The Lake Geneva Region is a hotbed of biomedical research. Leading scientists are united in a common goal: to find treatments for life-threatening diseases. The state-of-the-art cryo-electron microscopy technology provided by the Dubochet Center for Imaging will give them a decisive advantage.
A visionary project

Cryo-electron microscopy (cryo-EM) is a fundamental tool in the development of treatments for cancer, neurodegenerative disorders and other debilitating diseases. The Ecole polytechnique fédérale de Lausanne (EPFL) and the University of Lausanne (UNIL) plan to set up a cryo-EM imaging facility in Lausanne, with two objectives: to fully harness this technology in the biomedical field, and to take this technology to the next level by combining the two schools’ expertise.

The facility will be named the Dubochet Center for Imaging, after Jacques Dubochet, a Swiss researcher who played a pioneering role in developing cryo-EM technology in the 1980s – for which he won the 2017 Nobel Prize in Chemistry. Prof. Dubochet studied at the Ecole polytechnique de l’université de Lausanne (which became EPFL in 1969) and is currently a professor emeritus at UNIL. The Center will be managed jointly by EPFL and UNIL and work closely with the University of Geneva.

The power of cryo-electron microscopy

Understanding how the human body works on a molecular level is a critical step toward developing targeted, effective therapies – and cryo-EM is a powerful tool in this quest. Biomedical researchers can use it to explore the architecture of molecules in three dimensions at close to atomic resolution and in a near-native state.

Jacques Dubochet and his colleagues are credited with the breakthrough that opened the door to the broad use of cryo-EM. In the early 1980s, they created a simple method for preparing samples so that they could stand up to the harsh vacuum conditions used in electron microscopy. The method consists of flash freezing the samples in water so that they will retain their shape without forming ice crystals. Dr. Dubochet’s groundbreaking technique led to an explosion in scientific discovery.

Our impact

The Dubochet Center for Imaging will provide crucial support to biomedical research by offering state-of-the-art equipment and expertise. But it will also aim to advance the technology behind cryo-EM itself: drawing on the vast technological know-how available in Lausanne, the Center will develop a cryo-EM pipeline that outperforms current standards in terms of efficiency and resolution by orders of magnitude.
Leadership and responsibility

Strategic leadership

The Dubochet Center for Imaging is a joint initiative of EPFL and UNIL. Overall responsibility lies with the management of the two schools, represented by Prof. Nouria Hernandez, UNIL Rector, and Prof. Martin Vetterli, EPFL President. A scientific advisory committee composed of internationally recognized experts in the field of imaging will provide independent expert advice.

The Center will work closely with the University of Geneva. The three schools have a proven track record of successful collaboration in education and research, including the joint management of large facilities such as the Center for Biomedical Imaging (CIBM) and the Center for Advanced Surface Analysis (CASA).

Academic power

The Center will be directed by Henning Stahlberg, currently a full professor at the University of Basel's Biozentrum and the director of the University's Center for Cellular Imaging and NanoAnalytics. A physicist by training, Prof. Stahlberg is an internationally recognized expert in the pathogenesis of Parkinson's disease and other neurodegenerative disorders and is equally renowned for his numerous contributions to further advancements in cryo-EM. With his interdisciplinary background, Prof. Stahlberg is well-positioned to make the Center a success.

The Center will also expand regional capacity in this field by creating two new tenure-track assistant professor positions; one in the area of neurodegenerative diseases or cancer, and the other in method development.

In addition, it will train PhD and postdoctoral students, thus teaching the next generation of researchers how to use cryo-EM technology to address research questions of the highest medical relevance, and how to advance the method to new frontiers.

Objective 1: Boosting biomedical research

Neurodegenerative diseases: The Center's equipment will be used to study, with unparalleled precision, the structures of proteins involved in Parkinson's and Alzheimer's disease and the morphology of neuronal cells and brain tissue. This will help scientists understand the molecular causes and mechanisms underlying these diseases, so that they can develop effective therapeutic strategies.

Cancer: The Center will also investigate the ultrastructure of molecules that are drug targets for battling tumor growth, metastasis formation and multidrug resistance. With the help of three-dimensional reconstructions of proteins with bound drug molecules, scientists will learn more about these drugs' function as inhibitors in order to design more precise and selective treatments. The Center will also use its cryo-EM technology to characterize the state of affected tissue in order to visualize the impact of drugs on healthy or diseased cells.

Objective 2: Taking cryo-EM technology to the next level

Sample preparation: Currently, cryo-EM sample preparation involves repeated trials with relatively large volumes of samples. The Center will develop methods to improve the reproducibility of sample preparation, drastically reduce the required amount of sample – which will also allow the Center to study diseases for which only minuscule amounts of samples are available – and automate and accelerate the preparation of cryo-EM samples thanks to robotics and miniaturization.

Data collection: The Center will integrate innovative high-speed camera technology developed at the Paul Scherrer Institute into a modified cryo-EM instrument. This will significantly speed up data collection, reducing the time of one cryo-EM imaging session from a few days to less than one hour. The camera's improved signal-to-noise ratio will also increase the cryo-EM instrument's resolution.

Image analysis: During one cryo-EM session, scientists record multiple terabytes of data containing images of millions of individual protein particles. They then use computers to reconstruct the proteins' three-dimensional structure in high resolution. The Center will help improve this process by developing better algorithms and by implementing a fully automated data processing pipeline that can cope with the very high speed of data collection made possible by the aforementioned camera technology.
A joint venture with great impact

This highly ambitious initiative is designed as a joint venture initiative between EPFL, UNIL, canton of Vaud and private partners.

The startup cost of setting up the Dubochet Center for Imaging is estimated at CHF 35 million, primarily composed of the expenses for cutting-edge instruments and lab infrastructure. Another CHF 35 million to fund the three professorships and operational staff in the first 10 years as well as a running budget of CHF 1.5 million per year for instrument maintenance will be needed to ensure the reliable functionality of the center.

EPFL, UNIL and Vaud Canton have already committed generous support to set up the Dubochet Center for Imaging. To establish a first-class research center with high international visibility, however, significant additional funding will be required.

Leadership

Prof. Nouria Hernandez  
Rector UNIL

Prof. Martin Vetterli  
President EPFL

Honorary Committee

Pascal Couchepin, Committee Chair  
Former Federal Councillor

Prof. Patrick Aebischer  
Former President, EPFL

Prof. Yves Fluckiger  
Rector, University of Geneva

Prof. Pierre-François Leyvraz  
Director, CHUV

Ruth Dreifuss  
Former Federal Councillor

Prof. Pierre Ducrey  
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Prof. Barbara Haering  
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