ETH zürich

Press Release

Ten ERC Advanced Grants for ETH Researchers

A major success at the European level

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Ten professors from ETH Zurich – two of them female, and eight male – have secured prestigious ERC Advanced Grants. Three of them are receiving the coveted funding for the second time.

From ETH's perspective, it is not only the result of the current round of funding that is impressive, but also the high success rate: of the 18 applications submitted, 12, or two thirds, reached the second evaluation stage, and more than half were ultimately successful. To put ETH's outstanding achievement into context: only 269 applications out of a total of 2167 received an ERC Advanced Grant. This exceptional result is close to the 2009 record, when ETH researchers won 11 Advanced Grants. This ranks ETH Zurich as the third most successful institution in this research competition after the French CRNS (15 grants) and Oxford University (14 grants).

The grants awarded are worth between EUR 2.2 and 3.2 million each, with an overall total of around EUR 26 million. The new recipients come from seven ETH departments. The variety of topics is once again very broad, ranging from the development of electronically controlled gene circuits to research on weather processes that will shape extreme seasons in future.

At the forefront of the entire range of topics

Detlef Günther, ETH Vice President for Research and Corporate Relations, is particularly pleased that ETH researchers are delivering outstanding results in so many fields: "ETH researchers from a wide range of disciplines have continually succeeded in asserting themselves against strong international competition with their projects. This proves the high quality of the entire spectrum of ETH research."
To maintain its prominent international standing, Swiss business and political leaders, and society as a whole, must be aware of the importance of fundamental research and support it in the long term, says Günther: "While fundamental research does pay off in the short and medium term, its benefits are even greater in the long run. A patient approach, as well as freedom in research, are required. ETH provides both to its researchers – with obvious success."

Another EU grant for visionary ETH project
But that is not the end of ETH's success at the European level: the EU funding pot Future and Emerging Technologies (FET) is part of the Horizon 2020 programme and focuses on supporting particularly visionary and pioneering projects. As part of this programme, Dimos Poulikakos, ETH Professor of Thermodynamics, recently received an FET Grant worth EUR 3 million. He leads an international research team – the only researcher at a Swiss university to do so within the programme. The project aims to research and produce new high-efficiency condensation surfaces on a nanometre scale. The goal is to substantially improve the efficiency of thermal power generation, and also make an important contribution to the production of clean drinking water.

The ten projects at a glance:

Peter Bühlmann is a professor of Mathematics. His focuses are statistics, machine learning and bioinformatics. With the ERC Advanced Grant, he will develop efficient and robust prediction methods for use in questions and scenarios in biology and economics. This entails working on cause-effect relationships in complex volumes of data. The key idea is based on the insight that such relationships (causalities) do not change even if the experimental conditions change or various disturbing influences (perturbations) occur. The ETH researchers are reversing this idea: their algorithms search for stable, unchanging relationships in huge heterogeneous volumes of data. They then use these to infer causalities.

How does nationalism change the state? As part of his ERC Advanced Grant, **Lars-Erik Cederman**, Professor of International Conflict Research, proposes a new theory of nationalist state transformation. He aims to test this theory using historical maps and archival data selected using machine learning. In the ERC project, he examines how states emerge, how nationalism alters external borders and inner structures, and how such processes interact with warfare. Cederman plans to use the results to estimate the extent to which particular political reform proposals – such as territorial division or power sharing – can reduce emerging risks of conflict. The findings could be especially relevant to multi-ethnic states.

In his research, **Martin Fussenegger** looks into synthetic gene circuits for treating metabolic disorders. Some of the circuits are controlled by light. In his ERC project, he wants to develop the basis for electronically regulated gene networks. These innovative networks should allow electricity to control the gene expression and enable electronic genetic programming. The aim is for wirelessly powered implants of designer cells to monitor metabolism, and remotely synthesise protein therapeutics and dispense them in regulated amounts. ETH professor Fussenegger aims to validate the concepts and devices in a proof of concept based on diabetes. This is the second ERC Advanced Grant awarded to the Basel biotechnologist.

Ursula Keller, Professor of Ultrafast Laser Physics, has been awarded a second ERC Advanced Grant. In her new project, she aims to develop a new kind of dual-comb semiconductor laser for use in mid-infrared spectroscopy. This technology would be of interest to many areas of research and industry, such as environmental and pharmaceutical applications. She invented the new concept together

with her research group in the near infrared range. It is based on a single low-cost semiconductor laser that generates two frequency combs and does not need to be further stabilised for many applications, something that is unique in this field. She now wants to bring this laser technology into the mid-infrared range, which the semiconductor technology of her laser makes possible.

Ruben Kretzschmar is a Professor of Soil Chemistry at the Department of Environmental Systems Science. His research team studies processes controlling the cycling of trace elements, some of which are essential for ecosystem functioning and others can be potentially toxic. Iron, the fourth-most abundant element in the Earth's crust, plays a central role in this context, because it affects many biogeochemical processes. In his ERC project, Kretzschmar plans to develop new approaches to investigate iron mineral transformations for the first time *in-situ* in soils and sediments. This will provide novel insights into the cycling of iron and other elements in the environment, and will also have implications for contaminated site remediation, corrosion, archaeology, and other fields.

John Lygeros is a professor of Computation and Control. In his ERC project, he aims to develop new control methods that can be used to optimize large scale, complex systems in data-intensive applications. These include, for example, the foresighted energy management in large buildings or districts based on weather forecasts and other data that is subject to uncertainty. Another example are shared mobility systems that require the coordination of large numbers of users with unknown preferences.

The research of **Marco Mazzotti**, professor at the Institute of Process Engineering, deals with separation processes, with application to biopharmaceuticals and carbon dioxide capture and storage systems, and has a strong focus on crystallisation. Many products in the chemical, food and pharmaceutical industry are produced as powders through a continuous crystallization process, in which crystals are generated by secondary nucleation in agitated crystal suspensions. In his ERC project Mazzotti aims at filling the gaps of scientific understanding on secondary nucleation at the microscale, so as to enable the optimization and control of continuous crystallisation at the process scale. The ETH professor hopes the project will have a substantial impact on the science of crystallisation and the related industrial processes.

Rahul Pandharipande is a professor of mathematics who researches algebraic geometry, focusing in particular on a type of geometric space known as the moduli spaces of curves. The interactions established at the turn of the 20th century between algebraic geometry, quantum field theory and string theory have proven fertile ground – particularly the connections between the algebraic geometry of moduli spaces and path integrals in quantum field theory. Using these integrals, quantum mechanics records every possible path a particle will take when moving from A to B. Supported by a second ERC Advanced Grant, Pandharipande is looking to gain further insight into moduli spaces, and to help solve integrals that are relevant to string theory.

Ruth Signorell's research deals with aerosols and nanoparticles. In her ERC project, she uses photoelectron spectroscopy to study elementary transport processes of slow electrons in liquids and at the interface between liquids and gases, solids and other liquids. To this end, free electrons are generated in free-floating small droplets (aerosols) by the irradiation of high-energy light. A sensitive measurement set-up then measures the speed and direction of the electrons escaping from the droplets. This

project addresses an important question in fundamental research: In which way and how fast do slow electrons lose their energy through collisions with liquid molecules? Findings in this field have many ramifications including the understanding of radiation damage in living organisms.

Heini Wernli is Professor of Atmospheric Dynamics and is interested in the physical processes that determine the structure and development of weather systems, such as low-pressure systems and precipitation events. In his ERC project, he aims at obtaining a comprehensive picture of how meteorologically extreme seasons are shaped in current and future climates. More specifically, he would like to understand how, e.g., the “most rainy winter” might look like in various regions of the world, and what weather processes are responsible for it. In a sub-project, Wernli will also investigate the socio-economic impact of extreme seasons, such as the effect of high or low winter snowfall on Alpine tourism.

Further Information

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Benchmark for top researchers: ERC Grants

ETH researchers have been successfully applying for EU funding – ERC Research Grants – since 2007. In addition to the Advanced Grants, the European Research Council also annually awards Starting Grants to young researchers at the beginning of their careers and Consolidator Grants to successful researchers looking to establish their own group. What’s more, the large number of ERC Proof of Concepts produced by ETH Zurich (funds for drafting feasibility studies and business plans) shows that fundamental research often leads to market innovations with corresponding benefit for the entire economy. The European Research Council (ERC) is part of the EU Research and Innovation programme Horizon 2020 (2014-2020). Switzerland was readmitted as a full participant in Horizon 2020 on 1 January 2017.