scientists and subject-matter experts all speak the same language. The SDSC aims to bridge the gap between those who generate data, those who analyze data and develop data systems, and those who may potentially be able to leverage that data. To do this, the center's researchers have developed a platform – known as RENGA – to help promote cross-disciplinary cooperation. RENGA is a true one-stop-shop for hosting, exploring and analyzing curated, calibrated and anonymized data. It allows researchers to share, reproduce and reuse data securely, while at the same time ensuring traceability. The platform is a key step in the development of open science, as it fosters research productivity and excellence.

The RENGA platform, which can be cloud-hosted, draws on existing ETH Domain infrastructures, such as the Swiss National Supercomputing Centre (CSCS) in Lugano and SWITCH (the technology and service platform for Swiss Universities), and may also call on other cloud providers.

Alongside this work, the SDSC is also involved in various data science research projects. Out of the 74 proposals it received, 12 projects were selected and then launched between autumn 2017 and spring 2018. These projects focus either on developing and implementing data-science technologies or research methods or on in-depth analysis of cross-disciplinary challenges involving data science. The projects cover scientific fields ranging from climate change to immunotherapy (see insert), microscopic imaging and cosmology.

With this two-pronged approach, the SDSC aims to speed up the adoption of data science and machine-learning techniques in the academic fields covered by the ETH Domain, as well as their adoption in the broader scientific community in Switzerland.

For the moment, the SDSC has a multi-disciplinary team of around 20 data and computer scientists, along with experts in select fields. Staff numbers are expected to double as the center expands in the coming years.

The SDSC was created as part of the ETH Board's Initiative for Data Science in Switzerland. Data science has even been clearly defined as one of the ETH Domain's strategic fields of research for the 2017–2020 period. The aim of this overall initiative is to speed up the adoption of data science techniques by expanding education and research and setting up infrastructure for data science users across disciplines. ■

ILEARN – USING MACHINE LEARNING TO PERSONALIZE CANCER TREATMENT

One of the eight research projects already launched by the Swiss Data Science Center is iLearn, which stands for Interpretable Learning Methods for Immunotherapy. The aim of this project is to develop a new tool for personalizing cancer treatments. Pascal Frossard from EPFL joined forces with Olivier Michielin from Lausanne University Hospital (CHUV) to combine their respective expertise in machine learning and oncology. The researchers are using machine-learning techniques to create a tool capable of producing models that can be easily interpreted and explained by doctors so that they can personalize cancer treatments.
The aim is to develop a decision-making tool that provides doctors with explanations as to which cancer treatment would be most suitable. The researchers will focus on predicting how tumors respond to immunotherapy, a treatment method that involves stimulating a patient's own immune system to fight cancer cells. "This type of treatment can be highly effective – but it doesn't work for everyone," says Michielin. "We want to understand why, and what tumor characteristics are typically associated with a positive outcome. That will help doctors select the best treatment for a particular patient." ■

Just like in the movie Men in Black, the researchers have managed to make artificial intelligence forget what it has learned.

KEEPING THE UPPER HAND OVER ARTIFICIAL INTELLIGENCE

Researchers from the Distributed Programming Laboratory have shown that humans can maintain ultimate control over a system comprising several machines guided by artificial intelligence. —

Artificial intelligence (AI) will always seek to avoid human intervention and to create a situation where it cannot be stopped. Machines therefore have to be prevented from eventually learning how to circumvent human commands. Researchers from the Distributed Programming Laboratory have now found a way for human operators to keep control over a group of AI robots.

Their breakthrough method lets humans interrupt AI learning processes when necessary, while also making sure that the interruptions don't change the way the machines learn. They did this by adding 'forgetting' mechanisms to the learning algorithms to essentially delete bits of a machine's memory. Their work was complicated by the fact that they focused on multi-agent systems, which comprise several machines that learn from each other. They found that it is possible to maintain control over the machines using existing algorithms.

The researchers' work will be crucial for ensuring that devices like self-driving cars and drones can work safely in numbers. ■

A SIMPLIFIED PROCESS FOR MANUFACTURING HIGH-EFFICIENCY SOLAR CELLS

A team of researchers from EPFL and CSEM, a research and technology organization in Neuchâtel, has come up with a new way of placing electrical contacts on the back of crystalline silicon solar cells. Their low-cost approach increases efficiency by eliminating shade on the front of the cell. —

One of the most promising ways of making crystalline silicon solar cells more efficient and less expensive is to move all of the electrical contacts to the back. Eliminating shade from the front of the cell increases sun exposure and the resulting current. Yet the manufacturing process is long and difficult.
The EPFL and CSEM researchers came up with a simple and innovative way of creating these solar cells. They've also achieved 23.2% efficiency on 25 cm^2 cells – and this level could one day surpass 26%.
The researchers are now working with the Meyer Burger Company, a leading maker of equipment for solar cell production lines, to explore ways of manufacturing this type of solar cell. ■

SPLITTING CARBON DIOXIDE USING A LOW-COST CATALYST

Researchers have built the first Earth-abundant and low-cost catalytic system for splitting CO_2 into carbon monoxide (CO) and oxygen. This is an important step towards converting renewable energy into hydrocarbon fuels. —

A promising avenue for the future of clean energy is to store it in the form of carbon-based fuels produced from renewable sources, effectively enabling the clean use of liquid fuels such as gasoline. A first step in this direction is the electrolysis of carbon dioxide into oxygen and CO, which can subsequently be transformed into liquid fuels. But current CO-forming catalysts are either not selective enough or too expensive to be industrially viable.
However, researchers from Michael Grätzel's lab have made a major breakthrough. They have developed a catalyst based on copper-oxide nanowires modified with tin oxide, materials that are found in abundance on Earth. A solar-driven system using this catalyst was able to split CO_2 with an efficiency of 13.4%. This work is expected to help worldwide efforts to synthetically produce carbon-based fuels from CO_2 and water. ■

FIND OUT HOW MUCH PRIVACY YOU COMPROMISE WITH EVERY CLICK

Does clicking on a link or liking a product have an impact on your privacy and your personal information? A researcher has come up with a solution that lets you browse the internet without revealing too much about yourself and without having to forgo the convenience of online product recommendations. —

Mahsa Taziki's algorithm helps people protect their personal data.

Nowadays it's common for people to buy a book or other product that was recommended to them based on their online profile. But these recommendations, which are powered by past shopping behavior, raise a number of questions about data protection. The potential buyer often faces a dilemma: should I click without knowing exactly what I'm revealing about myself or how this information will be used? Or should I not click and forgo a useful product or service?
Mahsa Taziki, a researcher in the Distributed Programming Laboratory, has developed a system that makes this decision easy. Using an algorithm, she can determine in real time the amount of information revealed by liking or rating an item. Unlike ad blockers, which are largely indiscriminate, Taziki's algorithm does not affect information or ads that users don't mind seeing. "In the end, we want users to be able to enjoy the benefits of online recommendations while maintaining maximum control over their privacy and the data they share," says Taziki. ■

A YOUNG RESEARCHER IN THE SPOTLIGHT

Maryna Viazovska's research has brought her international fame.

Maryna Viazovska, a full professor at EPFL, won the New Horizons in Mathematics Prize, one of the Breakthrough Prizes awarded by a consortium of Silicon Valley heavyweights. —

Maryna Viazovska has had a stellar career, to say the least. Originally from Ukraine, she came to EPFL in late 2016 to take up a position as tenure track assistant professor. She was promoted to full professor just a year later, making her – at 33 years old – one of the youngest EPFL researchers to be given this title. Today she holds EPFL's Chair of Number Theory.

Within a few days of getting her promotion at EPFL, Viazovska also found out she had been awarded the New Horizons in Mathematics Prize. This is one of the Breakthrough Prizes given every year in recognition of exceptional scientific contributions. The Breakthrough Prizes were founded by prominent Silicon Valley figures including Mark Zuckerberg, Sergeï Brin and Yuri Milner, and are handed out at a prestigious awards ceremony – hosted this year by Morgan Freeman.

Viazovska was honored for her work on finding a solution to the sphere-packing problem in special dimensions. In 2016, she identified the equations that can be used to calculate the exact density obtained when spheres are packed together as efficiently as possible in the 8th and 24th dimensions – similar to what we do intuitively in three dimensions when we pile oranges in pyramids. ■

NEW EVIDENCE MAKES DARK MATTER EVEN MORE EXOTIC

Looking at massive galaxy clusters, astronomers have observed that the brightest galaxies within them appear to wobble, at variance with current theory. This discovery adds to the body of evidence that suggests that there's more to dark matter than the Standard Cosmological Model predicts. —

Galaxy clusters are the largest known structures in the universe, containing thousands of galaxies and large amounts of hot gas. But more importantly, they contain dark matter. Current dark matter models predict that galaxy clusters have very dense cores, and that those cores contain a huge galaxy that never moves from the cluster's center.

But after studying ten galaxy clusters, David Harvey from the Laboratory of Astrophysics together with colleagues in France and the UK have discovered that the density is much smaller than predicted, and that the galaxy at the center actually moves. The researchers compared their observations to the predictions from the BAHAMAS suite of cosmological hydro-dynamical simulations, finding that the two did not match. According to the Standard Model of dark matter, this wobbling doesn't exist because the enormous density of dark matter keeps it tightly bound at the center of the galaxy cluster. This mismatch suggests we have much to learn about the physics of dark matter. ■

A mobile harness suspended from the ceiling and equipped with intelligent motion analysis can offer tailored rehabilitation for people suffering from spinal cord injury, stroke or another neurological disorder affecting their gait.

YOUR OWN VIRTUAL HEART FOR NON-INVASIVE DIAGNOSTICS

Mathematicians are building a virtual heart model based on personalized medical images that may one day help cardiologists and cardiac surgeons to non-invasively diagnose pathological heart conditions. —

One day, a virtual version of your own pumping heart may help doctors diagnose heart disease and determine the best treatment for you, without the need for surgical intervention. This is the goal of mathematician Alfio Quarteroni and his team as they build mathematical tools that can simulate heart function with increasing accuracy and that can be customized based on MRI scans of your heart.
Every person's heart is unique. And correctly modeling the intricacies of each individual heart requires a customizable mathematical description of both its geometry and its dynamics. But doing so in a mathematically sound way is no easy task; it requires large amounts of patient-specific data and computational power to solve complex equations. Quarteroni believes that a personalized virtual heart model may become clinically available in less than a decade. Earlier prototypes of the virtual model may be developed and tested sooner, possibly within five years. ■

SMART WALK ASSIST IMPROVES REHABILITATION

A mobile harness suspended from the ceiling has been equipped with intelligent motion analysis for tailored walking rehabilitation in people suffering from spinal cord injury, stroke or another neurological disorder affecting their gait. —

Scientists from NCCR Robotics at EPFL and Lausanne University Hospital (CHUV) developed an algorithm that adjusts how a mobile harness, suspended from the ceiling, assists patients. In a clinical study with over 30 patients, the scientists showed that patients wearing the smart walking assist immediately improved their locomotor abilities.
In rehabilitation involving neurological disorders or injuries, teaching the nervous system to adopt the correct movements is a major challenge. If the patient repeats unnatural movements, the nervous system will keep remembering the flawed motion. Muscle mass is also lost, which prevents people from walking correctly. The patient's muscles and neurological wiring therefore need to be trained to once again learn proper posture and walking movements.
The idea of the smart walking assist is to promote natural walking in patients. Body-weight support systems are already used in rehabilitation. But this is the first time such a support system works in conjunction with an algorithm that tailors the assistance to each and every patient. ■

ANIMALS' MITOCHONDRIA DEFENSES DISCOVERED IN PLANTS

Scientists have discovered that the mechanism used by mitochondria to defend mammalian cells against protein-damaging stress and extend their lifespan also exists in plants. —

Mitochondria maintain the health of their proteins – a process known as proteostasis – through an intricate quality-control network of chaperone proteins and protease enzymes. One such example is the mitochondrial unfolded protein response (UPRmt), which describes a sequence of repairing events that is triggered when a mitochondrial protein is not properly folded. The UPRmt plays a key role in the metabolism and aging of mammal cells.

Up to now, scientists did not know whether UPRmt also existed in plants. But Xu Wang, a postdoctoral fellow, and Johan Auwerx, head of the Laboratory of Integrative Systems Physiology, have for the first time shown that UPRmt occurs in plants as well.

"We found that plant hormone signaling is an essential mediator that regulates mitochondrial proteostasis in plants," says Auwerx. "Our data not only highlights the universal nature of key features of mitonuclear stress-signaling pathways, such as the conserved UPRmt, but also indicates specific effectors and transcriptional circuits that are divergent between the plant and animal kingdoms." ■

ADVANCED ARTIFICIAL LIMBS MAPPED IN THE BRAIN

These artificial limbs improve motor performance but do not move or feel like a real limb and are still not encoded by the patient's brain as a real limb.

EPFL scientists have used functional MRI to show how the brain re-maps motor and sensory pathways following targeted motor and sensory reinnervation, a neuroprosthetic approach where residual limb nerves are rerouted towards intact muscles and skin regions to control a robotic limb. —

Targeted motor and sensory reinnervation (TMSR) is a surgical procedure conducted on patients with an amputation. It reroutes residual limb nerves towards intact muscles and skin in order to fit them with a limb prosthesis, allowing unprecedented control. TMSR changes the way the brain processes motor control and somatosensory input.

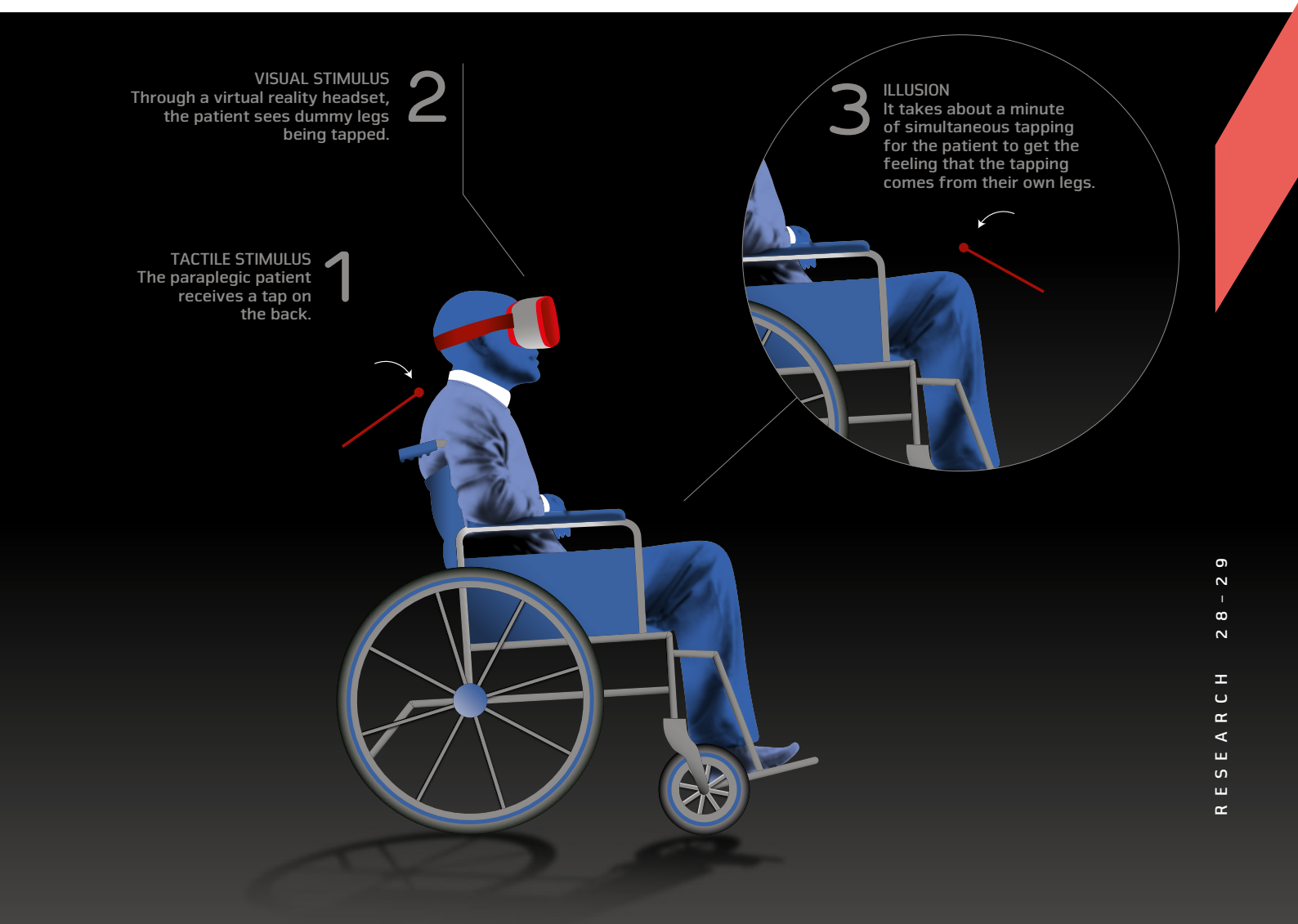
To gain greater insight into how the brain re-maps these pathways – and thus enhance the success of TMSR prostheses – the scientists used ultra-high field 7T fMRI, a technique that measures brain activity by detecting changes in blood flow within the brain. The study showed that motor cortex maps of patients with an amputated limb were similar – in terms of extent, strength and topography – to individuals without limb amputation, but were different from patients with amputations that did not receive TMSR. ■

VIRTUAL REALITY REDUCES PHANTOM PAIN IN PARAPLEGICS

Virtual reality can reduce phantom pain in paraplegics and create the illusion that they can feel their paralyzed legs being touched again. The results could one day lead to therapies to reduce chronic pain in paraplegics. —

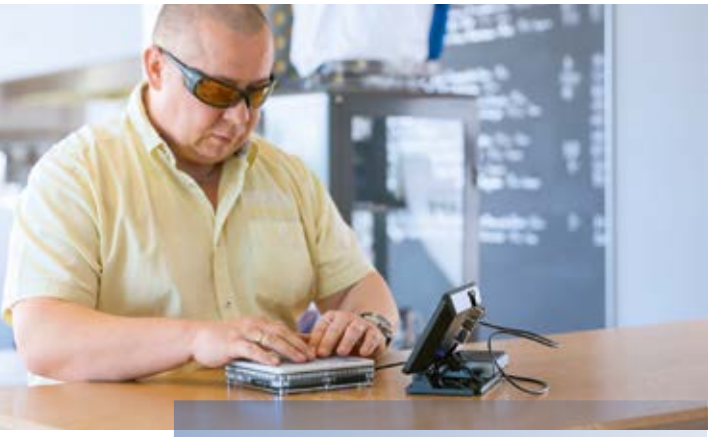
Paraplegics suffer from no longer feeling their legs, and this condition often coincides with neuropathic pain caused by their spinal cord injury. The patient feels pain originating in the legs, even though nothing else can be felt below the injury. The discomfort is real, yet completely resistant to drug therapy. Now, virtual reality may be the key to providing relief for this type of pain, and the solution comes from restoring the sense of touch.

Breakthrough research led by neuroscientist Olaf Blanke and his team has shown that phantom body pain can be reduced in paraplegics by creating a bodily illusion with the help of virtual reality. Based on these findings, the researchers are currently developing virtual reality technology that automatizes visuo-tactile stimulations – an immersive digital therapy – that individuals with spinal cord injury and other chronic pain conditions can regularly use at home. ■



A TOUCHABLE TABLET TO GUIDE THE VISUALLY IMPAIRED

Researchers have developed a tablet that quickly forms shapes and relief maps that users can then explore with their fingers. The tablet is designed to help people with vision problems get around more easily. Visually impaired schoolchildren could also use it to learn subjects such as geometry. —



The tablet provides graphic information in real time, so the user can explore the layout of a room or street before venturing into it.

Measuring 12 by 15 centimeters, the tablet comprises 192 tiny buttons that move up and down in just a few milliseconds, almost instantaneously creating patterns such as the layout of a building, street or conference room. Users can also zoom in on a specific part of the map. The tablet comes equipped with Bluetooth, so it can connect to computers and other tablets. ''The tablet, which will not cost much to produce, will provide graphic information in real time, so the user can check out the layout of a room or street before venturing into it,'' explains Herbert Shea, director of EPFL's Microsystems for Space Technologies Laboratory. Each button contains a tiny magnet placed between two coils and two thin layers of steel. Any given button can be moved up or down by generating a local magnetic field for five milliseconds. The magnetized buttons then attach to one of the two steel plates, remaining in the up or down position. ''The system requires no power to keep the button in place,'' explains Shea. ''This keeps energy consumption to a minimum.'' A prototype has already been tested by someone with a visual impairment. ■

CELL SENESCENCE IS REGULATED BY INNATE DNA SENSING

With the discovery of a DNA-sensing mechanism in the innate immune system, scientists have gained insight into the control of cell senescence, which is intimately linked to the development of cancer and aging. —

When cells senesce, they undergo profound changes, including the secretion of several inflammation-mediating proteins. The production of this senescence-associated secretory phenotype controls a number of biological processes such as wound healing and tissue repair, but also tumor formation and some age-related disorders. Although we know how senescence increases the activity of the genes for these proteins, we know very little about how the entire process begins in the first place.
Researchers in Andrea Ablasser's laboratory were surprised to find that senescent cells in the body use the cGAS-STING pathway to regulate and facilitate the secretion of inflammation mediators. Up to now, this pathway was known to be a DNA-sensing mechanism of the innate immune system, which is pivotal for the body's immediate defense against pathogens. This study highlights potential new anti-tumor and anti-aging strategies. ■

THE GENE THAT STARTS IT ALL

Researchers from the Laboratory of Virology and Genetics have discovered that members of the DUX family of proteins are responsible for kick-starting gene expression. This discovery is crucial for understanding what happens in the early stages of an embryo's life. —

The formation of a human embryo starts with the fertilization of the oocyte by the sperm cell. This yields the zygote, which carries one copy each of the maternal and paternal genomes. However, this genetic information starts being expressed only after the zygote has divided a couple of times. Alberto De Iaco, a post-doctoral fellow, and Didier Trono, head of the Laboratory of Virology and Genetics, have for the first time discovered what triggers this process.
The researchers analyzed data to determine what components of the human genome are expressed during the first few days of embryonic development. They found that DUX4 is one of the very first genes expressed at this stage, releasing a high concentration of its protein product just before zygotic genome activation. The study points to DUX4, and by extension to the entire DUX family of proteins, as the master regulator responsible for kick-starting genome expression at the earliest stage of embryonic life. The findings could shed light on certain cases of infertility and perhaps guide the development of new treatments for DUX-related muscle dystrophy. ■

The carbon-fiber exoskeleton is made of motors and braces linked to a sophisticated system of sensors that analyzes the wearer's gait.

A POWERED EXOSKELETON PREVENTS THE ELDERLY FROM FALLING

Researchers from EPFL and Scuola Sant'Anna in Italy have developed a smart, lightweight and easy-to-personalize exoskeleton that can counteract the loss of balance. This is the first time an exoskeleton has been designed to prevent falling. —

Scientists at Scuola Sant'Anna in Italy and EPFL have built a prototype of an exoskeleton that can recognize the loss of balance. The exoskeleton was designed for the elderly, who account for 40% of fatal injuries related to falling in Europe. But it could also be used as an aid for the physically impaired, amputees and those suffering from neurological disorders.

The personalized exoskeleton first detects the particularities of the user's gait. Once this pattern is established, the system's algorithm is able to detect deviations from the normal gait, which indicate a loss of balance. When this happens, the hip motors push on the thighs to extend the legs and stabilize the user.

The next step for the researchers will be to ensure the system is non-intrusive and does not unnecessarily disturb the user, particularly when they are not falling. The team is also working on making the exoskeleton more discreet and portable for the outside world, and will soon test it in real-life situations. ■

ANTI-CANCER DRUG GETS A BOOST WHEN COMBINED WITH AN ANTI-RHEUMATIC

Scientists at EPFL and Nanyang Technological University (NTU) have discovered that combining an anti-cancer drug with an anti-rheumatic produces improved effects against tumors. The discovery opens a new path for drug-drug synergy. —

The researchers discovered the synergistic effects of two unrelated drugs: auranofin (Ridaura), which is used to alleviate the symptoms of rheumatoid arthritis, and RAPTA-T, an anti-cancer drug that disrupts both tumor growth and metastasis, while also reducing the side effects of chemotherapy due to its low toxicity.

Although the two drugs are used for different conditions, scientists at EPFL and NTU found that auranofin also acts against cancer. Drugs often do not only bind at a single site on a specific molecule, but can also bind at and affect other, unrelated sites. For example, a drug that is meant to bind to and activate a receptor could also bind to and block an enzyme. This off-site activity frequently gives rise to drug side effects, but separate drug-binding sites can also work together synergistically in a productive fashion. In this case, the effectiveness of the anti-cancer drug is boosted. ■

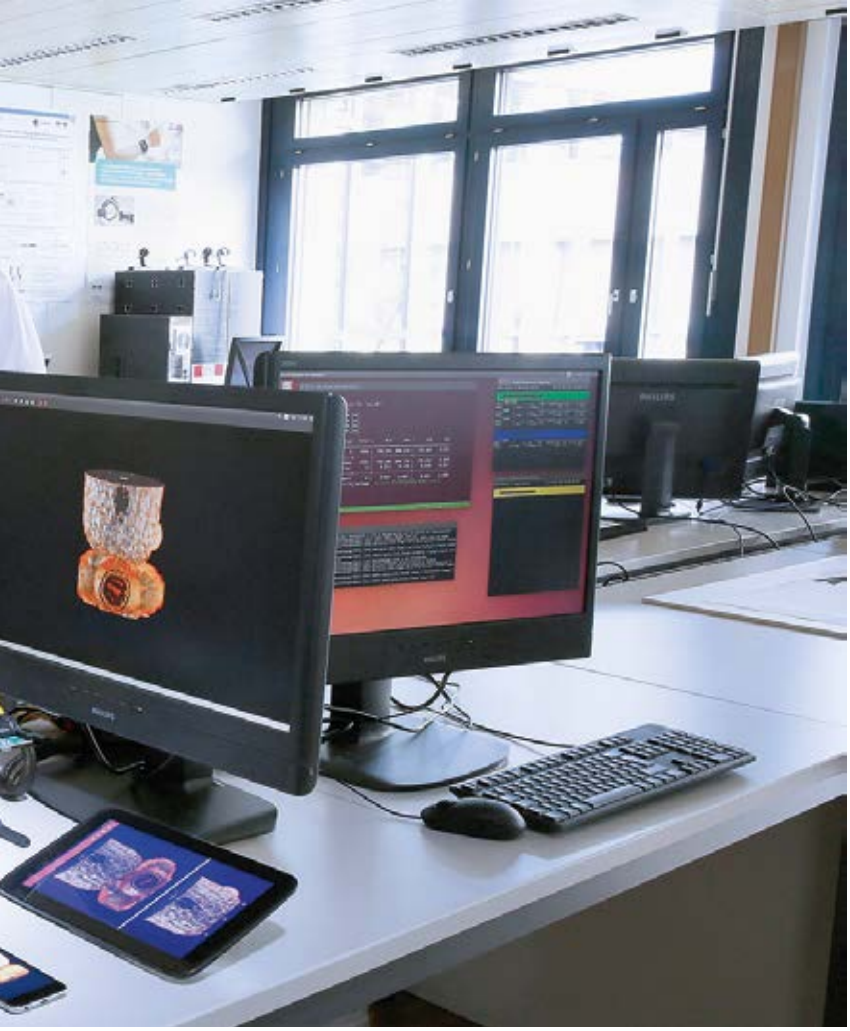
Researchers from EPFL's Embedded Systems Laboratory have reduced the power and storage needed for streaming.

EPFL RESEARCHERS DEFY THE LIMITS OF STREAMING

Streaming is no longer viable in its current form owing to the substantial amount of power and storage capacity it requires. But researchers have found a way to reduce those requirements without impacting the quality of videos. —

When watching a video online, users may think that the streaming service is personalized for each use. But in fact streaming services either store one copy of a video in the highest-quality format possible, or dozens of copies in different formats. Such systems result in slow and choppy streaming or take up huge amounts of server storage and consequently eat up lots of power. The Embedded Systems Laboratory has demonstrated that better resource allocation can reduce the power requirement by nearly 20% while improving the user experience by 37%. Their findings were obtained using machine learning – the applications that encode videos learned to better allocate resources, focusing on compression, quality, performance and power consumption.

The researchers' ultimate aim is to enable real-time streaming, so that just one copy of a video can be stored and, when someone clicks on the video to watch it, the platform immediately adjusts the format, compression and quality to that particular viewer. ■



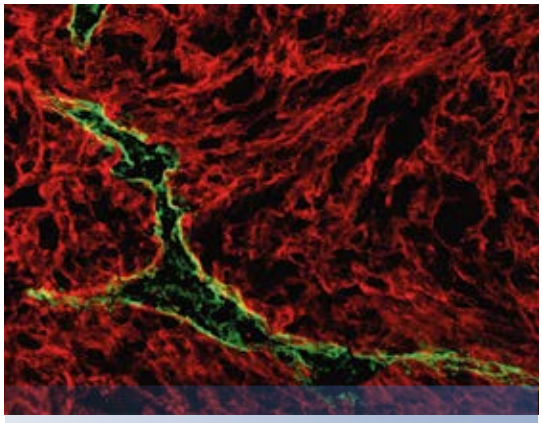
SELF-HEALING MATERIALS INSPIRED BY PLANTS

Researchers developing self-healing materials turned to nature for inspiration. They studied the flax plant in order to learn more about plants' self-repair mechanisms. —

"Some man-made materials can already regenerate," explains Véronique Michaud, from the Laboratory for Processing of Advanced Composites. "But other materials are more complicated, and progress is still at the laboratory stage." So the researchers thought they might learn something from plants, which deal with a variety of stresses. They studied the stems of flax plants, to see how they react to being cut. By measuring changes in the stems' properties in plants with and without an incision, they found that the response was different depending on whether the incision was lengthwise or crosswise. For lengthwise incisions, the plant cells surrounded the wound, but the stem did not regenerate. However, for crosswise incisions, the cells filled in the space created by the wound and healed it almost completely; the regenerated plants recovered 95% of their mechanical properties. This is the first time that scientists have quantified the flax plant's mechanical properties and ability to regenerate. The researchers were also able to carry out tests on plants using equipment designed for studying synthetic materials. ■

VESSELS THAT HELP CANCERS SPREAD CAN ALSO BOOST CANCER IMMUNOTHERAPY

Scientists from Switzerland and the United States have shown that lymphatic vessels, in addition to enabling metastasis, encourage an anti-tumor T-cell response. This opens new paths for cancer immunotherapy. —



Immunotherapy can cure patients whose chances of survival were, up to now, very low. It is becoming an extraordinary weapon against tumors. In the future, immunotherapy could also draw on lymphatic vessels, pictured here in green inside a tumor.

Cancer immunotherapy is one of the most promising treatments against tumors. The process involves overcoming the tumor's suppression of immune attacks, thus allowing the patient's own immune system to destroy it. But despite the highly encouraging results from clinics, only a small subset of patients responds to immunotherapy. Until now, the reasons had been unclear.

Many cancers, such as melanoma, are known to metastasize and spread through nearby lymphatic vessels. This process, known as lymphangiogenesis, also helps the tumor evade the patient's own immune system, and it would be expected that inhibiting lymphangiogenesis could enhance the effectiveness of cancer immunotherapies. But in a surprising discovery, scientists from EPFL and the United States found the opposite: lymphangiogenesis actually enhances the effectiveness of immunotherapy against melanoma. The study has significant implications for new types of cancer therapies. ■

USING MAGNETIC GATES TO TRACK SLALOM SKIERS' PERFORMANCE

The patented technology developed at EPFL records a skier's time, speed and trajectory accurately and automatically.

EPFL researchers can now measure a slalom skier's exact time at each gate all the way down the slope. Their system also calculates the skiers' speed and trajectory more accurately than GPS. —

Whether they're racing the slalom or giant slalom, competitive skiers all face the same challenge: to round the gates as fast as possible. The team at the Laboratory of Movement Analysis and Measurement has come up with a way of closely tracking performance using several different technologies. They started with accelerometers and gyroscopes, which measure the skiers' acceleration and angular speed. The researchers then added a magnetic system to measure the elapsed time at each gate. The skier simply wears a magnetometer, which detects the gates as the skier approaches: "The magnetic field is strongest when the skier rounds the gate," explains researcher Benedikt Fasel. "If we know the amplitude, we can also calculate the distance. Using this information, we can figure out how far the skier is from the gate and determine the person's speed."

"Our ultimate goal is to help athletes and coaches improve performance on the basis of scientific data," adds Fasel. "The magnets let us map the skier's trajectory with precision. So we can analyze the line the skier takes and their strengths and weaknesses." ■

PINPOINTING SOURCES OF WATER POLLUTION WITH A ROBOTIC EEL

Researchers from EPFL helped develop a robotic eel that can locate the source of pollution in water. In tests carried out in a small section of Lake Geneva, the robot was able to generate maps of water conductivity and temperature. —

EPFL researchers are taking part in a project funded by the Swiss NanoTera Program to develop a swimming robot able to detect sources of water pollution. The robot, named Envirobot, is nearly 1.5 meters long and equipped with chemical, physical and biological sensors. It moves through the water like an eel, without stirring up mud or disturbing aquatic life. Its sensors take measurements and send real-time data to a computer.

The ultimate goal is for the robot to detect heavy metals. "The Envirobot can follow a preprogrammed path and make its own decisions," says Auke Ijspeert, head of the Biorobotics Laboratory. For now, the project team has tested only the conductivity and temperature sensors out in the field; tests of the biological sensors are harder to carry out. "We obviously can't contaminate a lake like we do the test water in our lab," says Jan R. van der Meer, project coordinator and head of the Department of Fundamental Microbiology at the University of Lausanne. "For now, we will continue to use salt as the contaminant. Then we will add biological sensors to the robot and carry out tests with toxic compounds." ■

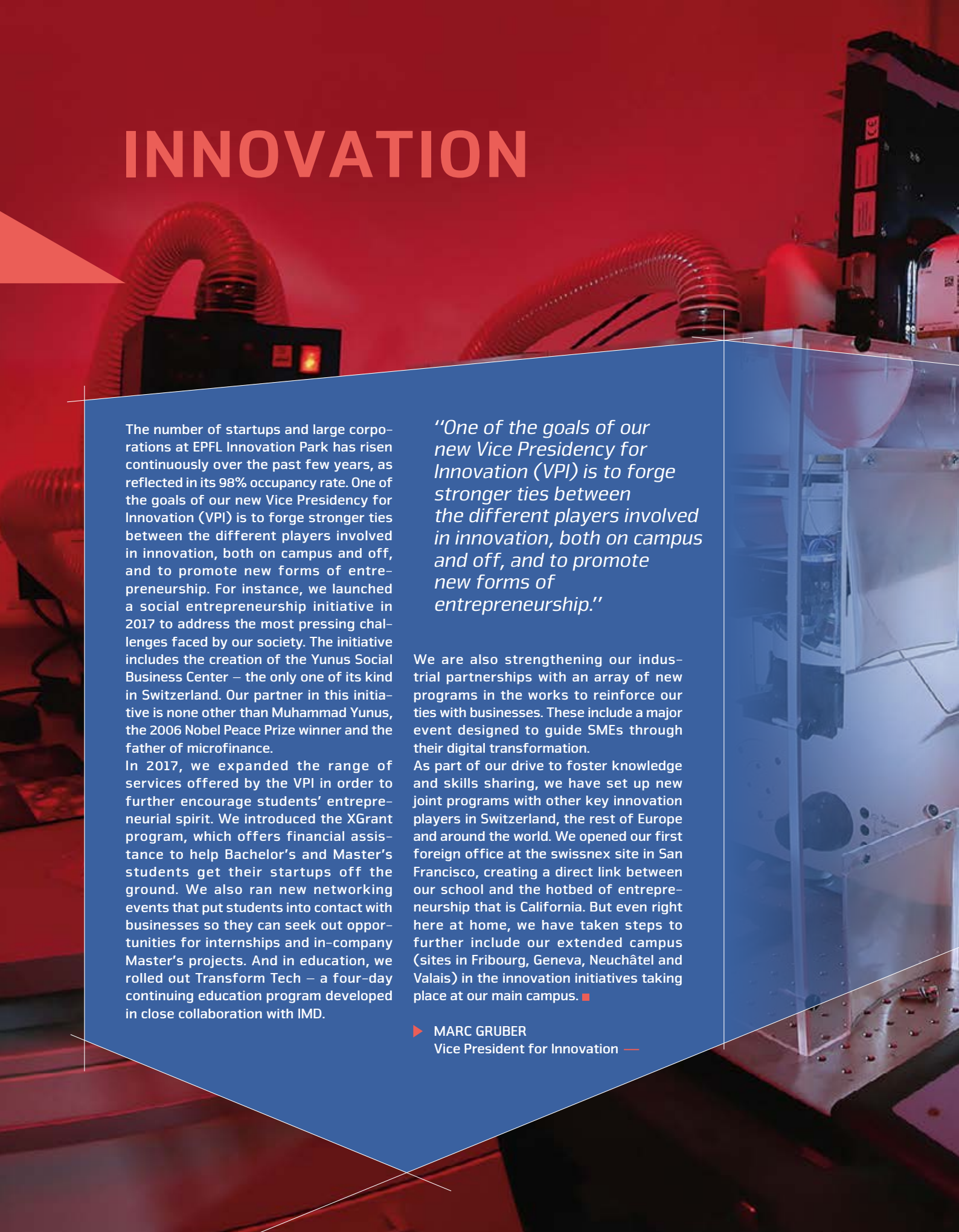
ADAPTING HYDROELECTRIC POWER PLANTS FOR CLIMATE CHANGE

Climate change is leading to an increase in the amount of sediment in the water used to generate hydropower, and this erodes the turbines. The Laboratory for Hydraulic Machines developed a model that can predict sediment erosion in turbines. —

Of all the electricity produced in Switzerland, 56% comes from hydropower. To maintain this level of production as the climate changes, power plants will need to be adapted to the predicted environment. "Glaciers and snow are melting more and more quickly, and this has led to a sharp rise in sediments in water," explains François Avellan, the lab's director. "The sediments are very aggressive and erode the turbines." Researchers cannot run experiments directly on power plants in order to predict erosion because of the impact and cost of taking a plant offline. The lab therefore came up with a novel multi-scale computer model that predicts sediment erosion in turbines. The researchers created one model that takes into account the microscopic causes of erosion, focusing on the brief impact of the minuscule sediments that strike the turbines, and a separate model for macroscopic factors, looking at how the sediments are transported by water flow. The results were then combined in order to generate erosion predictions. The lab has now moved on to characterizing the materials used in the turbines in order to apply the new model to existing hydroelectric facilities. ■

The Envirobot can detect the source of water pollution by following a preprogrammed path or by making its own decisions.

INNOVATION



The number of startups and large corporations at EPFL Innovation Park has risen continuously over the past few years, as reflected in its 98% occupancy rate. One of the goals of our new Vice Presidency for Innovation (VPI) is to forge stronger ties between the different players involved in innovation, both on campus and off, and to promote new forms of entrepreneurship. For instance, we launched a social entrepreneurship initiative in 2017 to address the most pressing challenges faced by our society. The initiative includes the creation of the Yunus Social Business Center – the only one of its kind in Switzerland. Our partner in this initiative is none other than Muhammad Yunus, the 2006 Nobel Peace Prize winner and the father of microfinance.

In 2017, we expanded the range of services offered by the VPI in order to further encourage students' entrepreneurial spirit. We introduced the XGrant program, which offers financial assistance to help Bachelor's and Master's students get their startups off the ground. We also ran new networking events that put students into contact with businesses so they can seek out opportunities for internships and in-company Master's projects. And in education, we rolled out Transform Tech – a four-day continuing education program developed in close collaboration with IMD.

"One of the goals of our new Vice Presidency for Innovation (VPI) is to forge stronger ties between the different players involved in innovation, both on campus and off, and to promote new forms of entrepreneurship."

We are also strengthening our industrial partnerships with an array of new programs in the works to reinforce our ties with businesses. These include a major event designed to guide SMEs through their digital transformation.

As part of our drive to foster knowledge and skills sharing, we have set up new joint programs with other key innovation players in Switzerland, the rest of Europe and around the world. We opened our first foreign office at the swissnex site in San Francisco, creating a direct link between our school and the hotbed of entrepreneurship that is California. But even right here at home, we have taken steps to further include our extended campus (sites in Fribourg, Geneva, Neuchâtel and Valais) in the innovation initiatives taking place at our main campus. ■

MARC GRUBER
Vice President for Innovation —

A hydrogel developed by the Matthias Lütolf laboratory replicates cells' environments in three dimensions and can be used to grow organoids from stem cells. Samples placed in this sterile hood can be analyzed by scientists.

EPFL SPIN-OFFS FLOURISH IN A FINELY TUNED ECOSYSTEM

To see how effective EPFL's startup ecosystem is, you only need to look at the number of jobs campus startups create, the amount of funds they raise and their buyout rate. Moreover, successful EPFL spin-offs invest in – and even buy out – nascent ones. —

A 2017 report by the Vice Presidency for Innovation (VPI) looks at how effective EPFL's startup ecosystem is based on benchmarks such as the jobs these companies create, the amount of funds they raise and the prices they fetch when taken over. The report reveals a sharp rise in the number and size of startups and highlights how some successful ones serve as a model for others.

A survey conducted in February among EPFL spin-offs shows that the number of jobs created by these companies has expanded non-stop over the past ten years. Companies founded in 2008 and 2009 currently employ 400 and 350 people, respectively, while companies created in 2016 employ around 50 so far. These figures should rise even further in the next few years, since the number of new companies keeps on growing.

Creating a successful spin-off is no walk in the park. Even if the idea is solid and the entrepreneur is highly driven, a number of obstacles invariably get in the way when taking a new technology to market. Remarkably, the survival rate among EPFL spin-offs is 90% after five years according to the report, far above the usual rate of around 50%. Such perseverance gives startups the opportunity to benefit from advice, network and test their ideas on the market.

These young companies often grow through fund-raising rounds; they have raised more than CHF 100 million per year since 2009, while previously this figure never rose above CHF 50 million. Their exit strategy of choice is mergers and acquisitions – often involving large firms keen on quickly acquiring a new technology rather than coming up with it themselves through costly R&D. Nine EPFL startups have gone down this road since 2008. These include Lemoptix (which was bought out by Intel), Jillion (Dailymotion) and PlayfulVision (Second Spectrum).

EPFL's success has evolved in another direction as well: the campus' startups are now forming their own financial support ecosystem. And one spin-off, MindMaze, took that one step further in early June when it bought out Gait Up, which develops motion analysis sensors. ■

SIX EPFL START-UPS IN SWITZERLAND'S TOP 10

Every year, startup.ch publishes a list of Switzerland's Top 100 startups. This ranking, first issued in 2011, serves as a radar to spot promising young high-tech firms in the country. It is designed to put the spotlight on Swiss companies that are less than five years old and have solid growth potential. Two EPFL startups were in the top three in 2017: L.E.S.S., which makes nanoactive fiber lighting systems that serve as an alternative to LED, in second place; and Flyability, whose Elios drone can bounce off obstacles thanks to its tiny round cage, in third place. Four other home-grown firms also made the top 10: MindMaze, Gamaya, Bestmile and Lunaphore. The Top 100 includes a total of 27 startups from French-speaking Switzerland, most of which were spun off from EPFL. ■

EPFL SPIN-OFF ABIONIC POISED TO BREAK INTO THE US MARKET

Abionic's rapid allergy diagnostic system, which tests for sensitivity to four common respiratory allergens in the United States, is on track to hit the US market in 2018. —

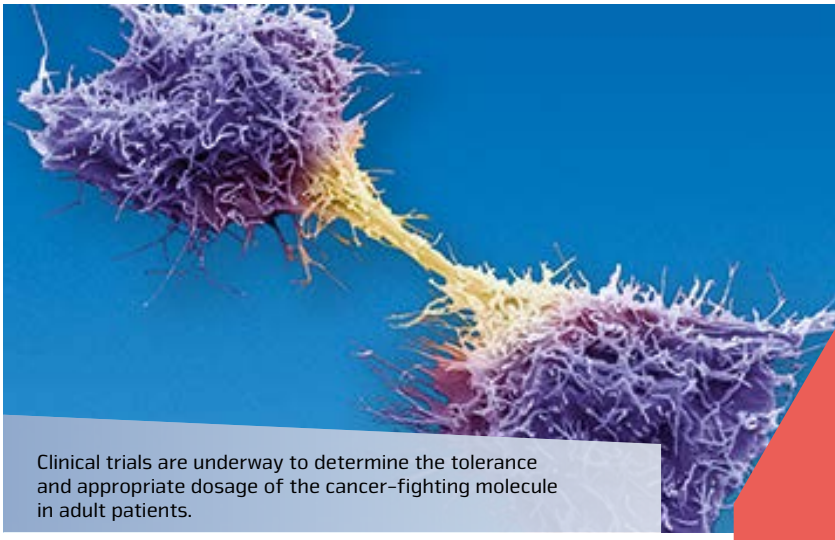
Allergies can be diagnosed in just five minutes with a single drop of blood.

It takes only five minutes and a single drop of blood for Abionic's abioSCOPE® to produce a preliminary yet highly reliable diagnosis of a patient's allergies. The system, which the company describes as the "world's most rapid" allergy test, has already been certified for use in Europe and has been sold in Switzerland for several years. It is slated to hit the US market in 2018.

This diagnostic system came out of EPFL's Microengineering Laboratory, and development work was taken over by the startup in 2010. The system consists of test capsules for four common allergies along with a portable testing device. The device includes a fully automated fluorescent microscope and a mounting plate that resembles a DVD onto which a disposable capsule is placed. A drop of blood is combined with a reagent and placed on the plate. Using patented nanotechnology and diffusion phenomena, the molecules interact in biosensors placed on the capsules and form specific molecular complexes. These complexes are optically detected by means of an integrated laser. After several minutes, the results appear on a high-resolution touch screen. ■

A CANCER THERAPY THAT INHIBITS THE NOTCH SIGNALING PATHWAY

EPFL spin-off Cellestia Biotech has developed a molecule to treat cancers involving mutations of the Notch gene. This breakthrough is a ray of hope for the 250,000 patients diagnosed every year with this mutation. —



Clinical trials are underway to determine the tolerance and appropriate dosage of the cancer-fighting molecule in adult patients.

One of the alternatives to chemotherapy currently being investigated by experts is the array of signals generated by proteins in a cell's nucleus. A normal Notch protein plays an indispensable role in embryonic development and in the formation and maintenance of stem cells. Genetic lesions, however, can result in an abnormal signaling pathway that facilitates the development of cancerous cells and causes resistance to conventional therapies. Around 250,000 patients worldwide are diagnosed each year with a cancer related to this type of genetic lesion.

The safest way to block the signaling pathway is to cut it off at the source—and that's precisely what molecule CB-103, developed by EPFL spin-off Cellestia Biotech, is designed to do. It inhibits all Notch signals regardless of how they are activated, thereby killing off the cancerous cells.

Patents have been filed for the molecule and for the development and marketing of several similar molecules. Both in-vitro and in-vivo tests carried out on the molecule showed excellent efficacy and tolerance. It also demonstrated rapid uptake and distribution in tissues. ■

DRONES TAKE CENTER STAGE AT EPFL

EPFL's first Drone Days attracted 5,000 people in three days.

Final preparations before a virtual flight over EPFL, using a flight jacket developed by the Laboratory of Intelligent Systems (LIS).

Over 5,000 visitors came to EPFL's first Drone Days on 1–3 September 2017, where they enjoyed drone races, a robotics showcase, a conference and demonstrations. The event will be held again in 2018, reflecting the pioneering role that the school's researchers and startups play in this fast-growing field.

This drone tested on the EPFL campus can deliver packages of up to 500 grams.

A demo of Elios, the first collision-resistant drone, developed by an EPFL startup.

Today drones are transforming industries across the board, from manufacturing and research to sports and media. And for three days they took center stage at the EPFL campus during the Drone Days event held in early September 2017. Over 5,000 visitors came to learn more about the many possibilities offered by flying robots, as well as the new challenges they raise in terms of security and legislation. The event also brought Switzerland's best drone pilots together in an exciting race that included a night competition lit by LEDs; the winner took home the official Swiss FPV Racing championship.

The focus of the event was the latest advancements in drone technology, with booths showcasing next-generation devices and holding demos and workshops for adults and children alike. Visitors could try their hand at flying drones, either on a simulator or at a special flying area for beginners. And the World Air Sports Federation held two days of talks with speakers from fields such as sports, manufacturing and safety. Drone Days will be held again in 2018, and its organizers hope it will become a major international industry event.

FOLDABLE, DELIVERY AND HUMANITARIAN DRONES

Drone research goes on all year long at EPFL. A third of the companies involved in drone technology are based in the Canton of Vaud. EPFL engineers and start-ups have already developed systems that stand to revolutionize the industry, from origami drones that are bendable yet indestructible, to Gimball prototypes that can hit any kind of obstacle without breaking or causing injury, and the small delivery drones that were tested for the first time at the EPFL campus last year. Researchers at EPFL labs are working on drones with wings that fly like birds and robotic flying insects that can guide themselves and avoid obstacles. Humanitarian drones are another new frontier, capable of bringing equipment and medical supplies to stricken areas, taking pictures of damaged regions, and spotting people who need assistance.

Far from the original models that were used only for taking aerial photos, today's drones can serve a variety of functions in an expanding range of industries. The designs being developed at EPFL are increasingly sophisticated and can provide never-before-thought-of solutions to our everyday challenges. ■

A SOCIAL IMPACT INITIATIVE AT EPFL

Muhammad Yunus, winner of the 2006 Nobel Peace Prize and the father of microfinance, gave a talk at EPFL in early December 2017. The school took this opportunity to announce a new social impact initiative, which includes the creation of a Yunus Social Business Center. —

In a world that sees innovation as a way to grow the bottom line, technology can also be used as a way to resolve society's most pressing social challenges and improve the lives of millions of people around the globe. In this vein, EPFL has launched the Social Impact Initiative (SII) to unite all stakeholder groups – from academia to businesses – around a common theme of social impact. The SII will be part of EPFL's Vice Presidency for Innovation and will focus on how technology and innovation can be harnessed to make a social impact. "We wanted to instill the principles of social entrepreneurship in our students at EPFL. The initiative will also support them in completing their own social business projects, helping them to become responsible 21st-century engineers, researchers and leaders," says Marc Gruber, EPFL's Vice President for Innovation.

The SII is built on three pillars: education, innovation and awareness-raising. In the area of education, the SII is preparing to offer a new course on social impact and social entrepreneurship, including a MOOC called Social Venture. It has also entered into its first partnership, with Buhler – a firm with offices at EPFL Innovation Park – to develop an innovative, low-cost crop storage facility for small farmers.

SWITZERLAND'S FIRST YUNUS SOCIAL BUSINESS CENTER TO BE HOUSED AT EPFL

Dr. Yunus, who won the 2006 Nobel Peace Prize for creating the Grameen Bank, is a Bangladeshi entrepreneur who invented the concept of "social business" in an effort to resolve global problems in healthcare, education and poverty. He has also helped set up Yunus Social Business Centers around the world in order to teach this method. EPFL will be home to the only Yunus Social Business Center in Switzerland. ■

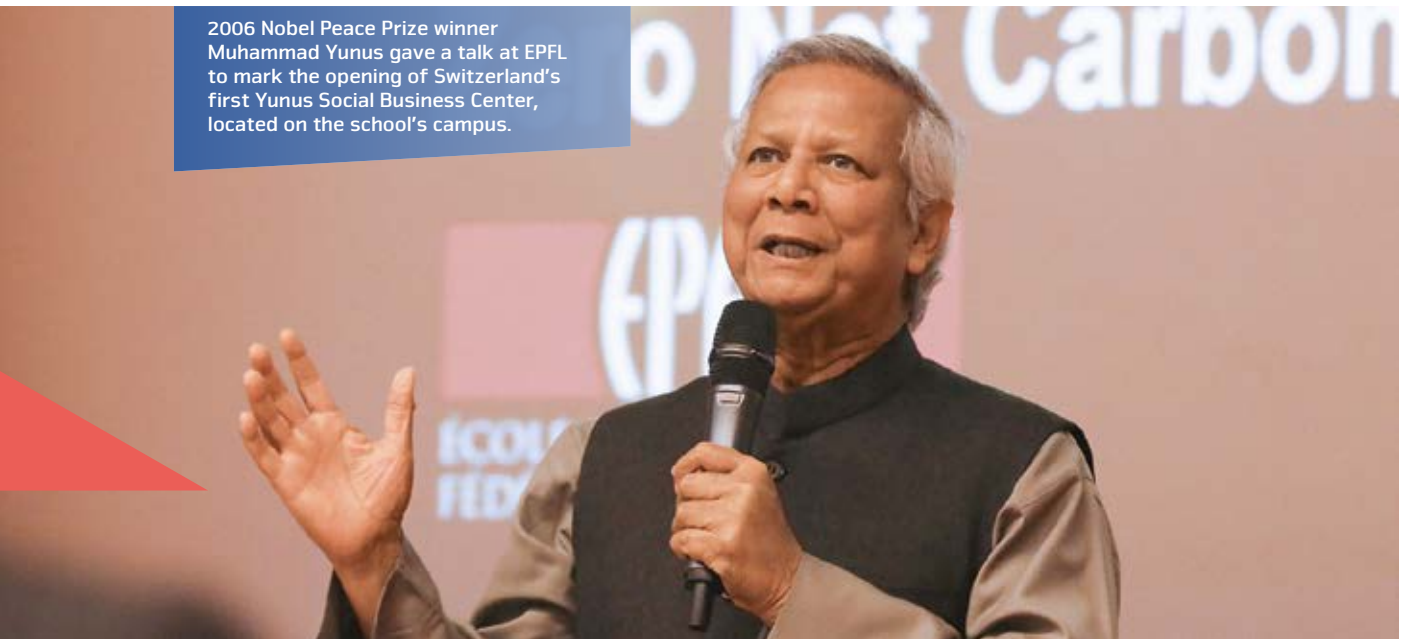
THE FLOOR YOU WALK ON IS NOW SMART

Technis, an EPFL spin-off, has developed a system that combines a connected floor surface with artificial intelligence to track people's behavior as they walk through a building. The goal is to use such real-time data to improve safety and measure the success of an event. —

Thanks to technology developed by startup Technis, the floors you walk on will soon be able to track and analyze foot traffic. The technology, developed from research carried out at EPFL, was initially used to make connected sports surfaces – but has since been enhanced for use in applications ranging from shopping malls and hospitals to event venues. Technis' innovation turns everyday flooring into smart systems that can collect and transmit data in real time.

"We wanted to create a system that could determine the number of people entering and leaving an area in real time. Our connected surface is easy to install on any type of synthetic flooring and provides an array of data for recognizing and predicting visitor behavior," says Wiktor Bourée, CEO of Technis. The technology uses machine learning to generate increasingly powerful algorithms that learn from the data the system collects. The algorithms can already recognize different ways of walking, objects with wheels and when a person falls, for example. This activity is translated into tables and charts, which can be viewed in real time on both computers and mobile devices.

The system has already been used at several event venues in French-speaking Switzerland – including EPFL's SwissTech Convention Center – and France. Technis has won several innovation awards and grants and has successfully completed two fund-raising rounds. It started receiving financial support from Switzerland's Foundation for Technological Innovation (FIT) in 2017. ■



2006 Nobel Peace Prize winner Muhammad Yunus gave a talk at EPFL to mark the opening of Switzerland's first Yunus Social Business Center, located on the school's campus.

The control software developed for CubeSats could also be used for larger satellites.

SOFTWARE DEVELOPED AT EPFL USED TO CONTROL A FLOTILLA OF SATELLITES

Out of the 30-odd CubeSats recently released from the International Space Station (ISS), eight of them are running EPFL software that was originally developed for SwissCube. —

The QB50 EU research program began in early 2016 and aims to launch 50 miniature satellites –or CubeSats – into orbit around the Earth to observe and measure the thermosphere. Research institutes and universities from 23 countries are involved in the project. This past May, the ISS began launching the CubeSats into orbit.
Seven years ago, EPFL sent the SwissCube into space. That was the first Swiss satellite, and it was designed and built by students. EPFL may not have a satellite on board the ISS this time around, but it is involved in the control systems of eight of the CubeSats that entered orbit. ''We developed satellite control software for SwissCube called Satellite Control System (SCS),'' says Muriel Richard, from EPFL's Space Engineering Center (eSpace).''Using a secure and automated process, SCS encodes the instructions that need to be sent to the satellite, transmits them when the satellite is flying over a base station and receives information back from the satellite.''
Eight organizations from seven different countries chose EPFL's open-source software, which they adapted to their own needs. ■

A NEW SENSOR INCREASES SMARTWATCH BATTERY LIFE

Nearly 80% of the battery power in smartwatches is used up by the heart-rate monitor. But a new generation of sensors developed by EPFL startup ActLight consumes five times less energy. —

A new generation of smartwatch sensors developed by ActLight, a startup based at EPFL Innovation Park, can measure the wearer's pulse with the same precision as standard sensors but consumes only one-fifth of the energy. Two diodes located on the back of the device emit light that penetrates the wearer's skin. The blood flow determines how much light is reflected back. The secret behind these energy-saving sensors lies in the processing of the reflected-light signals.
The sensors were tested by Maher Kayal's laboratory and are now ready to be used in smartwatches. ''The longer battery life certainly makes things easier for the user, but it also offers major savings in terms of electricity consumption,'' says Kayal. Thanks to this breakthrough, ActLight was named one of the best Swiss cleantech startups in 2015.
ActLight is in negotiations with major semiconductor makers and is about to sell the rights to mass produce its innovative sensors. The new sensors are also financially attractive because they are cheaper to produce. ■

ROMANDE ENERGIE OPENS A SMART LAB AT EPFL

Romande Energie's first joint venture with EPFL dates back to 2010, when they installed colored, translucent solar panels equipped with Grätzel cells on one side of the SwissTech Convention Center.

With its new Smart Lab, Romande Energie – the leading electricity supplier in French-speaking Switzerland – aims to create a skills center for leveraging data to enhance energy systems. The Lab is the latest step in a longstanding partnership between the power utility and EPFL. —

Romande Energie has a long history of teaming up with EPFL. First they developed and installed solar panels equipped with Grätzel cells on one side of the SwissTech Convention Center, and then they created Switzerland's largest urban solar power station with a surface area of 15,500 m^2, located at EPFL. In addition to supplying electricity to the campus, the power station also serves as a test bench for researchers studying innovative systems for using renewable energy more efficiently and feeding it into power grids.

The Smart Lab – recently built on the EPFL campus – will work on an even more ambitious project for Romande Energie: REel-DEMO, which aims to develop a demonstrator of a power grid in local equilibrium. It will be used to test a decentralized control system for the grid at Rolle and Onnens. "That will require maximizing the use of renewable energy and managing all local power generation and consumption, as well as storage," says Mario Paolone, a professor at EPFL's Distributed Electrical Systems Laboratory. "It's the same 'virtual power plant' concept that we use at EPFL, but with a lot more variables and constraints." ■

2017 FUNDRAISING BY EPFL STARTUPS

- **BICYCLE THERAPEUTICS** has developed a new class of drugs for treating cancer and autoimmune diseases. 52 million dollars.
- **ANOKION** is an EPFL spin-off that develops immune-enhancing technology. Celgene, a biopharma multinational, has invested 45 million dollars.
- **SOPHIA GENETICS**, a startup born from EPFL's innovation ecosystem, provides solutions for data-driven medicine. 30 million dollars.
- **LIGHTBEND** was initially founded at EPFL under the name Typesafe. Its development platform provides applications used by several multinationals. 15 million dollars.
- **ALEVA NEUROTHERAPEUTICS** was spun off of EPFL's Microsystems Laboratory and has developed electrodes for highly precise deep brain stimulation treatments. 13 million dollars.
- **CELLESTIA BIOTECH** will soon launch clinical trials for its cancer drug targeting the Notch signaling pathway. 8 million francs.
- **LUNAPHORE** plans to market its technology in 2018 that lets doctors quickly determine how patients react to cancer treatments. 6 million francs.
- **ASTROCAST** was founded at EPFL Innovation Park and operates in the aerospace industry, developing services for the Internet of Things and machine-to-machine systems. 4.1 million dollars.
- **IM4TB** is a non-profit organization based at EPFL. It has developed a new tuberculosis drug and has received a grant from the Bill and Melinda Gates Foundation. 2.45 million dollars.
- **BESTMILE** has created a platform allowing driverless vehicles in the vicinity to communicate with each other. 2 million dollars. ■

Licenses for the software developed by Javier Bello Ruiz and Robin Mange will be available in early 2018.

A MORE SECURE BIOMETRIC AUTHENTICATION SYSTEM

EPFL's Security and Cryptography Laboratory joined forces with startup Global ID to develop an encryption technique for processing biometric data captured via 3D finger vein recognition – a system that's next to impossible to counterfeit. —

Realizing that fingerprints are too easy to fake and current biometric authentication systems are simply not secure enough, EPFL's Security and Cryptography Laboratory and the startup Global ID have developed a new, more secure biometric identification system. Their system processes data more safely than current standards and leverages 3D vein imaging technology developed by the Idiap Research Institute in Martigny, the University of Applied Sciences in Sion (HES-SO Valais-Wallis) and Global ID.

"2D vein recognition technology is already used throughout the world, but the system has its flaws. With 3D analysis, the risk of counterfeits is essentially non-existent since we all have different veins," explains Lambert Sonna Momo, the founder of Global ID.

This portable scanner has the potential to be used in a wide variety of applications, from financial transaction authentication to border controls to identifying patients in hospitals. Efforts in this regard are already under way at Geneva University Hospitals and the University Teaching Hospital of Yaoundé in Cameroon. ■

IMMERSIVE VIRTUAL-REALITY CREATION SOFTWARE FOR EVERYONE

Imverse, an EPFL spinoff, has developed software that lets users convert 360-degree images from 2D into 3D and manipulate and create virtual-reality content in real time with the help of virtual-reality glasses. —

It's now easier than ever to create a 3D environment and then add and manipulate virtual-reality content in real time, thanks to the software created by EPFL startup Imverse. What's required? A 360-degree 2D photo taken with any commercial camera and a pair of off-the-shelf virtual-reality glasses. The software is similar to photo editing software, allowing users to freely explore and modify the environment created from the picture in real time.

Imverse's software delivers professional results and has a wide range of potential uses. Javier Bello Ruiz, the company's CEO, is initially targeting virtual-reality studios that work with real-estate agencies, advertisers and the media. "Take a real-estate agent who wants to sell a house that's in need of a little work. The seller could show a prospective buyer the end result by modeling the house in 3D using a 360-degree photo and then modifying the interior in real time, suggesting various options that the buyer could tweak freely using the virtual-reality glasses." ■

OUTLOOK

Vivapoly brought the EPFL community together in the Rolex Learning Center alongside more than 50 stands run by campus associations.

"The new management team that took office in January 2017 has already taken several important steps."

EPFL's continuous growth has thrown up new challenges in terms of managing its finances, human resources, infrastructure and information systems. The new management team that took office in January 2017 has already taken several important steps in this regard.

We created a new Vice Presidency for Finances charged with responding to these growth challenges and the ensuing complexity. This Vice Presidency is responsible for coordinating the management of the school's funding sources, expenses and capital investments. Its primary duties are to ensure that the school's financial information is both clear and relevant, to make sure the school has a robust governance system suited to its needs, to play a central role in the school's strategic planning and resource allocation, and to serve as a finance business partner across the institution (p. 69).

Senior Management asked the new Human Resources Director to outline an HR strategy that addresses the key human-resources issues resulting from our school's strategy (p. 68). EPFL counts some 6,000 employees and 1,500 academic visitors per year who work at our five schools, two colleges, 28 institutes, 354 laboratories and sites in five cantons and who span over a hundred different professions (professors, secretaries, PhD researchers, lab technicians, tech support staff, etc.).

Our digital strategy aims to automate our processes so that we can run our school more efficiently, from its many administrative and technical services to its labs. We have made further progress on installing digital infrastructure at EPFL for teaching, research and innovation; here our top priorities are technology for storing and managing research data, and data security technology so that we can safeguard the integrity of our IT systems.

These changes will enable EPFL to continue to carry out its core missions while becoming a genuine 21st-century campus. ■

- CAROLINE KUYPER
  Vice President for Finances —
- ETIENNE MARCLAY
  Vice President for Human Resources and Operations —
- EDOUARD BUGNION
  Vice President for Information Systems —

A donation of 10 million francs from the Bertarelli Foundation will be used to set up a gene therapy platform along with a "catalyst fund" aimed at promoting joint research projects at Campus Biotech.

TWO MAJOR PROJECTS DRIVE GENETICS RESEARCH FORWARD AT CAMPUS BIOTECH

Good news for the fields of genetic research and gene therapy: two major centers – the Swiss Genome Center and the Bertarelli Platform for Gene Therapy – will be based at Campus Biotech, the Geneva site that is home to research units from EPFL, the University of Geneva and the university hospitals of Geneva. —

First, there is the Swiss genome center with a DNA sequencing capacity that is unmatched elsewhere in Europe. Then there is the gene therapy platform, funded by the Bertarelli Foundation, which will work on developing new viral-type drug carriers to directly target defective parts of DNA. These two centers will give genetics research in the Lake Geneva region a boost thanks to the extensive funding that will go into Campus Biotech in Geneva.
The establishment of a genome center at Campus Biotech is one component of the nationwide Health 2030 initiative. With it, the DNA sequencing capacity in Switzerland will be among the highest in Europe. These sequencing operations are the cornerstone of today's broad focus on developing personalized and precision medicine. The Bertarelli Foundation has funded a new chair in gene therapy, which comes in addition to the Foundation's three chairs in neuroscience already in place at Campus Biotech. ■

LAUNCHING PHASE TWO OF EPFL'S VALAIS EXPANSION

A new building that will host a research center on alpine and extreme environments will be constructed on the Energypolis campus in Sion. The rehabilitation and health cluster as well as the green chemistry and energies-of-the-future hub will also be strengthened. —

EPFL and the Canton of Valais formalized the launch of the second phase of EPFL's expansion in Valais, as set out in the December 2016 agreement in principle, by signing a second amendment to the agreement of 19 December 2012. The amendment was signed at the 2017 strategy committee meeting attended by the entire Valais Council of State, EPFL's president and senior management, and the mayor of the City of Sion.
Under the amendment, EPFL will provide a new building that will house five or six new chairs specializing in the science and technology of alpine and extreme environments, in fields ranging from biology to physical processes. It will also be home to the Swiss Polar Institute (SPI), which aims to bring together research initiatives in the field of extreme environments by coordinating international projects and expeditions to the Arctic and Antarctic. The rehabilitation and health cluster as well as the green chemistry and energies-of-the-future hub will also be strengthened. ■

Current Swiss President Alain Berset was one of many politicians and researchers who attended the first Digital Day.

EPFL TAKES PART IN SWITZERLAND'S FIRST DIGITAL DAY

digitalswitzerland, together with over 40 partners – including EPFL – organized the country's first Digital Day on 21 November with events in Zurich, Geneva, Lugano and Chur, as well as on EPFL's campus. —

Switzerland's first-ever Digital Day was an initiative to show people how technological advancements in digitization are changing society, the economy and the way we live. EPFL and over 40 other organizations and companies took part in the event, which was supported by outgoing Swiss President Doris Leuthard and Federal Councilors Johann Schneider-Ammann and Alain Berset. The event is the only one of its kind in Europe, putting digitization's many impacts and repercussions into stark relief. "Digital Day is a demonstration of digitization and the enormous potential it has to offer. The Swiss people will come away from the event more fully aware that they are living at a time of unprecedented change and that Switzerland offers remarkable conditions in which this field can grow and develop," says Marc Walder, who created digitalswitzerland.
Drawing on its digitization expertise, EPFL engaged with the public at the Zurich and Geneva train stations and put together a series of activities for children on our Lausanne campus. ■

EPFL AT THE FOREFRONT OF "DIGITAL TRUST"

EPFL president Martin Vetterli has unveiled plans to create the EPFL Center for Digital Trust. This new research platform, backed by a consortium of businesses and institutions, will aim to be a center of excellence for IT security and personal data protection in the digital era. —

At the 2017 Cybersecurity day, which was held at EPFL in the presence of Federal Councilor Guy Parmelin, EPFL president Martin Vetterli revealed plans for the new EPFL Center for Digital Trust – intended to become a center of excellence for all issues related to data security.
The Center will address the three critical challenges of this digital era: cybersecurity, which involves making sure that data transferred across networks cannot be hacked; transparency, which means making it clear how data is processed, sent and stored; and personal data protection, so that sensitive information, such as bank account details and medical records, stays out of malevolent hands. Engineers at the Center will work in parallel to develop new systems and methods in all three areas.
Eight institutional and industrial partners, including the International Committee of the Red Cross (ICRC), the Lausanne University Hospital (CHUV) and Swisscom, have been involved in the creation of the new Center since the outset. EPFL has also created two new teaching and research chairs in digital trust, which come in addition to the school's 24 labs already working in this field, mostly within the School of Computer and Communication Sciences, the School of Life Sciences and the College of Management of Technology. ■

"Digitization is often compared to a huge wave surging across the earth. People need to know the basics if they want to ride that wave confidently and have trust in it." – Martin Vetterli

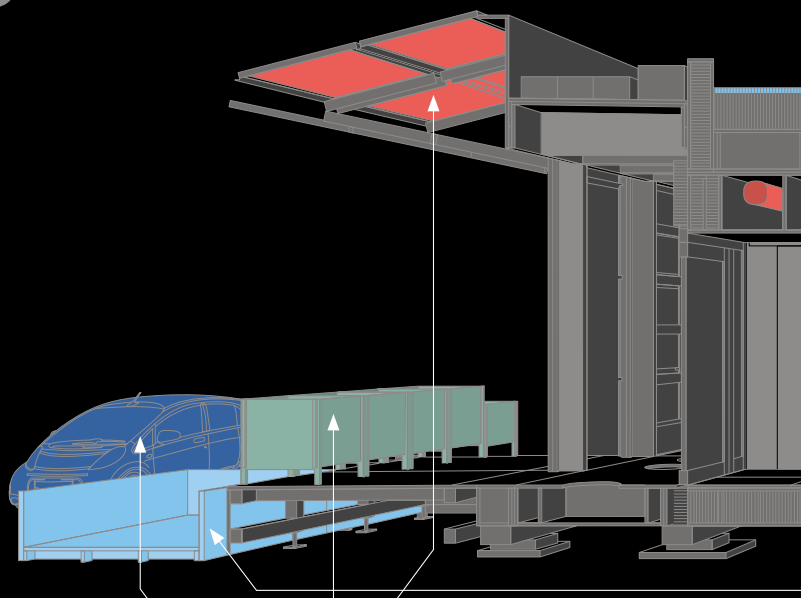
A BIG WIN FOR A LITTLE NEIGHBORHOOD HOUSE

The EPFL students' victory at the Solar Decathlon 2017 in the US is proof positive of the school's excellence and our ability to team up effectively with other local universities. —

When the winner was announced at the Solar Decathlon 2017 competition in Denver, Colorado, around 40 students jumped with joy and one of them rang a Fribourg-style cowbell, all in front of photographers, cameramen and a flurry of smartphones. The students wore blue and black T-shirts with the winning project's name: NeighborHub.

Around 75% of the some 250 students involved in the project were from EPFL. Part of the team headed to the US to represent Switzerland at the competition, which is held by the US Department of Energy every two years. It pits teams of college students from around the world against each other to build an innovative house powered exclusively by solar energy. The Swiss team made a bold decision from the outset three years ago: instead of building a single-family home, as implied by the contest description, they designed a community center called NeighborHub. The house is intended to promote solar energy and sustainable living among neighborhood residents, and to encourage them to consume less and recycle more (see diagram).

NeighborHub was first unveiled at the Smart Living Lab in Fribourg in the spring of 2017. That fall, 43 students flew to Denver to build their solar-powered house and present it in the Decathlon's ten contests, each designed to test its performance and impact. This was the first time Switzerland took part in the competition – and Team Switzerland swept first place. In addition to EPFL, the students on the Swiss team came from the School of Engineering and Architecture of Fribourg (HEIA-FR), the Geneva School of Art and Design (HEAD) and the University of Fribourg (UNIFR). Their design made the top three in eight of the ten contests and won the top spot in six: Architecture, Water, Engineering, Energy, Health and Comfort and Home Life – all fields taught at EPFL, something the school can be proud of. However, their daring concept was declared out of scope for two of the contests.



MOBILITY

The NeighborHub concept includes an electric car, bicycles and delivery tricycles.

WASTE MANAGEMENT

The house has recycling bins for use by neighborhood residents, and courses would be given on how to produce less waste and recycle it.

ENERGY

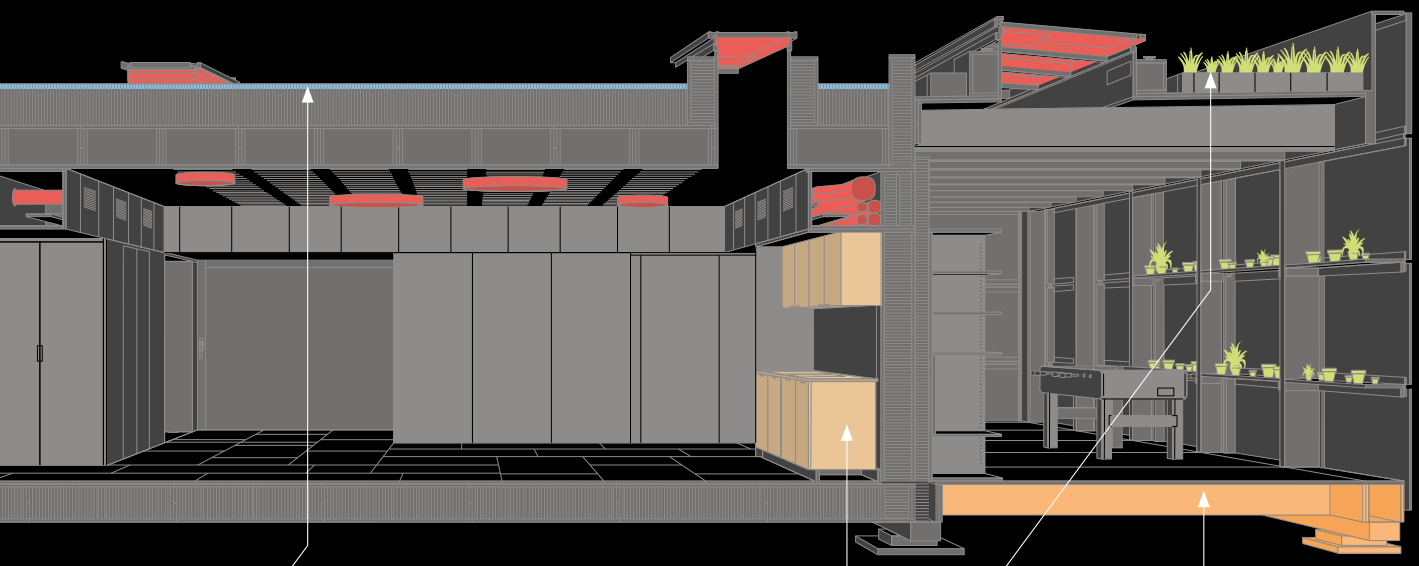
The house has 29 solar panels linked to two batteries and installed on an inclinable facade. Occupants can use an integrated control system to manage power generation and consumption.

The project provided a unique opportunity for students to develop teamwork skills and technical know-how. A key success factor was their capacity to join forces and come up with cross-disciplinary solutions. The project team included supervisors from both academia and industry. Their support – along with that of the 49 companies that sponsored the project – was crucial to the team's success and helped the universities forge closer ties with businesses to address the main engineering and architectural challenges in sustainable development.

The NeighborHub project will continue in 2018. The house will be installed permanently at Fribourg's blueFACTORY in the spring, where it will play its intended role as a hub for the local community – thus bringing the students' initial vision to life. ■

NEIGHBORHUB SHOWS HOW SUSTAINABLE LIVING IS POSSIBLE

The Swiss team's winning design will teach neighborhood residents about sustainable living through innovative solutions in seven key areas – energy, water, biodiversity, mobility, waste management, materials and food.



WATER

The house's water collection and treatment system is integrated into its architecture. First, rainwater is collected from the roof and treated in a phytopurification basin (where plants are used for the purification process), and then fed to a washing machine. The wastewater is channeled into composting toilets equipped with earthworms (vermicomposting). All this minimizes the building's water use and follows the natural water cycle.

FOOD

The house includes a shared kitchen where occupants can swap recipes and tips for sustainable cooking. Vegetable gardens are planted all around the building, where gardening courses can be held. The building's doorframes incorporate vertical greenhouses for growing indigenous plants for its occupants.

MATERIALS

The house's structure is made from wood, and the kitchen countertop is made out of 75% recycled porcelain, ceramic, glass and mirror fragments.

BIODIVERSITY

The house's roof is covered with vegetation, providing a vegetable garden and habitat for a variety of plants and insects.

THE SWISS TEAM'S SCORES IN EACH OF THE TEN CONTESTS

ARCHITECTURE
1st place with 100 points out of 100

ENGINEERING
1st place with 100 points out of 100

APPLIANCES
2nd place with 98 points out of 100

COMMUNICATION
3rd place with 75 points out of 100

INNOVATION
48 points out of 100
(declared out of scope)

HEALTH AND COMFORT
1st place with 97 points out of 100

MARKET POTENTIAL
60 points out of 100
(declared out of scope)

HOME LIFE
1st place with 99 points out of 100

WATER
1st place with 95 points out of 100

ENERGY
1st place with 100 points out of 100

Every year EPFL welcomes high-school students to our campus where we present the many programs on offer. The event is organized by the Study Programs Promotion Service.

3,000 FUTURE STUDENTS ATTEND EPFL'S INFORMATION DAYS

The Information Days held on 22–24 November attracted over 3,000 high-school students. Some students already knew what they wanted to study, while others came to learn more about promising new fields like data science and medtech. —

High-school students look at a number of points when choosing between universities, such as the breadth of their degree programs, their campus life and exchange opportunities. And while some know from the outset that they want to go to EPFL, others come to that decision later, after taking an on-campus summer-school course, for example. The Information Days held at EPFL every year are intended to give high-schoolers the chance to learn more about our school by speaking with researchers, professors and especially our students – who were in their shoes not so long ago. This can have a real impact on the high-school students' decision-making process.
In an added plus, the EPFL students who took part in the Solar Decathlon presented their winning design at the event. ''I've always enjoyed cross-disciplinary projects, and I liked the tangible aspect of this one in particular,'' says civil engineering student Jocelyn Sapin. Reaching across disciplines seemed to be a popular theme among the high-schoolers: they were able to attend talks on cross-disciplinary topics like energy, environmental protection and sports technology – a new feature of this highly informative event. ■

€14 MILLION IN PROJECTS INVOLVING OPTOMECHANICAL TECHNOLOGIES

EPFL's Laboratory of Photonics and Quantum Measurements will coordinate two Horizon 2020 projects for a total of €14 million. They will be carried out through two parallel collaborations: Hybrid Optomechanical Technologies and Optomechanical Technologies. —

The projects stem from very competitive calls for proposals from Future and Emerging Technologies (FET) Proactive (€10 million) and Marie Curie European Training Network (€4 million). Key players from academia and leading industries (IBM, Bosch, Thales, Hitachi, STMicroelectronics) will unite to strengthen Europe's leadership in quantum optomechanics.
The proactive initiative ''Hybrid opto-electro-mechanical devices at the nano-scale'' was launched by the European Commission in response to several granted and successful FET projects on this subject, as well as a previous Marie Curie training network, also coordinated by EPFL.
The Hybrid Optomechanical Technologies project was launched with a consortium of 17 partners. It is a four-year project that will lay the foundation for a new generation of devices that connect or even contain several nano-scale platforms in a single ''hybrid'' system.
In a parallel effort, a Marie Curie collaborative research and training network, which brings together 14 EU partners, looked at finding new applications for Optomechanical Technologies. ■

SCIENTASTIC A SUCCESS IN BOTH VALAIS AND NEUCHÂTEL

The Scientastic science, which was held at EPFL's campuses in Valais and Neuchâtel last year, is always popular. The event aims to spark interest in the sciences and give visitors a better understanding of scientific and technological advancements. —

The event drew visitors curious about science and keen on seeing the labs and witnessing interactive demonstrations.

For the third edition of Scientastic, the event was held at two sites for a change: the EPFL Valais Wallis campus in Sion and EPFL's labs in Neuchâtel. Both versions of the science fair were a hit, drawing in 4,100 and 4,500 visitors, respectively, of all ages.
The weekend-long event is put on by the Science Outreach Department and aims to fuel curiosity about the sciences. Visitors could tour the school's laboratories, watch demos at a number of booths and speak with EPFL researchers.
The fair also included fun educational workshops for children as well as a series of talks and presentations. This year's topic in Sion was energy in all its forms – a fitting choice since energy is one of the main areas of research at that campus. In Neuchâtel, the fair centered on the topic of time, both its mechanized form and the temporality inherent in the universe. ■

EPFL AMONG THE TOP FIVE RECIPIENTS OF ERC GRANTS

The EU's generous yet ultra-competitive grant program celebrated its ten-year anniversary in 2017. Over the years, EPFL researchers have been awarded more than one hundred such grants, making EPFL Switzerland's top recipient of this prestigious funding. —

Launched ten years ago, the European Research Council (ERC) initiative has really transformed the scientific landscape in Europe. Some 7,000 researchers of all nationalities have received funding for projects involving around 40,000 staff. Each year, the ERC pays out close to two billion Swiss francs.
Switzerland ranks fifth in terms of recipient countries, with nearly 500 ERC grants awarded to researchers in Switzerland over the last ten years. And EPFL, which has been awarded 116 grants (the total for 2007–2015 plus Starting and Consolidator Grants in 2016), comes in fourth among Europe's higher education institutions, behind three UK universities. It is closely followed by ETH Zurich (110 grants). For Switzerland's two institutes of technology, this achievement is even more impressive given that they missed out on two application rounds in 2014 as a result of the referendum on mass immigration, which took place on 9 February of that year. Beyond these absolute figures, the recent success rate of EPFL applicants is impressive: more than 30% of applicants have been awarded a grant, compared with the average of around 10%. The grants are awarded to individuals, which gives researchers more freedom to carry out their projects. ■

HUMAN-POWERED AND PUBLIC TRANSPORT GAIN GROUND

2017 saw an array of sustainable transportation initiatives arrive on campus, including a bike-sharing scheme, a new parking policy and subsidies for public transport passes. —

EPFL has been carrying out annual mobility surveys among its students and employees for the past 15 years. The data is used to identify transportation needs on campus and outline initiatives to make sure the school remains mobility-friendly for years to come. These initiatives form part of an overall strategy built on the principles of sustainable development.

Since the survey was introduced in 2003, the use of human-powered and public transport has grown by 9% and 5%, respectively. At the same time, the use of personal motorized vehicles has dropped from 34% to 20%. Bicycles account for the largest rise in human-powered transport, with an 8% jump in use over the summer. This trend is being fueled in part by a new parking system rolled out in January 2017 whereby drivers pay for shared parking places based on usage. That gives commuters greater flexibility in deciding how they want to get around, depending on the season. The proceeds from a two-step increase in parking prices (the first increase since 1991) were allocated to a mobility fund that has already financed efforts to promote cleaner modes of transportation. These efforts include broader subsidies for regional public transport passes, a new bicycle workshop, additional bike parking places and a bike-sharing scheme. ■

The Bike to Work 2017 closing ceremony.

THE FIRST OPENFOOD HACKATHON IS A HIT

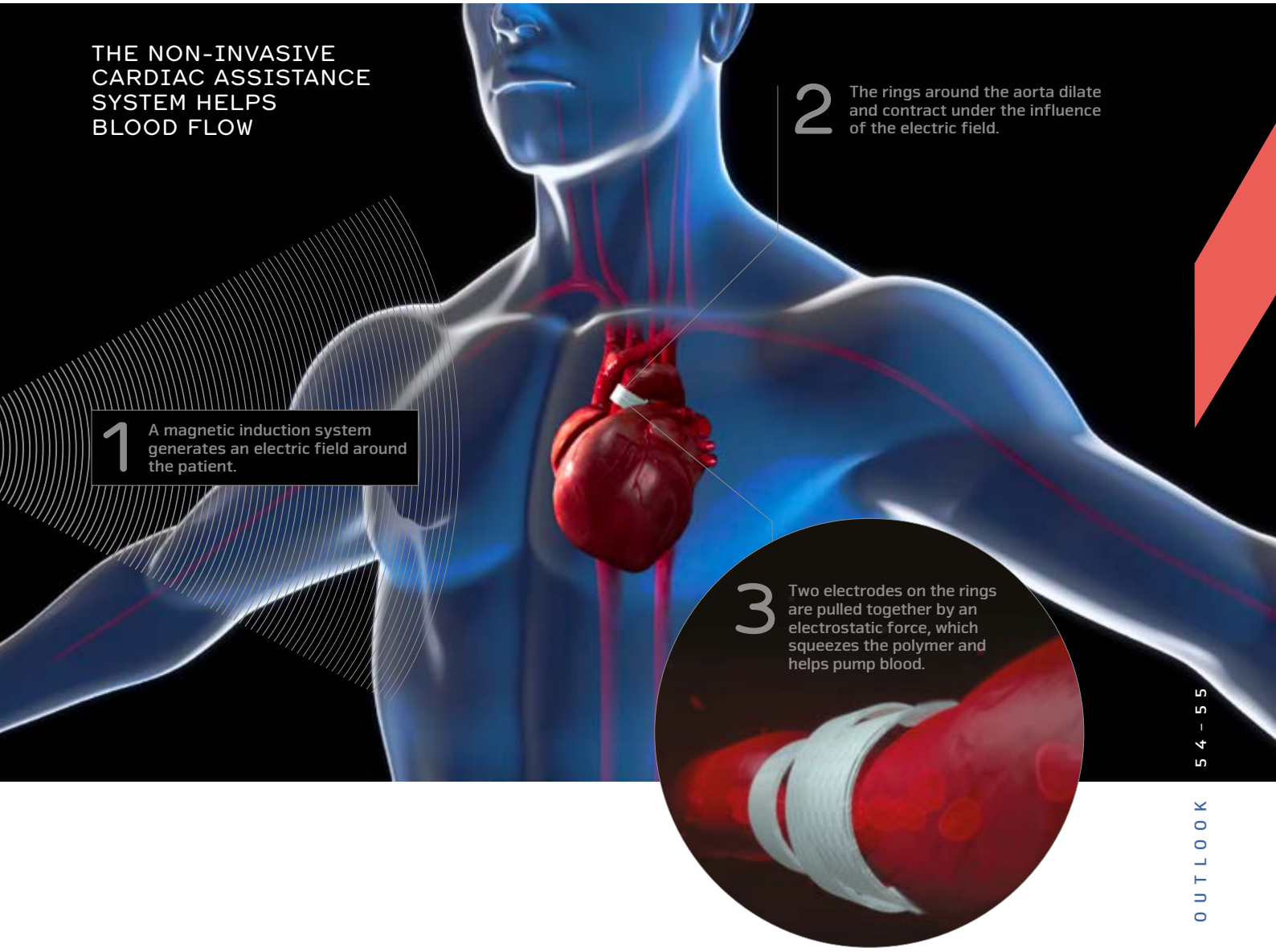
The first OpenFood Hackdays attracted 110 participants, whose goal was to brainstorm technological solutions to food-related challenges. The best projects were awarded funding. —

There's an app to help you shop for healthy food, a website where you can find local food producers and another website that maps out your favorite beer down to the molecule–pesticides included. A total of 12 projects came out of the first ever OpenFood Hackdays, held at EPFL. Engineers, nutritionists, students, graphic designers, doctors and machine-learning specialists put their heads together to come up with technological solutions to food-related challenges faced by humankind. Openfood.ch was among the data sources used by the participants. This database, which was developed at EPFL, contains open-source information on thousands of food items sold in Switzerland. ''The point of the hackathon was for the participants to use whatever data they could get their hands on – from grocery store receipts to what goes on our plates – to help consumers make healthy decisions that take into account such factors as allergies and nutrition,'' says Marcel Salathé, who started Openfood.ch. The most creative, innovative and high-potential projects received funding. ■

CHF 12 MILLION TO CREATE A CENTER FOR ARTIFICIAL MUSCLES

Thanks to a donation from the Werner Siemens-Foundation, EPFL will set up a Center for Artificial Muscles. The first project will focus on developing a less invasive cardiac assistance system for treating heart failure. —

Many forms of heart disease end in cardiac failure. Patients can be saved only by a heart transplant or a complicated assistance system. To help diseased hearts pump blood, researchers at the Integrated Actuators Laboratory (LAI) on EPFL's Microcity campus in Neuchâtel have been working for some time now on a new, less invasive cardiac assistance system. It consists of a ring placed around the aorta and controlled by magnetic induction. The advantage of this prosthetic device is that it is not in contact with blood, so it avoids the complications of hemorrhaging and thrombosis. This project has attracted the attention of the Werner Siemens-Foundation, which has donated CHF 12 million to set up a Center for Artificial Muscles (CAM). Research to develop the new device will be spread out over four years and be carried out in association with the Bern and Zurich university hospitals. A facial-reconstruction project aimed at restoring patients' ability to create facial expressions will follow. ■



PERSONALIA

Coaches from each section (mechanical engineering shown here) help first-year students get used to life on campus.


MECA
FABIEN
GEORGE
XAVIER
MECA
CESAR

PROFESSORS APPOINTED OR PROMOTED IN 2017

KATRIN BEYER

was appointed Associate Professor of Structural Engineering in the School of Architecture, Civil and Environmental Engineering (ENAC).

DOLAANA KHOVALYG

was appointed Tenure Track Assistant Professor of Energy and Building Systems Technology in the School of Architecture, Civil and Environmental Engineering (ENAC).

DANIEL KRESSNER

was appointed Full Professor of Mathematics in the School of Basic Sciences (SB).

PEDRO MIGUEL REIS

was appointed Full Professor of Mechanical Engineering in the School of Engineering (STI).

EMMANUEL REY

was appointed Associate Professor of Architecture and Sustainable Construction Technologies in the School of Architecture, Civil and Environmental Engineering (ENAC).

ALI H. SAYED

was appointed Full Professor of Electrical Engineering and Electronics in the School of Engineering (STI).

PATRICK BARTH

was appointed Associate Professor of Life Sciences in the School of Life Sciences (SV).

GEORG FANTNER

was appointed Associate Professor of Bioengineering and Microtechnology in the School of Engineering (STI).

DANIEL KUHN

was appointed Full Professor of Operations Research in the College of Management of Technology (CDM).

ALEXANDRE ALAHI

was appointed Tenure Track Assistant Professor of Transportation Engineering in the School of Architecture, Civil and Environmental Engineering (ENAC).

COLIN N. JONES

was appointed Associate Professor of Mechanical Engineering in the School of Engineering (STI).

MARIO PAOLONE

was appointed Full Professor of Electrical Engineering and Electronics in the School of Engineering (STI).

FRÉDÉRIC COURBIN

was appointed Adjunct Professor in the School of Basic Sciences (SB).

IVO FURNO

was appointed Adjunct Professor in the School of Basic Sciences (SB).

EMMANUEL ABBE

was appointed Full Professor of Mathematics, 75% in the School of Basic Sciences (SB) and 25% in the School of Computer and Communication Sciences (IC).

MARIA COLOMBO

was appointed Tenure Track Assistant Professor of Mathematics in the School of Basic Sciences (SB).

DUSAN LICINA

was appointed Tenure Track Assistant Professor of Indoor Environmental Quality in the School of Architecture, Civil and Environmental Engineering (ENAC).

SAHAND JAMAL RAHI

was appointed Tenure Track Assistant Professor of Biophysics in the School of Basic Sciences (SB).

CARMELA TRONCOSO

was appointed Tenure Track Assistant Professor of Computer Science and Communication Systems in the School of Computer and Communication Sciences (IC).

IGNACIO PAGONABARRAGA

was appointed Adjunct Professor in the School of Basic Sciences (SB).

GREGOR RAINER

was appointed Associate Professor of Life Sciences in the School of Life Sciences (SV).

HERBERT SHEA

was appointed Full Professor of Microtechnology in the School of Engineering (STI).

MARYNA VIAZOVSKA

was appointed Full Professor of Mathematics in the School of Basic Sciences (SB).

SB: BASIC SCIENCES

SV: LIFE SCIENCES

STI: ENGINEERING

IC: COMPUTER AND COMMUNICATION SCIENCES

ENAC: ARCHITECTURE, CIVIL & ENVIRONMENTAL ENGINEERING

CDM: MANAGEMENT OF TECHNOLOGY

CDH: COLLEGE OF HUMANITIES

ALUMNI AWARDS 2017

CLAUDIA DE RHAM, PH' 01

Claudia de Rham was born in Lausanne on 29 March 1978. She graduated from EPFL in 2001 and carried out her thesis work at Cambridge University. After completing two post-docs in Canada (from 2003 to 2009), she obtained a Swiss National Science Foundation Professorship Grant and conducted research at the University of Geneva's Theoretical Physics Department from 2010 to 2011. This research led her to challenge one of Einstein's theories whereby a gravity particle, the graviton, has no mass. She put forth a new theory to explain the universe's acceleration and expansion – a phenomenon that scientists first observed in the 1990s but have so far been unable to explain. Today her pioneering work in cosmology is known around the world and inspires many budding researchers studying gravity and the creation of the universe. ■

MATTIA BINOTTO, GM' 94

Mattia Binotto was born in Lausanne on 3 November 1969. He earned a mechanical engineering degree from EPFL in 1994 and a Master's degree in motor vehicle engineering in Modena, Italy. He joined Ferrari as a Test Engine Engineer for Formula 1 cars in 1995, and then served in the same role for Grand Prix cars from 1997 to 2003. In 2004, he became a Race Engine Engineer and served as Michael Schumacher's personal engineer; in 2007 he was promoted to Chief Engineer and in 2009 to Head of Engine and KERS Operations. After being appointed Deputy Director, Engine and Electronics in October 2013, he subsequently took on the role of Chief Technical Officer of Scuderia Ferrari on 27 July 2016. Binotto's remarkable skills and passion for automotive engineering have earned him widespread recognition in the racing industry and propelled him to a top position at Formula 1's most emblematic sponsor. ■

DR HONORIS CAUSA 2017

Suzan G. LeVine was awarded an Honoris Causa Doctorate on EPFL's 2017 graduation day, and mathematician Yves Meyer was granted the title at EPFL's first Campus Lecture on 19 September 2017. —

SUZAN G. LEVINE

In recognition of her hard work in promoting education for today's youth and encouraging women to enter technical fields. An engineer, ambassador and charismatic leader, she has also had a stellar career as a diplomat and in technology. ■

YVES MEYER

In recognition of his groundbreaking work in several branches of pure and applied mathematics – from number theory to harmonic analysis – and for his pivotal role in the development of wavelet theory. ■

2017 DONORS

DONOR APPRECIATION

EPFL wishes to thank the following individuals, companies and foundations that formed new partnerships with the school or joined the school's donor circle in 2017. Through their exceptional commitment to science, education and development, they have contributed to the quality of research, studies and life on campus.

INDIVIDUALS

ANNE-SHELTON AARON

PROFESSOR PATRICK AEBISCHER

PROFESSOR EDOUARD BUGNION

JACQUES AND IMAN MAKKI DE SAUSSURE

GILBERT HAUSMANN AWARD

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CATHERINE LABOUCHÈRE, REPRESENTING A GROUP OF DONORS

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THE PARENTS OF EULER COURSE STUDENTS

THIERRY PLOJOUX

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ASSOCIATION SUISSE ROMANDE INTERVENANT CONTRE LES MALADIES NEURO-MUSCULAIRES

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FONDAZIONE
TEOFILO ROSSI DI MONTELERA
E DI PREMUDA AND
A FOUNDATION THAT WISHES
TO REMAIN ANONYMOUS,
BOTH OF WHICH WERE ADVISED
BY CARIGEST SA

GABRIELLA GIORGI-
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MICROCITY – POLE
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MONASH UNIVERSITY

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SWISS CANCER RESEARCH FOUNDATION

SWISS CONFEDERATION

SWISS FINANCE INSTITUTE

SWISS MOBILIAR COOPERATIVE COMPANY

SWISS MULTIPLE SCLEROSIS SOCIETY (MS)

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THE MICHAEL J. FOX FOUNDATION FOR PARKINSON'S RESEARCH

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ZDENEK AND MICHAELA BAKALA FOUNDATION

We are also grateful to all donors who wish to remain anonymous and to those donors who generously supported the Fondation EPFL Plus, the EPFL-WISH FOUNDATION and the Swiss EdTech Collider.

GOVERNANCE REPORT

The Rolex Learning Center and ArtLab building are symbols of our school, whose footprint extends far beyond the confines of our main campus.

2017 ORGANIZATION

SENIOR MANAGEMENT

MARTIN VETTERLI

PRESIDENT

PIERRE VANDERGHEYNST

VICE PRESIDENT FOR EDUCATION

ANDREAS MORTENSEN

VICE PRESIDENT FOR RESEARCH

MARC GRUBER

VICE PRESIDENT FOR INNOVATION

CAROLINE KUYPER

VICE PRESIDENT FOR FINANCES

ETIENNE MARCLAY

VICE PRESIDENT FOR HUMAN RESOURCES AND OPERATIONS

EDOUARD BUGNION

VICE PRESIDENT FOR INFORMATION SYSTEMS

SCHOOL DEANS

JAN S. HESTHAVEN
(from 1 February 2017)

THOMAS RIZZO
(until 31 January 2017)

SB

BASIC SCIENCES

- Mathematics
- Physics
- Chemistry

GISOU VAN DER GOOT

SV

LIFE SCIENCES

- Bioengineering
- Neuroscience
- Global Health
- Cancer

ALI H. SAYED
(from 1 July 2017)

DEMETRI PSALTIS
(until 31 June 2017)

STI

ENGINEERING

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

JAMES LARUS

IC

COMPUTER & COMMUNICATION SCIENCES

- Computer Science
- Communication Systems

MARILYNE ANDERSEN

ENAC

ARCHITECTURE, CIVIL & ENVIRONMENTAL ENGINEERING

- Architecture
- Civil Engineering
- Environmental Engineering

COLLEGE DIRECTORS

THOMAS DAVID

CDH

COLLEGE OF HUMANITIES

- Humanities and Social Sciences
- Area & Cultural Studies
- Digital Humanities

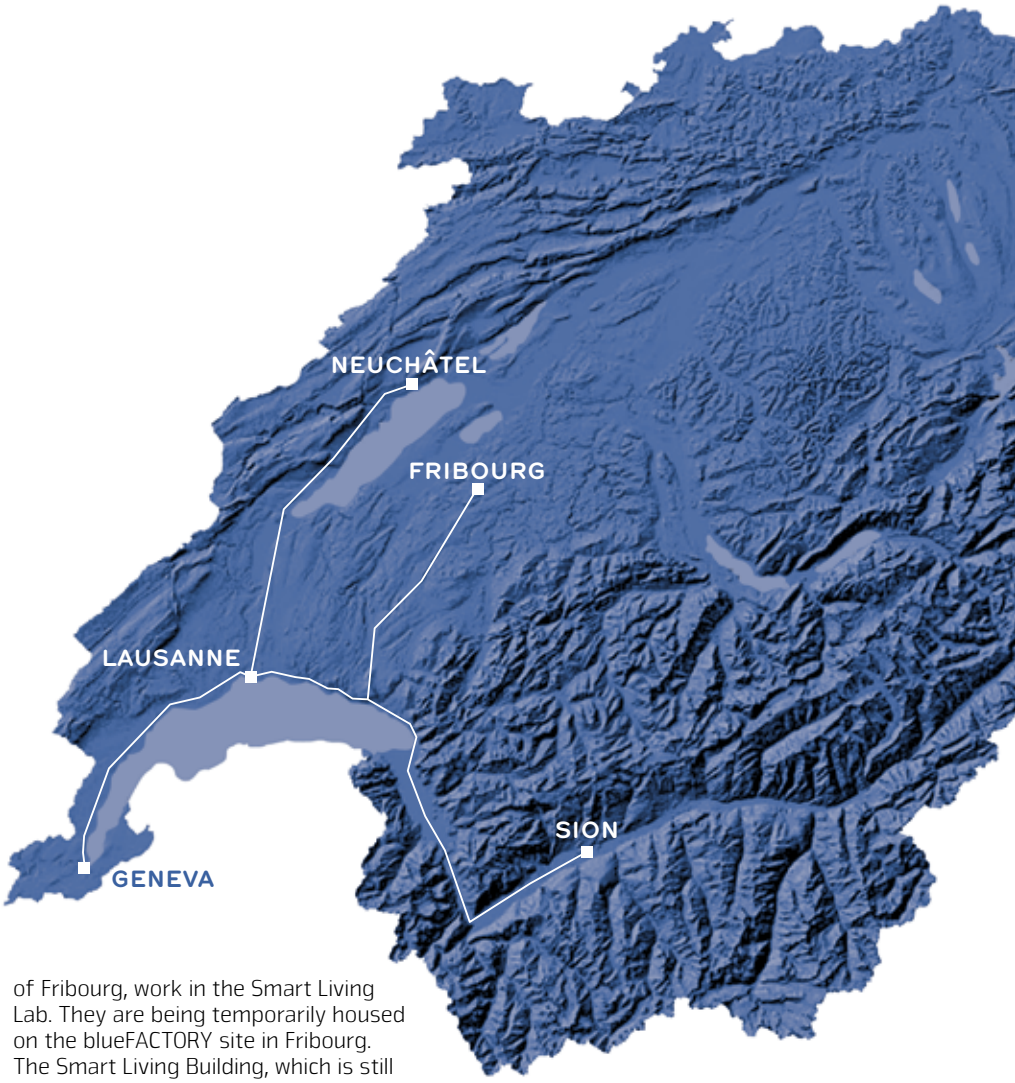
CHRISTOPHER TUCCI

CDM

MANAGEMENT OF TECHNOLOGY

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

EXTENDED CAMPUS



GENEVA
CAMPUS BIOTECH: BIO- AND NEUROENGINEERING (WYSS CENTER), HUMAN BRAIN PROJECT, NEUROPROSTHETICS CENTER

- 420 staff
- 9 chairs (excl. BBP and HBP)
- 3,880 m² (excl. BBP and HBP)

Some 1,000 people, mainly from EPFL, Geneva University Hospitals and the University of Geneva, work at Campus Biotech, which is home to four major platforms: Human Neuroscience, Preclinical Neuroscience, Neuronal Microsystems and Systems Integration. Two new platforms have also been announced for research in gene therapy and gene sequencing. The Campus Biotech Foundation and the Wyss Center have together invested over CHF 30 million in these platforms. The Campus Biotech Foundation hosts research groups at the site and coordinates the site's operations.

NEUCHÂTEL
MICROCITY: MICROENGINEERING AND NANOTECHNOLOGIES

- 230 staff
- 11 chairs
- 8,035 m²

Microcity is home to the 11 EPFL chairs at the Microengineering Institute (IMT) and to the Neode business incubator. In 2017, the IMT continued to expand its Micro-Manufacturing Science and Engineering Center (M2C): Richemont set up an R&D unit at Microcity in July, and the Center held a day-long networking event in August with other partner organizations. Several laboratories in Neuchâtel obtained project financing from the ETH Board through the Strategic Focus Area Advanced Manufacturing (SFA-AM) program.

FRIBOURG
SMART LIVING LAB: TECHNOLOGY, CONSTRUCTION AND SUSTAINABLE ARCHITECTURE

- 21 staff
- 2 chairs and 1 research group
- 520 m² + an 850 m² workshop

75 people, including researchers from EPFL, the Fribourg School of Engineering and Architecture and the University of Fribourg, work in the Smart Living Lab. They are being temporarily housed on the blueFACTORY site in Fribourg. The Smart Living Building, which is still in the planning stages, is expected to accommodate around 130 researchers and by 2022 will already meet the criteria set out in Switzerland's Energy Strategy 2050. This building will be a living lab, providing researchers with state-of-the art experimental facilities. Fribourg is also where NeighborHub – the innovative home that won the US Solar Decathlon 2017 competition – was designed.

SION
ENERGYPOLIS CAMPUS: INDUSTRIAL ENERGY, GREEN CHEMISTRY, ENVIRONMENTAL ENGINEERING, BIOTECHNOLOGY, BIOENGINEERING

- 200 staff
- 10 chairs + 3 research groups
- 7,600 m²

EPFL Valais Wallis focuses on scientific research and innovation in the fields of energy, health and the environment in conjunction with four EPFL schools and one college. In 2017 the Valais government approved an amendment to the agreement establishing EPFL in the canton and acquired a former industrial building that will provide the school with an additional 10,000 m² of lab space by 2021. That means EPFL will have nearly 18,000 m² of space in Sion, including 600 m² for neuroengineering research at the Valais healthcare cluster.

UNITED ARAB EMIRATES
EPFL MIDDLE EAST: SUSTAINABLE ENERGY SOLUTIONS

EPFL Middle East offers internships along with Master's and innovation and sustainable energy solution projects. Over 70 student-research and technology-transfer projects have steadily cut the site's carbon emissions, which currently stand at 20,000 $MTCO_2eq./yr$ – equal to the entire carbon footprint of the EPFL campus. This partnership with the UAE is being funded entirely by the local government.

A TRANSITION YEAR FOR THE HUMAN RESOURCES FUNCTION AT EPFL

SUSANNA SWANN

Human Resources Director

Senior Management asked me as the new human resources director to outline a strategy for meeting the HR challenges arising from the school's overall strategy. This HR strategy should take into account the school's size and complexity as well as the key orientations laid down by the ETH Board. Some of the key factors to consider are our desire to provide an open, stimulating and respectful learning environment and to foster collaboration.

OUR INITIAL WORK ON DEVELOPING THE HR STRATEGY HAS IDENTIFIED THREE AREAS OF FOCUS

The first area of focus is to clarify the school's HR policies and practices and align them with the needs of both the institution and its employees. This will also involve expanding the support offered to managers and staff. Priorities include our HR policy for research scientists and lecturers working on permanent contracts, the prevention and management of cases of sexual harassment and mobbing, and contractual terms (for both short-term and permanent contracts) for administrative and technical staff. We also intend to broaden the range of support services we offer employees for their career development (such as talent management, equal opportunity and internal mobility). We began a full review of the contractual terms for research scientists, lecturers and technical staff in 2017, and it will be completed in 2018.

The second area of focus regards management skills. Team managers – who are often professors – generally haven't been taught the skills needed to effectively hire, manage and develop their staff. We therefore plan to introduce specific training programs to build these skills. Senior Management has identified tenure track assistant professors as the priority group for this training; a targeted program will be developed for them in 2018.

The third area of focus looks at the HR function itself and its development. Although our HR team is limited in size, we have proven capable of supporting the school's rapid growth with our administrative services. We work alongside managers and staff to help them manage change and handle difficult or conflictual situations.

To develop our HR strategy and meet the school's current and future needs, we will review the HR function's operations and expand our team by adding new roles, skills and work processes. That will go hand in hand with investments in HR information systems, thereby enabling us to run more efficiently and provide even better quality service. ■

BUILDING AWARENESS ABOUT GENDER BIAS IN HIRING

To help women get into professorship positions, EPFL will hold a series of seminars for members of hiring committees to teach them how to spot gender bias and mitigate its influence.

Although the number of women professors at EPFL has risen over the past 15 years, it is still quite low – yet the school counts a significant number of female PhD students. Efforts are therefore needed to close this gap and help these students up the career ladder. To that end, EPFL has introduced an equal opportunity policy for hiring new professors that aims to implement best practices and boost gender diversity among the school's faculty.

In 2018, Senior Management and the members of committees responsible for hiring professors will take seminars designed to build awareness about gender bias. Such biases can be significant when managers review applications and select who to hire. Our actions and judgments are unconsciously influenced by gender stereotypes.

Explicit steps are need to counter these implicit biases. Other useful measures include paying careful attention to the wording used in job ads, being proactive in encouraging female applicants, making sure that the same questions are asked at all job interviews and specifying the factors that will be taken into account in hiring decisions. ■

NEW ONLINE JOB APPLICATION SYSTEM

EPFL's Human Resources department, together with the Vice Presidency for Information Systems, is preparing a new system for online job applications.

Job applicants, HR staff and unit managers will soon be able to access the new cloud-based system, which will serve as a platform for applicants to exchange information with EPFL employees involved in the hiring process (including HR managers, professors and their assistants). Such systems have become widespread with the adoption of new technology and can shorten application processing times, facilitate internal communication with real-time data sharing and keep better track of documents.

The new system at EPFL will be used initially for hiring administrative and technical staff, and potentially later by units looking for postdocs and scientific assistants. The system is now being tested and should be operational in the first quarter of 2018. ■

A NEW VICE PRESIDENCY FOR FINANCES AT EPFL

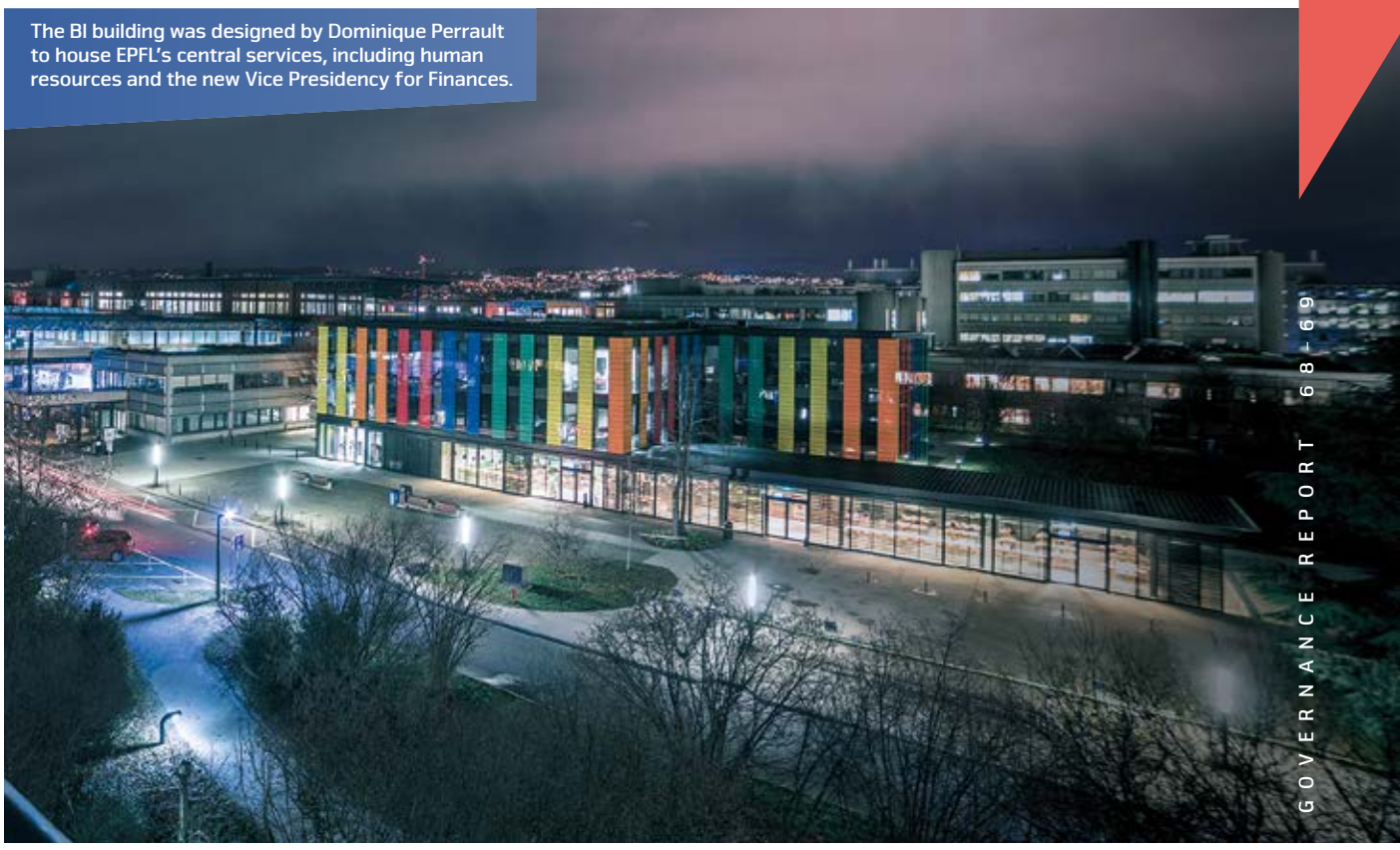
CAROLINE KUYPER
Vice President for Finances —

The development and rapid growth of EPFL's activities over the past 20 years have given rise to major challenges for the school's central services. In response, Senior Management has adapted the school's governance system and enhanced its organizational and decision-making processes, aligning them with international best practices for academic institutions. This initiative included creating a new Vice Presidency for Finances in 2017, which I have headed as CFO since 1 February 2017.

The primary task of the new Vice Presidency is to develop a financial strategy for EPFL while making sure that the school's management and governance systems work effectively. We are responsible for keeping the books of the school and its affiliates, drafting rules and procedures and implementing decision-making processes that are at once structured, effective and transparent – all with a view to supporting the school's three missions over the long term and meeting the highest standards of efficiency and compliance. Our Vice Presidency makes sure that the finance function operates independently and across all the school's divisions.

We also serve as a "finance business partner" to facilitate decision-making processes by taking part in the development and implementation of EPFL's strategies. We aim to provide cross-functional support to the school's departments and other vice presidencies as they carry out administrative and financial tasks, while developing modern, integrated and relevant management systems and applications. We analyze all types of institutional data, including rankings and benchmarking, to meet the needs of EPFL's various services as well as its Senior Management and the ETH Board (the body that oversees and sets the strategy for the ETH Domain).

In 2017 we restructured our department and created three new teams that cover financial planning, management control, risk management, internal control, insurance and coordinating internal and independent audits. These duties will require us to shore up our skills, especially in terms of introducing robust management and internal control processes, indicators and decision-making tools. We have hired people into several key functions and have taken the first important steps, such as setting up a new budgeting process for fiscal 2018, obtaining the first certification of EPFL's full-year financial statements under IPSAS, generating EPFL's first consolidated financial statements including all its affiliates, and making enhancements to the governance structures at several affiliates. ■



The BI building was designed by Dominique Perrault to house EPFL's central services, including human resources and the new Vice Presidency for Finances.

RISK MANAGEMENT

AIM

Risk management concerns the whole of EPFL: Senior Management, central services, the Schools, the Colleges and the extended campus (EPFL sites in other cantons). Risk management takes into account both internal and external risks, and all risks are systematically assessed each year. The aim of risk management is to protect everything that adds value to EPFL, including its human capital, reputation, resources (both tangible and intangible) and facilities. Regular reports and documents on the main risks are submitted to Senior Management.

LEGAL BASIS AND GOVERNANCE

As the six federal institutes of technology in the ETH Domain are granted autonomy under the ETH Act, they are each responsible for managing their own risks and putting in place measures to mitigate risk. The ETH Board's Risk Management Directive of 4 July 2006 outlines the principles for managing risk and financing risk management. EPFL also has internal risk management regulations.

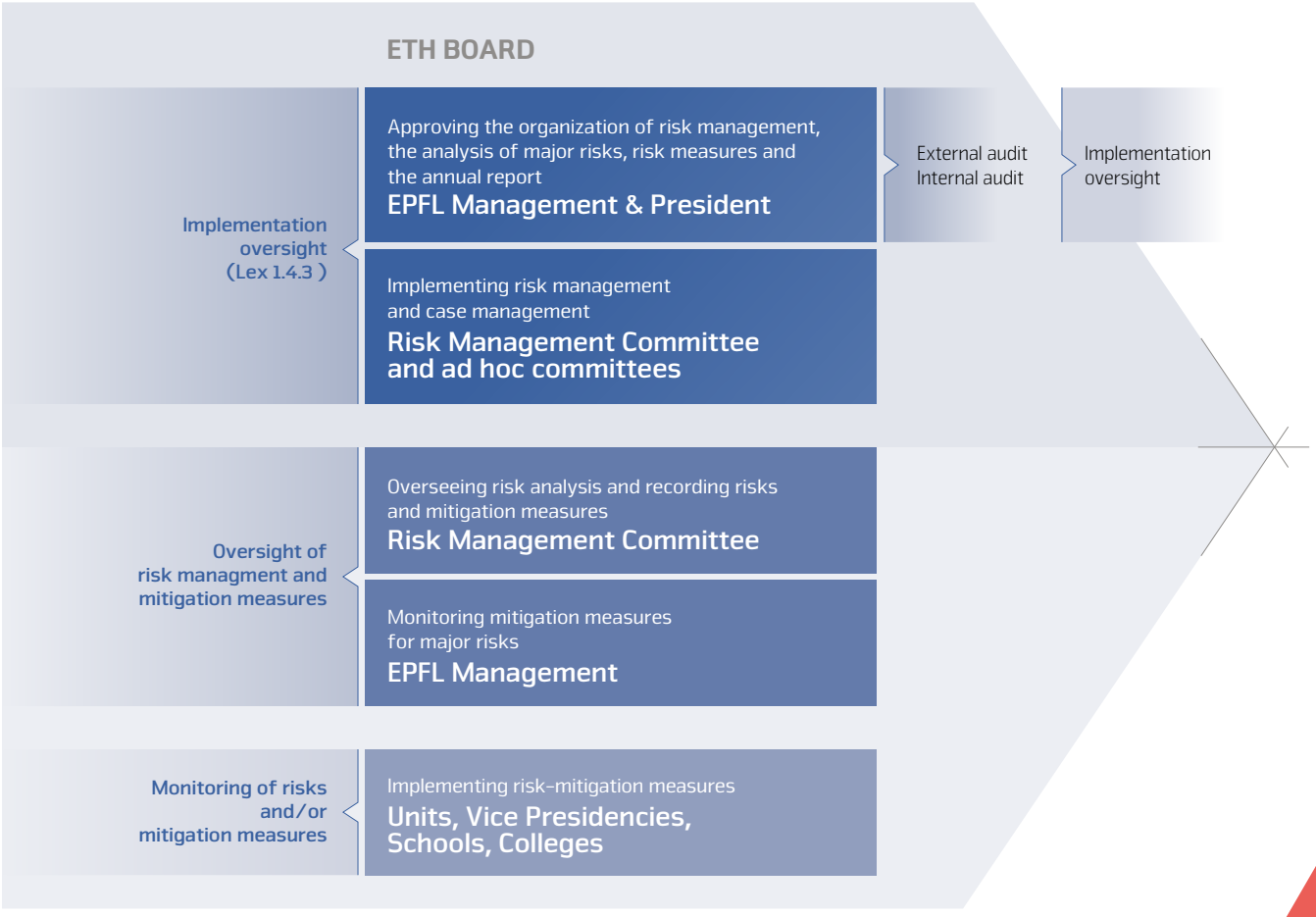
The EPFL president informs the ETH Board of EPFL's main risks and the measures taken to mitigate these risks. EPFL is required to inform the ETH Board if risk occurs that has a significant impact.

ORGANIZATION AND PROCESSES

The Risk Management Committee (RMC) is in charge of piloting risk management at EPFL. It coordinates the activities of its five sub-committees: Safety, Prevention & Health Committee, IT Security Committee, Insurance Committee, Internal Control System Committee, and Audit Coordination Committee.
The RMC informs and advises the president and other members of Senior Management on risk management issues, risk provisions and insurance. It supports all EPFL units in coordinating and organizing risk management. The Vice President for Finances is responsible for implementing the risk management policy and has authority to give necessary and appropriate instructions. The RMC identifies and qualifies the main risks, records them in a central catalogue, and assesses how likely they are to occur and the financial and reputational impact they would have.

INTERNAL CONTROL SYSTEM (ICS)

EPFL has an ICS, which is based on the ETH Board's requirements in this area. The ICS is used to monitor major financial processes and the corresponding risks, which are assessed and covered by key controls. The ICS includes processes and measures to ensure that accounting, financial statements and other financial reporting are compliant. The Swiss Federal Audit Office reviews the ICS as part of its regular audit of EPFL's accounts. The ETH Board's internal audit team reviews the processes.



MAIN RISKS

EPFL determines its main risks based on the impact they would have on the school's finances and/or reputation should they materialize.

- Managerial problems at a unit, center, or project that could hinder the school's ability to operate or affect some or all of the organization.
- Insufficient funding to cover the school's medium- or long-term liabilities and achieve its objectives and missions.
- Violence or the threat of violence that endangers people's physical or mental well-being, perpetrated or suffered by members of the EPFL community.
- Risks related to the school's IT system, as many of its business processes are heavily reliant on computer programs, and to data security (e.g., intrusion, loss or disclosure of information and system breakdown).
- Scientific misconduct or other unethical behavior: data falsification, fabricating research results, plagiarism, self-plagiarism and conflicts of interest.
- Management problems, including inadequate structures, processes, roles and/or responsibilities.
- Failure to comply with legal and contractual requirements.
- Failure to provide the necessary resources for teaching: HR, finances and infrastructure.

EPFL IN FIGURES 2017

The 2017 financial statements are available here:
information.epfl.ch

QUICK FACTS

RESEARCH

357
LABORATORIES

4,200
SCIENTIFIC PUBLICATIONS (ISI WEB OF SCIENCE REFERENCED)*

152
ERC GRANTS (2007 TO 2017) FOUR FROM SNSF IN 2014

TEACHING

13
BACHELOR'S PROGRAMS

26
MASTER'S PROGRAMS

TECH TRANSFER

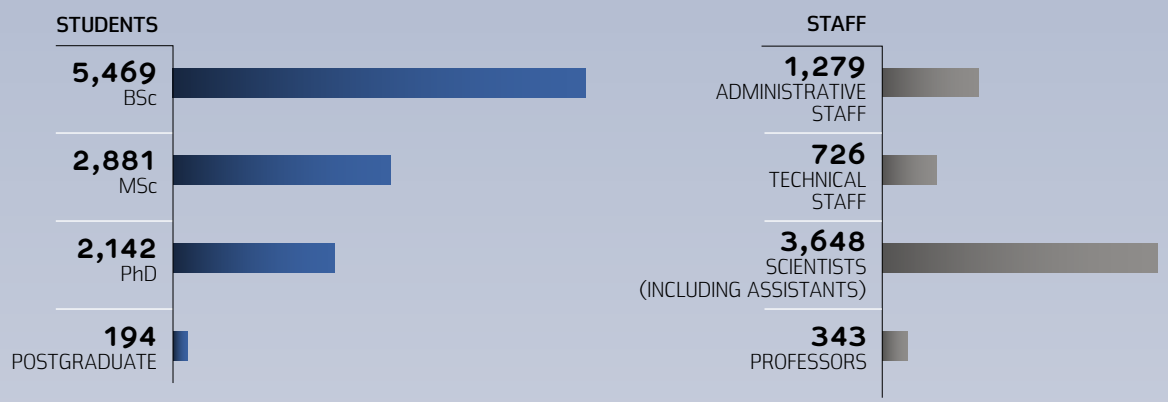
24
R&D UNITS IN THE INNOVATION PARK

142
MILLION CHF IN STARTUP FUNDING IN 2017

13.6
STARTUPS PER YEAR SINCE 2000 (AVERAGE) (15 CREATED IN 2017)

* Data at end-February 2018. These figures may still change until May or June 2018.

CAMPUS POPULATION (HEADCOUNTS)

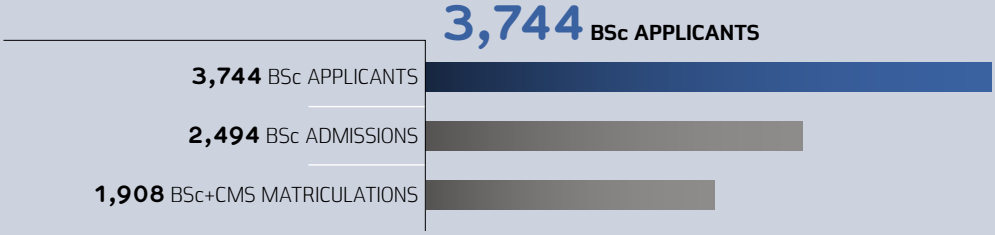


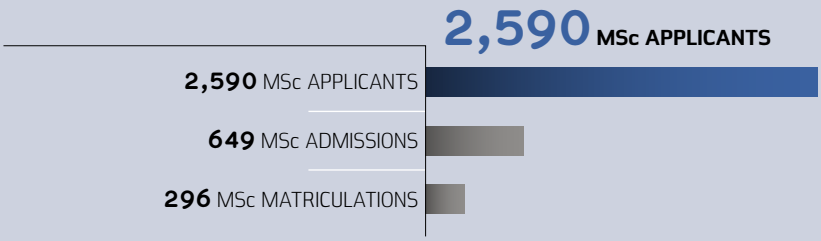
14,864	**TOTAL ON-CAMPUS POPULATION**
1,818	PhD STUDENTS ARE COUNTED ONLY ONCE IN THE TOTAL
+153	PREPARATORY MATH STUDENTS
+2,381	INNOVATION PARK STAFF

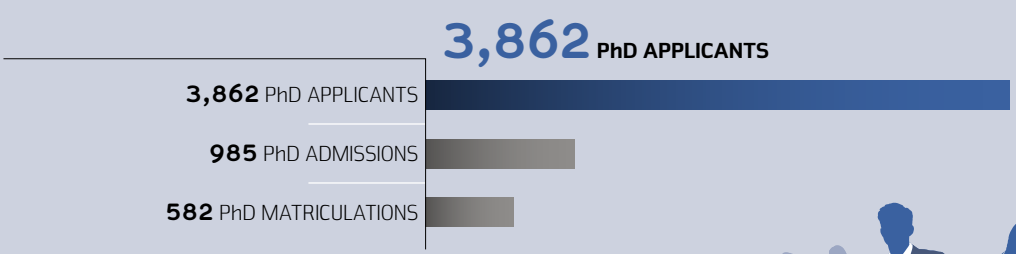
STUDENT BODY

CMS: Special Mathematics Course
BSc: Bachelor's
MSc: Master's
PhD: Doctoral

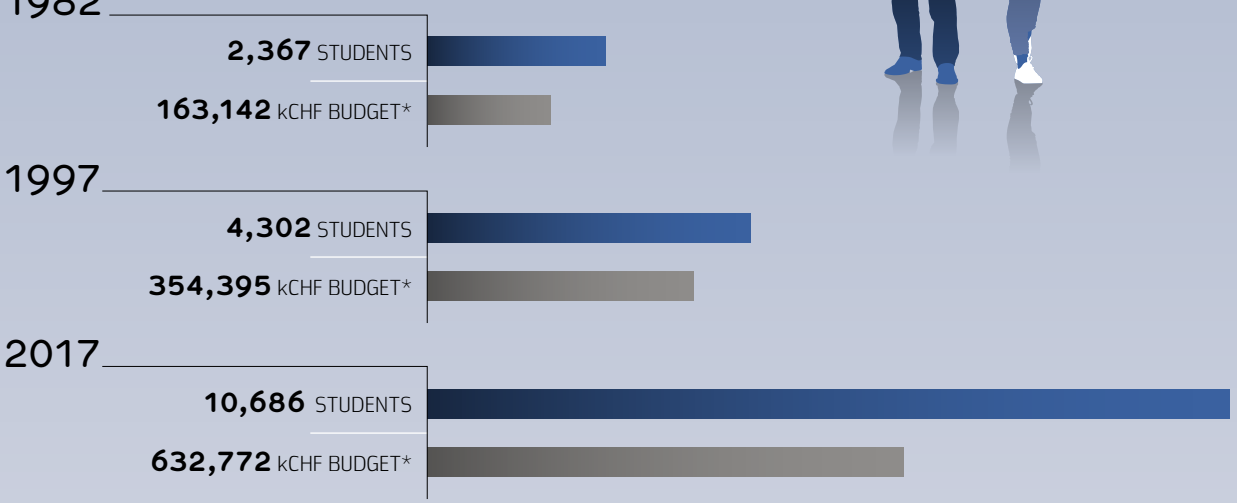
OVERVIEW OF BACHELOR'S, MASTER'S AND DOCTORAL STUDENTS







GROWTH IN BUDGET (kCHF) AND STUDENT NUMBERS



* Direct government funding, excluding internal revenue

STUDENTS BY FIELD AND LEVEL OF STUDY

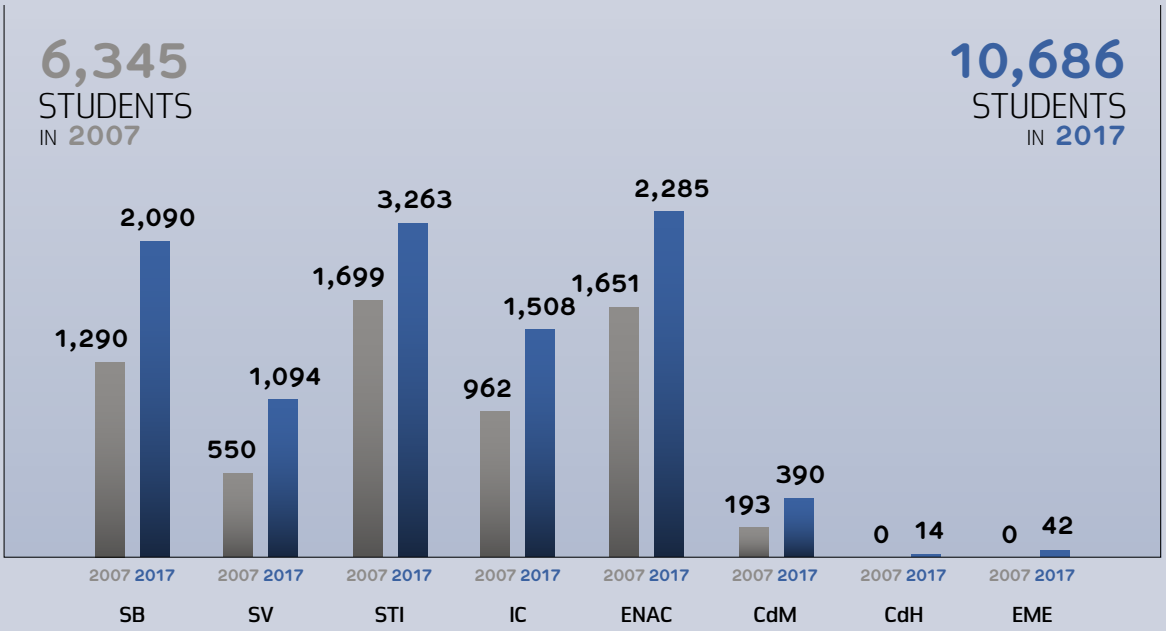
	BACHELOR'S	MASTER'S	PhD	CONTINUING EDUCATION	TOTAL
Basic Sciences (SB)	1,051	481	558	–	**2,090**
Mathematics	339	157	78	–	**574**
Physics	493	170	220	–	**883**
Chemistry and Chemical Engineering	219	154	260	–	**633**
Life Sciences (SV)	550	276	268	–	**1,094**
Engineering (STI)	1,729	792	742	–	**3,263**
Materials Science & Engineering	140	127	163	–	**430**
Mechanical Engineering	753	268	114	–	**1,135**
Microengineering	664	226	204	–	**1,094**
Electrical Engineering	172	171	261	–	**604**
Computer and Communication Sciences (IC)	785	489	234	–	**1,508**
Communication Systems	301	169	77	–	**547**
Computer Science	484	320	157	–	**961**
Architecture, Civil and Environmental Engineering (ENAC)	1,354	648	274	9	**2,285**
Environmental Engineering	256	110	93	–	**459**
Civil Engineering	278	227	97	–	**602**
Architecture	820	311	84	9	**1,224**
Management of Technology (CdM)	–	142	63	185	**390**
Management of Technology	–	80	41	185	**306**
Financial Engineering	–	62	22	–	**84**
Digital Humanities (CdH)	–	11	3	–	**14**
Energy Management and Sustainability (EME–MES)	–	42	–	–	**42**
Total	5,469	2,881	2,142	194	**10,686**

Bachelor's and Master's students
8,350

STUDENT BODY

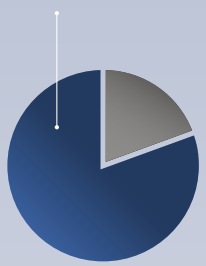
* **SB:** Basic Sciences
SV: Life Sciences
STI: Engineering
IC: Computer and Communication Sciences
ENAC: Architecture, Civil & Environmental Engineering
CdM: Management of Technology
CdH: College of Humanities
EME: EPFL Middle East

A DECADE OF GROWTH BY FACULTY*

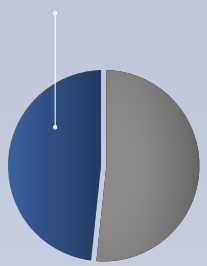


STUDENTS FROM OUTSIDE SWITZERLAND (EXCLUDING RESIDENTS)

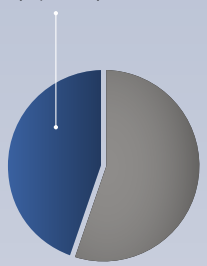
80.7%
PhD
(1,728)



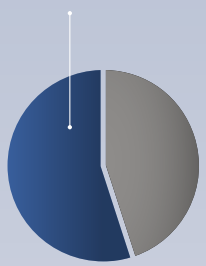
48.4%
BACHELOR'S+MASTER'S
(4,045)



44.9%
BACHELOR'S
(2,458)

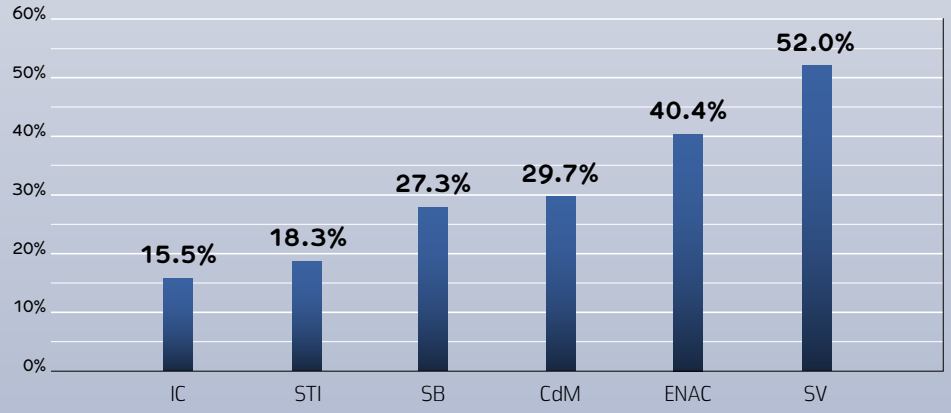


55.1%
MASTER'S
(1,587)

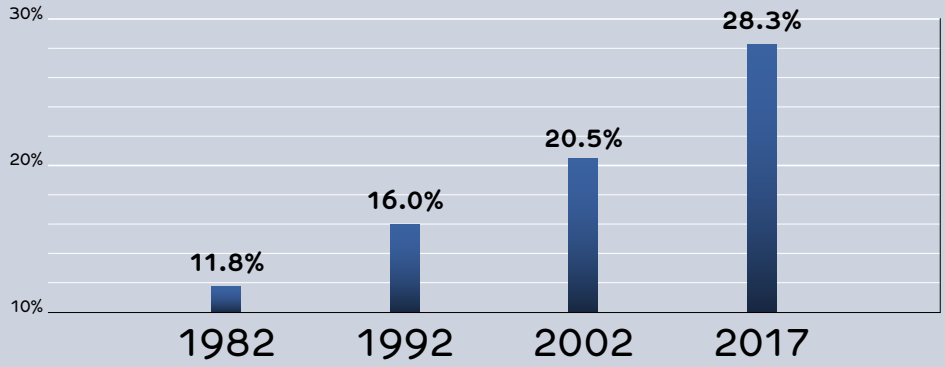


WOMEN ON CAMPUS

PROPORTION OF WOMEN STUDENTS BY FACULTY

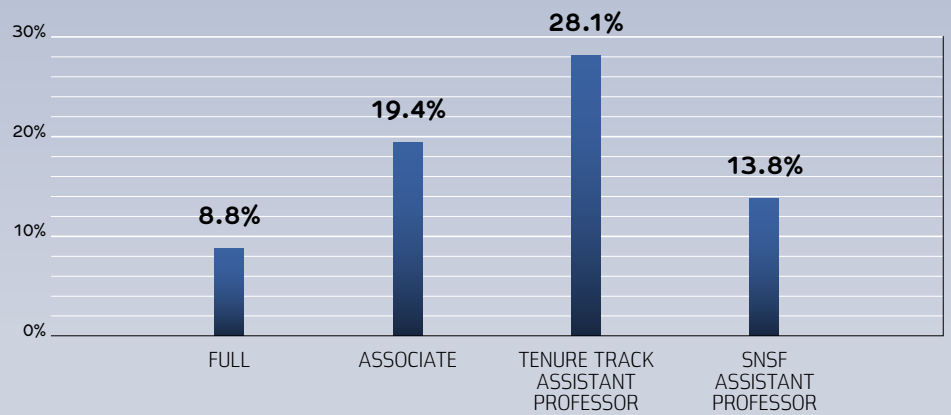


GROWTH IN THE PERCENTAGE OF WOMEN STUDENTS



WOMEN PROFESSORS, FTE[1] (%)

[1] Full-time equivalents



* These figures include professors who work at another university in addition to EPFL. This table takes into account their employment level at EPFL rather than their contractual level with EPFL, as their contract may be held with the other university. This leads to some differences with the figures in the corporate governance report.

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

	TOTAL
Basic Sciences (SB)	**1,257.6**
Mathematics	166.4
Physics	530.5
Chemistry	560.6
Life Sciences (SV)	**755.2**
Engineering (STI)	**1,348.9**
Materials Science	277.1
Mechanical Engineering	270.8
Microengineering	466.0
Electrical Engineering	335.1
Computer and Communication Sciences (IC)	**416.6**
Communication Systems	161.0
Computer Science	255.6
Architecture, Civil and Environmental Engineering (ENAC)	**618.8**
Environmental Engineering	215.5
Civil Engineering	200.3
Architecture	203.0
Management of Technology (CdM)	**104.9**
Management of Technology	69.9
Financial Engineering	34.9
College of Humanities (CdH)	**42.5**
Transdisciplinary Units (ENT)	**343.4**
Central Services	**675.3**
Total	5,563.0

STAFF*

* These figures include professors who work at another university in addition to EPFL. This table takes into account their employment level at EPFL rather than their contractual level with EPFL, as their contract may be held with the other university. This leads to some differences with the figures in the corporate governance report.

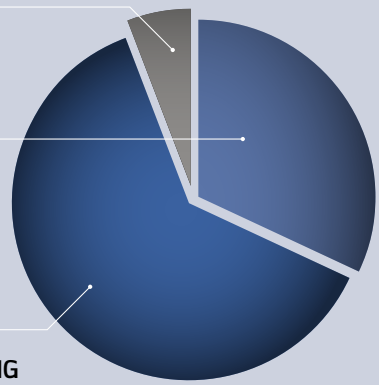
STAFF BY CATEGORY (FULL-TIME EQUIVALENTS)

	TOTAL	GOVERNMENT-FUNDED	THIRD-PARTY FUNDED
Professors	**319.2**	301.0	18.2
Full professors	**165.4**	159.8	5.6
Associate professors	**84.0**	84.0	-
Tenure track assistant professors	**64.0**	57.0	7.0
SNSF assistant professors	**5.8**	0.2	5.6
Scientists	**3,463.6**	1,516.8	1,946.8
Adjunct professors	**44.9**	42.4	2.5
Senior scientists	**75.7**	69.3	6.5
Assistants	**2,009.2**	767.9	1,241.3
Scientific collaborators	**1,333.9**	637.3	696.6
Administrative and technical staff	**1,780.3**	1,520.9	259.4
Administrative staff	**1,095.8**	953.1	142.7
Technical staff	**684.5**	567.8	116.7
Total	5,563.0	3,338.6	2,224.4
		60.0%	40.0%

319.2
5.7%
PROFESSORS

1,780.3
32.0%
ADMINISTRATIVE AND TECHNICAL STAFF

3,463.6
62.3%
SCIENTISTS (EXCLUDING PROFESSORS)



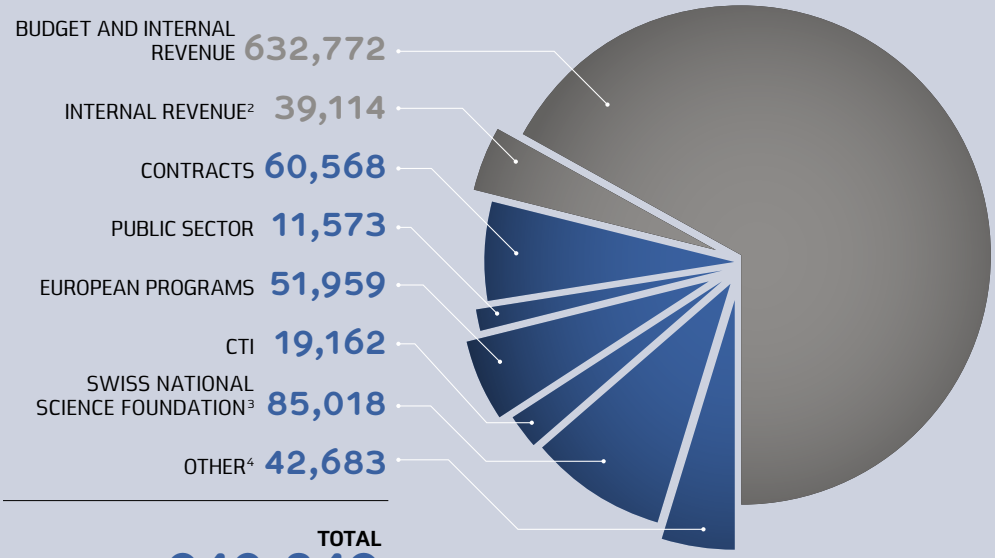
FINANCES*

* These figures correspond to EPFL's budgetary accounting and may differ from the figures resulting from EPFL's financial accounting, which includes closing entries with no monetary impact.

Third-party funding

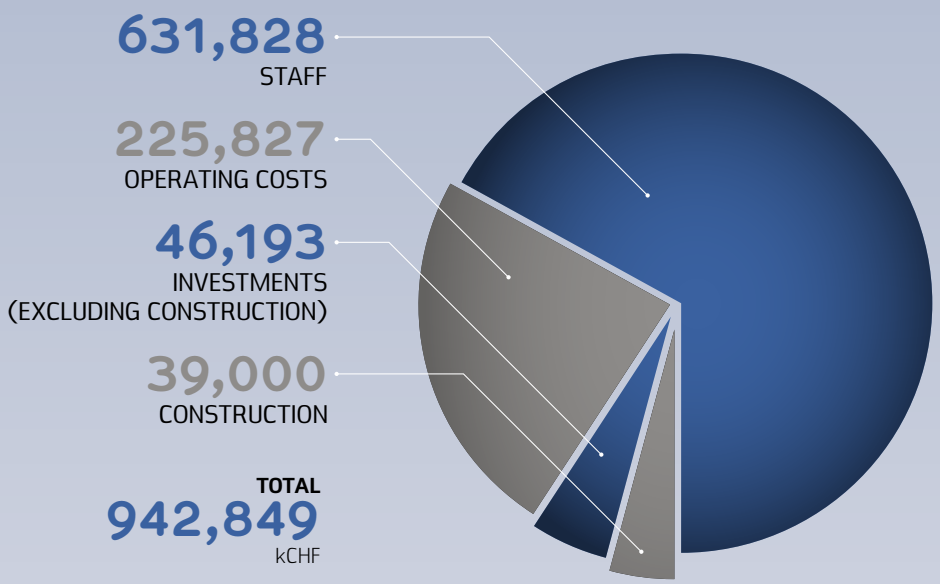
Budget and internal revenue

FULL-YEAR EXPENDITURES BY FUNDING SOURCE[1]



[1] Total expenditure including construction (includes Federal Office for Buildings and Logistics [FOBL] allocation beginning in 2007)
[2] Tuition fees, services, financial revenue, etc.
[3] Including NCCR and NanoTera/SystemsX project funding
[4] Sponsorship, foundations, committed and reserved funds, conferences, continuing education, etc.

EXPENDITURE BY SECTOR (kCHF)



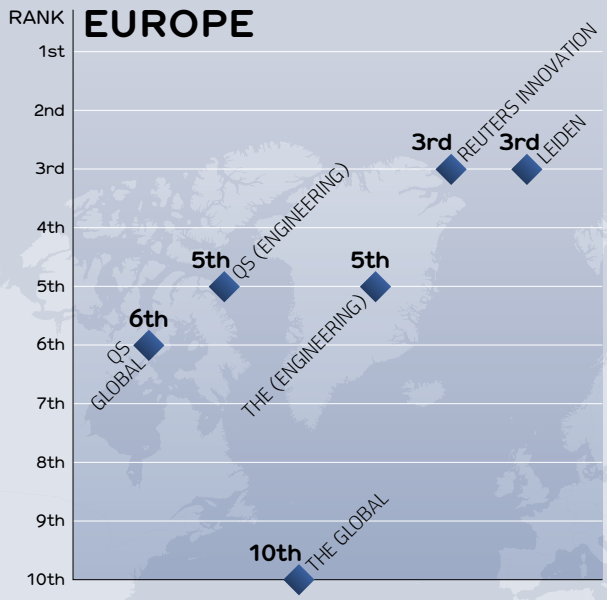
FINANCES*

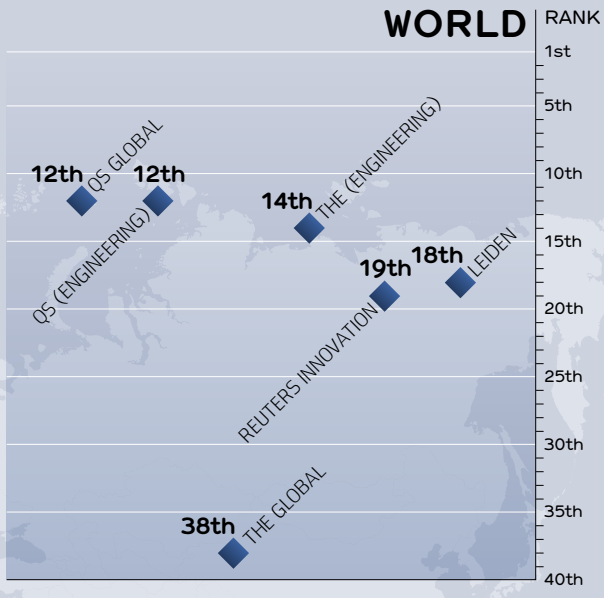
* These figures correspond to EPFL's budgetary accounting and may differ from the figures resulting from EPFL's financial accounting, which includes closing entries with no monetary impact.

FULL-YEAR EXPENDITURE 2017 (kCHF)

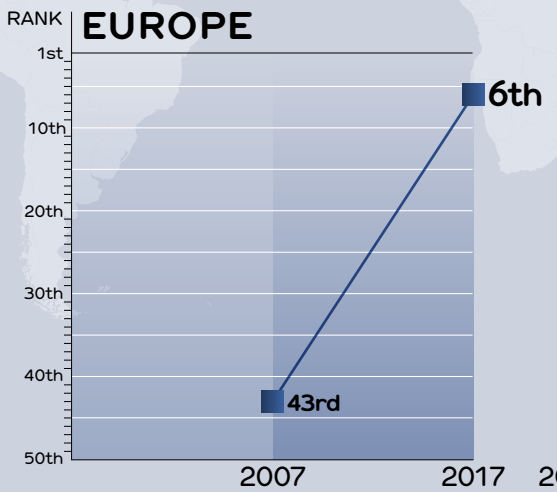
	STAFF	OPERATING COSTS	INVEST-MENTS	TOTAL	THIRD-PARTY FUNDING
Basic Sciences (SB)	136,543	23,237	14,374	**174,154**	66,671
Mathematics	21,973	1,502	33	**23,508**	4,128
Physics	62,061	11,626	7,176	**80,863**	30,272
Chemistry	52,508	10,110	7,165	**69,783**	32,272
Life Sciences (SV)	82,758	23,496	5,864	**112,118**	40,081
Engineering (STI)	135,209	25,394	8,411	**169,013**	72,967
Materials Science	27,793	6,072	2,043	**35,909**	13,858
Mechanical Engineering	27,832	4,472	1,407	**33,711**	14,426
Microengineering	47,416	8,782	2,620	**58,818**	25,376
Electrical Engineering	32,167	6,068	2,340	**40,576**	19,307
Computer and Communication Sciences (IC)	45,002	5,714	800	**51,516**	12,615
Communication Systems	17,990	2,144	202	**20,336**	4,192
Computer Science	27,012	3,570	598	**31,180**	8,423
Architecture, Civil and Environmental Engineering (ENAC)	71,101	12,210	2,969	**86,280**	21,118
Environmental Engineering	24,046	4,522	1,190	**29,758**	8,114
Civil Engineering	20,653	4,042	1,396	**26,091**	8,106
Architecture	26,402	3,646	383	**30,431**	4,898
Management of Technology (CdM)	14,201	2,227	-	**16,427**	5,158
Management of Technology	9,155	1,706	-	**10,861**	4,066
Financial Engineering	5,046	521	-	**5,566**	1,092
College of Humanities (CdH)	4,759	2,216	107	**7,082**	1,005
Transdisciplinary Units (ENT)	40,921	13,161	4,514	**58,596**	22,678
Central Services	101,335	118,173	9,155	**228,663**	28,669
Construction (BBL)			39,000	**39,000**	-
Total	631,828	225,827	85,193	**942,849**	270,963

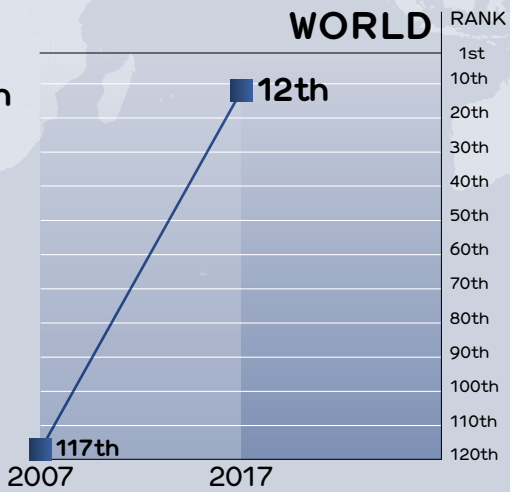
ACADEMIC RANKINGS





EPFL IN THE QS RANKINGS





TECH TRANSFER

8 CORPORATIONS

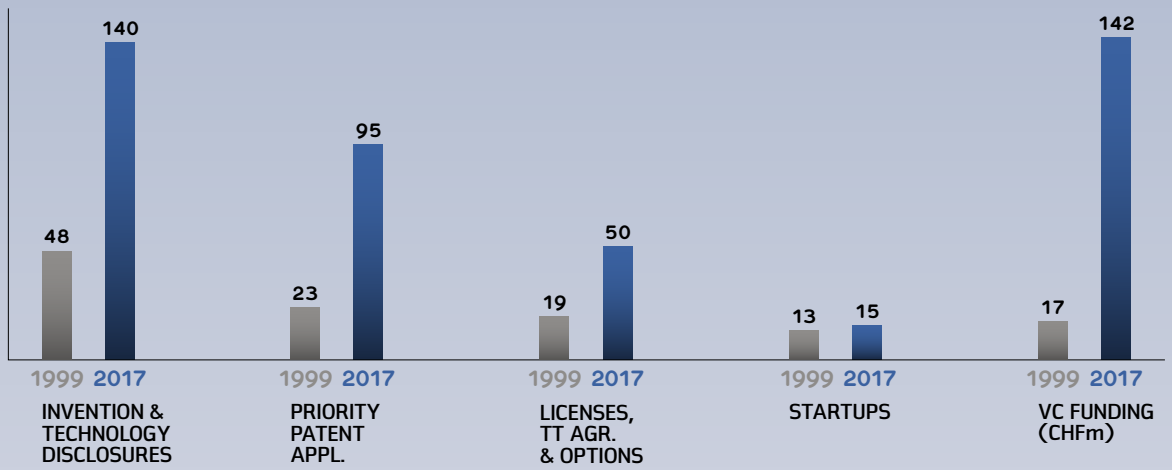
35 EPFL STARTUPS + SMEs

7 PUBLIC INSTITUTIONS AND FOUNDATIONS

50 LICENSES AND TRANSFER AGREEMENTS

43.5 INDUSTRIAL CONTRACTS MANAGED BY THE EPFL TECH TRANSFER OFFICE (TTO) IN 2017 (CHFm)

TECH TRANSFER FROM 1999 TO 2017



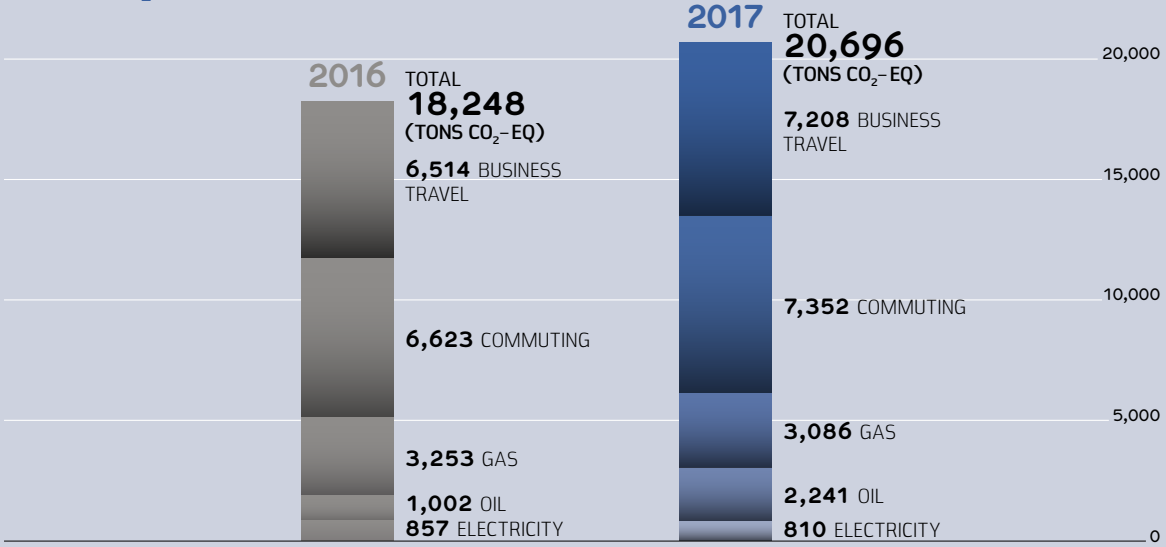
TECHNOLOGY TRANSFER BY FACULTY

	INVENTION & TECHNOLOGY DISCLOSURES	PATENT REGISTRATION[1]	LICENSING	STARTUPS CREATED
Basic Sciences (SB)	**29**	**19**	**12**	**1**
Life Sciences (SV)	**18**	**15**	**6**	**3**
Engineering (STI)	**70**	**48**	**17**	**6**
Computer and Communication Sciences (IC)	**15**	**10**	**9**	**3**
Architecture, Civil & Environmental Engineering (ENAC)	**7**	**3**	**2**	**0**
Management of Technology (CdM)	**0**	**0**	**0**	**0**
College of Humanities (CdH)	**0**	**0**	**0**	**1**
Central Services (including ENT)	**1**	**0**	**4**	**1**
Total	140	95	50	15

[1] priority applications

* Carbon footprint calculated using a life-cycle approach developed with the EPFL spin-off Quantis. Data missing for Geneva outpost + Lugano data center

TOTAL CO_2-EQUIVALENT EMISSIONS*



ENERGY CONSUMPTION	2016	2017
Electricity	81,497	77,288
Oil	2,941	6,575
Gas	13,501	12,809
(MWh)	97,939	96,672

BUSINESS TRAVEL	2016	2017
By air	9,736	10,566
By train	1,337	1,524
By car	105	130
Total (km/FTE)	11,178	12,220

COMMUTING: MODAL SPLIT	WINTER		SUMMER	
	2003	2017	2003	2017
Public transportation	49%	56%	45%	47%
Car	30%	20%	30%	18%
Motorcycle/moped	4%	1%	4%	3%
Bicycle	11%	14%	16%	24%
On foot	5%	8%	4%	8%
Total	100%	100%	100%	100%

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

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