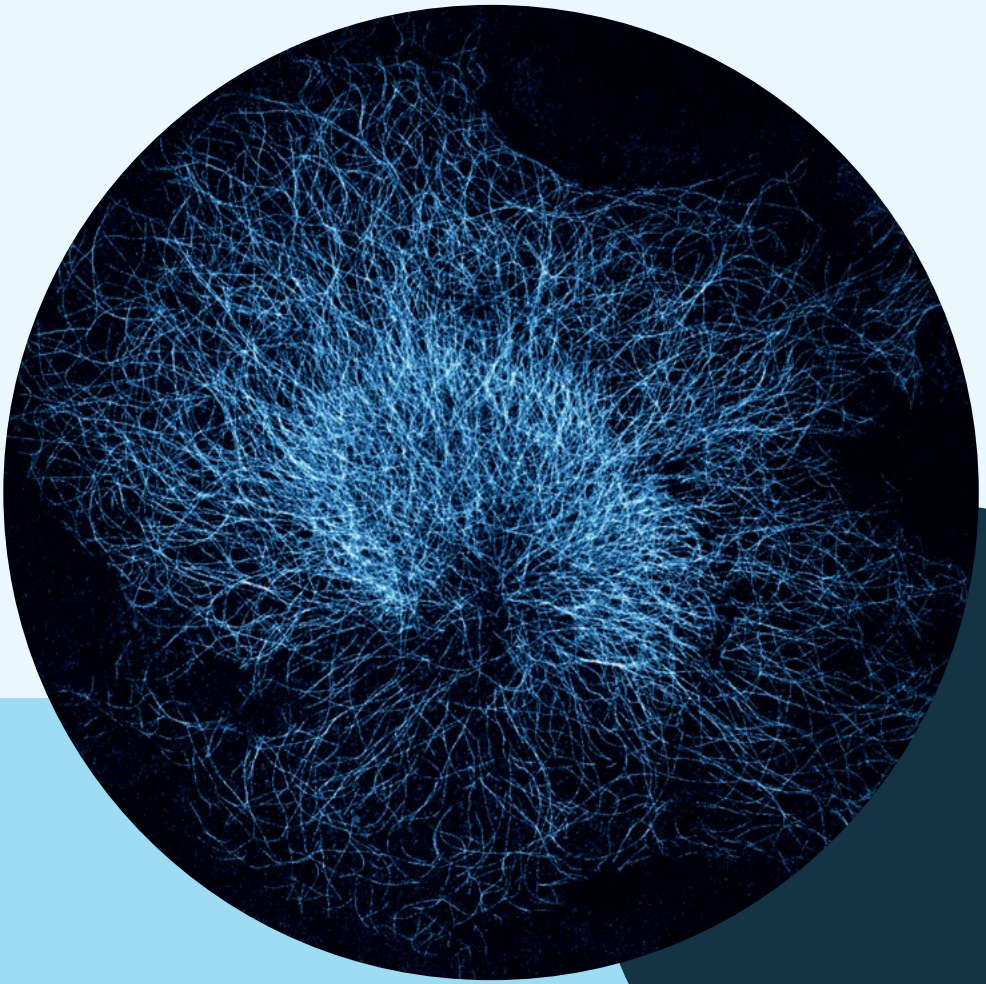
Luxembourg Centre for Systems Biomedicine

LCSB



Highlights 2025

LCSB in brief

The LCSB is an interdisciplinary research centre at the University of Luxembourg. Its 280 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:
Super-resolution microscopy image of a neuron-like cell showing labelled cytoskeletal filaments.

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Editorial

A clear roadmap for the LCSB

In 2025, the LCSB underwent an external research evaluation. This assessment of our research centre recognised past achievements and provided valuable guidance for future development. The panel of international experts who examined our scientific output, infrastructure and societal engagement identified several strengths. They commended our systems biology approach to complex diseases and internal initiatives designed to encourage collaboration across disciplines. This collaborative and interdisciplinary spirit has indeed been at the heart of the LCSB since its inception, as evidenced by the numerous examples you will find within these pages.

Besides the LCSB excellent scientific performance, the evaluation highlighted the quality of our state-of-the-art platforms, our strong integration within Luxembourg and our participation in outreach activities. The subsequent launch of a new platform to advance responsible animal research further, and the cutting-edge equipment installed at the LCSB in 2025 demonstrate our ongoing commitment to technological excellence. Similarly, the LCSB's involvement in the Scienteens Lab, an initiative which has given to 20.000 high school students across the country the opportunity to experience hands-on research, illustrates our continued connection with society at large.

The past year has also shown the LCSB's ability to attract talented researchers from abroad and develop talent from within. Four new research groups have been established. Two led by principal investigators coming from other European institutions. Two led by LCSB researchers taking on new responsibilities. Each will contribute essential expertise to our centre. The novel chemical neurobiology approach and advanced imaging capabilities brough by Prof. Ivana Nikic-Spiegel will open up entirely new experimental possibilities at the LCSB. The team of Dr Rico Schieweck will study gene expression dynamics, strengthening the molecular and mechanistic dimension of our research on neurodegeneration. Finally, additional machine learning and computational expertise, respectively provided by the groups of Dr Shekoufeh Gorgi Zadeh and Dr Venkata Satagopam, will bridge the gap between fundamental research and clinical translation.

Importantly, the evaluation provided a clear roadmap for the next chapter of the LCSB. It encouraged us to consolidate our core expertise in neurodegenerative disease research, strengthen interdisciplinary collaborations, and focus more on technology transfer. In line with these recommendations, additional recruitments have just been completed or are underway, bringing yet another layer of expertise to the LCSB. From biophysics to neuroimmunology and bioinformatics, they will complement existing assets. In the longer term, the LCSB also intends to venture into neuroradiology, with a dedicated MRI scanner, which will significantly enhance clinical and translational research. We plan to address traumatic brain injury as well, a major societal and health challenge with clear potential for innovative research. Lastly, focusing on AI-guided structural biochemistry and drug development will further deepen our translational research efforts.

I am proud of how the LCSB is growing and expanding its infrastructure. By embracing new technologies, leveraging interdisciplinary expertise and nurturing talent, we are well on our way to establishing our centre as a prominent player in the international research landscape, shaping the LCSB for many years to come.

Michael Heneka

Supporting cutting-edge research through international exchanges

Supported by the Gerhard und Ilse Schick Foundation, the LCSB Research Stay grants enable short term visits to partner laboratories abroad, giving researchers the opportunity to access expertise and technologies outside Luxembourg.

In 2025, the grants supported stays of early-career researchers Lucia Gallucci, Lorina Bilalli and Elle Wilson at internationally recognised research centres. Lucia Gallucci visited the Radboud University Medical Center in the Netherlands, where she acquired advanced expertise in stem cell differentiation and in the generation of astrocytes, specialised brain cells that play a key role in rare neurological disorders. Lorina Bilalli carried out her research stay at Charité Berlin in Germany, where she learned new imaging skills that make it possible to visualise in great detail the protein synthesis machinery in brain cells. Elle Wilson spent her stay at Juntendo University in Tokyo where she discovered new laboratory tools to study genes linked to Parkinson's disease and strengthened the ongoing collaboration with the Japanese institution.

Across all stays, the researchers worked closely with host teams, contributed to ongoing projects and gained practical experience in different research environments. Learning from international experts strengthened their skills while bringing fresh ideas back to the LCSB. These grants illustrate how targeted philanthropy helps early-career researchers to grow, accelerates knowledge exchange and strengthens international collaborations.

Watch the videos

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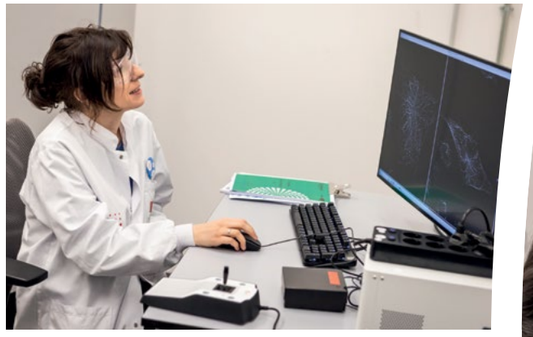
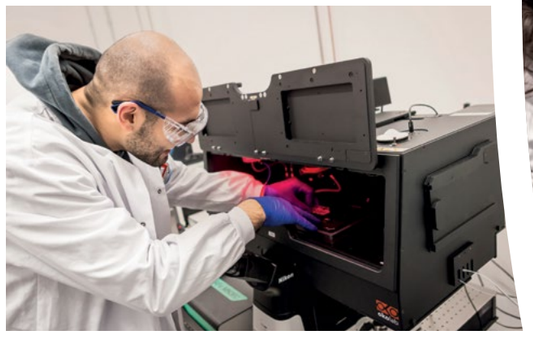
Axonal injury under the super-resolution microscope

In 2025, the creation of four new groups brought to 20 the number of research teams at the LCSB. Among them, the Chemical and Molecular Neurobiology group, led by Prof. Ivana Nikić-Spiegel, bridges microscopy and chemical biology to decipher the molecular mechanisms behind brain diseases, in particular multiple sclerosis, and identify ways to protect neurons from injury. Their approach: Using nanoscale imaging and advanced molecular tools to get a better overall picture of neurodegeneration.





The Chemical and Molecular Neurobiology team

The group focuses on multiple sclerosis, a chronic neurological disorder that affects 2,8 million people worldwide – mostly young adults – and presents with very heterogeneous symptoms. Current treatments can delay the long-term progression of the disease but there is no cure for multiple sclerosis, placing a heavy burden on patients and societies. "Multiple sclerosis is characterised by the formation of lesions in the brain and spinal cord. These arise from inflammation, driven by immune cells, that damages myelin, the protective coating of nerve fibres, and can also injure the nerve fibres themselves," explains Prof. Nikić-Spiegel. "As a result, communication within the nervous system is disrupted, contributing to disability over time. However, the molecular mechanisms underlying these processes are still not fully understood."

This is where the group's unique technical expertise comes in. Combining imaging, from live-cell to super-resolution microscopy, chemical biology and proteomics, the researchers explore the organisation and dynamics of

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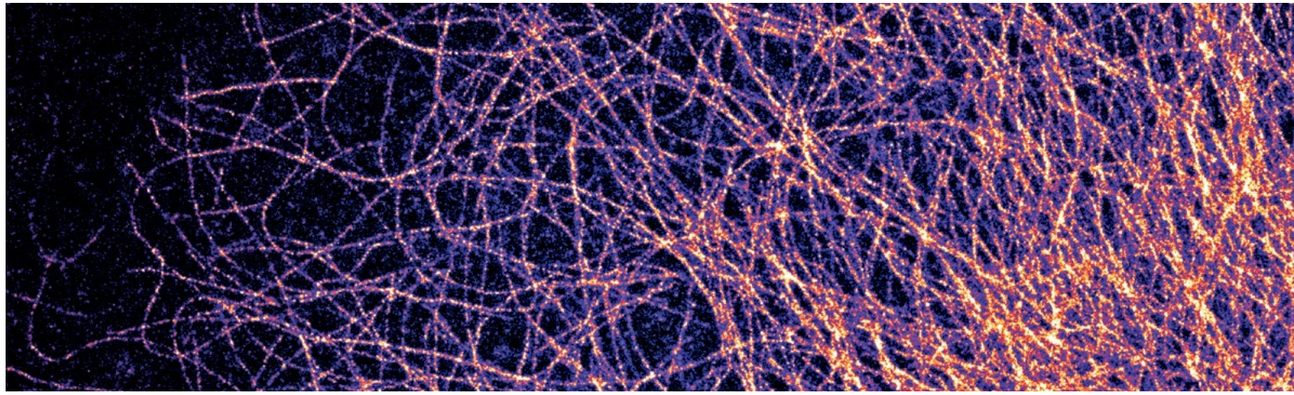

Magnified region of the cover image revealing a dense cytoskeletal filament network in a neuron-like cell, reconstructed from numerous single-molecule localisation events.

proteins within brain cells. By labelling newly synthetised proteins in a given cell type and during a specific time frame, they are able to investigate processes that get disrupted by the disease. "We first conduct untargeted proteomics studies to find out which proteins are up- or downregulated in different phases of multiple sclerosis. It helps us pinpoint proteins of interest that could constitute good targets for treatments," details Prof. Nikić-Spiegel.

Once promising proteins have been identified, the researchers turn to advanced microscopy to study both these new targets and established candidate proteins more closely. For example, they investigate ion channels, found in the gaps between myelin sheaths, and cytoskeletal proteins that give neurons their structure. Live imaging combined with advanced fluorescent labelling allows them to follow how these proteins reorganise over time. With super-resolution microscopy, they can even reach the single-molecule level, enabling them to map the precise localisation of proteins within cells. As neuronal communication depends on the highly organised nanoscale distribution of proteins, this technology is essential for detecting subtle changes that cannot be observed with conventional imaging. A brand-new microscope recently installed at the LCSB allows the team to visualise proteins or protein clusters measuring just 10 to 15 nanometres, opening new possibilities to understand how alterations in molecular organisation contribute to neuronal dysfunction.

By harnessing the power of cutting-edge technologies and developing new methodologies for their use in complex systems such as cell cultures and *in vivo* models, the Chemical and Molecular Neurobiology group aims not only to unravel the molecular mechanisms of multiple sclerosis, but also to find commonalities with other brain diseases. "Processes such as oxidative stress and neuroinflammation play a role in all these disorders. Similarly, beyond its well-established role in multiple sclerosis, myelin is emerging as an important factor in other neurodegenerative diseases," underlines Prof. Nikić-Spiegel. "So, we hope that our findings on how to protect the nervous system from axonal injury and demyelination could translate from multiple sclerosis to Parkinson's and Alzheimer's disease."

> **We develop advanced imaging and chemical biology tools to study how brain cells function and to uncover molecular pathways that could guide the development of targeted therapies.**

Another similarity between these neurodegenerative disorders is the need for reliable biomarkers to detect the disease early and to better understand its progression. Addressing this challenge requires experimental models that capture key aspects of each disease. In multiple sclerosis, this is particularly complex due to the interactions between multiple cell types, making the disease difficult to fully model in human cell systems. To tackle this issue, the group hopes to develop increasingly complex human models that more closely reflect the cellular interactions underlying multiple sclerosis. Initial efforts will focus on refining two-dimensional systems, while also exploring, over time, more advanced 3D models such as lab-grown brain organoids by building on existing expertise at the LCSB.

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Rejuvenating the brain with the help of a computational clock

As the world population is ageing rapidly, age-related brain disorders are on the rise. Living longer but in poor health is not only a daunting prospect, it also places a substantial burden on healthcare systems worldwide. The idea of being able to counteract the functional decline of our brain through rejuvenating interventions sounds therefore promising. The question is how can we identify compounds that have the potential to efficiently rejuvenate brain cells and to protect the ageing population from neurodegeneration? With the support of the Fondation Jean Think, Prof. Antonio Del Sol and his teams of computational biologists, based both at the LCSB and at the CIC bioGUNE in Bilbao, used their machine learning expertise to tackle this challenge.

The researchers developed what is called an "ageing clock", a computational tool designed to measure the biological age of cells, as opposed to their chronological age. Indeed, the organs and tissues of people of the same age can evolve differently over time, depending on genetic and environmental factors, leading to different biological ages. These clocks are therefore useful tools to assess ageing at the molecular level and can help in understanding its causes and consequences.

The clock designed by the LCSB and CIC bioGune researchers is specific to the brain and uses gene expression information from 365 genes to make predictions. Using a machine learning approach, it was trained on data from healthy individuals, aged from 20 to 97, and could accurately predict their age. Further tests showed that the clock is able to estimate the biological age of different cell types in the brain, especially neurons. Lastly, by looking at the predicted biological ages for healthy individuals and for patients with neurodegenerative conditions, the researchers observed that patients exhibited a higher biological age.

"Our results tell us that the biological age of the brain cells calculated by our clock reflects the decline in brain function experienced by the patients and is even correlated with the degree of neurodegeneration," explains Dr Guillem Santamaria, postdoctoral researcher at the LCSB. "This correlation suggests that the rejuvenating interventions identified by the clock could serve as neuroprotective agents."

The researchers wanted to use the clock to find genetic or chemical interventions that would significantly shift back the biological age of brain cells. They explored the effect of thousands of compounds and identified 453 unique rejuvenating interventions. Among the identified compounds, several are known to extend lifespan in animal models. Others are already used to treat neurological disorders. However, the vast majority has not yet been studied in the context of health-span extension. The researchers tested three of these compounds in mice: They produced rejuvenation at the molecular level in the cortex of aged mice, and improved behavioural and cognitive functions.

"First, the fact that our computational platform identified drugs that have a known effect on brain function supports the idea that using the predicted effect of a compound on the biological age is an efficient way to evaluate its neuroprotective potential," concludes Prof. Antonio Del Sol. "Then, the results also highlight that our clock can help us find many new drug candidates that haven't been studied before for their rejuvenating properties. This opens up a lot of new avenues for future therapeutic development in neurodegenerative diseases."

Microbial molecules to detect Parkinson's disease early

In July 2025, Prof. Paul Wilmes was awarded a Proof of Concept grant by the European Research Council (ERC) to investigate whether small proteins originating from gut microbes could serve as biomarkers for Parkinson's disease.

"As part of the ExpoBiome project, funded by an ERC Consolidator Grant, we have uncovered that small proteins produced by the gut microbiome can trigger the aggregation of α-synuclein, the molecular hallmark of Parkinson's disease," explains Prof. Wilmes, head of the Systems Ecology group at the LCSB. "We now want to establish the utility of these microbiome-derived proteins as predictive biomarkers, meaning to determine whether quantifying them in faecal or blood samples could become an efficient way of identifying people at risk and of detecting the disease early."

Prof. Wilmes and his team have already developed a method, based on advanced omics technologies and state-of-the-art artificial intelligence, to identify the most promising microbial molecules. With the new ERC grant, the researchers will refine the existing method, address its technical feasibility, and assess its commercial potential. The project will involve several international partners for clinical research and for developing a go-to-market strategy.

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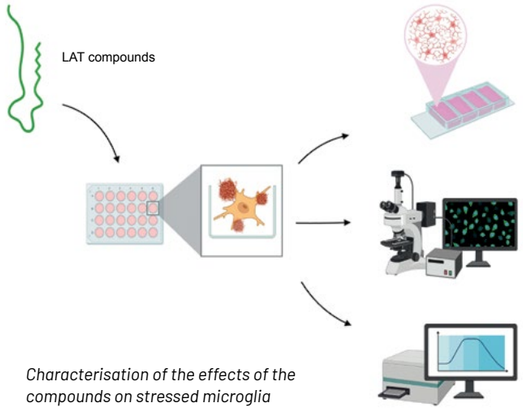
Advancing Alzheimer's research with Lateral Pharma

Collaboration between academia and industry plays a key role in translating fundamental discoveries into tangible benefits for patients. At the LCSB, such partnerships often combine cutting-edge research models with innovative therapeutic approaches developed by companies worldwide. A current collaboration with the Australian biotech company Lateral Pharma illustrates how this synergy can accelerate drug development in the field of neurodegenerative diseases.

The project brings together Lateral Pharma and the Neuroinflammation group led by Prof. Michael Heneka to investigate the potential of peptide-based compounds for the treatment of Alzheimer's disease. Lateral Pharma had previously developed and clinically tested short peptides derived from human growth hormone fragments, initially for indications such as neuropathic pain, a chronic type of pain caused by damage or dysfunction in the nervous system. As the compounds were shown to be safe in humans and to target pathways involved in cellular stress responses, the company sought to explore their potential role in neuroinflammation, a hallmark of Alzheimer's and other neurodegenerative disorders.

To this end, Lateral Pharma approached Prof. Heneka, whose group is internationally recognised for its expertise in neuroinflammatory mechanisms and disease-relevant model systems. From the outset, the collaboration was supported by the LCSB's Innovation and Partnering team, which worked closely with both sides to establish a framework tailored to the project's scientific and translational goals. "The company was looking for a partner who could assess their compounds in highly specialised experimental settings that go beyond standard testing pipelines," explains Dr Clemens Ostrowicz, team leader of Innovation and Partnering at the LCSB. "What we offer here is not a routine service, but tailored sponsored research built on unique scientific capabilities."

The collaboration started with an initial pilot phase focusing on *in vitro* experiments. Working at the interface between fundamental research and drug development, postdoctoral researcher Dr Bora Tastan investigated how the peptide compounds influence microglial functions, including inflammatory signalling and the cells' ability to remove toxic material. These first studies suggested that the compounds may primarily modulate communication between cells rather than acting on individual cell types in isolation. Based on these findings, both partners agreed to move to a second phase involving studies in an established mouse model of Alzheimer's disease. "This step marks a decisive moment in the project," says Dr Tastan. "The *in vivo* study is designed as a go-or-no-go phase, where we will assess whether treatment can reduce pathological hallmarks and disease severity."



Characterisation of the effects of the compounds on stressed microglia

Beyond the scientific objectives, the project highlights the added value of close interaction between researchers, innovation specialists and industry partners. While academic research often follows an exploratory path, the collaboration introduced a more structured, milestone-driven approach. "Industry partnerships encourage a more holistic view of project planning," Dr Tastan explains. "They require researchers to consider the full trajectory of a project from the very beginning." For the LCSB, the collaboration provides access to novel compounds not available in the public domain, generates opportunities for joint scientific publications, and strengthens its position as an internationally visible partner for translational research. For Lateral Pharma, it offers rigorous validation of drug candidates in state-of-the-art disease models. Together, the partners aim to bring new therapeutic strategies one step closer to patients affected by Alzheimer's disease.

Connecting research and dementia care

In 2025, staff members from the LCSB and the Luxembourg Alzheimer Association (ALA) took part in a "science meets care" initiative, which brought together research and care professionals.

ALA supports people living with Alzheimer's disease and other forms of dementia, offering residential care and nursing services. In April, a group from the LCSB visited one of their facilities. The visit began with an introduction to the association's values and services, followed by a tour of the residential and nursing home "Beim Goldknapp" in Erpeldange-sur-Sûre. LCSB participants observed how care teams tailor their daily work to the individual needs of people living with dementia.

This visit followed an earlier exchange during which the ALA team visited LCSB laboratories and had the opportunity to learn more on Alzheimer's research from Prof. Michael Heneka. By fostering mutual understanding between science and care, these exchanges help ensure that research remains closely connected to the needs and day-to-day realities of people living with Alzheimer's disease.

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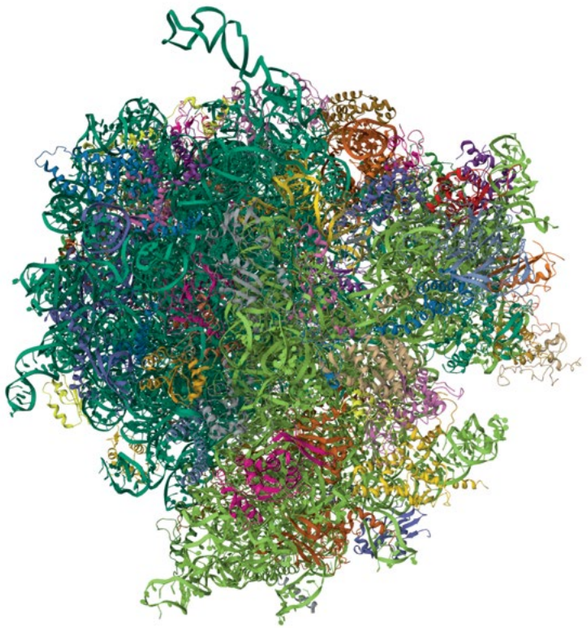
Understanding gene expression dynamics in neurological diseases

The regulation of gene expression is central to understanding how neurological disorders develop and progress. In early February 2025, Dr Rico Schieweck joined the LCSB as a Junior Principal Investigator to establish the Gene Expression Dynamics group. The Junior Principal Investigator scheme is a dedicated career development programme that enables early-career researchers to launch and lead their first independent research group with initial institutional support. His work strengthens the centre's expertise in translational regulation and expands ongoing efforts to investigate the molecular mechanisms underlying neurodevelopmental and neurodegenerative diseases.



We want to unravel the dynamics of protein synthesis and establish how alterations in ribosome speed influence protein folding, stability and consequently cellular function.

Protein synthesis determines how genetic information is converted into functional proteins and is ultimately shaping cellular identity and function. A central molecular machine in this process is the ribosome. It uses the messenger RNA as a blueprint to translate its sequence into a protein sequence. Although the fundamental steps of this process are well understood, the dynamic interplay between translation and protein functionality remains elusive. The Gene Expression Dynamics group therefore aims to unravel the dynamics of translation and establish how alterations in ribosome speed influence protein folding, stability and consequently cellular function in the nervous system.

The team is particularly interested in genetic variants that do not alter the protein sequence. Although these variants are considered silent, they can have an impact on the speed at which the ribosome reads along the messenger RNA. Consequently, these 'silent' variants can affect the 3D structure, that proteins start to acquire during their synthesis, and the stability of the final molecule. Their contribution to the pathological processes is therefore essential to elucidate. However, this class of genetic variant is widely neglected in clinical practice.

The Gene Expression Dynamics group is addressing these questions in different disease models including those for neurodevelopmental and neurodegenerative disorders such as autism, spinal muscular atrophy and Parkinson's disease. Recent findings from the group and from other labs strongly suggest that altered ribosome dynamics play a critical role in the pathology of all these diseases.

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Above: The Gene Expression Dynamics team - On the left: The 3D structure of the 80S human ribosome

Dr Schieweck and his collaborators have secured competitive funding from the Luxembourg National Research Fund (FNR), with a recent FNR CORE grant awarded to investigate the effects of altered ribosome speed, marking an important early achievement for the newly appointed Junior Principal Investigator.

To study ribosome dynamics, the team applies an integrated experimental strategy that combines several omics approaches – transcriptomics, proteomics and translatomics – to characterise entire sets of molecules, from RNA to proteins, which contribute to protein synthesis. In addition, they apply kinetic ribosome profiling, a technique that provides a global snapshot of ribosome activity, and allow them to quantitatively assess ribosome speed. These methods provide insight into co-translational protein folding in healthy and diseased cells. They are integrated with complementary biochemical approaches to generate a comprehensive view of translational regulation in neuronal systems. "Our research aims to clarify how changes in translation control contribute to neurological disease," says Dr Schieweck. "A better understanding of these mechanisms will help us determine which molecular alterations are directly relevant to pathology and which are compensatory mechanisms that buffer potential damage."

Alongside developing the scientific programme, Dr Schieweck is currently expanding his team. A first PhD student has recently joined, and further recruitment is ongoing. Supported by the centre's scientific platforms and technical expertise, the Gene Expression Dynamics group is building the foundation for its future research activities. It will broaden the LCSB's research activities in RNA biology and molecular neuroscience, complementing existing expertise in neurodegenerative research and enhancing the centre's ability to investigate disease mechanisms across multiple regulatory layers.

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Venturing into the brand-new field of organoid intelligence

Researchers at the LCSB are modelling the complexity of the human brain in a dish. In March 2025, their work was highlighted in an episode of Primer, a global series from Bloomberg Originals that breaks down the complex science, technologies and industries shaping the future.

The 30-minute episode, titled "Can Living Human Brain Cells Power AI?", explored the world of biocomputing, where scientists are laying the foundation for a field that may blur the lines between the biological and synthetic.

It featured the work of biotech companies from Australia and Switzerland, as well as researchers from the University of California and Johns Hopkins University, and highlighted the relevance of research conducted by Prof. Jens Schwamborn and his team at the LCSB.

The Developmental & Cellular Biology group works with brain organoids, 3D cell cultures, to model physiological and pathological processes in the brain. While neurodegenerative processes are at the heart of the team's work, they are now venturing into the brand-new field of organoid intelligence. They want to harness the computing power of brain tissue by producing a biological processer unit based on stem cell-derived brain organoids.

Watch the episode

Forever chemicals, diving into troubled waters

The term "forever chemicals" refers to a category of synthetic chemicals called per- or polyfluoroalkyl substances (PFAS). Characterised by very stable bonds formed by carbon and fluorine in their structure, PFAS do not degrade easily, hence the label "forever". They can be found in many products, from industrial goods to fabric, cookware and cosmetics, but their presence in our environment and their impact on human health are a growing concern.

PFOS and PFOA are two PFAS that were widely used for several decades. Their use is now regulated by the Stockholm Convention on Persistent Organic Pollutants due to clear links with cancer, premature birth and thyroid diseases. "Unfortunately, this regulation triggered a mechanism known as "regrettable substitution", where industries developed new compounds to replace them," explains Prof. Emma Schymanski, head of the Environmental Cheminformatics group at the LCSB. "Over time, we have seen that some of these "replacement" PFAS also remain in the environment and cause undesirable health effects."

Based on the recent OECD definition, over 7 million known chemicals can be considered PFAS. Among them, one is gaining attention: Trifluoroacetic acid (TFA). Manufactured for industry but also occurring as a degradation product of other PFAS, its concentration in the environment is increasing at an alarming rate. "There are countless sources of TFA, many of which are still unknown, and we lack studies on its effects," details Prof. Schymanski. "What we do know is that if this trend continues and, worse, if adverse health effects are found, we will face a big challenge." As a matter of fact, TFA is very difficult, and thus expensive, to remove from water.

While the situation seems to call for a total ban of all PFAS, it seems a difficult task. "How do you implement a regulation that bans 7 million compounds?" asks Dr Federica Piras, post-doctoral researcher in the group. Alternatively, enhanced treatment of industrial and domestic wastewater is an option that may reduce the emission of PFAS into the environment, helping to keep the levels of pollutants in water sources under control. This is where research can help.

"My project explores the ability of a nature-based technology, called constructed wetlands, to limit the emission of PFAS from wastewater treatment plants and aims to implement a less costly and less energy-intensive treatment compared to existing methods," explains Dr Piras. Nature could indeed contribute to more sustainable solutions: In the right setting, organisms like plants, bacteria and fungi can play a relevant role in abating PFAS. To what extent? This is what researchers want to investigate in rural areas of Luxembourg, also addressing various aspects such as the availability of space for implementation. This highly interdisciplinary project, called PFAS-QUEST, is funded through the Institute for Advanced Studies at the University of Luxembourg, and conducted in close collaboration with the Department of Engineering, syndicates and international partners.

Additionally, Prof. Schymanski and her team are involved in analysing water all over the country and surrounds to get a better overview of the situation in Luxembourg. They also contribute to databases on existing chemicals, making scientific information freely available to all, from specialists to decision-makers and the general public. All steps in the right direction for a greener – or maybe bluer – future.

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New milestone for the Scienteens Lab

In 2025, the Scienteens Lab reached a new milestone: 20.000 students have now participated in their workshops! After sparking teenagers' interest in science throughout the Greater Region for over a decade, this research lab for high-school students, launched by the LCSB back in 2013, is still going strong.

Offering 26 different workshops for classes in four disciplines, the Scienteens Lab has also broadened its offer with activities dedicated to girls, workshops for adults, and an interactive booth travelling through the country.

"It is amazing to see how far we have come and to experience the constantly renewed enthusiasm of teachers and students alike for science outreach activities," says Dr Elisabeth John, head of the Scienteens Lab. "It motivates our team to strive to reach new audiences, raise awareness on important topics and to make science exciting and accessible for all!"

A platform to further advance responsible animal research

The responsible and efficient use of animal models is essential for advancing biomedical research, particularly in complex diseases such as Parkinson's and Alzheimer's disease. At the LCSB, the newly established Model Biobank and Tissue Analytics platform provides access to a centralised biobank of animal tissues and expert analytical support for animal model research.

The platform was created to strengthen responsible animal research in line with the principles of refinement, reduction and replacement. By centralising biological materials from studies involving animal models and providing expert scientific support, the platform helps researchers to make informed decisions about animal experimentation and guarantees the optimal reuse of existing material. "Our goal is to support high quality research while ensuring that animal welfare and scientific responsibility always go hand in hand," says Dr Manuel Buttini, manager of the platform.

At its core, the platform combines a structured biobank and expertise in tissue-based analyses. It focuses on tissues and biofluids collected from mouse and zebrafish models, with particular emphasis on neurodegenerative diseases. By preserving and sharing surplus tissues from animal studies, the platform enables researchers to build on existing material, reduce duplication of experiments and minimise additional animal use. Through systematic cataloguing of samples from past and ongoing studies, alongside standardised processes, study designs become more robust and experiments more comparable, supporting more sustainable research practices.

Beyond biobanking, the platform helps researchers throughout the scientific life cycle of animal studies. This includes advice during the early planning phase, such as selecting appropriate models and defining study designs that address specific biomedical research questions. Close coordination with the LCSB rodent and zebrafish facilities ensures that experiments are well prepared and aligned with ethical approvals. After studies are completed, the platform supports tissue processing and storage, as well as molecular and neuropathological analyses, and assists researchers in interpreting their results in a translational context.

A concrete example of this approach is the collaboration with the Biomedical Data Science group, investigating the biological mechanisms underlying sex differences in Alzheimer's disease. The platform contributed to selecting suitable models and age groups, coordinated tissue collection and supported the integration of experimental findings with computational analyses. This type of collaboration illustrates how the platform helps translate complex biological data into meaningful scientific insight.

Watch the video

While the Model Biobank and Tissue Analytics platform primarily serves researchers at the LCSB, it is also open to external users. Sharing well-characterised biological material with partners beyond Luxembourg allows valuable samples to support new research questions and strengthens scientific collaboration, while upholding the highest standards of scientific quality, ethics and animal welfare. This new platform positions the LCSB as a reference centre for high-quality *in vivo* research by making animal model studies more accessible, efficient and collaborative.

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Advancing biomedical imaging through artificial intelligence

Artificial intelligence (AI) is increasingly shaping biomedical research. The analysis of complex imaging data and the support of clinical decision-making are just two examples of how AI is transforming the field. In September 2025, Dr Shekoufeh Gorgi Zadeh was appointed Junior Principal Investigator at the LCSB to establish the Artificial Intelligence in Biomedical Imaging group, having previously joined the centre as postdoctoral researcher. Her team will reinforce the centre's expertise at the interface of AI, biomedical data analysis and translational research, and complement existing strengths in systems biomedicine and data-driven disease research.

Dr Gorgi Zadeh develops computational methods that extract meaningful and reliable information from biomedical images. Her work focuses on improving performance while ensuring transparency and interpretability. "Artificial intelligence systems must be developed with the biomedical context in mind," she explains. "They should assist experts in making informed decisions rather than functioning as isolated black boxes."

Dr Shekoufeh Gorgi Zadeh

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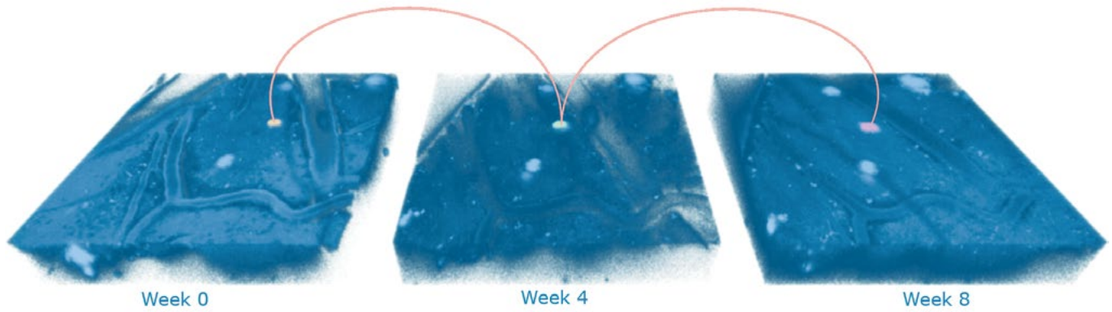

Automated 3D tracking of amyloid plaques in two-photon microscopy images over several weeks.

The group's activities are structured around two complementary pillars. The first centres on the application of foundation models, large-scale artificial intelligence systems trained on diverse datasets that can be adapted to specific biomedical tasks with limited additional data. Such approaches are particularly relevant in clinical settings, where high-quality annotated datasets are often scarce. One current collaboration aims to develop computational tools to detect dental malocclusions in intraoral images, in partnership with an orthodontic clinic in Luxembourg, demonstrating the translational potential of these methods.

The second pillar addresses a key challenge in biomedical image interpretation: Uncertainty. Medical images are not always completely clear, and experts may seek additional input before reaching a conclusion. Conventional AI models, however, typically provide a single prediction without indicating confidence levels. Dr Gorgi Zadeh integrates this dimension of uncertainty directly into computational systems. Models can be designed to highlight ambiguous regions and to flag cases that require closer expert review. "Making uncertainty visible allows specialists to focus their attention where it is most needed," she notes.

Active learning strategies further strengthen the interaction between human expertise and machine learning. Once trained, models can be refined through expert feedback. Incorporating uncertainty into this process increases efficiency by directing attention to the most informative cases and enhances collaboration between computational scientists and biomedical researchers.

Within the LCSB, Dr Gorgi Zadeh collaborates closely with several research groups. In partnership with the Neuroinflammation group led by Prof. Michael Heneka, her team analyses amyloid plaque development in two-photon microscopy images over time. This collaboration illustrates how advanced computational approaches can support ongoing research in neurodegenerative disease and contribute to longitudinal imaging studies. The group also engages with other data-driven initiatives at the LCSB to explore applications in areas such as retinal imaging and multimodal biomedical data integration. It benefits from the centre's established data science infrastructure, imaging platform and collaborative research environment, which provide the technical and organisational framework required to develop and validate new computational tools.

As a Junior Principal Investigator, Dr Gorgi Zadeh is shaping both the scientific direction of the group and its collaborative culture. Recruitments are planned to support the next phase of development and further integrate artificial intelligence expertise within the LCSB research ecosystem. The group will expand the centre's expertise in data-driven biomedical research and enhances collaboration between computational scientists and disease-focused research teams, facilitating the development of robust and transparent AI tools tailored to biomedical applications.

> **Artificial intelligence should support experts, not replace them. By making uncertainty visible, we can build systems that are more transparent, trustworthy and useful in biomedical research.**

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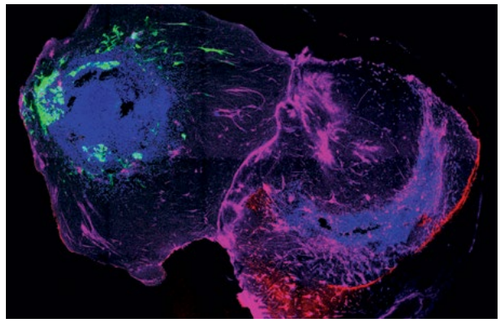
Brain assembloids reveal Parkinson's disease progression



Brain assembloid

Parkinson's disease is a progressive neurodegenerative disorder, but how it spreads through the brain has remained poorly understood. Patients are usually diagnosed once motor symptoms such as tremor, stiffness and slowed movements appear. However, the disease begins silently years earlier. Understanding how pathological changes move from one brain region to another is therefore crucial to unravel the earliest stages of disease progression.
To address this question, the Developmental & Cellular Biology group at the LCSB, led by Prof. Jens Schwamborn, simulated early disease processes in the laboratory.
The researchers showed that the protein alpha-synuclein progressively clumps and spreads in a patient-derived brain assembloid model. A brain assembloid is created by fusing small, lab-grown brain tissues that represent different brain regions, allowing scientists to study how these regions interact. Their findings, published in the journal *Advanced Science*, support a widely discussed theory suggesting that Parkinson's disease may begin in the lower brain regions and then gradually spread to other parts of the brain.

At the centre of Parkinson's disease is a protein called alpha-synuclein. In healthy neurons, this protein helps regulate communication between nerve cells. In Parkinson's disease, it misfolds and accumulates into toxic aggregates that form Lewy bodies, a hallmark of the disease.
To understand how these aggregates spread between connected brain regions, the team developed brain assembloids by combining two types of human stem cell-derived organoids. Organoids are small, lab-grown tissues produced from human stem cells that resemble specific brain regions. In this study, one organoid represented the hindbrain where Parkinson's disease is thought to begin. The other the midbrain, which contains the dopamine-producing neurons that are progressively lost in patients.

The researchers used reprogrammed stem cells derived from Parkinson's patients carrying a genetic mutation that leads to an overproduction of alpha-synuclein. The hindbrain organoids spontaneously developed toxic protein aggregates. When these were connected to healthy midbrain organoids to form an assembloid, pathological alpha-synuclein spread into the previously unaffected midbrain tissue within 30 days. "This patient-derived assembloid model gives us an unprecedented look at how toxic alpha-synuclein accumulates and spreads between brain regions," explains Prof. Schwamborn. "It is the first time we have been able to observe this pathology progression in a fully human-based system, without artificially increasing protein levels to trigger the effect."

Importantly, the presence of excess alpha-synuclein in the hindbrain alone was sufficient to initiate its spread to the midbrain. Even before neurons began to die, the researchers detected early problems in communication between nerve cells. Using advanced measurement techniques, the team confirmed that the fused organoids formed functional and directional connections between nerve cells similar to those in the human brain. As alpha-synuclein pathology progressed, these connections weakened, indicating early disruption of brain network activity.

By mimicking the brain's natural architecture and connectivity, assembloids provide a controlled human model to study disease progression in detail. Because the organoids are derived from individual patients, the system also opens new opportunities for developing more personalised treatment approaches tailored to individual patients. "This model offers a unique opportunity to study early disease mechanisms and to screen for drugs that could block the spread of alpha-synuclein before irreversible damage occurs," concludes Prof. Schwamborn. "Ultimately, this could help us stop the disease before it spreads." This work was supported by Horizon 2020.

Visit of the Hereditary Grand Ducal couple

On 24 March, their Royal Highnesses the Hereditary Grand Duke and the Hereditary Grand Duchess of Luxembourg visited the Belval campus, alongside Stéphanie Obertin, Minister for Research and Higher Education. After a presentation of the university by the Rector and a guided tour of the university's Media and Learning Centres, the royal couple came to the LCSB.

During their visit, Prof. Michael Heneka presented the centre's interdisciplinary research on neurodegenerative diseases, before accompanying the distinguished guests on a tour of his laboratory. The tour featured the work of the Neuroinflammation group and their efforts to unravel how the immune system influences brain health and contributes to Alzheimer's progression. Dr Dimitri Budinger introduced how the team uses pluripotent stem cells to obtain cultures of different cell types, such as microglia and neurons, in order to understand their interaction. Dr Arnaud Mary showcased the cutting-edge microscopy equipment that LCSB scientists rely on to observe cells and study structures like tunnelling nanotubes.

Scheduled a few months before the Hereditary Grand Duke became the new head of state, this visit reaffirmed the university's role as a national hub for excellence in research and higher education. It also highlighted the LCSB's commitment to advancing biomarker discovery and new therapeutic strategies that could pave the way for improved treatments of neurodegenerative diseases.

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10 years of progress in Parkinson's research

In October 2025, Luxembourg celebrated the 10th anniversary of the National Centre for Excellence in Research on Parkinson's Disease (NCER-PD) with an international conference. The event brought together leading scientists, clinicians, and policymakers to reflect on a decade of achievements and to look ahead to the next frontier in prevention and personalised care.

Over the past 10 years, NCER-PD has united Luxembourg's major research and healthcare institutions with the support of the Luxembourg National Research Fund (FNR).

Together, they have built one of Europe's most comprehensive research cohorts of people living with Parkinson's disease. What began as a national effort to bridge fundamental research, clinical practice, and patient engagement has evolved into an internationally recognised research alliance.

The LCSB contributed to establishing NCER-PD's foundations by building data infrastructure, analytics, and the patient engagement programme. Using the collected samples, LCSB researchers developed advanced cellular models and identified molecular and digital biomarkers. These efforts have paved the way for precision medicine approaches. "Our next challenge, besides our efforts to develop disease-modifying treatments, is to create personalised prevention strategies, putting people with Parkinson's and those at risk at the centre of our work," says Prof. Rejko Krüger, coordinator of NCER-PD.

Strengthening zebrafish research

Understanding rare neurodegenerative diseases requires not only the right models, but also the right combination of expertise. Within the Enzymology and Metabolism group led by Prof. Carole Linster, researchers at the LCSB have strengthened their zebrafish research through a close collaboration with the Institute of Biomedicine of Seville (IBiS), showing how working with complementary partners can open new perspectives on disease mechanisms.

The partnership developed around a shared interest in neuronal ceroid lipofuscinosis (NCL), a group of rare inherited disorders also known as Batten disease. These disorders are characterised by progressive neurological decline and often begin early in life. The LCSB team had already established zebrafish models for defects in the *CLN3* and *CLN12* genes associated with Batten disease, and built strong expertise in studying metabolism and testing potential treatments in these models. At the IBiS, the Molecular Physiology of the Synapse group led by Prof. Rafael Fernández-Chacón has a long-standing experience in synaptic biology, advanced imaging, and proteomics, with a main focus on mouse models of Batten disease linked to the *CLN4* gene. As the two teams were investigating different genes associated with the same family of rare diseases, joining forces made sense.

The collaboration is supported through the LCSB International Fellowship programme, which was launched to strengthen strategic partnerships with international centres of excellence in neurosciences. As part of this programme, Dr Santiago López-Begines joined the LCSB as a postdoctoral researcher and spent time at both the LCSB and the IBiS over two years, facilitating direct exchange of expertise and hands-on transfer of methods between the two teams. Through the collaboration, new experimental approaches were introduced and adapted to zebrafish research within Prof. Linster's group. In particular, the scientists established new ways of studying proteins in zebrafish tissues, together with improved approaches for handling and interpreting the resulting data, making it possible to examine changes in the zebrafish brain in much greater detail than before. The collaboration also strengthened imaging-based research. By applying techniques such as immunohistochemistry, high-resolution microscopy and electron microscopy to zebrafish models of Batten disease, the researchers could reveal subtle early changes in cells and tissues that occur before clear neurological symptoms develop.

Beyond individual experiments, the partnership led to the creation of a structured collection of zebrafish brain and eye samples taken at different stages of development. This resource makes it possible to follow how disease-related changes develop over time and to make further use of samples as new research questions arise. Importantly, the collaboration established methods and resources that remain available at the LCSB and the IBiS, and continue to support ongoing and future zebrafish projects. It also supports coordinated work across research sites, from sample generation and processing to data interpretation. A zebrafish facility is now being developed at the IBiS, which will further facilitate the exchanges between both institutes.

Looking ahead, the LCSB-IBiS collaboration has laid a strong foundation for future joint projects. "It significantly expanded the range of biological questions that can be addressed using zebrafish, as well as the methods available to study them," explains Prof. Carole Linster. As a result, this partnership not only advances research into rare neurodegenerative diseases but also strengthens zebrafish as a valuable model for research that aims to bridge fundamental science and clinical questions. Additionally, it provided a template for other scientific exchanges currently running between the LCSB and leading research centres in Europe: the Ace Alzheimer Center Barcelona and Paris Brain Institute.

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From data to knowledge

Huge amounts of data are generated daily in laboratories and clinical studies: A treasure trove of information for research on human health, provided that we can effectively harness these diverse and complex datasets. This is where the Clinical and Translational Informatics group steps in. Established at the beginning of 2025 by building on the expertise developed over the years within the LCSB, this new team combines data science, bioinformatics, and IT solutions to advance digital health and translational medicine.

The Clinical and Translational Informatics team

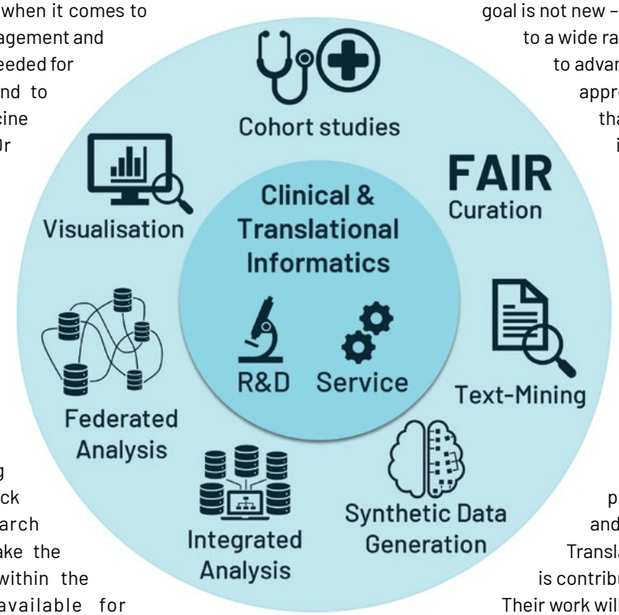
Led by Dr Venkata Satagopam, who has honed his skills as a bioinformatics expert at the LCSB since 2013, the group is, to say the least, data-driven. "We want to harmonise and integrate diverse biomedical data, from multi-omics readouts and microscopy to medical images, clinical information collected by hospitals and health apps, to inform our research on neurodegenerative diseases," details Dr Satagopam. "Bringing together information from a wide range of sources can accelerate biomarker discovery, help identify molecular signatures of disease progression, and improve our understanding of disease mechanisms."

Streamlining data use and analysis pipelines for research purposes is not easy given the heterogenous nature of the data in content and format. This team of data scientists, bioinformaticians and IT specialists is hard at work to make it happen. Within the LCSB, they contribute to collaborative research projects by ensuring that data management workflows are designed properly from the outset. Data must be curated, standardised and securely processed, in compliance with European personal data regulations (GDPR) and according to the FAIR principles of findability, accessibility, interoperability, and reusability. "We already have strong connections with several research groups when it comes to developing the data management and analysis infrastructure needed for large clinical studies, and to working on digital medicine projects," details Dr Satagopam. "We are now looking forward to sharing this expertise with the LCSB at large."

> **Let's unlock the potential of AI and data science for biomedical research and healthcare.**

Local and international partners also benefit from the group's unique skillset. For example, hospitals in Luxembourg are working with the team to unlock health data for research purposes. The goal: Make the information collected within the healthcare system available for secondary use in scientific studies, while ensuring it is kept secure. This forms part of the roadmap towards the European Health Data Space (EHDS), that will be implemented over the coming years, and the country is preparing for it with the help of the LCSB data experts. Similarly, a project, involving several national stakeholders and supported by funding from the Luxembourg National Research Fund (FNR), is set to begin in 2026. Called AID-Care, this project will leverage artificial intelligence (AI) to transform unstructured electronic health records into interoperable data, in order to detect early warning signs of cognitive decline, and to improve management of dementia and other neurodegenerative diseases.

"Going from a written note in a medical file to a format that can be easily analysed will help with clinical decision support, ultimately improving care planning and quality of life for patients," explains Dr Satagopam. Additionally, as the project will be carried out in collaboration with Japan, it will also contribute to enable trusted data collaboration with partners outside Europe.



All these projects are representative of a current trend: Building federated data infrastructures. The goal is not new – making data accessible to a wide range of researchers to advance science – but the approach has evolved. Rather than centralising all data in one place, the current method is to keep the data where it is collected and build the infrastructure that will enable scientists across Europe to access it while following GDPR, EDHS and AI regulations. Within the framework of large-scale European projects such as Clinnova and IDERHA, the Clinical and Translational Informatics group is contributing to this endeavour. Their work will help shape federated data management solutions and will bring new tools to the table for the analysis of federated data.

Analysing these large-scale datasets requires machine learning, deep learning, and statistical methods with which the group is already familiar. From predictive modelling to innovative digital healthcare solutions, these bioinformatics approaches will pave the way toward earlier diagnostics, better patient stratification, and personalised treatments, in line with the group's "bench to bedside" motto.

Looking to the future, it may even become possible to integrate data from all fields, from socio-economics to environmental science, to connect the dots, gain a broader understanding, and more effectively tackle human diseases. "It will involve massive coordination efforts and very complex projects, but these are the fun ones. If it were too easy, it wouldn't be as exciting," smiles Dr Satagopam.

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Putting science on the board

Parviel Chirsir (left) and Dr Louis Krieger (right)

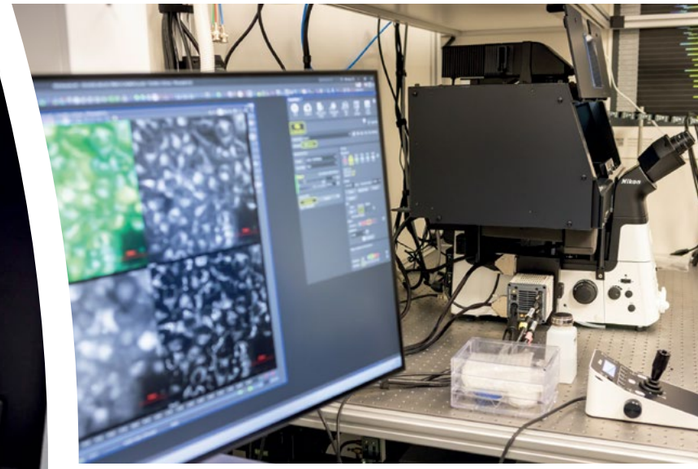
Science and outreach often go hand in hand, and what better way to mix the two than board games? This is exactly what happens with “Environmental Detectives” and “Power Planner”, two games developed respectively by Parviel Chirsir, doctoral researcher in the Environmental Cheminformatics group at the LCSB, and Scienteens Lab’s members Dr Louis Krieger & Sébastien Elixander. These fun and educational creations are perfect examples of how to convey scientific information and to tackle complex problems in a playful manner.

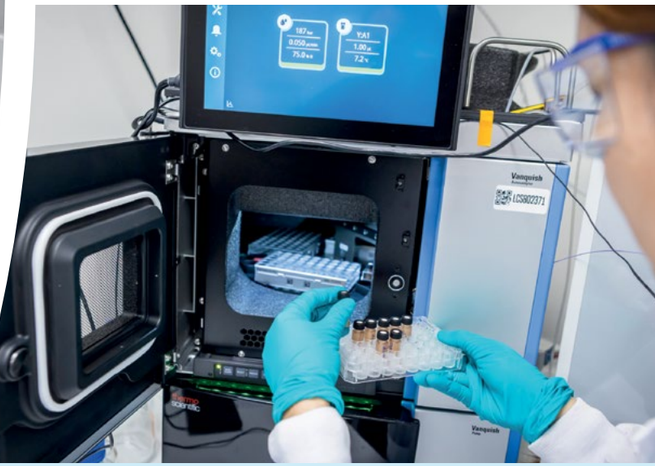
In “Environmental Detectives”, players gather around corkboards and are invited to solve an environmental mystery. What makes a family of squirrels living in your attic sick? Why are the perch in the local river not doing so good? After picking one scenario among the eight stories available, they have to investigate to find the chemical villain responsible. “The players have to collect clues about the source of the pollution, how victims are exposed to it and its environmental impacts,” explains Parviel Chirsir. “They learn about chemical properties, like persistence, mobility or bioaccumulation, and they do so while having fun by gathering information on a detective board with a red thread tying all the clues together.”

This first game was created within the framework of DESCOM, a programme providing science communication training for doctoral candidates at the University of Luxembourg. It is a joint effort between Parviel and Franco Catuogno, from the Luxembourg Institute of Health. It took them roughly eight months of intensive work to come up with the concept and make it happen. They crafted stories about “forever chemicals”, pesticides and plastic additives that we can all relate to and designed striking cards to give a strong visual identity to the game. The result is worth it: “Environmental Detectives” was tested with a wide range of players, and the responses were incredibly positive. “Many people told us that the game helped them understand complex scientific issues in an enjoyable way,” highlights Parviel. “It really shows that by engaging people through storytelling and games, we can build scientific literacy, empower individuals to think critically about environmental issues and to make informed choices.”

Same approach from the Scienteens Lab’s team. In their game, players must provide energy to their city, balancing supply and demand through the four seasons. Two years in the making, “Power Planner” manages to convey how complex meeting your population’s energy demand is. Based on scientific data, it teaches about grid management and infrastructure while considering political and economic aspects. “We went through a lot of trials and errors to get the right combination,” details Dr Louis Krieger, in charge of the physics & sustainability activities at the Scienteens Lab. “Now, we have a game that makes players reflect on the technology they should use to fulfil the needs of their citizens in terms of electricity and heating, but also on how to manage a budget and to plan for unpredictable events that will have an impact on their strategy.”

So far, 50 classes have played “Power Planner” and watching a game unfold is fascinating. Students keep brainstorming: Should we go for a nuclear power plant or rather a mix of renewable energy sources? Do we have to change our strategy after a difficult winter? Should we negotiate with our neighbours? The game takes a life of its own and it gets better after every round! It is so popular that the Scienteens Lab plans to commercialise the game, first to high schools in Luxembourg and then to educational organisations across Europe.





Bringing in advanced technologies

To address the needs of researchers in a fast-changing scientific environment, the LCSB regularly introduces new high-tech equipment. In 2025, two of the centre’s platforms, Bioimaging and Metabolomics & Lipidomics, expanded their toolboxes with additional microscopes and a proteomics set-up.

While the new ZEISS Cell discoverer 7 combines widefield, confocal, and Airyscan modules and enables projects involving small model organisms and organoids that require super-resolution, the Nikon Ti2 widefield microscope is ideal for fast calcium imaging and smart microscopy. Both devices can also image several samples in sequence and assist researchers with artificial intelligence. The proteomics equipment is another exciting new feature. It will complement the existing state-of-the-art mass spectrometry approaches, allowing scientists to measure and compare protein levels in complex biological samples such as cells, tissues, and body fluids.

“These advanced technologies will benefit all LCSB research groups as well as external users thanks to their expanded functionalities”, emphasises Dr Jan Rozman, Scientific Coordinator of the LCSB platforms. “They will support the use of a broad range of sample types and open up new opportunities for exploring emerging fields of research.”

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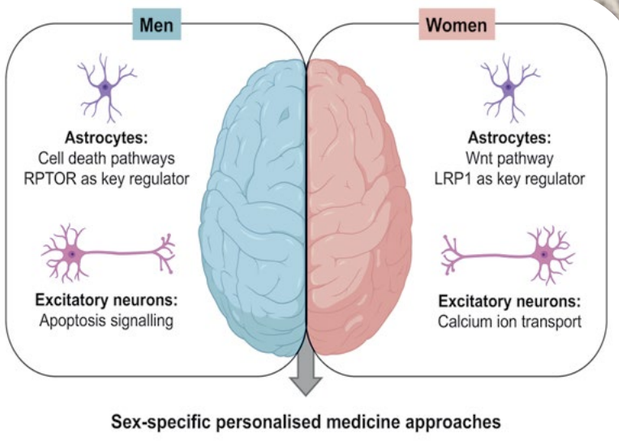
Molecular differences between men and women in Alzheimer's disease

Alzheimer's disease is the leading cause of dementia worldwide, but it does not affect everyone in the same way. Women are at a higher risk of developing the disease and often experience more severe symptoms than men, even when differences in life expectancy are taken into account. While these disparities have long been observed clinically, the biological mechanisms behind them have remained largely unclear. With the support of the Luxembourg Fondation Wivine and of the FNR, researchers at the LCSB have now uncovered sex-specific molecular differences in Alzheimer's disease, offering new perspectives for more personalised therapeutic approaches.

The Biomedical Data Science team

Led by Prof. Enrico Glaab, head of the Biomedical Data Science group at the LCSB, the study reveals that Alzheimer's disease affects different types of brain cells in distinct ways in men and women. By analysing molecular changes at single-cell resolution, the researchers were able to identify sex-dependent disease mechanisms that had previously remained hidden. The findings were published in the journal *Alzheimer's & Dementia*.



Sex-specific personalised medicine approaches

Tailoring treatments to sex-specific molecular differences could improve therapeutic efficacy and pave the way for more personalised medicine.

Using advanced single-cell analysis, the research team studied more than 2.3 million brain cells, including both neurons and different types of glia cells, from people with Alzheimer's disease and healthy controls who had donated their brains to research after death. They were particularly interested in the pre-frontal cortex, a key area responsible for decision making and memory retrieval. The researchers measured the gene expression levels of thousands of genes in individual cells, a process also referred to as single-cell transcriptomics. They then compared the changes between patients and healthy controls but also between the two sexes in the affected and non-affected groups to look for sex-dependent changes. This approach allowed them to analyse in detail gene activity patterns and cellular processes across multiple types of brain cells that play a role in the disease.

Their findings revealed distinct molecular signatures in men and women with Alzheimer's. In male patients, astrocytes, a subtype of glial cells responsible for metabolic, structural, homeostatic, and neuroprotective functions, showed significant changes in pathways associated with cell death. In contrast, female patients showed alterations in pathways involved in cellular communication and growth regulation. "By focusing on individual cells, we can investigate sex-dependent disease mechanisms and subtle differences between cell types of the brain that might otherwise remain hidden," explains Mohamed Soudy, PhD student in the Biomedical Data Science group and first author of the study.

A key feature of Alzheimer's disease is a breakdown in how brain cells communicate with each other, leading to neuronal death and widespread loss of brain function. The researchers found indications that some of these communication disruptions manifest differently between the sexes. Male Alzheimer's disease brains showed pronounced changes in cell death signalling, while female brains showed altered calcium signalling, a process that is essential for memory formation and normal brain function. "These sex-specific differences and the complex interplay of cellular processes provide a clearer picture of how Alzheimer's manifests distinctly in men and women," says postdoctoral researcher Dr Sophie Le Bars in the group and co-author of the study.

To look for potential drug targets, the researchers used computational methods that analyse how molecular regulators interact with each other and with other substances in the cell to control gene expression levels. Through the systematic analysis of these cell type-specific gene regulatory networks and by simulating potential drug effects, key regulatory molecules were identified as candidates that could be modulated to revert sex-dependent pathological changes.

In male patients, *RPTOR*, a molecule involved in cell survival and metabolism, was identified as a potential mediator of sex-specific changes in Alzheimer's disease. In female patients, the researchers identified *LRP1* as a key regulatory molecule. This protein plays an important role in clearing toxic proteins such as amyloid-beta from the brain. *LRP1*'s position as a central mediator in female-specific gene networks in Alzheimer's suggests it could merit further investigation as a target for sex-specific therapies.

"These findings highlight the benefits of considering sex as an important biological variable in Alzheimer's research," says Prof. Glaab. "Tailoring treatments to such molecular differences could improve therapeutic efficacy and pave the way for more personalised medicine." A much-needed approach as the global burden of Alzheimer's disease continues to rise.

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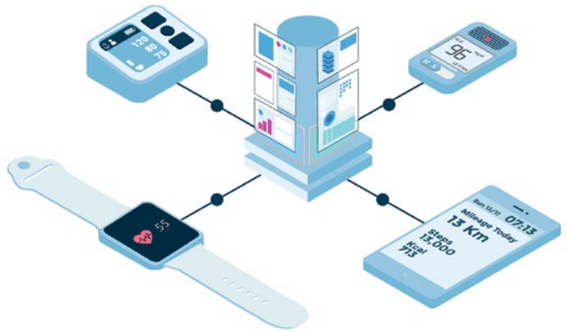
Home monitoring for personalised Parkinson's care



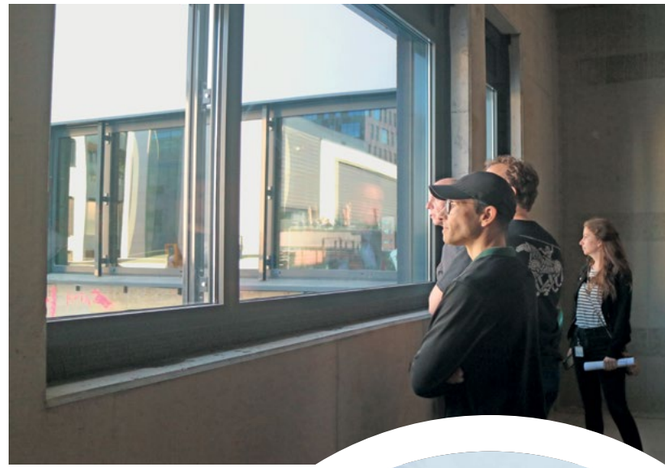
Parkinson's disease is most often associated with tremor, slowness of movement and gait disturbances. Yet, for many patients the so-called "non-motor" symptoms limit daily activities even more. Among them, a condition known as orthostatic hypotension leads to dizziness or fainting because of sudden drops in blood pressure when standing up. As these events are unpredictable, they are notoriously difficult to assess during routine medical visits. To address this challenge, researchers from the Digital Medicine and AI Modelling and Prediction groups joined forces to explore how wearable technologies and advanced data analysis can enable continuous home monitoring of cardiovascular regulation in people with Parkinson's disease.

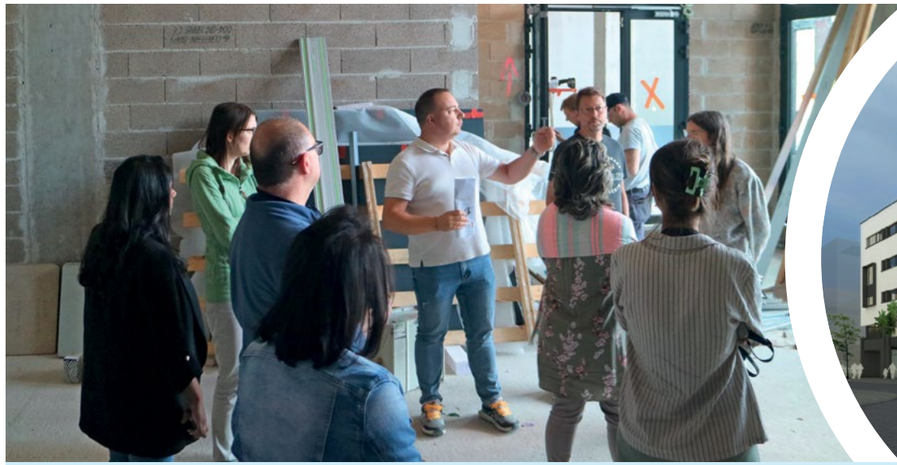
Called PDHOME, this project was initiated as a Tandem project to foster interdisciplinary collaborations within the LCSB. Projects such as this one are supported by internal competitive funding to encourage strategic partnerships between teams and help kick-start new research ideas. In this case, coming from the clinical perspective, the Digital Medicine group, led by Prof. Jochen Klucken, was seeking to move beyond motor symptoms and address non-motor manifestations of Parkinson's disease. "When patients report dizziness or fainting, this often points to a dysfunction in cardiovascular regulation," explains Prof. Klucken. "These symptoms are highly relevant for patient safety, yet they are difficult to capture with standard clinical tests in clinical settings, and they often occur at home." This is where the extensive expertise of the AI Modelling and Prediction group headed by Prof. Jorge Gonçalves when it comes to analysing complex time-series data from wearable sensors came in.

Building on earlier feasibility work demonstrating that orthostatic reactions can be detected in real-world environments using wearables, the two teams combined clinical insight with advanced signal processing and machine learning to develop a shared analytical framework. "Our goal is to translate continuous sensor signals into information that is meaningful for clinicians," says Prof. Gonçalves. The researchers relied on certified medical technologies that could be readily deployed in clinical studies. Participants were equipped with different wearable sensors which recorded movement and heart-related signals, and allowed detailed cardiovascular measurements. The project combined controlled assessments in clinical environments with longer monitoring phases at home. "In the clinic, doctors may have access to only a handful of data points," notes Prof. Gonçalves. "With continuous monitoring, we suddenly have days or even weeks of information. The challenge lies in identifying which patterns truly matter."

While the project itself focused on establishing technical and analytical feasibility, it also acted as a catalyst for additional research. Building on the PDHOME framework, several observational clinical studies are now ongoing in collaboration with hospitals across Luxembourg to further investigate cardiovascular regulation and related symptoms in different patient cohorts. "The success of this project lies in creating a common language between clinicians and data scientists," underlines Prof. Klucken. The resulting datasets now allow researchers to return to the analytical phase, refining algorithms and exploring how continuous monitoring can support clinical decision-making.

In the long term, the researchers envision that approaches developed within PDHOME could support more personalised disease management, helping doctors evaluate treatment effects, adjust therapies based on objective data, or identify early signs of dysregulation before serious events occur. The project illustrates how targeted internal funding can catalyse sustainable collaborations. What began as a one-year Tandem project has evolved into a broader research trajectory linking computational science, clinical research and hospital partnerships. "Our skills are complementary," concludes Prof. Gonçalves. "We develop better analytical tools, while our clinical colleagues focus on improving patient care. Together, we can turn complex data into insights that genuinely matter for patients."





A first glimpse into the future

In May 2025, LCSB staff visited the future Biotech 3 (BT3) building on Campus Belval for the first time. Currently under construction, BT3 will significantly expand the centre's infrastructure, creating new space for research, education and public engagement, and will be shared with the Department of Health, Medicine and Life Sciences (DHML). During the guided tour, colleagues explored the raw floors, before interior design and partitioning begin, and gained an early impression of how the new research hub will take shape.

The building will feature a spacious entrance lobby opening onto a central atrium with views across all five floors, designed as a welcoming environment for researchers and visitors alike. It will house state-of-the-art laboratories, a participant stratification centre, a lecture hall for scientific and public events, and a cafeteria with terrace.

BT3 will also bring research and outreach closer together. The Scienteens Lab will be located under the same roof as LCSB research groups, strengthening exchanges between scientists and high-school students. A footbridge connecting BT3 to the existing Biotech 2 will further encourage daily interaction and interdisciplinarity. Scheduled to open in early 2027, BT3 is set to become a key hub for research, training and dialogue with society.

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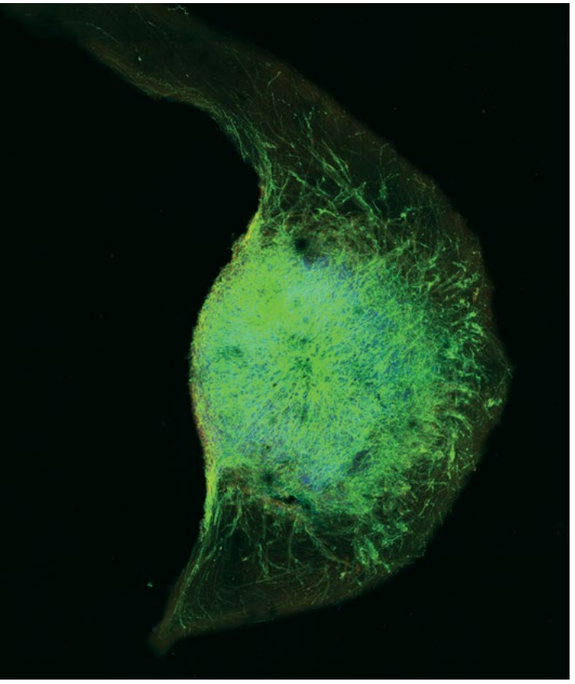
Internal collaboration shines a light on Miro1

LCSB researchers keep unfolding the molecular mechanisms underlying neurodegeneration in Parkinson's disease. In a collaborative effort bringing together different teams, with the support of the Luxembourg National Research Fund (FNR), they highlight the impact of a mutation affecting the Miro1 protein. With its link to altered energy metabolism, alpha-synuclein accumulation and loss of dopaminergic neurons, this protein confirms the significant effect of some rare genetic variants and the relevance of mitochondrial pathologies in Parkinson's disease.

Complex by nature, Parkinson's disease is not only clinically but also a genetically heterogenous. If a few well-known mutations are associated with the disease, there is growing evidence that rare variants in different genes might also have substantial effects. *RHOT1* has been identified as one of the genes with the highest burden of rare genetic variants in people with Parkinson's, meaning alterations in this gene could play an important role in genetic susceptibility to the disease.



Miro1 mutant midbrain organoid

Miro1, a protein encoded by *RHOT1*, has recently been linked to the disease. It is essential for maintaining equilibrium in mitochondria, key components of the human cells, and it interacts with other proteins that are major players in Parkinson's. In a study, supported by the Luxembourg National Research Fund (FNR) and published in *Brain*, LCSB researchers investigated a specific mutation in Miro1 and the role it plays in different cellular activities and pathways relevant for neurodegeneration. "After describing the first patients carrying distinct mutations in the gene encoding Miro1 several years ago, we wanted to validate the underlying pathological mechanisms using advanced gene-editing technologies *in vitro* and *in vivo*," explains Prof. Rejko Krüger, head of the Translational Neuroscience group at the LCSB.

The scientists first performed experiments in patient-derived *in vitro* models: Midbrain organoids – 3D cell cultures that mimic a specific region of the human brain – and cultures of dopaminergic neurones, both originating from pluripotent stem cells, either from a patient carrying the Miro1 mutation or from healthy controls. "These patient specific cell cultures allow us to investigate the effects of Miro1 mutations at the cellular level," details Prof. Jens Schwamborn, principal investigator of the Developmental & Cellular Biology group. "Brain organoids recapitulate the complexity of the human midbrain and thereby make it possible to study what happens when the protein is mutated not only in a single cell but in the complex interaction of various cell types, including dopaminergic neurons and astrocytes."

Additionally, to study the effect of the mutation *in vivo*, the researchers developed the first Miro1-mutant mouse model. By introducing a mutation homologous to the one existing in humans with CRISPR/Cas9 technology, they could observe changes typical of Parkinson's disease in the brain as well as in the behaviour of mice over time.

University of Luxembourg • LCSB • Highlights 2025 • Parkinson's disease

From left to right: Prof. Krüger, Prof. Grünewald and Prof. Schwamborn

Taken together, the results obtained in the organoids, the neuronal cultures and the mice showed that the Miro1 mutation is sufficient to cause the loss of dopaminergic neurons, likely mediated through mitochondrial dysfunction. "There is increasing evidence that mitochondrial impairment is a major driver of neurodegeneration. The results from this study further strengthen this idea: The mutation in Miro1 seems to increase susceptibility to mitochondrial damage, which impacts the energy production and ultimately leads to cell death in the investigated models," underlines Prof. Anne Grünewald, head of the Molecular & Functional Neurobiology group.

> **Miro1 is a convergent player in neurodegeneration, as well as a potential drug target and molecular biomarker.**

Building on the interdisciplinary skills of different teams, a strategy at the core of the LCSB, has made these findings possible. Three research groups brought their expertise to the table, from the organoid methodology, to the mitochondria know-how, and the deep understanding of the genetic basis of Parkinson's and its validation in patient-derived models. Technical knowledge also played a key part with the contributions of the rodent facility and bioimaging platform for the experimental work with mouse models and image-based analyses.

As a result, the study further demonstrates the importance of genetic variance in Parkinson's disease susceptibility. It provides a new mouse model that comprehensively encompasses key characteristics of the disease, it unveils a novel molecular mechanism linking Miro1 and α-synuclein accumulation, and identifies Miro1 as a convergent player in neurodegeneration. The protein is now a potential drug target and molecular biomarker, relevant for developing new disease-modifying therapies.

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The ordering wizards

The lab procurement team

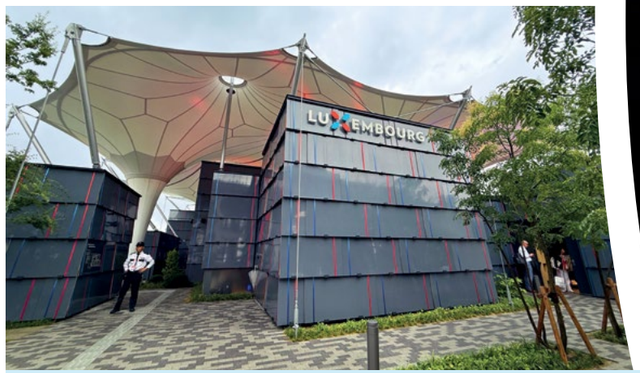
At the LCSB, there is a stock room full of supplies. Piles of packages are delivered every day, bringing consumables to the laboratories. High-tech equipment enables researchers to conduct innovative experiments. But how does it all get there? Contrary to what some might believe, not via a few clicks in an all-knowing piece of software, but rather thanks to the hard work of the lab procurement team. These six people seldom take the spotlight, but they play a central role in ensuring the laboratories run seamlessly. They oversee the many steps between a click in Quarks, the aforementioned programme, and a product arriving on the lab bench, between the initial discussions about a new microscope and its installation. In short, they are the unsung ordering wizards of the LCSB.

"How many orders do I place in a year? Over 3000," smiles Biagio Latella, one of the members of the lab procurement team. "And this is just for the consumables, such as chemicals and small products. It doesn't include what is needed for our common stock and in terms of safety equipment," adds his colleague Thea Van Wüllen. Their team truly juggles a broad range of responsibilities: From ensuring that orders placed by technicians and researchers reach the LCSB, to negotiating the best conditions with suppliers and achieving savings on nearly every order. From maintaining compliance with public procurement law to integrating green principles when selecting supplies.

If the job seems straightforward at first glance, it is actually more complex than it appears. Administrative tasks linked to invoicing and payment are a time-consuming part of the exercise, but far from the only one. "We have to take care of the packages when they arrive, prepare labels for inventories. We have to be very efficient there, especially when dealing with urgent deliveries and with sensitive products that must stay cold or be handled with care," details Fasavanh Sanichanh who is part of the team. "There is also a human side to it, since we interact with the companies that sell the goods, as well as with the end users in our labs. We are at the interface, ensuring that information flows and that things get done."

Additionally, the team makes sure that specific services needed in the laboratories, such as software licences, run continuously. They also collaborate closely with central departments of the university during the preparation of tender proposals for larger purchases. This is where Paula Ferro and Alexandra Ferrao step in, supporting researchers throughout all purchase phases for cutting-edge technologies. And the process doesn't end after selecting the best-suited piece of equipment, its installation, calibration and maintenance must be organised, as well as training sessions for the staff. In short, placing the order is only the tip of the iceberg.

A lot goes on behind the scenes 24/7, making the team a cornerstone of the LCSB. Without this dedicated group of people, activity in the laboratories would grind to a halt as all the research groups rely on their expertise to obtain the right supplies. "People tend to overlook what it takes to support almost two hundred scientists on a daily basis," concludes Thea Van Wüllen. "It requires quite a lot of planning, a good head for numbers and a bit of diplomacy. Worth remembering the next time an urgent package makes its way to the lab bench."



Luxembourg's Parkinson's research on the world stage

Luxembourg's Parkinson's research was prominently featured at the World Expo in Osaka, offering unprecedented international visibility for a field that has become a cornerstone of the country's biomedical landscape. Presented within the Luxembourg Pavilion, the exhibit highlighted more than a decade of coordinated efforts to advance Parkinson's research from fundamental discovery to patient-centred clinical application within the framework of the National Centre of Excellence in Research on Parkinson's Disease (NCER-PD), funded by the Luxembourg National Research Fund (FNR).

A short video showcasing Luxembourg's distinctive multi-institutional approach illustrated how close collaboration between research centres, hospitals and clinical partners has enabled the development of internationally recognised expertise in Parkinson's disease. Designed for a broad audience, the content made complex topics accessible through multilingual and interactive formats, and conveyed a clear message: Addressing complex neurological diseases requires long-term commitment and a shared vision that places patients at the centre. With the World Expo attracting a large international audience, the exhibit provided a unique opportunity to engage directly with the public and key stakeholders.

Beyond raising visibility, the Expo also served as a platform to strengthen existing collaborations and initiate new research partnerships. The decision to feature Parkinson's research in Osaka was closely linked to Luxembourg's longstanding cooperation with leading Japanese research institutions in biomedical and health research. Presenting an exhibit reflecting this sustained collaboration in Osaka underscored the continuity, mutual trust and depth of this bilateral partnership.

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When diet impacts our gut microbiome and then our brain

Resistant starch might be the latest hit on food blogs and among nutrition enthusiasts, but it turns out its impact on our gut is also being studied in the context of neurodegenerative diseases. The Systems Ecology group at the LCSB, whose research focuses on the microbiome and its role in health and disease, recently observed that a diet enriched in resistant starch has promising effects on symptoms of Parkinson's disease.

While most people associate Parkinson's disease with the brain, it might be less well-known that the gut is also impacted in this neurodegenerative disorder. Neurodegeneration occurs in the enteric nervous system early on, as well as alterations in the gut microbiome, leading to gastrointestinal symptoms in the first stages of the disease, before the classical motor symptoms appear. Changes observed among the microorganisms present in the gut of Parkinson's patients have been of particular interest to scientists studying the disease, as it seems they promote neuroinflammation and aggravate the pathological mechanisms. "There is growing evidence that the gut microbiome plays an important role in Parkinson's disease, and we know that diet shapes the microbiome structure and function," explains Prof. Paul Wilmes, head of the Systems Ecology group. "So, targeted dietary interventions represent a promising avenue to alleviate symptoms, especially as they are generally well tolerated by patients."

Wilmes' team, in collaboration with the group of Prof. Brit Mollenhauer from the Paracelsus Elena Clinic in Kassel and with the support of the the Michael J. Fox Foundation, recently focused on the potential of resistant starch. When consumed, this complex carbohydrate transits through the stomach and small intestine without being absorbed and reaches the large intestine where it is digested by microorganisms. In Parkinson's disease, it could, along with other dietary fibres, help modulate the gut microbiome in a beneficial way. Resistant starch occurs naturally in foods such as green bananas, beans, seeds and nuts, and can also be formed by cooking and cooling potatoes, rice or pasta.

In a pilot study, the scientists worked with 74 Parkinson's patients following different diets – a conventional diet, one supplemented with resistant starch, and a classical high-fibre diet – for two to forty weeks. The researchers collected stool and blood samples, as well as clinical, pharmacological, and nutritional data regularly, allowing for a detailed comparison of the effect of the different diets and durations. "We analysed the structure of the gut microbiome, its functional potential, and the types of molecules found in the blood and stools through advanced methods such as shotgun sequencing and multi-omics approaches," details Dr Viacheslav Petrov, postdoctoral researcher in the group. "Together with questionnaires about the severity of symptoms, it gave us a very good overview of the impact of diets high in resistant starch or dietary fibres in general."

Their findings reveal that both the addition of resistant starch and fibres in the diet, even for a short period, remodels the gut microbiome of participants, leading to an increase in health-related bacteria and a decrease in opportunistic pathogens. When prolonged for several weeks, the consumption of resistant starch had further benefits, from increased levels of anti-inflammatory molecules in stool and blood, to improvements of both motor and non-motor symptoms of the disease.

"The resistant starch supplement provides resources for beneficial microorganisms in the large intestine," describes Dr Petrov. "As a result, we see a shift in the composition of the gut microbiome that is tightly linked to changes in its functional potential, the ability of these microorganisms to form biofilms that protect from intestinal damage for example. It also has an impact on the metabolic activity and the inflammatory response of the body." The most striking consequence of this health-promoting change being of course the significant improvements observed in the symptoms and quality of life of the patients.

While this study highlights the potential of dietary interventions to modulate the gut microbiome and help manage Parkinson's disease, the work of the Systems Ecology group keeps unveiling the intricate role of this community of microorganisms in health and disease.

University of Luxembourg • LCSB • Highlights 2025 • Systems Ecology

The LCSB members, from the Systems Ecology group and the platforms, who co-authored the studies.

"It is highly rewarding to get results that can directly lead to nutritional recommendations and have beneficial outcomes for the patients," says Prof. Wilmes. "Yet, our research also shows how complex the connections between the gut and the brain are. The more we learn, the more questions we have. For example, is the microbiome simply affected by the disease? Can it trigger its emergence or conversely could it have a protective role?"

Some of the team's recent publications have for example shown how the gut microbiome is already disrupted at prodromal stages of Parkinson's disease, such as in patients with idiopathic REM sleep behaviour disorder, a condition that is often seen as a precursor of Parkinson's. These early shifts affect key functions of the microbiome that help regulate the immune system and brain functions, with overall implications for human health. As part of the ERC-funded ExpoBiome project launched in 2020 and the following Proof of Concept grant (AMY-Dx) obtained in 2025, the team is also looking at small proteins that are produced by the gut microbiome and can trigger the aggregation of α-synuclein, the molecular hallmark of Parkinson's disease.

> **Dietary interventions represent a promising avenue. Yet, our research also shows how complex the connections between the gut and the brain are.**

They are both interested in the possible pathogenic role of these microbial molecules and investigating how to use them as predictive biomarkers to detect the disease early.

These new insights into the role of the gut-brain axis in neurodegeneration will contribute to a better understanding of several diseases and to the development of treatment strategies focused on microbiome restoration including in larger and longer-term dietary interventions.

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LCSB short stories

Venusberg conference 2025

In May, the LCSB hosted the Venusberg Meeting on Neuroinflammation for the second time, gathering over 250 researchers, clinicians and students from around the world. The theme chosen for this edition was “Cerebral immune activation at the crossroads of healthy aging, senescence and neurodegeneration”. Over 30 talks explored the roles that microglia, oligodendrocytes and astrocytes play in diseases such as Alzheimer’s, frontotemporal dementia, and multiple sclerosis. The conference also offered a vibrant networking environment, with over 100 scientific posters and blitz talks by young academics. The interdisciplinary nature of this three-day event fostered thought-provoking discussions and promoted future collaborations. It was supported by the Luxembourg National Research Fund (FNR) and several industrial sponsors.

GOLD certification

In 2025, the LCSB renewed its My Green Lab GOLD certification, with an improved score of 66%. This certification is a widely recognised lab sustainability program that offers a science-based approach to help laboratories commit to sustainable science. This new result reflects the strong engagement and ongoing commitment of the LCSB teams toward more sustainable lab practices. Let’s keep supporting a greener research environment!

LCSB on Tour keeps on going

This year, the “LCSB on Tour” initiative kept spreading the word about biomedical research carried out at the LCSB to all four corners of Luxembourg. After being held in Diekirch, Steinfort, Echternach and Ettelbruck in 2024, this series of public lectures visited Bettembourg, Mersch and Kehlen in 2025. Each time, around 100 people had the opportunity to meet researchers, listen to presentations on the gut microbiome, fasting and health, or Parkinson’s disease, and participate in interactive discussions. New lectures are already programmed for 2026!

University of Luxembourg • LCSB • Highlights 2025 • Short stories

Student delegation from Delft

In October, 40 students from the BSc & MSc in Nanobiology of the Delft University of Technology visited the LCSB. After a short introduction about the centre, the group exchanged with Prof. Ivana Nikic-Spiegel and visited different laboratories. They learned about the work conducted by the Enzymology & Metabolism and Integrative Cell Signalling groups, and discovered the high-tech equipment available in the LCSB platforms for disease modelling and screening, and bioimaging. They also had the opportunity to discuss about studies, interdisciplinary expertise, work environment and the daily life in the lab with LCSB scientists. Overall, an enriching visit for both sides.

Rare diseases and solar energy at the Science Festival

The latest edition of Science Festival welcomed 9,000 visitors, and both the LCSB and the Scienteens Lab contributed to this successful event with popular booths. The Enzymology & Metabolism group designed an interactive introduction to research on rare diseases while kids could discover how to harness the power of the sun through experiments and a race with solar-powered cars with the Scienteens Lab’s team. A big thank you to all the volunteers for their enthusiasm and dynamism!

Selection of a new artwork

At the end of the year, the LCSB announced the winners of its artistic competition, which will lead to the installation of a new permanent art piece at the entrance of its Biotech2 building on Campus Belval. The competition invited artists to explore the intersection of art, science, and society, inspired by the LCSB’s research on the brain. After reviewing 14 high-quality submissions, the jury selected “Synaptic Bloom”, the project of Luxembourgish artists Raphaël Gindt & Daniel Mac Lloyd. This large brain sculpture, forged from locally sourced corten steel and half covered by vibrant graffiti patterns, will be installed in spring 2026.

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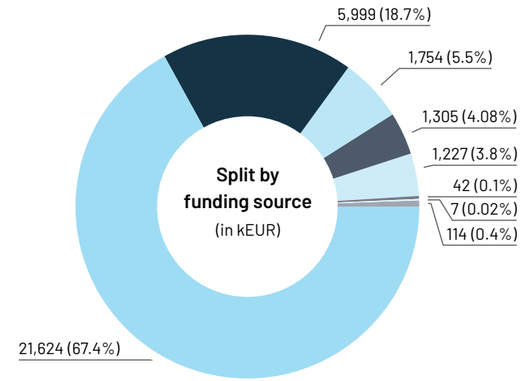
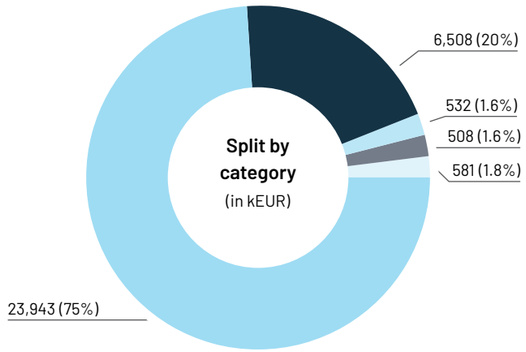
Facts & Figures

LCSB expenses 2025

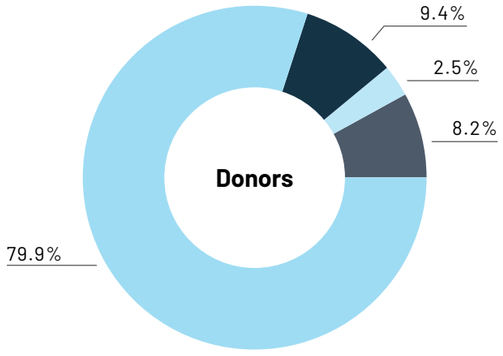


- University of Luxembourg
- Luxembourg National Research Fund (FNR)
- EU programmes
- Fundraising
- Further grants
- Ministries
- Funds for knowledge transfer
- Industry cooperation

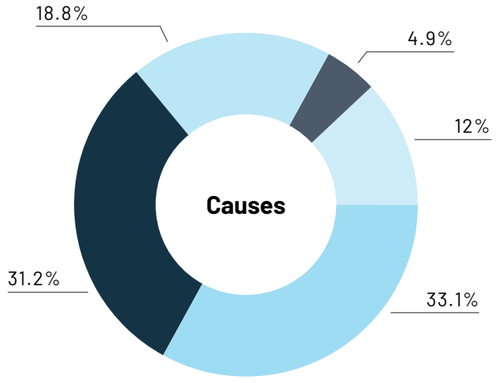


- Wages
- Operating expenses
- Investments
- Representation and registration
- Travel

Fundraising



- Foundations
- Corporate
- Associations
- Private individuals



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

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LCSB organisation chart

LCSB Director (M. Heneka)

Director's office
- Research Strategy
- Personal assistant

Research groups

AI in Biomedical Imaging (S. Gorgi Zadeh)	**AI Modelling & Prediction** (J. Gonçalves)	**Bioinformatics Core** (R. Schneider)
Biomedical Data Science (E. Glaab)	**Chemical & Molecular Neurobiology** (I. Nikić-Spiegel)	**Clinical & Translational Informatics** (V. Satagopam)
Computational Biology (A. Del Sol)	**Developmental & Cellular Biology** (J. Schwamborn)	**Digital Medicine** (J. Klucken[1])
Environmental Cheminformatics (E. Schymanski)	**Enzymology & Metabolism** (C. Linster)	**Gene Expression & Metabolism** (E. Williams)
Gene Expression Dynamics (R. Schieweck)	**Immunology & Genetics** (D. Brenner[2])	**Integrative Cell Signalling** (A. Skupin)
Medical Translational Research (J. Schneider)	**Molecular & Functional Neurobiology** (A. Grünewald)	**Molecular Biophysics** (T. Scheidt[4])
Neuroinflammation (M. Heneka)	**Systems Ecology** (P. Wilmes)	**Translational Neuroscience** (R. Krüger[3])

Scientific central services (J. Rozman)

Aquatic (M. L. Cordero Maldonado)	**Bioinformatics** (S. Narayanasamy)
Bioimaging (P. Antony)	**Disease modelling & screening[2]** (J. Rozman)
Genomics (R. Halder)	**Metabolomics & Lipidomics** (C. Jäger)
Model Biobank & Tissue Analytics (M. Buttini)	**Rodent** (D. Coowar)

[1] in cooperation with CHL
[2] in cooperation with LIH
[3] in cooperation with LIH & CHL
[4] start January 2026

Infrastructure (N. Bonjean)

Safety, Quality & Sustainability
- Safety & Biosafety# (safety culture, emergency response plans & trainings)
- Quality assurance & SOPs (electronic laboratory notebook, R3 support & PPC§)
- Green lab initiatives

Equipment
- Instrument purchase & care
- Technology platforms

Procurement & Logistics
- Laboratory procurement
- Laboratory supplies
- Sample shipment
- Technical support

Infrastructure
- Facility management & development
- Access management
- Infrastructure business continuity plans
- Lab space coordination

Operations (A. Vogler)

Communication
- External comms & outreach
- Internal communication
- Event management
- Onboarding & alumni

Fundraising
- Donor acquisitions & mgmt.
- Charity events

Scienteens Lab
- Curriculum development
- Outreach to schools

Management & Strategy*
- Strategic planning
- Process management

Innovation & Partnering
- Business development & legal
- Technology transfer

Finance & Grants
- Budget planning, reporting & control
- Grant funding opportunities, submission, project support, contracts & reporting

Secretariat
- Business trip arrangements
- Purchase orders & invoices
- Newcomer & guest mgmt.
- PI-level event organisation
- Office supplies

Shared UL Functions
HR, IP, DPO, etc.

* in cooperation with LCSB Research Strategy § in cooperation with LCSB Bioinformatics Core # in cooperation with responsible UL department

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National grants in 2025

PROJECT ACRONYM	PROGRAMME	LCSB RESPONSIBLE	PROJECT COORDINATOR *
IMOR-PD	FNR AFR Individual	Cyrille Lorenz, Alexander Skupin	
NMNI	FNR AFR Individual	Vincent Florentin, Anne Grünewald	
TRACE-ME-AD	FNR AFR Individual	Varsha Venkatesha Murthy, Enrico Glaab	
INDA	FNR CORE	Alexander Skupin, Jens Schwamborn	
MicroAmylo-PD	FNR CORE	Paul Wilmes	
RiboPD	FNR CORE	Rico Schieweck, Anne Grünewald, Patrick May	
TANDEM	FNR CORE Junior	Emanuele Frattini	
OH(T)SIZON	FNR Industrial Fellowships	Beatriz Soares Carneiro da Silva	Exobiosphere
NEUROH-CHANGE	FNR INITIATE	Paul Wilmes	
FadA-AD	FNR INTER Mobility	Michael Heneka, Yiping W. Han	
BioAI	FNR RESCOM Lecture Series	Enrico Glaab	
Harnessing the Power of the Sun	Science Festival	Elisabeth John	
Let's care for rare	Science Festival	Carole Linster	

*if applicable

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European grants in 2025

PROJECT ACRONYM	PROGRAMME	LCSB RESPONSIBLE	PROJECT COORDINATOR *
AMY-Dx	ERC Proof-of-Concept	Paul Wilmes	
BE READY NOW	Horizon Europe	Paul Wilmes	INSERM, France
PFAROS	IHI-JU	Emma Schymanski	University of Ghent, Belgium
METAMIC 3	MSCA Doctoral Networks	Paul Wilmes	Leibniz Institute for Analytical Sciences - ISAS, Germany
AUDACITIES	FNR INTER ANR	Jorge Goncalves, Michael Heneka	Inria Branch at the University of Montpellier, France
EU-RESOLVE	FNR INTER COST	Enrico Glaab, Rashi Halder	Queen Mary University of London, UK
INFLAMomx	FNR INTER COST	Alexander Skupin, Venkata Satagopam	University of Split, Croatia
OrganMitoML	FNR INTER DFG	Antonio Del Sol Mesa	Heinrich-Heine-University Düsseldorf, Germany
PhORECaST	FNR INTER EP PerMed	Antonio Del Sol Mesa	Technical University Dresden, Germany
SynLeigh	FNR INTER ERDERA	Antonio Del Sol Mesa	Heinrich-Heine-University Düsseldorf, Germany
AMPD	FNR INTER WEAVE	Jens Christian Schwamborn	Mossakowski Medical Research Institute, Polish Academy of Sciences, Poland
PD-on-a-chip	Thiemann Foundation	Alexia Tiberi	

International grants in 2025

PROJECT ACRONYM	PROGRAMME	LCSB RESPONSIBLE	PROJECT COORDINATOR *
mtDNA	Michael J Fox Foundation	Anne Grünewald	Hertie Institute for Clinical Brain Research, University of Tübingen, Germany
PDcoPath	Michael J Fox Foundation	Jens Schwamborn	Biomedical Research Foundation of the Academy of Athens, Greece
REACT	Cure SMA	Rico Schieweck	

*if applicable

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Key performance indicators

PERSONNEL

Research groups:	21
PEARL (active):	2
ERC (active):	2
Total staff:	281
Externally funded staff:	122
PhD students:	54
Nationalities:	60

EXTERNAL COMPETITIVE FUNDING 2025

Total:	**14.7 M EUR**

FUNDRAISING 2025

Total:	**2.07 M EUR**

COLLABORATIONS

Industrial partners active in projects in 2025:	9

PUBLICATIONS

Total publications:	180
Publications IF>10:	47
Publications in 25% best of field*:	84%
Open Access (OA) publications:	92%
Publications in OA journals:	57%
Cumulative number of publications°:	1,929

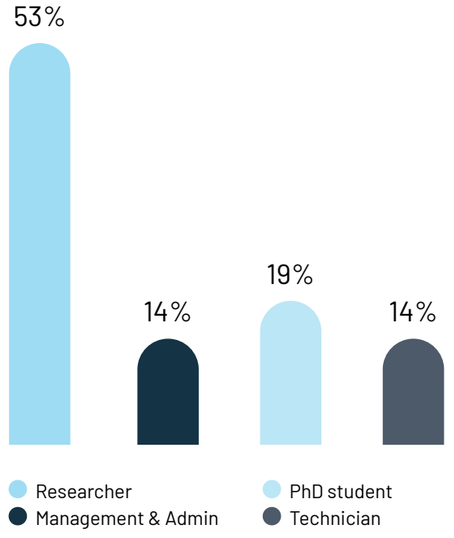
INNOVATION

Patents°:	42
Proof of concept°: (total 4.3 M EUR)	10
Spin-offs active:	3

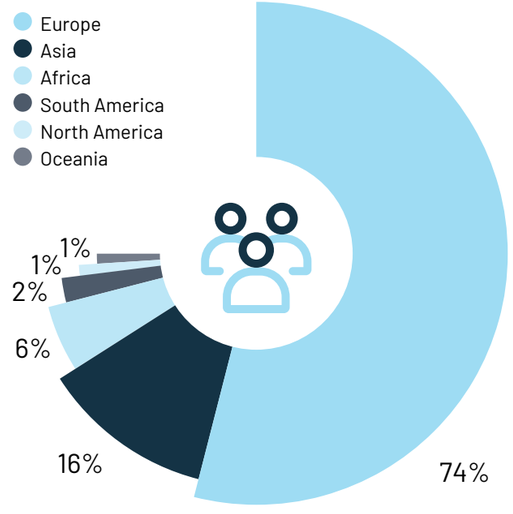
* based on WoS

° cumulative (2009-2025)

Staff categories 2025



Staff origins



Scientific Advisory Board

MEMBERS

Maria Grazia Spillantini	Professor of Molecular Neurology, University of Cambridge
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Lennart Mucke	Professor of Neuroscience, University of California
Hans-Christian Pape	Professor of Physiology, Westfälische Wilhelms-University
Andreas Beyer	Professor for Systems Biology, University Cologne

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Publications 2025

Book

1. Venkata Satagopam et al., "Best Practices for Reproducible Microbial Genomics Analyses", *Next Generation Sequencing Standard Operating Procedures and Applications*, 173-183, 10.1201/9781003354062-12

2. Mathias Galati et al., "Best Practices in Single-Cell RNA-seq Data Analysis", *Next Generation Sequencing Standard Operating Procedures and Applications*, 107-122, 10.1201/9781003354062-7

Book Series

1. Stefano Sapienza et al., "Measuring Functional Impairments Using Novel Technologies", Neuromethods, 213 - 151-161, 10.1007/978-1-0716-4083-8_10

Conference Proceeding

1. Alberto Zancanaro et al., "BlockDTW: Efficient and Scalable Similarity Search Algorithm for Healthcare-Focused Time-Series", *2025 IEEE Conference on Standards for Communications and Networking Cscn* 2025, 10.1109/CSCN67557.2025.11230700

Dataset

1. Irina Balaur et al., "FAIR assessment of Disease Maps fosters open science and scientific crowdsourcing in systems biomedicine.", *Scientific Data*, 12 - (1) - 851, 10.1038/s41597-025-05147-w

Journal

1. Sibylle Bechet et al., "Precision prevention for neurodegenerative diseases: lessons learnt from Alzheimer's disease translated into perspectives for Parkinson's disease.", *Journal Of Neural Transmission*, 133 - (2) - 265-277, 10.1007/s00702-025-03090-z

2. Serap Ozlu et al., "CSF biomarkers of neuroinflammation are associated with regional atrophy.", *Journal Of Neurology*, 273 - (1) - 46, 10.1007/s00415-025-13564-5

3. Gianfranco Frigerio. "Streamlining feature elaboration and statistics analysis in metabolomics: the GetFeatistics R-package.", *Journal Of Integrative Bioinformatics*, 10.1515/jib-2025-0047

4. Marwan N Sabbagh et al., "Repurposing glucagon-like peptide-1 receptor agonists for the treatment of neurodegenerative disorders.", *Nature Aging*, 6 - (1) - 56-67, 10.1038/s43587-025-01029-3

5. Zeynep Bendella et al., "Longitudinal Monitoring of Brain Volume Changes After COVID-19 Infection Using Artificial Intelligence-Based MRI Volumetry.", *Diagnostics*, 15 - (24) - 10.3390/diagnostics15243244

6. Viacheslav A Petrov et al., "Resistant starch improves Parkinson's disease symptoms through restructuring of the gut microbiome and modulating inflammation.", *Brain Behavior And Immunity*, 132 - 106217, 10.1016/j.bbi.2025.106217

7. Emadeldin Hassanin et al., "Modifiable lifestyle factors and genetic risk of obesity in Indians.", *Scientific Reports*, 10.1038/s41598-025-30530-3

8. Hussein Ghazale et al., "MicroRNA-mediated neuronal detargeting alters astrocyte cell fate conversion trajectories in vivo.", *Communications Biology*, 8 - (1) - 1750, 10.1038/s42003-025-09169-3

9. Marcio L Acencio et al., "The inflammatory skin disease map: an interactive computational resource focused on psoriasis and atopic dermatitis molecular mechanisms.", *British Journal Of Dermatology*, 194 - (3) - 597-599, 10.1093/bjd/ljaf491

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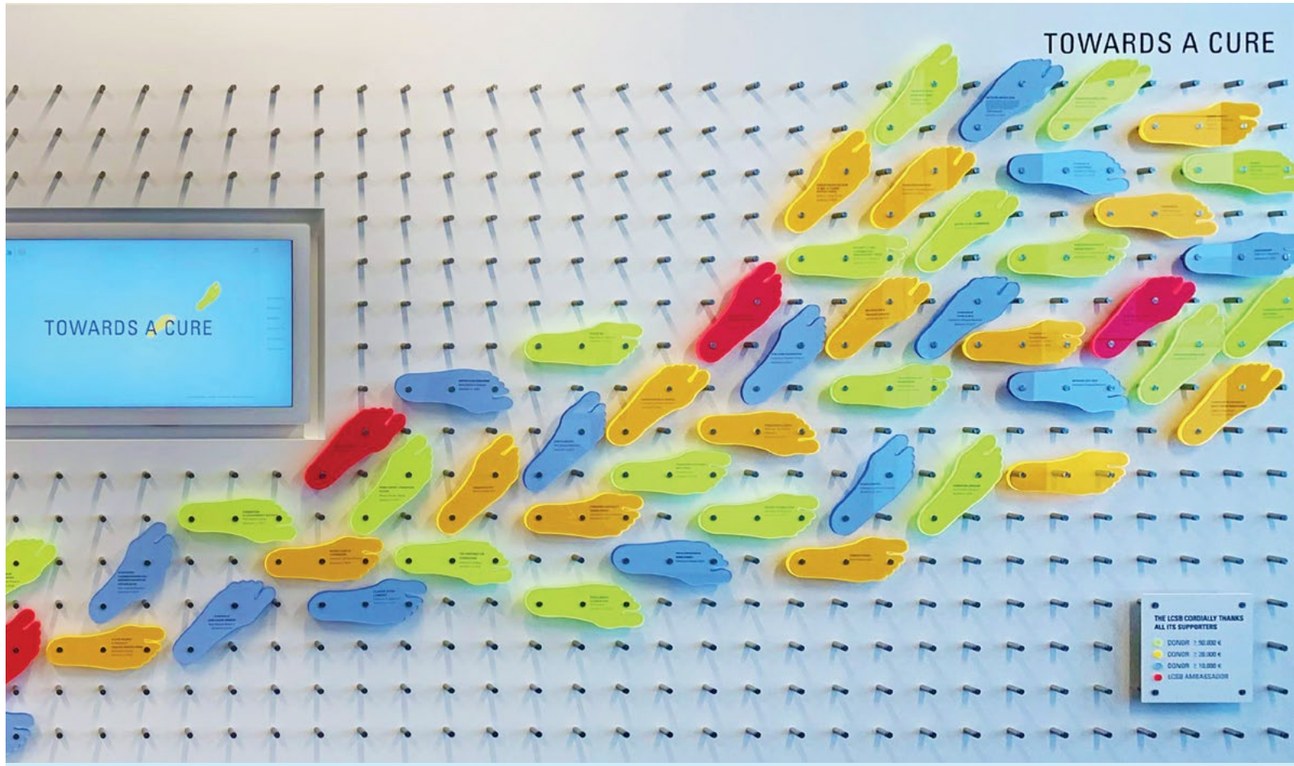

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