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Alexander von Humboldt professorship for Simon Elsässer – "You can think of it as a kind of cellular memory"

Prof. Dr Simon Elsässer will be awarded one of this year's Alexander von Humboldt Professorships in Berlin on 12 May 2026. He took up this post in October 2025 as Professor of Synthetic Biology at the University of Freiburg. With funding of five million euros, Elsässer will strengthen Freiburg's research focus 'Signals of Life' over the next five years. He is also a Carl Zeiss Endowed Professor. Elsässer is one of the world's leading researchers in the advancement of epigenetics and synthetic biology. In this interview, he discusses complex decision-making processes in cells, the significance of signals and what makes the research environment in Freiburg so special.

Professor Elsässer, what is the most exciting aspect of your research?

What fascinates me about research in general is that it involves looking in places where no one has looked before. For me, the possibility of making discoveries is the most exciting aspect of my job. From a technical point of view, I find the question truly fascinating: how can a single blueprint – the human genome – give rise to such a complex organism as the human body, in which there are thousands of different cell types and every cell ultimately has a specific function? In principle, the genome is a raw text: it contains only the base pairs; the proteins are encoded, but when which protein is needed, when and under what conditions a cell divides and changes its properties – or indeed does not – these topics of gene regulation or epigenetics are highly complex and very exciting.

Genes aren't everything...

Exactly, the issue of control or regulation exists in every organism: it must constantly know when to regenerate which cells in different organs in such a way that it does not produce too many new cells, but also not too few. A malfunction here can lead to the formation of tumours. However, it is also extremely important, even in the very earliest stages of embryonic development, that the cells know what the plan is – so that cell lines with different cell types are formed from a single fertilised egg. For example, we have investigated the question of how the early cells decide whether to become the embryo or to form the supporting tissue, i.e. the placenta. The first cell lines divide very early on, before implantation in the uterus even takes place. We have discovered that certain enzymes influence gene regulation in this process: if you manipulate these enzymes, you also manipulate the decision regarding cell type. Ultimately, I am always concerned with the question of how cells, at the molecular level, receive, store, transmit and interpret information at any given time. One can imagine this as a kind of cellular memory, in which a cell's states and previous decisions are represented at the molecular level – within the context of this existing information, the cell then interprets new signals it receives.

What is new about the methods you have developed for your research?

We do not use actual embryos, but rather cell-based model systems or so-called in vitro cell cultures of pluripotent stem cells, which represent the early, undifferentiated cells. Synthetic biology comes into play when we want to control or analyse processes within cells with a very high degree of precision, for example by rapidly switching genes on and off using light or chemical molecules introduced into the cell culture. Here, synthetic biology offers new approaches that are particularly rapid and precise. We spend a lot of time thinking about how we can capture epigenetic processes in a cell in a dynamic way, rather than just taking a static snapshot. It enables us to use the new methods to ask new biological questions: What exactly happens from the moment a signal reaches the cell until it decides to activate new genes or not? How is epigenetic information passed on across cell divisions? In addition to precise manipulations of the cells, we use various omics technologies from systems biology, which allow us to take a holistic look at what happens in the cell following a manipulation at the level of proteins, the genome, gene expression… Here in Freiburg, we have an excellent infrastructure for this; this includes a new mass spectrometer, which we were able to purchase thanks to funding from the Alexander von Humboldt Professorship. This makes it possible to identify and precisely quantify thousands of proteins that exist in the cells.

"The strong research in synthetic biology and the Cluster of Excellence 'CIBSS – Centre for Integrative Biological Signalling Studies', housed in the University of Freiburg's 'Signalhaus', together with the Max Planck Institute of Immunobiology and Epigenetics in Freiburg, offer truly excellent opportunities for my research." - Prof. Dr Simon Elsässer (Alexander von Humboldt Professor and Carl-Zeiss-Stiftung Endowed Professor of Synthetic Biology at the Faculty of Biology, University of Freiburg, and member of the CIBSS Cluster of Excellence)

You are also investigating how our genes interact with factors such as environmental influences, diet, lifestyle and medical history. Could you explain that in more detail?

Yes, these projects are essentially funded by my Carl-Zeiss-Stiftung Endowed Professorship. This is another, equally fascinating branch of epigenetic research. Investigating how, for example, environmental factors influence a person's epigenome is challenging – after all, we cannot usually work with cell cultures here… However, we can glean a great deal from small blood samples taken from people: These contain DNA fragments that still bear the epigenetic modifications of the cells from which they were released. This means we can track epigenetic changes at the level of the entire organism, for example during the course of a disease or ageing. We know that, alongside our genes, many environmental factors such as an unbalanced diet influence our health – but the molecular mechanisms are often still unclear.

Could your findings lead to the development of new treatments?

In clinical practice today, molecular diagnostics are already used much more widely than in the past. In future, epigenetic changes could, for example, serve as diagnostic markers for certain diseases, and the results of such analyses could then be incorporated into clinical decisions regarding appropriate treatments. In our studies on epigenetics in embryonic development, the link to a specific application may not be immediately apparent, but in humans in particular, early pregnancy – when the first cells differentiate and have to organise themselves – is an extremely critical phase; the priority here is to gain a deep understanding of the fundamental mechanisms.

"My Alexander von Humboldt Professorship is a fantastic catalyst for ‚hitting the ground runnning' at University of Freiburg, but just as important is the long-term vision that I can develop here for the professorship; together building a strong research, training and teaching environment creates added value for the faculty and for myself."- Prof. Dr Simon Elsässer (Alexander von Humboldt Professor and Carl-Zeiss-Stiftung Endowed Professor of Synthetic Biology at the Faculty of Biology, University of Freiburg, and member of the CIBSS Cluster of Excellence)

An Alexander von Humboldt Professorship offers many opportunities … Why did you decide to apply for it together with the University of Freiburg?

Even before I applied, I had the feeling that my research would fit in very well with the research environment in Freiburg. This became even clearer during the discussions leading up to my recruitment: The strong research in synthetic biology and the Cluster of Excellence 'CIBSS – Centre for Integrative Biological Signalling Studies', housed in the University of Freiburg's 'Signalhaus', together with the Max Planck Institute of Immunobiology and Epigenetics in Freiburg, offer truly excellent opportunities for my research. We are in the very fortunate position that the CIBSS has been extended for a further seven years from 2026; in my view, this is a real boost for cutting-edge research, not least in terms of its appeal to young research groups. My Alexander von Humboldt Professorship is a fantastic catalyst for ‚hitting the ground runnning' at University of Freiburg, but just as important is the long-term vision that I can develop here for the professorship; together building a strong research, training and teaching environment creates added value for the faculty and for myself. Ultimately, what matters is how one can get involved and flourish within the local community, and where one can find common ground for joint research projects. Research today encompasses so many different facets, methods and questions that interdisciplinary collaboration always brings tremendous added value.

About Simon Elsässer

Simon Elsässer is an Alexander von Humboldt Professor and Carl-Zeiss-Stiftung Endowed Professor of Synthetic Biology at the Faculty of Biology, University of Freiburg, and a member of the CIBSS Cluster of Excellence – Centre for Integrative Biological Signalling Studies. Until 2025, he was an Associate Professor at the Karolinska Institutet in Solna, Sweden, where he took up his first group leadership position in 2015 as part of the Science for Life Laboratory Fellows Programme. He completed his PhD from 2007 to 2011 at Rockefeller University in New York, USA, and subsequently undertook a postdoc in Cambridge, United Kingdom. Elsässer has been awarded numerous prizes and fellowships, including the Swedish Svedberg Prize, the College for Life Science Fellowship from the Wissenschaftskolleg zu Berlin, the Wallenberg Academy Fellowship and the Future Research Leader Fellowship from the Swedish Foundation for Strategic Research. He has also successfully secured an ERC Starting Grant and an ERC Consolidator Grant.

The Alexander von Humboldt Professorship is Germany's most prestigious academic award and is awarded exclusively to leading researchers who are world leaders in their field, currently working abroad, and who are expected to relocate to Germany on a long-term basis to take up the professorship. The Humboldt Professorship is awarded by the Alexander von Humboldt Foundation and funded by the Federal Ministry of Research, Technology and Space (BMFTR). It enables long-term, forward-looking research at universities and research institutions in Germany and contributes to the international competitiveness of Germany as a research location. Since 2008, Humboldt Professorships have been awarded annually as part of the International Research Fund for Germany. In 2020, the Alexander von Humboldt Professorships for Artificial Intelligence (AI) were also established. The award is presented as soon as the appointment procedure for the professorship has been successfully completed.

Press release

11-May-2026
Source: University of Freiburg

Further information

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