



University of Luxembourg

LCSB - Luxembourg Centre
for Systems Biomedicine

Highlights 2023

LCSB in brief

The LCSB is an interdisciplinary research centre at the University of Luxembourg. Its 250 staff members combine their expertise in a broad spectrum of disciplines - from computational biology to clinical and experimental neuroscience - to study the brain and its diseases. Research at the LCSB focuses on neurodegenerative disorders such as Alzheimer's or Parkinson's. Collaboration between biologists, medical and computer scientists, physicists, engineers as well as mathematicians offers new insights into complex biological mechanisms and disease processes, with the aim of developing new tools for diagnostics, prevention and therapy.

The LCSB has established strategic partnerships with scientific partners worldwide and with all major biomedical research units in Luxembourg. The centre also carries out collaborative projects with hospitals and research-oriented companies, accelerating the translation of fundamental research results into clinical applications, for the benefit of patients. ■

Cover picture:

Reactive astrocytes (in purple) are surrounding an amyloid plaque (in green) in the brain of an Alzheimer's patient.

Table of Contents

» First Venusberg Meeting in Luxembourg	2
» Editorial	3
» Imaging artificial intelligence	4
» The complex genetics of epilepsy	6
» Excellent Thesis Award	7
» When diet and microbiome modulate Parkinson's disease	8
» The Scienceteens Lab celebrates its 10 th anniversary!	9
» Better care for patients	10
» 100 th PhD graduate	12
» A special advisor for open science	13
» Official visit at the LCSB	14
» Midbrain organoids on the International Space Station	15
» Training the next generation of data scientists	16
» Blood-borne biomarker for Parkinson's	18
» First Industry Partnering Day	19
» Students award best medical teacher	20
» Programme to strengthen international network	21
» Empowering HealthTech Innovation	22
» Mentors meet mentees	24
» First edition of the Digital Medical Device summer school	25
» Invaluable support	26
» A successful decade for "Espoir en tête"	27
» LCSB short stories	28
» Facts & Figures	30
» Publications	35



First Venusberg Meeting in Luxembourg

From 11 to 13 May, the Venusberg Meeting on Neuroinflammation brought together over 250 international students, researchers, clinicians and industry representatives to foster collaboration and discuss the latest advances. Originally held on the Venusberg in Bonn, Germany, the event, led by Prof. Michael Heneka, successfully moved to the University of Luxembourg following his appointment as director of the LCSB in 2022, with the support of the Luxembourg National Research Fund (FNR). The conference, which covered basic and clinical aspects of neuroinflammation and neurodegeneration, explored the multiple roles of immune mechanisms in neurological diseases and their potential as diagnostic or therapeutic targets.

“Our programme showcased the interdisciplinary research that is essential to advance our knowledge and ultimately improve the lives of people affected by neurodegenerative diseases,” said Prof. Heneka after the conference. “Alongside 30 renowned speakers, over 100 excellent posters were presented. The addition of blitz talks also provided an exciting opportunity for young researchers to present their work,” he added. Editors from major journals such as *Cell*, *Nature* and *Science* attended the event as well.

The success of the event cemented its position as a premier conference and established the LCSB as a key institution in neuroinflammation research. Planning is already underway for the next edition in 2025. ■

Building on young talents and international connections

2023 was a challenging year for many, marked by a difficult economic situation and geopolitical tensions worldwide. During times such as these, it feels all the more important to build a sense of community, foster education and allow new talents to rise. In this annual report, you will see how the LCSB contributes to training the next generations of scientists. For example, many of our researchers share their expertise in key disciplines, such as medicine and data science, with bachelor and master students. Some of our group leaders also take part in a new mentoring programme, helping young scientists in Luxembourg to navigate a career in academia. Lastly, the Scienseens Lab, an outreach initiative launched a decade ago, keeps sparking pupils' interest in science, representing a fantastic interface with the Luxembourgish society.

2023 has seen the 100th PhD student graduating at the LCSB as well. Over a few years spent in our midst, doctoral candidates grow into fully-fledged researchers, some of them even rewarded by an Excellent Thesis Award for their work. They are the driving force behind many of our projects and, when they pursue their career elsewhere, they become LCSB ambassadors by joining a network of LCSB alumni and friends in research institutions all over the globe.

Fostering international collaborations is high on the LCSB priority list. Through recurring exchanges with other research centres in Europe, we want to create a tight-knit community working together towards a better understanding of the human brain. We truly believe that sharing skills and knowledge through open science is the way to go. High-level scientific events such as the Neuroinflammation conference that we brought to Belval in 2023 are another way to contribute to the academic community at large. From summer schools to lecture series, we strive to invite international participants to discover our research and our campus.

Biomedical research is a team sport, one where you also need partners from industry and the healthcare sector. The new bioincubator that opened its doors at the edge



of the campus will help the LCSB develop collaborations in that direction and bring our research closer to the market. A successful example of how science can benefit patients and society in general is the launch of the first Réseau de compétences in Luxembourg, an integrated care network for neurodegenerative diseases building on several years of Parkinson's research. In the upcoming years, the LCSB will expand its collaborations with hospitals and healthcare stakeholders in the country aiming to improve the clinical diagnosis and therapy for patients suffering from neurodegenerative disease in Luxembourg.

What better objective is there for the LCSB than doing science with an impact, research with cutting-edge tools to address pressing issues? Our 18 research groups will keep this ball rolling. Including the newest one that focuses on how to best use artificial intelligence to tackle challenges in the field of biomedical imaging, under the leadership of a young principal investigator. And we will soon recruit additional talents, including a new junior group leader, to keep developing a dynamic research centre. ■

Michael T. Heneka

Michael Heneka

Imaging artificial intelligence

In June 2023, the creation of a new group brought to eighteen the number of research teams at the LCSB. Called "Imaging AI", it originates from the computational branch of a previously existing larger group and will focus on how to best use artificial intelligence (AI) to tackle biomedical problems. Led by Dr Andreas Husch, the group aims to bridge the gap between cutting edge algorithms from fundamental AI research and their practical implementation in the field of biomedicine.

"In my opinion, substantial progress in biology and medicine is impossible without computational methods," states the new junior group leader who has combined computer science and medical topics from the start of his career. "This is why our group is dedicated to transferring the latest AI and vision algorithms to real world application, especially when it comes to biomedical imaging." Rather than focusing on developing algorithms, the main task of the team is to integrate novel methods into complex computational pipelines to solve concrete research questions. The goal: make sure the LCSB keeps up with the fast-paced advances in the field. "While it is normal that state-of-the-art technologies take a while to be included in the standard toolbox of researchers, we shouldn't lag too much behind," continues Dr Husch. "Our objective is to have a maximum delay of one generation." It would give the LCSB the opportunity to explore if brand new algorithms are as promising as initial findings suggest and to be among the first putting these to the test with current biomedical challenges.

The applications are numerous and previous projects of the team include work on electrode localisation for Deep Brain Simulation, AI-based image analysis for COVID-19 diagnosis and innovative spectroscopy for fast discrimination of brain tumours. "In recent years, machine-learning models enabled significant advances in the field of medical image analysis," details Dr Husch. "Nevertheless, there are some major roadblocks for a more systematic deployment of these techniques in clinical settings, such as bias, shortcut-learning - when the model learns a simple decision rule that doesn't transfer to real-world scenarios - and data inhomogeneity." One of the team's current projects, done in collaboration with German universities and supported by an INTER grant from the Luxembourg National Research Fund (FNR), is hence aiming towards more robust machine learning approaches for medical image computing.

Another exciting project received an AUDACITY grant from the Institute of Advanced Studies of the University of Luxembourg in December 2023. Called "Audacious

Brain Cognition Data Embeddings" (ABCDE), it was conceived with Dr Marian van der Meulen from the Cognitive Neuroscience group at the Faculty of Humanities, Education and Social Sciences. It aims to integrate different types of biomedical data to study brain function and cognition. "We will transfer a widespread concept called embeddings and use it to combine image analysis with other markers," explains Dr Andreas Husch. "Embeddings can be used to capture the relationships between different types of data. Just like some AI tools are now able to link sound, image, video and text, we want to do the same with functional MRI, blood markers and cognitive test scores." By fusing these - originally quite incompatible - data thanks to recent machine learning and AI techniques, the researchers hope to create a solution to jointly analyse this assemblage for the first time. As brain imaging, cognitive scores and biomarkers form a combination that is highly relevant in neurodegenerative disorders like Alzheimer's or Parkinson's, the results could in the long term also help with predicting disease progression.

"While there is currently a big hype around AI, we are looking forward to provide quality solutions that actually work for specific problems," concludes Dr Husch. "We will strive to translate technological developments into widely applicable clinical tools; to go from machine learning models to coherent, fast and scalable ways for diagnosis and prognosis of diseases." ■



Imaging the brain: From a brain MRI to a digital 3D surface model to a sculpture in real life.



The Imaging AI team

Substantial progress in biology and medicine is impossible without computational methods.

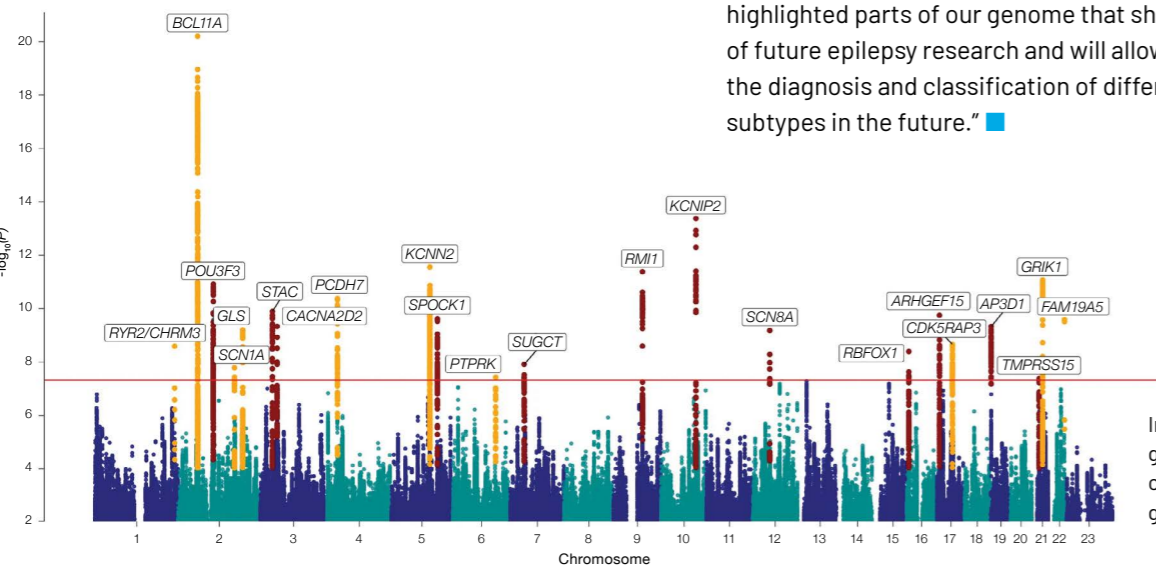


The complex genetics of epilepsy

Epilepsy, a common neurological disorder affecting more than 50 million people worldwide, often has a genetic predisposition. Many genes are known to be involved in epilepsy but, for a relatively common familial form, the underlying genetic causes have been poorly understood.

With a vision of a world where epilepsy is no longer a life-limiting condition, the International League Against Epilepsy (ILAE) brings together 150 researchers from around the world. A key goal is to focus on making progress towards fully decoding the genetic components of the disease. With its dedicated Bioinformatics Core, the LCSB is part of the major international initiatives in epilepsy genetics like EuroEPINOMICS, EpiPGX and Epi25, and serves as the primary data hub for the ILAE Genetics and Genomics Subgroups, overseeing data management and providing state-of-the-art analytical infrastructure.

To unravel the complex genetic background of the disease, the consortium conducted a comparative analysis of nearly 30,000 people with epilepsy and 52,500 without. "Managing and harmonising all the genetic and phenotypic data of such a large cohort is crucial for the success of a study," explains Dr Roland Krause, one of the study's principal investigators at the LCSB Bioinformatics Core. "This is where our long-standing expertise in biomedical data management comes into play."



In red, newly identified genes that are likely to contribute to genetic generalised epilepsy.

The study, supported by the FNR and published in *Nature Genetics*, identified 26 regions of DNA that may play a role in the development of epilepsy, including 19 that are specific to the type of epilepsy known as genetic generalised epilepsy. Within these DNA regions, the researchers also found 29 genes that are likely to contribute to epilepsy. "We were interested in identifying genetic differences between different types of epilepsy," adds Dr Patrick May, who led the genetic analysis at the LCSB. "Together with our team and international collaborators, we were able to show significant differences within a specific subtype of 'generalised' epilepsies and a genetic overlap with other brain diseases."

With a better understanding of the genetic make-up of epilepsy, the researchers were able to show that many of the current treatments target the same epilepsy risk genes. Based on their data, they could suggest some potentially effective alternative drugs that target other risk genes they uncovered in the study. These compounds are currently used to treat other conditions and are therefore excellent candidates for drug repurposing trials.

"These discoveries have only been possible through international collaboration on a global scale, demonstrating what can be achieved when scientists work openly together and share data from around the world," says Professor Helen Cross, President of the ILAE. "We have highlighted parts of our genome that should be the focus of future epilepsy research and will allow us to improve the diagnosis and classification of different epilepsy subtypes in the future." ■



Prof. Simone Niclou, vice-rector for research, and Dr Daniele Proverbio.

Excellent Thesis Award for research on critical transitions

At the 2023 graduation ceremony, Dr Daniele Proverbio received an Excellent Thesis Award of the University of Luxembourg for his work on the classification and detection of critical transitions, which he carried out in the Systems Control group at the LCSB, in the framework of a Doctoral Training Unit called CriTiCs. This is the third year in a row that an LCSB graduate has received this award.

During his doctorate, Dr Proverbio challenged the difficulty of predicting the evolution of complex systems. Examples include the transition of stem cells into specialised cells, unexpected epidemic outbreaks or epileptic seizures. He worked on a general model and then applied it to specific situations. In this way, he was able to move from theoretical modelling to real applications in neuroscience and population biology, as well as epidemiology in the framework of the COVID-19 Task Force.

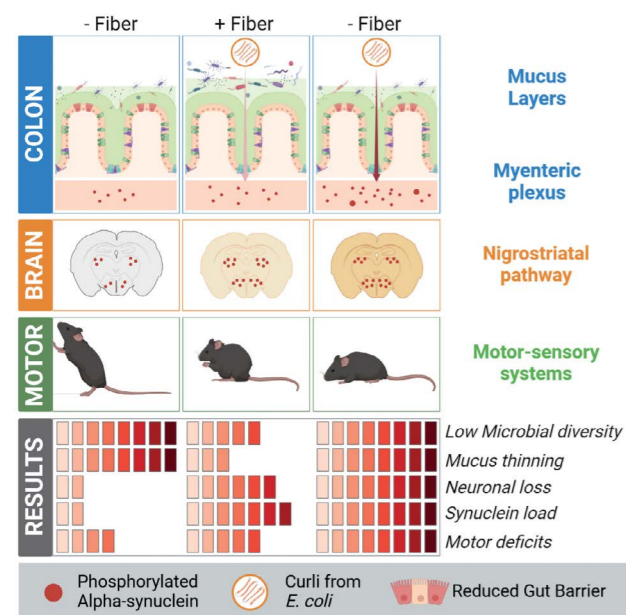
Dr Proverbio is now a postdoctoral researcher in Italy where he is looking at the theoretical underpinnings of such models. "At the LCSB, I found the interdisciplinary synergy I needed to take my work from abstract mathematical theory to direct applications. Within the research group I joined in Trento, I hope to maintain close links with the LCSB and I am looking forward to future collaborations." ■

When diet and microbiome modulate Parkinson's disease progression

In a recent study, supported by the European Research Council (ERC) and the FNR, the Systems Ecology group and the Neuropathology group collaborated to explore the role of diet and the gut microbiome in the progression of Parkinson's disease. Their results, published in *Cell Reports*, show that dietary fibre deprivation and exposure to a specific bacterial protein can exacerbate the disease, highlighting the importance of lifestyle management for patients.

While several risk factors for Parkinson's disease are well-known, it is not yet clear what can modulate its progression over time. In this context, researchers from the two LCSB groups combined their respective expertise to study the effects of diet, the gut microbiome's composition and proteins secreted by these microorganisms in a mouse model of the disease.

These specific transgenic mice overexpress the protein α -synuclein, leading to the progressive apparition of motor symptoms. When fed a low-fibre diet, the microbial diversity in their gut declined. Bacteria associated with



The effects of low-fibre diet and exposure to curli on the gut, brain and motor behaviour of mice.

neuroprotective functions decreased, whereas mucus-foraging ones increased, leading to a thinning of the outer mucus layers in the colon. "As these layers act as a physical barrier against pathogens and the molecules they produce, mucus erosion driven by changes in the microbiome could facilitate access of pathogenic agents to the deeper layers of the gut, notably reaching its nerve cells," details Prof. Paul Wilmes, head of the Systems Ecology group.

Additionally, when combining fibre deprivation with the exposure to curli, a protein produced by bacteria such as *Escherichia coli* that can accelerate the aggregation of human α -synuclein, the gut barrier integrity was further disrupted. Researchers from the Neuropathology group noticed that the presence of curli led to an increase in α -synuclein aggregation in the peripheral nerves populating the colon. "Surprisingly, on top of affecting the gut itself, we saw that this process propagated to the brain," continues Prof. Wilmes.

When the group further explored the effect of this combinatory treatment on the transgenic mice, they first observed that it exacerbated motor deficits: The mice exposed to curli and low fibre showed reduced coordinative ability over time. Similarly, α -synuclein aggregation in the brain intensified under these conditions. "Moreover, when assessing the loss of neurons in the brain of these mice, we concluded that curli combined with a low amount of fibre increased neurodegeneration in this model of Parkinson's disease," explains Dr Manuel Buttini, senior researcher in the Neuropathology group.

These findings indicate that a chronic lack of dietary fibre and specific alterations in the gut microbiome might worsen the progression of Parkinson's disease through the gut-brain axis. The study suggests that some lifestyle modifications could help mitigate the evolution of the disease, such as maintaining a well-balanced diet and exercising caution with antibiotics, as their overuse could promote the growth of detrimental bacteria, particularly those producing curli. ■



From left to right: Prof. Simone Niclou, Prof. Paul Wilmes, HRH the Hereditary Grand Duchess of Luxembourg and Dr Elisabeth John.

The Scienseens Lab celebrates its 10th anniversary!

To mark this important milestone, the Scienseens Lab invited a hundred guests on campus Belval on 12 October. In the presence of Her Royal Highness the Hereditary Grand Duchess of Luxembourg, all the stakeholders who have supported this pioneer project could discover interactive activities, meet Scienseens Lab's alumni and celebrate a successful decade together.

Initiated by the LCSB to spark the interest of young people in science, the Scienseens Lab has welcomed over 14,000 pupils in ten years. "Many contributed to make this adventure possible, from creative researchers working along our very dedicated team to enthusiastic teachers and curious participants," details Dr Elisabeth John, head of the Scienseens Lab. "Similarly, the support of public institutions and sponsors was key to our success. I would like to express my heartfelt gratitude to all of them. Their interest and trust got us here." ■

Better care for patients with neurodegenerative diseases

On 26 September 2023, the 'Réseau de compétences maladies neurodégénératives - ParkinsonNet Luxembourg' was inaugurated on campus Belval. This new national network, the first of its kind in Luxembourg, aims to ensure the best possible care for people with neurodegenerative diseases through close collaboration and improved communication between all relevant institutions.

In response to the challenges posed by an ageing population and the increasing prevalence of neurodegenerative diseases, a joint effort between the healthcare system and scientific research is essential. The new network, launched in the presence of the Minister of Health and the Minister of Higher Education and Research, aims to ensure that each patient receives the best possible care based on the latest scientific knowledge. Initially focused on Parkinson's disease and its atypical forms, the network aims to extend its scope to other neurodegenerative diseases in the future.

Neurodegenerative disorders such as Parkinson's are highly complex and can have many causes, from environmental and lifestyle factors to genetic predisposition. Each person will also experience a different course of the disease. This complexity has led to the identification of different subgroups of patients, each requiring individually tailored therapies. "In order to provide the best possible care for the diversity of people affected by these diseases, the various players in the healthcare and research sectors must work hand in hand," explains Prof. Rejko Krüger, the main initiator of ParkinsonNet Luxembourg. Head of the Translational Neuroscience group at the LCSB and of Transversal and Translational Medicine at the Luxembourg Institute of Health, he is also the clinical coordinator of the new network at the Centre Hospitalier de Luxembourg (CHL).

The réseau de compétences - maladies neurodégénératives is led by the CHL and involves healthcare professionals in hospitals and private practices. It builds on the success of a six-year pilot project led by the National Centre for Excellence in Research on Parkinson's disease (NCER-PD) and based on a concept developed for the Netherlands by Prof. Bas Bloem and Dr Marten Munneke of the Radboud

University Medical Centre in Nijmegen. The network is a model of integrated care, characterised by a high level of collaboration and communication between the healthcare professionals involved. These include neurologists, physiotherapists, occupational therapists and speech therapists, with new professions such as nurses, dieticians, psychologists and social workers soon to join the network. "The team members discuss patients' care, draw up individual treatment plans according to each

person's needs and undergo ongoing specialised training. This ensures optimal care based on the latest scientific knowledge for patients at home, in care institutions and hospitals," explains Sylvia Herbrink, Care Management Coordinator of ParkinsonNet Luxembourg.

Luxembourg's eHealth strategy also plays a key role in facilitating networking for healthcare partners. ParkinsonNet Luxembourg is introducing digital support for care management, an important step in improving day-to-day care for patients. "Luxembourg is in an ideal position to use digital solutions to improve patient care and connectivity within the healthcare system," says Prof. Jochen Klucken, holder of the FNR PEARL Chair for Digital Medicine.

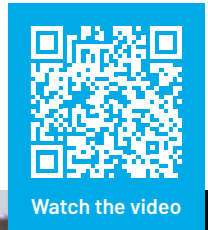
In addition to instigating the implementation of digital medical devices within the new care network, NCER-PD will continue research on Parkinson's disease. Through its large cohort study, researchers have gained fundamental knowledge to better differentiate between the diverse forms of the disease, diagnose them more accurately and thus implement strategies for personalised medicine. In the next phase, specific subgroups of patients will be invited to the Parkinson Research Clinic to study their exact characteristics. Research results will continue to flow directly into ParkinsonNet Luxembourg, where they will be integrated into daily care practices and thus quickly benefit people living with the disease. ■



Optimised care for every patient based on the latest scientific evidence.



Patient ambassador Alex Kloos (centre) becomes the first member of the new integrated care network ParkinsonNet Luxembourg. On his right, the Minister of Higher Education and Research Claude Meisch. On his left, the Minister of Health Paulette Lenert and Prof. Rejko Krüger.





100th PhD graduate at the LCSB

On 13 January, Dr Mariana Ribeiro made history as the 100th PhD graduate of the LCSB. Her thesis, entitled "Identifying key transcription factors of cellular mechanisms in single cell environment for regenerative medicine", was supervised by Prof. Antonio Del Sol, head of the Computational Biology group.

The LCSB is committed to providing cutting-edge resources and mentorship to ensure that its PhD graduates embark on high-impact research careers. PhD students make up a substantial proportion of the centre's academic staff and contribute significantly to the advancement of science.

Since March 2023, Dr Ribeiro has been working as a scientist at the Single Cell Genomics Platform of the Institute of Molecular and Clinical Ophthalmology in Basel, Switzerland. "My time as a PhD student at the LCSB has been invaluable to shape me as a researcher, providing me with a solid foundation in Molecular and Computational Biology," she said after her graduation ceremony in December. "Growing in this interdisciplinary field definitely prepared me to succeed in my new job in translational research." ■

A special advisor for open science

Ensuring accessible data and reproducible results is a hot topic within the research community and part of the mandate of Prof. Emma Schymanski as the new special advisor for open science at the University of Luxembourg. The head of the Environmental Cheminformatics group at the LCSB was nominated for a year (renewable) in May 2023 and tasked with developing policies for research data management and open science.

As a researcher working on the identification of chemical pollutants in the environment and their effect on human health, Prof. Schymanski has developed a keen interest in open science. "Very often, information about these products is locked away in closed databases, which can be very frustrating and has motivated scientists to develop open alternatives freely available worldwide," she explains. Her extensive expertise on the topic is internationally recognised. In January 2023 for example, she was invited to contribute an opinion paper focusing on the importance of open science in water research for the launch of the new journal *Nature Water*.

Appropriate data management and open science practices underpin reproducible research and knowledge dissemination, regardless of the field, and this is where the special advisor comes into play. Her first task: setting up a working group to elaborate a research data management plan at the university. "Together with Dr Inma Peral from FSTM and Dr Helena Korjonen at the Learning Centre, we are mapping practices in the different faculties and centres when it comes to data curation and storage. This way, we will be able to improve how we manage our research data overall," details Prof. Schymanski. The goal is to comply with open and FAIR principles, European regulations and requirements of funders such as the Luxembourg National Research Fund (FNR), without undue burden on researchers.

Encouraging best practices also requires education and outreach activities. Discussions are in progress to train PhD students in data management. When it comes to open science, events are in the planning to raise awareness on the topic. A first event is planned for March 2024, targeting mainly students. Then, an Open Science Week



will be organised in October with seminars and interactive activities. "Open science means several things: Open access publishing of course but also open source code development and open data repositories," underlines Prof. Schymanski. "There is a lot to cover and we need to find the right incentives to convince people."

At the LCSB, 86% of scientific articles published are already open access. Several teams share code developed in-house via GitLab and use open repositories like Zenodo for their research. "PhD students learn from the start to work this way and can see that it has many advantages, including increased visibility, even before publication, and more opportunities for interactions with the academic community," describes Prof. Schymanski. Nonetheless, some aspects require improvements, especially as research at the LCSB often involves clinical data where privacy is a must, making the transition toward open science more complex. "We should still strive for 'as open as possible' as it will ensure the success of large collaborative efforts and the dissemination of knowledge. Together, several small steps could create a world of difference, so I hope many will join in this quest for open and reproducible science!" ■



The German President and his wife (on the right) visit the LCSB, accompanied by the Grand Ducal couple (on the left), and guided by Jenny Ghelfi and Prof. Anne Grünewald (in the foreground).

Official visit at the LCSB

On 11 July, the President of the Federal Republic of Germany, Frank-Walter Steinmeier, and HRH Grand Duke Henry, accompanied by their spouses as well as a governmental and academic delegation, visited campus Belval. "A place that reminds us of the roots of Luxembourg's prosperity but also of the need for change," said President Steinmeier, expressing his admiration for the campus.

The tour included a visit of the LCSB, where the delegation was warmly welcomed by Deputy Director Prof. Paul Wilmes and Prof. Rejko Krüger, head of the Translational Neuroscience group, who introduced the centre and presented its main research topics. During a lab tour, Dr Bruno Santos showed the state-of-the-art Disease Modelling and Screening Platform, while Prof. Anne Grünewald, Dr Sandro Pereira and Jenny Ghelfi presented various models of neurodegenerative diseases.

"I am very proud to see that Luxembourg is at the forefront of research in this field, with the support and commitment of the population," said HRH Grand Duke Henry during his exchange with Prof. Rejko Krüger and Prof. Jochen Klucken at the reception that followed the visit. ■

Midbrain organoids on the International Space Station

In March 2023, an interdisciplinary team of students from the LCSB and the Interdisciplinary Centre for Security, Reliability and Trust (SnT) sent midbrain organoids to the International Space Station (ISS) as part of the Biological Research using Artificial Intelligence in Space (BRAINS) project. These organoids are 3D neural cell cultures composed of diverse neuronal cell types found in the human midbrain and are essential for studying brain development and diseases, particularly Parkinson's disease. The aim of the BRAINS project was to further improve these organoid models by investigating the effect that microgravity could have on their development. The experiment was selected in the framework of the Überflieger 2 competition, organised by the Luxembourgish Space Agency and the German Aerospace Centre.

"This was an amazing opportunity and a great honour for us as our project was the first experiment from Luxembourg to be launched into space," explains Elisa Zuccoli, leader of the BRAINS team and PhD student in the Developmental and Cellular Biology group at the LCSB. Prior to the launch of the organoids grown at the LCSB aboard a SpaceX Falcon 9 rocket, the team made final preparations at the Space Stations Processing Facility at the Kennedy Space Centre in Florida, USA. "Working side-by-side with other international teams added a unique dimension to our project," says Daniela Vega Gutierrez, an LCSB master's student at the time.

The organoids were housed in the CUBELAB, a miniaturised and fully automated cell culture laboratory developed by Lina María Amaya Mejía, Aelyn Chong Castro and José Delgado at the SnT. "Using the SnT's expertise in space robotics, we were able to create a system that could autonomously replace the cell culture media and allow the experiment to run for 30 days without any intervention from the busy ISS astronauts," explains José Delgado.

"Despite a software error that caused one of the cell culture containers to leak, we were able to recover several intact organoids from the second container and we have just completed the control experiments that were performed



The BRAINS team at the Kennedy Space Centre.

here on Earth," explains Elisa Zuccoli, who looks forward to completing the in-depth analysis of all the samples in 2024. Preliminary results suggest that the organoids sent into space may have survived longer and developed further than those that stayed on Earth.

"With this project, our students have tried to improve this research model to gain further insights into neurodegenerative diseases such as Alzheimer's and Parkinson's," explains Prof. Jens Schwamborn, head of the Developmental and Cellular Biology group. Together with Prof. Miguel Olivarez Mendez, his counterpart from the SnT, he fully supported the project from the beginning, providing guidance, advice and additional resources. In addition to the funds awarded as part of the Überflieger 2 competition, the BRAINS team is thankful to the private sponsors – Banque Internationale de Luxembourg (BIL), Foyer Assurances SA, Technoport SA, Amis de l'Université du Luxembourg and SES – who made this incredible project possible. ■

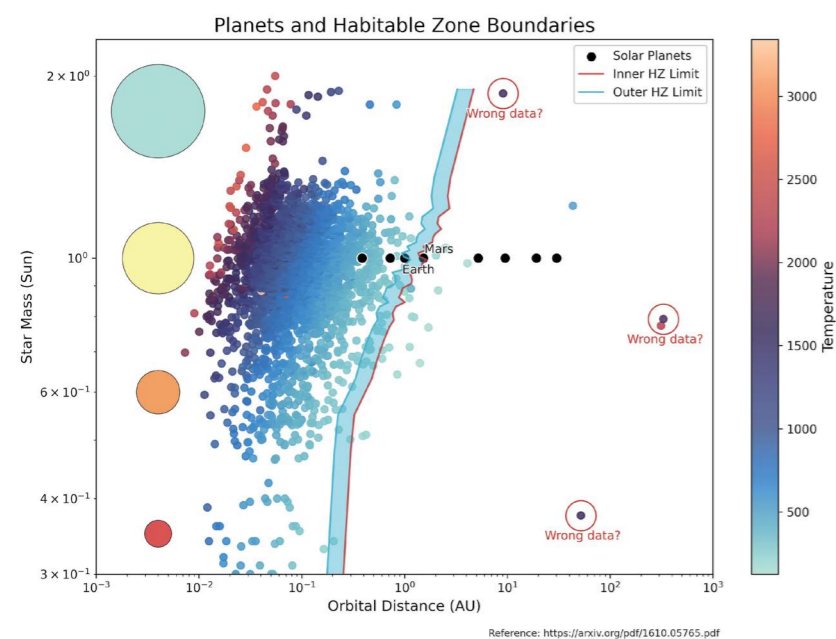
Training the next generation of data scientists

Research in life science is reliant on vast amounts of data, computational tools and statistics. Thus, there is a critical need for data science and bioinformatics expertise in the field. Researchers must learn skills in computational data analysis early on and develop an understanding of concepts such as machine learning and artificial intelligence (AI).

“Progress toward educating and training life scientists in the fundamentals of bioinformatics has been slow,” explains Dr Venkata Satagopam, researcher in the Bioinformatics Core at the LCSB and co-chair of the Education committee at the International Society for Computational Biology (ISCB). With a group of international collaborators, he regularly reflects on what is needed to improve education in the field. In 2023, they published an article in *Nature Biotechnology* identifying the existing challenges, from defining the core competencies that students should master to supporting lifelong learning for researchers and keeping pace with computing and technology advances. “We want to provide a framework to help develop curricula that match the needs of different stakeholders and harmonise training worldwide.”

At the LCSB, data scientists and bioinformaticians are highly sought. “We are having difficulties recruiting analysts,” says Dr Roland Krause, researcher in the Bioinformatics Core. “So it was obvious that we should contribute to educate and train the future generations ourselves.” When the University of Luxembourg launched a Master in Data Science directed by Prof. Yannick Baraud from the Faculty of Science, Technology and Medicine, several LCSB members were involved from the start, teaching courses ranging from data visualisation and AI to integrative bioinformatics and an introduction to biology for non-biologists. Over the course of the two-year programme, Dr Krause and colleagues Dr Andreas Husch, head of the Imaging AI group, Prof. Emma Schymanski, head of the Environmental Cheminformatics group, Prof. Alexander Skupin, head of the Integrative Cell Signalling group, and Prof. Anne Grünewald, head of the Molecular & Functional Neurobiology group, teach around 250 hours of lectures and practical workshops.

Data science has blossomed in the past decade as the amount of data collected in all aspects of life increased massively through digitalisation. “It is an interdisciplinary hybrid field that relies on computer science, statistics and analytical science,” details Dr Krause. “It has strong ties to mathematics, but it is very connected to real-world questions and by now it is at the core of the scientific research process.” By teaching students the basics of data science – collecting, managing and analysing large amounts of data while ensuring data privacy and security – they can then apply it to any field they want.



Plot created by a student of the master during the data visualisation course.



From left to right: Prof. Emma Schymanski, Prof. Anne Grünewald, Dr Roland Krause, Dr Andreas Husch and Prof. Alexander Skupin, lecturers for the Master in Data Science.

Data management and analysis are now at the core of the research process.

Dr Krause continues: “These students will strengthen Luxembourg’s work force in general and some will contribute to biomedical research. Several of them stayed in academia for their master’s thesis and trained by working on research projects, so they are already helping with our needs in term of data scientists.” Along the same lines, Dr Andreas Husch, who introduces the students to imaging AI and applying it to medical problems during the last semester, hopes to train scientists who could become members of his research group later on.

In December 2023, the Master in Data Science awarded its first diplomas to 14 graduates who are already forging their careers as analysts, data scientists and research assistants across various sectors, both in Luxembourg and internationally. Their teachers are now training around 30 new students from all over the world and from diverse academic backgrounds who will become the next generation of experts in this expanding field. ■

Blood-borne biomarker for Parkinson's

In 2023, an international team of researchers from Japan and Luxembourg showed for the first time that pathological forms of the α -synuclein protein present in the blood of patients can be used for the diagnosis of Parkinson's disease and its differentiation from several other neurodegenerative motor disorders. Their groundbreaking results, published in *Nature Medicine*, constitute a major step towards developing better diagnostics based on a simple blood test.

Parkinson's disease, dementia with Lewy bodies and multiple system atrophy compose a group of neurodegenerative disorders called synucleinopathies. They are caused by the abnormal aggregation of a protein called α -synuclein. These aggregates progressively appear in the brain of patients causing neuronal cell death and leading to different neurological symptoms. Diagnosis can be a lengthy process, involving clinical examinations and medical imaging. Furthermore, differentiation between these diseases is a challenge in the early stages.

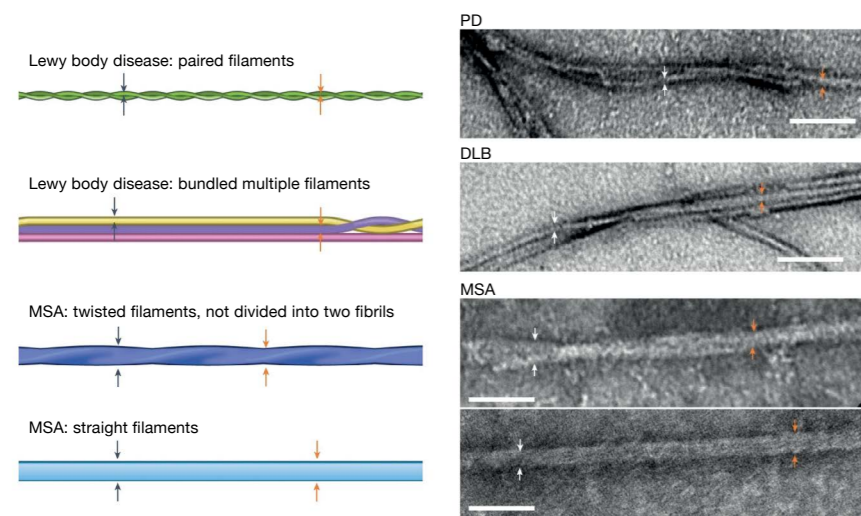
As previous studies had revealed that α -synuclein accumulates not only in the brain but also in peripheral nerves, researchers from Juntendo University, the RIKEN Centre for Brain Science and Nagasaki University hypothesised that so-called α -synuclein seeds might

also be found in the blood of patients. These pathological forms of the protein, that can induce the misfolding and aggregation of normal α -synuclein molecules, would then circulate through the vascular system and contribute to the progression of the disease.

The Japanese scientists developed a novel method to detect very small amounts of α -synuclein seeds in serum and then conducted a large-scale screening of patients with different synucleinopathies. They teamed up with scientists from Luxembourg to benefit from the unique longitudinal clinical and neuropathological database established during the past decade in the country, as part of the National Centre of Excellence in Research on Parkinson's Disease. "We have been following large groups of people diagnosed with Parkinson's disease and other forms of parkinsonism annually for up to nine years in which we have traced clinical progression and collected biological samples," details Prof. Rejko Krüger, director of Transversal Translational Medicine at the Luxembourg Institute of Health and head of the Translational Neuroscience group at the LCSB. Prof. Michel Mittelbronn, head of the Luxembourg National Centre of Pathology, adds: "We have also established the Luxembourg Brain Bank which gives us access to brains donated by study participants for *post-mortem*

analyses. It provides complementary neuropathological diagnostics, the gold standard for diagnosing neurodegenerative disorders, which can be used to validate clinical findings."

The collaboration proved successful: the new method detected α -synuclein seeds in the serum of 95% of patients with synucleinopathies. In addition, it also revealed that the structure of these seeds shows specific patterns that differ between diseases. These results will help to establish a simple diagnostic test based on the presence and specific shape of α -synuclein seeds in blood: a game-changer when it comes to the diagnosis of synucleinopathies. ■



Representation of the structures of the α -synuclein filaments observed in different diseases, along microscopy images of samples from patients with Parkinson's disease (PD), dementia with Lewy bodies (DLB) and multiple system atrophy (MSA).



First Industry Partnering Day

On 18 October, the LCSB hosted its first Industry Partnering Day, an event aimed at positioning the centre as a key player in the research and innovation landscape. The initiative was designed by the Innovation and Partnering team to present the high-impact activities of the LCSB to relevant stakeholders, attract industry partners for collaboration and explore additional funding opportunities through industry partnerships.

The event was attended by guests from fourteen different companies, seven of which were from the Greater Region. Attendees came from a variety of backgrounds, representing sectors such as pharmaceuticals, biotechnology, information technology and contract research organisations. Industry representatives were invited to gain an insight into the diverse research groups and platforms at the LCSB, and the centre's overall contribution to neuroscience research. The day included lab tours, a networking lunch and one-to-one meetings with principal investigators and platform managers.

"It was a great success as we already had follow-up discussions on several collaborations between companies and our researchers," said Prof. Michael Heneka, director of the LCSB and initiator of the event. Looking ahead, the LCSB plans to make the Industry Partnering Day a regular occurrence, with the aim of increasing its size and including showcases of successful industry projects. ■



Students award best medical teacher

Prof. Jochen Schneider, head of the Medical Translational group at the LCSB and of chronic disease research at the Department of Life Science and Medicine of the Faculty of Science, Technology and Medicine, was voted Best Medical Teacher 2022-2023 by the students of the Bachelor of Medicine.

The award was presented at the opening of the winter semester, in recognition of his dedication to teaching hormonology-endocrinology as well as pathobiochemistry and laboratory medicine. "Receiving this award came as a complete surprise to me," said Prof. Schneider. "I am very grateful and honoured to receive this recognition from the students and I look forward to further develop our teaching programme in medicine in the coming years."

Prof. Schneider has been involved in the Bachelor of Medicine since its inception in 2019. With an additional teaching position as Professor of Internal Medicine and Endocrinology at Saarland University Hospital Homburg/Saar and a teaching accreditation in Pathobiochemistry and Laboratory Medicine at the University of Würzburg, Prof. Schneider brings a wealth of experience in medical education to the University of Luxembourg. ■

Fellowship programme to strengthen international network

Collaborations with international partners are key elements for the success of an interdisciplinary research centre. As part of its internationalisation strategy, the LCSB launched the International Fellowship Programme in 2023 to foster exchanges between its groups and research institutions in Europe and beyond, and to further establish itself as a sought-after collaboration partner worldwide. For the LCSB research groups, this is an additional source of funding for projects with selected institutions that fit within the centre's key strategic objectives.

"We launched the first international fellowship call at the beginning of 2023 with the aim of consolidating the already existing links with the Institute of Biomedicine of Seville (IBiS) in Spain," explains Dr Françoise Meisch, strategic advisor at the LCSB. "After careful consideration of the three proposals submitted and based on external reviews, the project of Dr Santiago López-Begines was selected for funding. He has now joined the LCSB as a postdoctoral researcher but will also spend some time at IBiS, where he has worked before."

The project 'Molecular mechanisms of neurodegeneration in zebrafish models of neuronal ceroid lipofuscinosis' aims to combine the expertise of the Enzymology and Metabolism group led by Prof. Carole Linster at the LCSB and of the Molecular Physiology of the Synapse group led by Dr Rafael Fernández-Chacón at IBiS. Both teams conduct research in the field of lysosomal storage disorders, a group of rare genetic diseases in which a specific digestion and recycling pathway is disrupted, leading to the accumulation of waste products that damage cells and tissues. They focus on neuronal ceroid lipofuscinosis, a subset of these disorders caused by defects in 14 different CLN genes, at least 8 of which cause the accumulation of lipopigments in neuronal cells.

"IBiS and the LCSB have developed different models of gene deficiencies involving the CLN3, CLN4 and CLN13 genes. We hope to be able to combine our technical expertise and knowledge of each model to advance



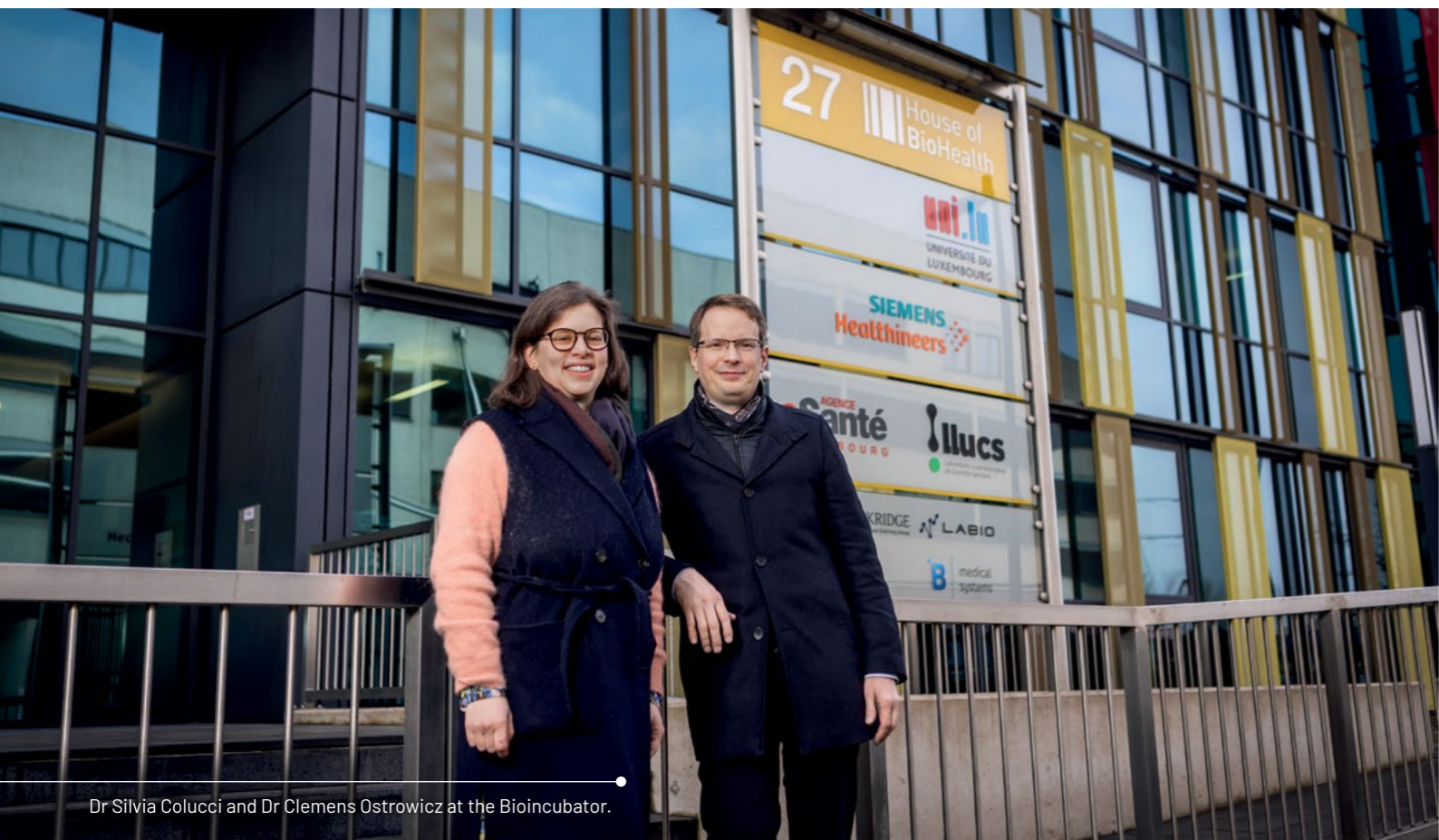
the understanding of the different diseases and move towards the discovery of pharmacological interventions," explains Dr López-Begines.

In addition, the project combines several strategic objectives of the LCSB. "CLN genes are also associated with Parkinson's disease and tau progression in Alzheimer's disease, so it brings together our evolving focus on rare childhood diseases with our cornerstone research focus on age-related neurodegeneration," comments Prof. Michael Heneka, head of the LCSB. "All this while consolidating our links with this leading institute in Sevilla."

The LCSB will continue the International Fellowship Programme with at least one call per year. Each call will be tailored to a selected partner institution, with the aim of fostering a long-term strategic collaboration and establishing the LCSB as a household name in the field of neurodegenerative diseases research worldwide. ■

Empowering HealthTech Innovation

The LCSB is committed to being an integral part of the country’s evolving biohealth innovation ecosystem. At the heart of this initiative is the Innovation and Partnering team, which enables the efficient transfer of knowledge and technology developed at the LCSB into tangible applications with societal impact.



Dr Silvia Colucci and Dr Clemens Ostrowicz at the Bioincubator.

“We act as a link between researchers and industry partners, facilitating collaborations that enrich the R&D ecosystem and bridge the gap between academia and industry,” explains Dr Clemens Ostrowicz who leads the team. “This enhances the LCSB visibility and opens up new avenues for the practical application of research results.”

The team aims to leverage the existing healthtech innovation ecosystem in Luxembourg and abroad. “In order to guide our researchers towards the best partnership opportunities, we need to have a good

overview and understanding of possible partners and potential areas of mutual interest,” says Léa Delacour, Technology Transfer Officer at the LCSB. “Being part of and contributing to this ecosystem not only enables exciting collaborations but also opens up career options for our staff beyond their immediate academic environment.”

One of the team’s recent achievement is its involvement in the establishment of Luxembourg’s first Bioincubator that provides equipped laboratory space tailored to the

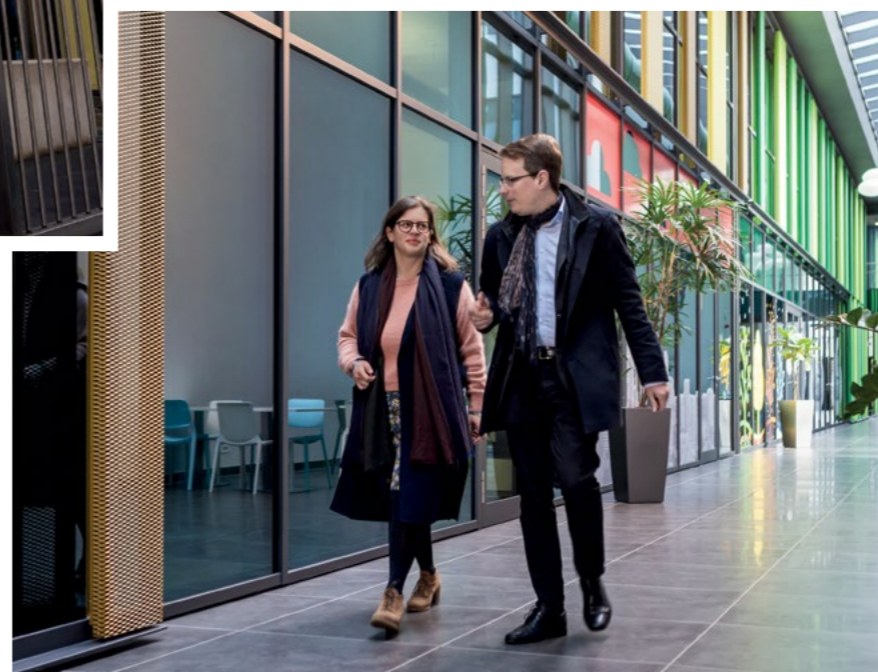
specific needs of health technology start-ups. Supported by the Ministry of the Economy and the Luxembourg National Research Fund (FNR), the Bioincubator is a collaboration between the LCSB, the Luxembourg Institute of Health (LIH) and Technoport, the leading technology incubator in Luxembourg. The management team includes Dr Clemens Ostrowicz in the Executive Committee and Dr Silvia Colucci, Partnership Development Officer at the LCSB, as the current manager. This initiative is a testament to the country’s commitment to fostering a robust entrepreneurial ecosystem in the HealthTech sector.

Located in the House of BioHealth in Esch-sur-Alzette, the Bioincubator is part of the larger HE:AL campus currently under construction. It is strategically located near the future Südspidol hospital campus, the University of Luxembourg and other national research institutions, providing an ideal environment for HealthTech companies. This unique facility not only offers flexible wet lab and office space on over 300 m² but also provides essential business support services to early-stage companies. Among the companies hosted by the bioincubator are two LCSB spin-offs: OrganoTherapeutics, which uses brain organoids for drug discovery in Parkinson’s disease, and NIUM, a platform that provides personalised metabolism-based dietary recommendations.

“Next to its involvement in the Bioincubator, our team is also here to support any new LCSB spin-off initiative. We identify projects that are suitable and support them in the first steps of their entrepreneurial journey, facilitating the transition between academia and business,” says Dr Silvia Colucci. On top of working in tight collaboration with researchers, the team also collaborates with the central technology transfer office of the university. Furthermore, two legal advisors manage the LCSB industry partnerships, all of which require a precise legal framework. They ensure that partnership agreements are fair to all parties and comply with the latest legal standards.

By bringing together all the necessary expertise, the Innovation and Partnering team acts as a catalyst: It helps moving innovative ideas from the lab to industry, contributes to the growth of Luxembourg’s HealthTech ecosystem and supports the establishment of the LCSB as a sought-after industry collaboration partner. ■

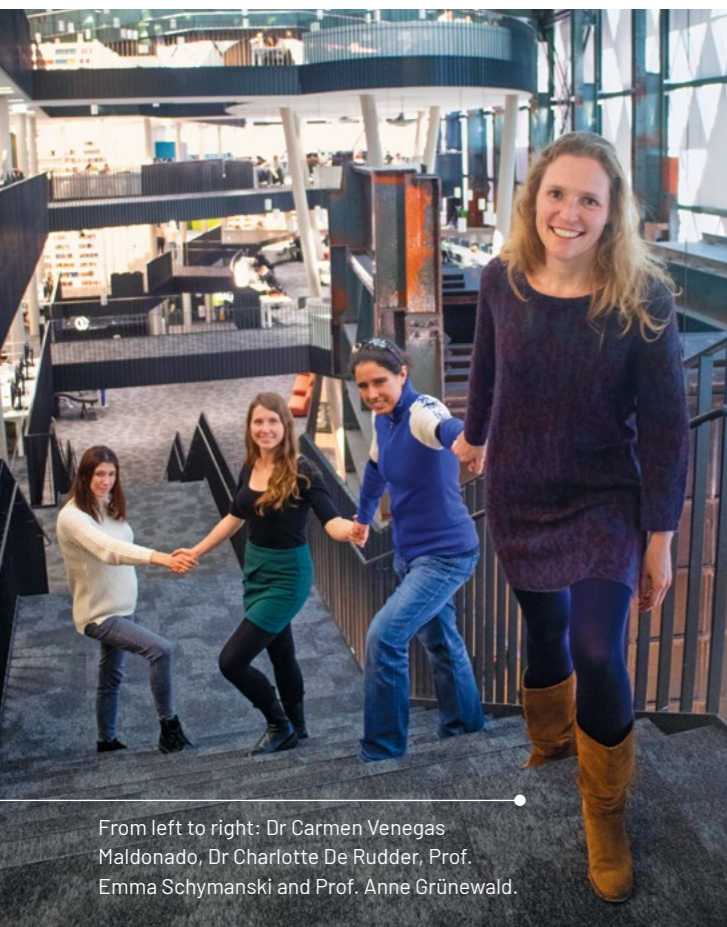
Contributing to the R&D ecosystem, identifying innovative ideas and acting as a catalyst for exciting industry collaborations.



Mentors meet mentees

In 2023, several LCSB members participated in the ADVANCE mentoring pilot programme initiated by the Gender Equality Office of the university. The objective: facilitating career development through conversations between a mentor and a mentee, and offering training to support women and other underrepresented groups in academia. For both the principal investigators who shared their knowledge and the post-doctoral researchers who received guidance, the experience was eye-opening.

“It was my first time as an official mentor, but I have some experience with this type of interaction,” explains Prof. Anne Grünewald, head of the Molecular & Functional Neurobiology group at the LCSB. “I have myself somebody who acts as a sort of advisor and who I turn to when I make big career decisions, so I know how important this can be.” Along with Prof. Emma Schymanski, head of the



From left to right: Dr Carmen Venegas Maldonado, Dr Charlotte De Rudder, Prof. Emma Schymanski and Prof. Anne Grünewald.

Environmental Cheminformatics group, she was one of the two LCSB principal investigators who took part in the programme. As mentors, their main role was to have regular one-on-one discussions with their mentees. “We covered different questions, from the pros and cons of a career in academia to how to deal with the non-scientific part of the job such as conflict resolution,” details Prof. Grünewald. “For me, it was interesting to get some insight into the mind of the younger generation and their outlook on their career and, for mentees, it is of course crucial to consider all these aspects when choosing their next steps.”

Dr Charlotte De Rudder, the post-doctoral researcher in the Systems Ecology group, who was paired with Prof. Grünewald agrees: “These discussions gave me the opportunity to explore different career options. I now have some insights into what it means to be a team leader in academia but also to work in other positions as Anne put me in contact with people she knows in different sectors. As a result, I have a much clearer picture of what I would like to do next.” In addition to the one-on-one sessions, the programme includes workshops for the mentees, allowing them to meet young researchers from all disciplines and to build a network of peers. “We were able to share our experiences and struggles, and it gave participants a welcome boost of confidence,” explains Dr De Rudder.

Another LCSB mentee, Dr Carmen Venegas Maldonado, post-doctoral researcher in the Molecular & Functional Neurobiology group, concurs. She mentions how she stayed in touch with the people she met during a workshop on leadership in science focusing on female researchers. “These two intensive days of presentations and practical exercises were a highlight. Along with the CV writing training, they complemented the mentoring sessions really nicely,” she says. Another strength of the programme according to her: the organisation team whose availability and flexibility helped her navigate the different activities.

With such positive reviews, no doubt the ADVANCE programme has a bright future ahead, just like the mentees it empowers. Hopefully, it will contribute to bring or keep many young women on the path of a successful career in science, at the LCSB and elsewhere. ■



First edition of the Digital Medical Device summer school

On 10-21 July, the University of Luxembourg and the IESE Business School of the University of Navarra held the first Digital Medical Devices summer school, a training programme for future digital healthcare innovators funded by the European Union through EIT Health.

Seventy international participants were selected for two weeks of intensive learning to discover the lifecycle of digital medical devices, from identifying unmet clinical needs to bringing a new device to the market. The first week was held in Luxembourg and the second in Barcelona. The hands-on training comprised of lectures and workshops during which participants worked on challenges in groups, like in a hackathon.

“This first edition was an outstanding example of how to support digital adoption and transformation of medicine through education,” says Prof. Jochen Klucken, FNR PEARL Chair for Digital Medicine at the LCSB and the Luxembourg Institute of Health, and coordinator of the summer school in Luxembourg. “After this success, we are already planning the next editions of the Digital Medical Devices Summer School.” ■

Invaluable support



The Finance & Grants team

At the LCSB, the Finance & Grants team plays a key role: They help the centre's principal investigators (PI) navigate the funding and financing process for their research projects, ensuring that they can focus on their scientific endeavours while making the most efficient use of available resources.

In order to best support the researchers, the team's approach covers every stage of a project's lifecycle, starting at the very beginning: "Once a PI expresses interest in submitting a funding proposal for a project, our research facilitators can guide them toward the best-suited funding opportunities," explains Mounir Maaoui, team leader of Finance & Grants. "While our grants experts give some helpful input during the proposal writing process, our financial controllers provide assistance in estimating various costs, be it staff salaries, consumables or larger one-off purchases."

Once a project has been approved, a kick-off meeting is held with the PI, the researchers working on the project and the Finance & Grants team to set out the scientific expectations and the precise budget framework. The team's support continues throughout the project, including monthly or quarterly budget reviews and regular meetings. "These meetings help us establish a trusting

relationship between the PIs and their dedicated research facilitators and financial controllers. This enables smooth communication and allows us to stay on top of potential issues," details Mounir Maaoui.

The importance of the Finance & Grants team becomes even more apparent in the pre-closing phase, when remaining budgets are assessed and measures are taken to ensure that these funds remain available for necessary purchases. The team's proactive involvement in reallocation and budget management comes into play. "Keeping up to date with a project's progress and remaining funds, especially towards the end, helps to ensure that resources are used efficiently," adds Mounir Maaoui. "By thoughtfully managing finances, we also maintain the LCSB reputation and high standing with funding bodies, that can trust that the resources they provide are used according to their expectations."

The LCSB Finance & Grants team is a cornerstone of the support offered to researchers at the centre. The team's expertise allows a balance to be struck between providing the necessary flexibility in spending to enable researchers to achieve their scientific goal and providing clear and auditable accounts to funding partners in Luxembourg, Europe and beyond. ■



From left to right: René Friederici, Tom Reinert, Prof. Paul Wilmes, Norbert Friob and Frank Hartmann.

A successful decade for "Espoir en tête"

On 21 November, the LCSB celebrated the success of the "Espoir en tête" initiative launched a decade ago. Members of all the Rotary clubs of Luxembourg attended the event.

Originally started by Rotarians in France, Espoir en tête organises film premieres and donates the proceeds from ticket sales to research. Mr Norbert Friob, a prominent figure in Luxembourg and one of the university's earliest and most dedicated donors, was instrumental in bringing this successful initiative to the country in 2013. To date, it has raised well over half a million euros for brain research.

An evening of science, featuring a lecture on the role of the microbiome by Prof. Paul Wilmes, was the perfect occasion to celebrate this fundraising achievement. It was an opportunity for Rotarians to learn about the latest scientific findings and to present Prof. Wilmes with a special award of 50,000 euros, generously donated by Mr Friob. ■

LCSB short stories



20 years of ideas!

In 2023, the University of Luxembourg celebrated its 20-year anniversary. On this occasion, the university organised a lecture series entitled "20 years of ideas!". Open to all and held in different languages, these scientific lectures showcased research carried out in Luxembourg. In this framework, Prof. Michael Heneka, director of the LCSB, and Prof. Paul Wilmes, head of the Systems Ecology group, presented their work on Alzheimer's disease and the microbiome to large audiences.



Emma Schymanski promoted to full professor

Prof. Emma Schymanski, the principal investigator of the Environmental Cheminformatics group, was promoted to full professor as of September 2023. She started to work at the LCSB in 2017 before becoming a FNR ATTRACT fellow just a year later. She is successfully leading research on identifying unknown chemicals and their effects on human health, and taking part in several international consortia. Congratulations!



Open labs!

On 18 March, the university organised its Open Day, during which prospective students and the general public could explore the campus. On this occasion, the LCSB invited visitors to take a look behind the scenes and learn more about biomedical research. Researchers from the Neuroinflammation group, the Developmental and Cellular Biology group and the Enzymology & Metabolism group offered guided lab tours. Around 60 visitors discovered how we study the human brain, using high-tech equipment and model organisms.



Chime Bell Award

In May, Prof. Jorge Gonçalves, head of the Systems Control group, received the Chime Bell Award in recognition of his work in the fields of modelling and machine learning. This award is presented to foreign experts who made significant contributions to the Hubei province of China. Prof. Gonçalves has a long-standing collaboration with the Huazhong University of Science and Technology. One of his projects focused on survival prediction in patients with severe COVID-19 infection.



Prize for the COVID-19 Task Force

Under the aegis of the Fondation de Luxembourg, the 2022 Science for Society Prize was awarded to the Research Luxembourg COVID-19 Task Force, represented by Prof. Paul Wilmes. This task force, a collective effort between several Luxembourg institutions, was commended for its key role in coordinating the support from the research community to healthcare providers and the government while bringing research findings to the public's attention in informative ways.



Hands-on discoveries

The LCSB participated in the Science Festival 2023 with a workshop about the brain. A team of researchers and communicators invited visitors to put together a brain puzzle, explore neuronal networks and compete in a board game on prevention of neurodegenerative diseases. The Scienceteens Lab also had a booth at the event where participants could find out how scientists use robots to measure and transfer liquid.

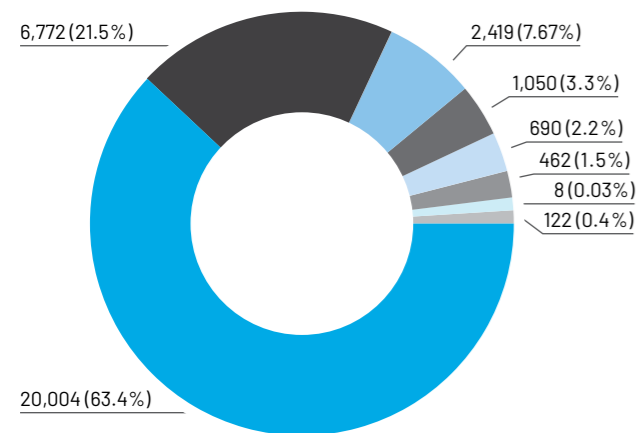


European grants

In 2023, several research projects involving LCSB scientists received European funding. The LCSB contributes for example to IDERHA, a public-private partnership addressing the obstacles in accessing and analysing health data. Researchers from the Bioinformatics Core also participate in LEOPARD, a project developing computational tools to improve liver transplants, and in COMMUTE, focusing on comorbidity between COVID-19 and neurodegenerative diseases.

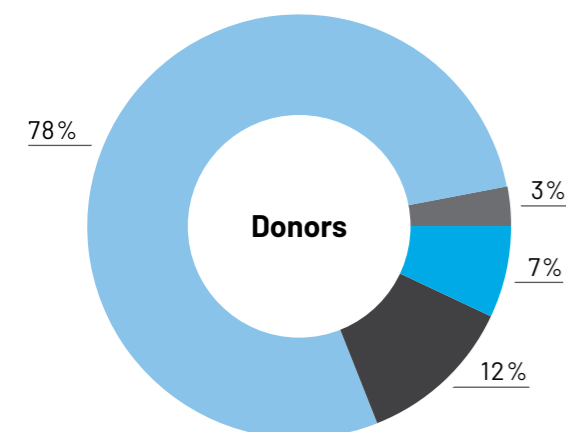
Facts & Figures

2023 LCSB income (in kEUR)



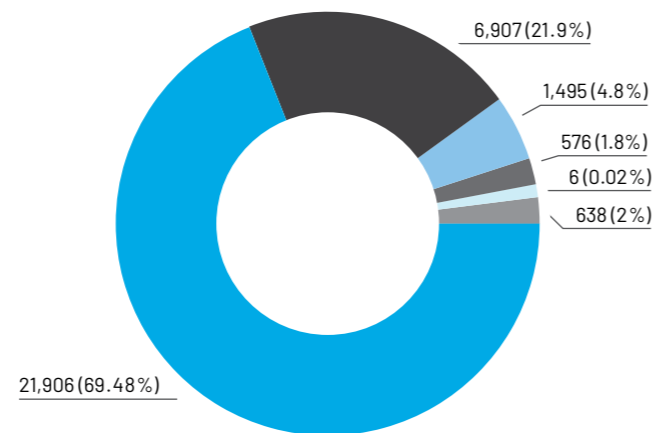
- University of Luxembourg
- Luxembourg National Research Fund (FNR)
- EU programmes
- Fundraising
- Further grants
- Ministries
- Funds for knowledge transfer
- Industry cooperation

Fundraising

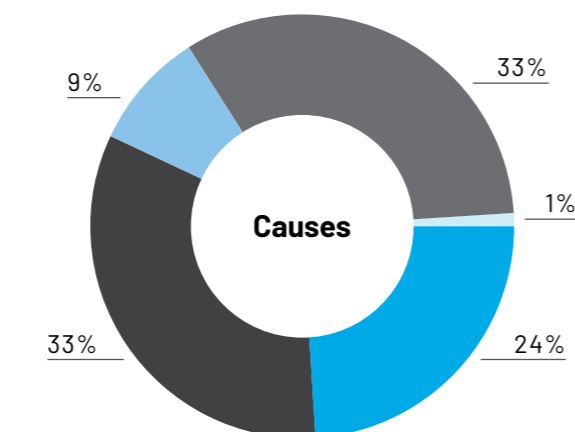


- Associations
- Corporate
- Foundations
- Private individuals

2023 LCSB expenses (in kEUR)

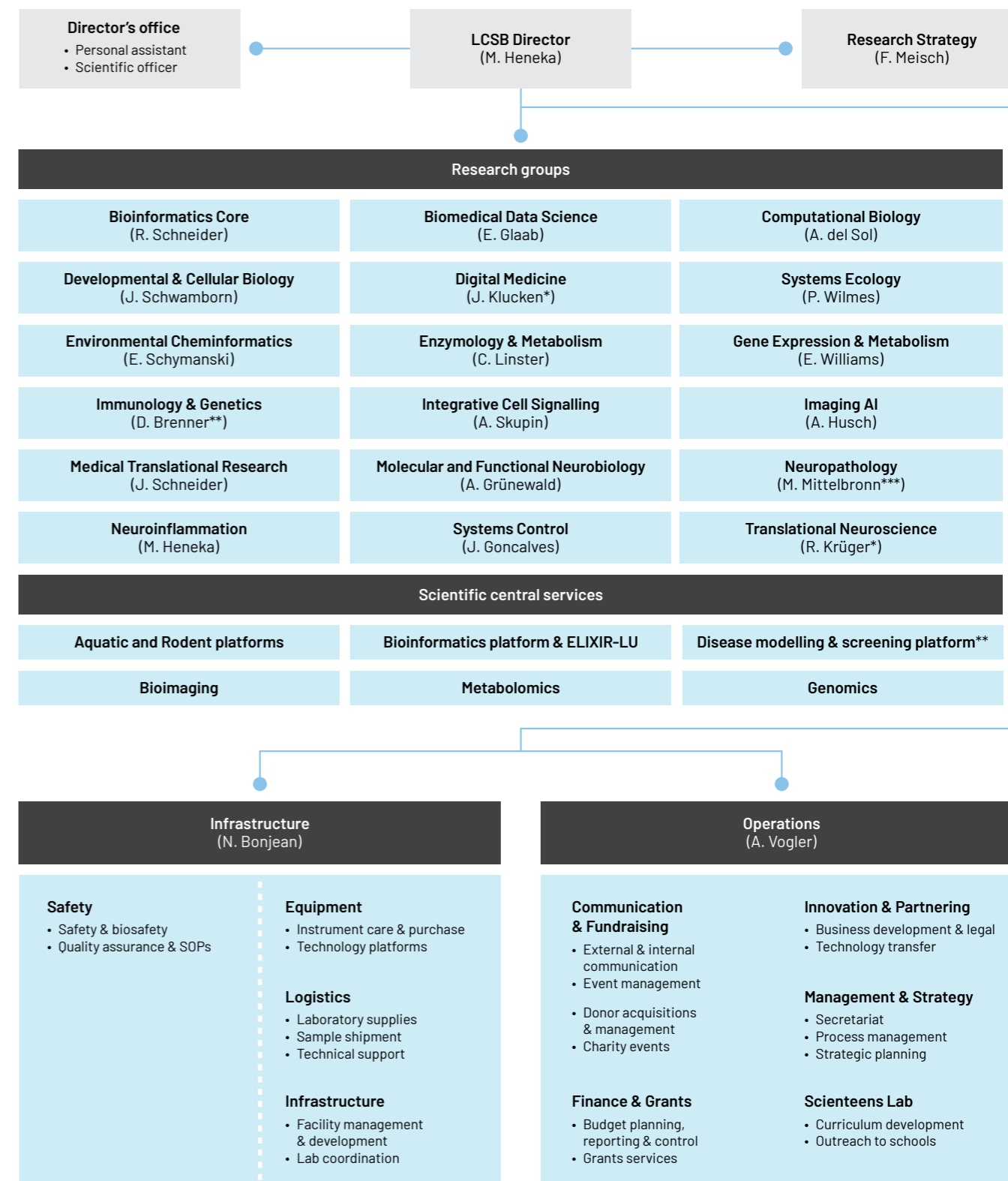


- Wages
- Operating expenses
- Investments
- Representation and registration
- Sub-contracting
- Travel



- Alzheimer's research
- Parkinson's research
- Rare disease research
- Education
- Other topics

LCSB organigram



* in cooperation with LIH & CHL ** in cooperation with LIH *** in cooperation with LNS & LIH

National grants in 2023

Project acronym	Programme	LCSB responsible(s)	Project coordinator (if applicable)
IBD-OAC	FNR AFR Individual	Lena Weidert, Paul Wilmes	
LysoRisk-PD	FNR AFR Bilateral	Rejko Krüger, Anne Grünewald	
Infectome	FNR CORE INTER EMBL	Paul Wilmes	
ReForMCaS	FNR CORE	Alexander Skupin	
DIGITRACK	FNR Industrial Fellowships	Alan Mejia Castro, Jochen Klucken	
InhibitPD	FNR Industrial Fellowships	Gemma Gomez Giro, Michael Heneka	OrganoTherapeutics, Luxembourg
JULES	FNR INTERMOBILITY	Ibrahim Boussaad	
LongCovid	FNR INTERMOBILITY	Piyapong Khumrin	
MicroMol	FNR INTERMOBILITY Fulbright Awards Programme	Paul Wilmes	
7th Venusberg Meeting on Neuroinflammation	Ministère de l'Economie	Michael Heneka	
ABCDE	UL IAS Audacity	Andreas Husch	

European grants in 2023

Project acronym	Programme	LCSB responsible	Project coordinator
COMMUTE	Horizon Europe	Reinhard Schneider	Fraunhofer Gesellschaft, Germany
LEOPARD	Horizon Europe	Venkata Satagopam	Assistance Publique - Hôpitaux de Paris, France
Digital Medical Devices Summer School	EIT Health	Jochen Klucken	University of Navarra, Spain
PDnetGO	EIT Health	Jochen Klucken	Portables HealthCare Technologies
RestorPro	FNR INTER ANR	Paul Wilmes	French National Institute for Agriculture, Food, and Environment, France
FAIRClinical	FNR INTER CHIST-ERA	Venkata Satagopam	University of Luxembourg, Luxembourg
GENOMIT5	FNR INTER EJPRD	Emma Schymanski	Klinikum Rechts der Isar der Technischen Universität München, Germany
AD-PLCG2	FNR INTER JPND	Enrico Glaab	Institut Pasteur de Lille, France
ADPriOMICS	FNR INTER JPND	Michael Heneka	University Hospital Cologne, Germany
CCAD	FNR INTER JPND	Michael Heneka	INSERM, France
AD-CD300f	Pasqual Maragall Foundation	Michael Heneka	University of Barcelona, Spain

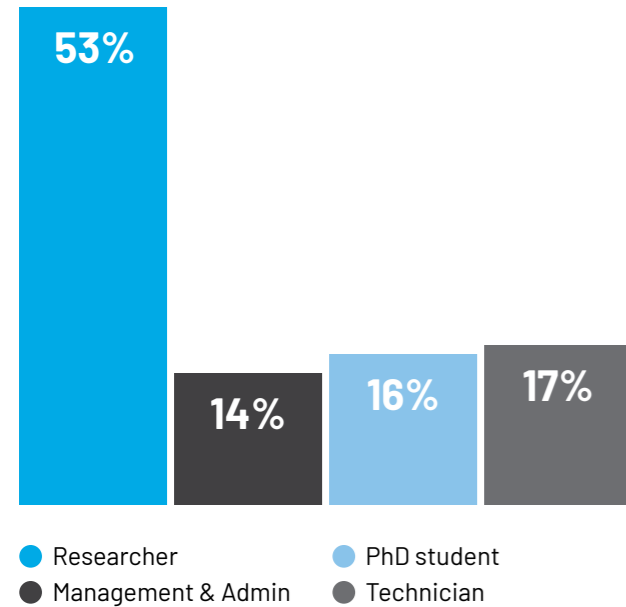
Key performance indicators

Personnel		Publications	
Research groups:	18	Total publications:	150
PEARL (active):	2	Publications IF>10:	29
ATTRACT (active):	1	Publications in 25% best of field*:	71%
ERC (active):	1	Open Access (OA) Publications:	88%
Total staff:	257	Publications in OA journals:	57%
Externally funded staff:	110	Cumulative number of publications [°] :	1545
PhD students:	40		
Nationalities:	59		
External competitive funding [°]		Innovation	
Total:	136 M EUR	Patents [°] :	45
Fundraising [°]		Proof of concept [°] : (total 4.1 M EUR)	9
Total:	8.2 M EUR	Spin-offs active:	3
Collaborations			
Collaborative projects active in 2023:	541		
Industrial partners in active projects:	65		

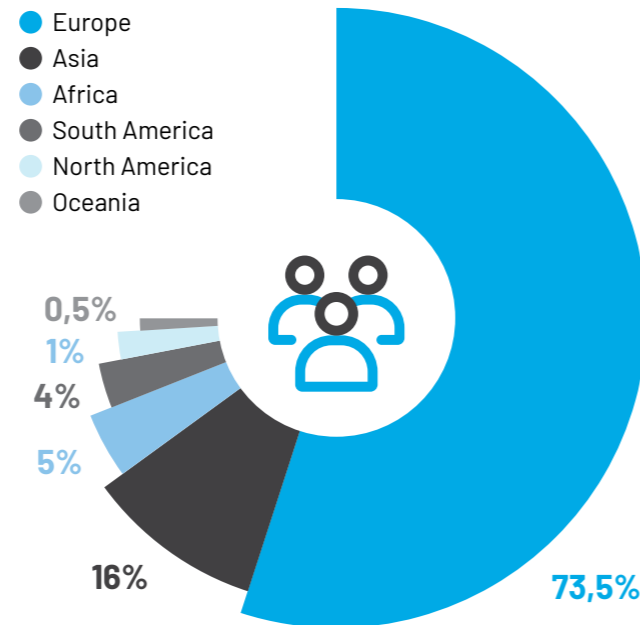
* based on Web of Science

[°] cumulative (2009-2023)

Staff categories 2023



Staff origins



Scientific Advisory Board

Members	
Maria Grazia Spillantini	Professor of Molecular Neurology, University of Cambridge
Li-Huei Tsai	Professor of Neuroscience, MIT
Hermona Soreq	Professor of Molecular Neuroscience, Hebrew University of Jerusalem
Natasa Przulj	Professor of Biomedical Data Science, Barcelona Supercomputing Center
David Holtzman	Professor of Neurology, Washington University
Lennart Mucke	Professor of Neuroscience, University of California
Hans-Christian Pape	Professor of Physiology, Westfälische Wilhelms-University
Etienne Hirsch	Professor of Neuroscience, Paris Brain Institute
Andreas Beyer	Professor for Systems Biology, University Cologne

Publications 2023

Book Series

1. Adam Šmelko et al., Astute Approach to Handling Memory Layouts of Regular Data Structures. *Lecture Notes in Computer Science* (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 13777 LNCS - 507-528, 10.1007/978-3-031-22677-9_27

Comment

1. Michael T Heneka, ApoE4 makes microglia trem(2)bling. *Neuron*, 111 - (2) - 142-144, 10.1016/j.neuron.2022.12.032

Journal

1. Sybille Barvaux et al., SinCMat: A single-cell-based method for predicting functional maturation transcription factors. *Stem Cell Reports*, 10.1016/j.stemcr.2023.12.006

2. Isabel Rosety et al., Impaired neuron differentiation in GBA-associated Parkinson's disease is linked to cell cycle defects in organoids. *Npj Parkinsons Disease*, 9 - (1) - 166, 10.1038/s41531-023-00616-8

3. Wout Bittremieux et al., Open access repository-scale propagated nearest neighbor suspect spectral library for untargeted metabolomics. *Nature Communications*, 14 - (1) - 8488, 10.1038/s41467-023-44035-y

4. Armin Rauschenberger et al., Penalized regression with multiple sources of prior effects. *Bioinformatics*, 39 - (12) - 10.1093/bioinformatics/btad680

5. Dagny Aurich et al., Non-target screening of surface water samples to identify exposome-related pollutants: a case study from Luxembourg. *Environmental Sciences Europe*, 35 - (1) - 10.1186/s12302-023-00805-5

6. Lisa Lützwow et al., The effects of an individualized smartphone-based exercise program on self-defined motor tasks in Parkinson's disease: a long-term feasibility study. *Journal Of Patient-Reported Outcomes*, 7 - (1) - 106, 10.1186/s41687-023-00631-6

7. Louis Chauviere et al., Firalink: A bioinformatics pipeline for long non-coding RNA data analysis. *Non-Coding Rna Research*, 8 - (4) - 602-604, 10.1016/j.ncrna.2023.09.002

8. Patrycja Mulica et al., Comparison of two protocols for the generation of iPSC-derived human astrocytes. *Biological Procedures Online*, 25 - (1) - 26, 10.1186/s12575-023-00218-x

9. Juliane Hollender et al., NORMAN guidance on suspect and non-target screening in environmental monitoring. *Environmental Sciences Europe*, 35 - (1) - 10.1186/s12302-023-00779-4

10. Gianfranco Frigerio et al., Prenatal and childhood exposure to per-/polyfluoroalkyl substances (PFASs) and its associations with childhood overweight and/or obesity: a systematic review with meta-analyses. *Environmental Health*, 22 - (1) - 56, 10.1186/s12940-023-01006-6

11. Markus Haake et al., Tumor-derived GDF-15 blocks LFA-1 dependent T cell recruitment and suppresses responses to anti-PD-1 treatment. *Nature Communications*, 14 - (1) - 4253, 10.1038/s41467-023-39817-3

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