WEL Research Institute

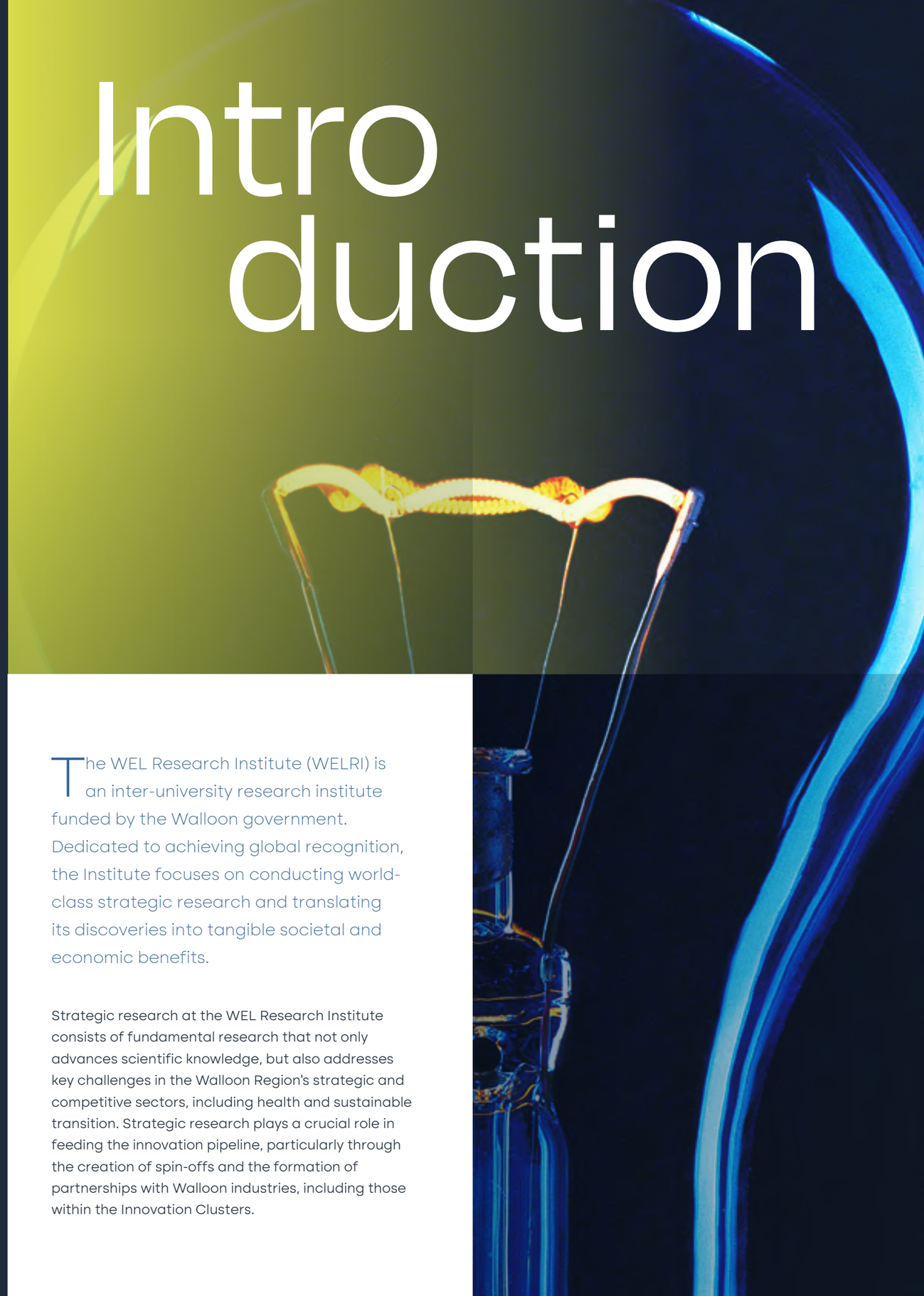
2024

From Research to Impact

The WEL Research Institute's Commitment to Excellence

Annual Report

Intro duction



The WEL Research Institute (WELRI) is an inter-university research institute funded by the Walloon government. Dedicated to achieving global recognition, the Institute focuses on conducting world-class strategic research and translating its discoveries into tangible societal and economic benefits.

Strategic research at the WEL Research Institute consists of fundamental research that not only advances scientific knowledge, but also addresses key challenges in the Walloon Region's strategic and competitive sectors, including health and sustainable transition. Strategic research plays a crucial role in feeding the innovation pipeline, particularly through the creation of spin-offs and the formation of partnerships with Walloon industries, including those within the Innovation Clusters.

The activities of the WEL Research Institute are channelled through two departments:

- WELBIO: Fundamental research in life sciences dedicated to the advancement of medical, pharmaceutical, and veterinary biotechnology.
- WEL-T: Fundamental research in engineering, chemistry and physics dedicated to advancing sustainability.

Strategic developments in 2024

The Institute continued to expand in 2024, supported by increased funding from the Walloon Region through the regional recovery plan, and closed the year with 59 Investigators leading active programmes. Further growth is expected by June 2025, when the results of the second WEL-T call, launched in September 2024, will be announced. This growth is reflected in a steady increase in the cumulative number of patent applications filed, enabling the WEL Research Institute to expand its valorisation efforts into diverse sustainable technologies, alongside its established focus on the health sector.

In 2024, the Governing Board allocated €300,000 in funding for two Bridge Fund applications, aimed at leveraging AI tools to accelerate the translation of academic discoveries into benefits for patients. Fundamental research in life sciences is crucial for understanding the complex mechanisms of cell signalling and identifying disruptions that can lead to diseases. However, translating this knowledge into new drug therapies presents numerous challenges within an academic environment. In recent years, artificial intelligence (AI) has begun to significantly transform the drug discovery process, offering new opportunities that will be tested in the valorisation process of the WEL Research Institute.

Also in 2024, the WEL Research Institute defined its core values to further strengthen its identity and establish a cohesive foundation for its operations and decision-making processes. In an ever-evolving research landscape, these values reinforce the Institute's commitment to excellence, partnership, ethical standards, and to the pursuit of ground-breaking solutions to address global challenges in health and sustainability.

Driving ground-breaking research to tackle global challenges in health and sustainability.

Commitment to scientific excellence with a social and economic impact

Investigators for the WEL Research Institute are selected by an international scientific committee on the basis of a 4-year research programme submitted in response to calls for proposals. The organisation of the annual calls, which alternate between the WELBIO and WEL-T funding instruments, and the financial management of the research contracts are entrusted to the FRFS, a specialised fund of the FNRS.

Through the WELBIO and WEL-T funding instruments, the Walloon Region allocates significant resources – over several years – to the Investigators within the WEL Research Institute to develop ambitious research programmes and achieve major scientific breakthroughs. These programmes are a pillar of the Investigators' laboratory and are flexible so that the scope of the research can be adapted over time as needed. This funding strategy enables researchers to develop ambitious programmes that address critical unmet needs in their fields.

Two funding categories have been established to support Investigators based on their career progression:

- Advanced Investigators are established researchers with a proven track record of significant achievements and are recognised leaders in their field due to the originality and significance of their research contributions.
- Starting Investigators are in the process of establishing their own independent research teams. With less than 12 years of postdoctoral experience, they have scientific independence and are initiating ground-breaking research programmes.

Our Investigators are selected for their scientific excellence, their awareness of unmet needs in their field of research, and their willingness to translate research discoveries into applications with social and economic impact. This commitment is underpinned by a robust intellectual property valorisation process and individualised support provided to our Investigators, in collaboration with representatives from the Knowledge Transfer Office (KTO) of our partner universities.

Institutional framework & governance

- University partnerships: The Institute works closely with five universities in the Wallonia-Brussels Federation: UCLouvain, ULB, ULiège, UMons and UNamur. The researchers of the WEL Research Institute are affiliated to these universities, which reinforces the dual nature of their research commitment.
- Governance and management: Governed by a General Assembly and a Board of Directors, the Institute's leadership includes representatives from industry, academia and the Walloon Region, ensuring effective oversight of all key stakeholders.

CHAPTER

02

In recent years, the integration of artificial intelligence (AI) has begun to transform drug discovery. The Governing Board approved funding for two Bridge Fund applications with aimed at using AI tools to fast-track the translation of academic discoveries into benefits for patients.

Highlights of 2024

Artificial intelligence to accelerate the translation of academic discoveries into tangible benefits for patients

Fundamental research in life sciences is crucial to understanding the intricate mechanisms behind cell signalling and identifying the dysfunctions that can lead to diseases such as cancer, neurodegenerative disorders, and metabolic diseases. However, translating this knowledge into new drug therapies presents many challenges in an academic setting.

One of the major hurdles in drug development is the identification of druggable targets, i.e. specific proteins or molecules within signalling pathways that can be effectively modulated by small molecules or biologics to restore normal function. Traditional methods of target discovery have relied heavily on experimental techniques but are often limited by the complexity of biological systems, the sheer number of potential targets, and the difficulty in predicting how small molecules will interact with these targets.

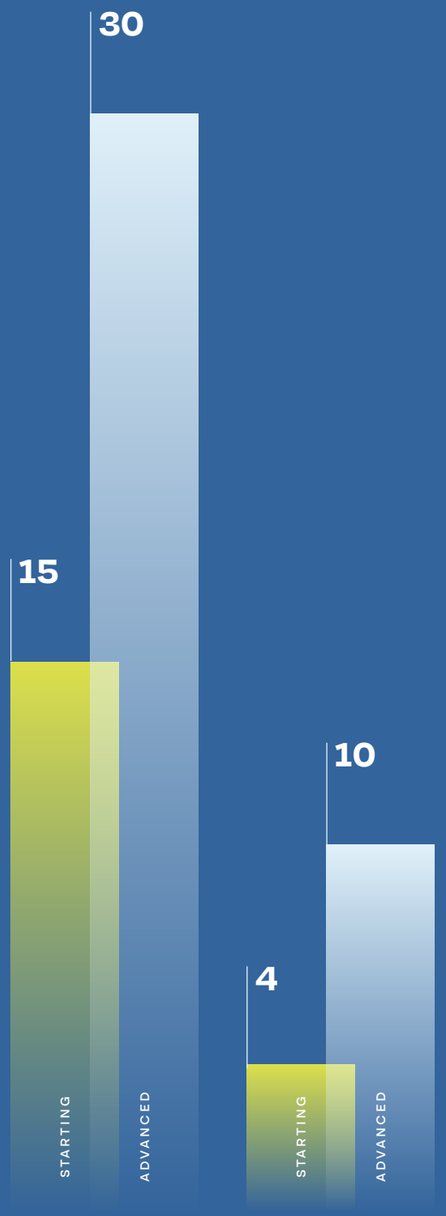
Secondly, high-throughput screening (HTS), in which large libraries of chemical compounds are tested for activity against a specific target, has been a key strategy in drug discovery. However, HTS is a resource-intensive process that requires significant infrastructure, specialised equipment, and considerable time and is not typically the responsibility of basic life science researchers.

In recent years, the integration of artificial intelligence (AI) has begun to revolutionise drug discovery. To support the identification of druggable targets, AI-driven tools can analyse vast amounts of biological data and predict which proteins or other molecular targets within a signalling pathway are most likely to be modulated by a drug. The combination of high-throughput in silico screening and AI also plays a critical role in the design of novel molecules that can specifically target these druggable sites. While in silico screening uses computational methods to screen large virtual libraries of compounds, AI could optimise the chemical structure of potential drug candidates or create de novo molecules.

In 2024, the Governing Board approved funding for two Bridge Fund applications, totalling €300,000, aimed at leveraging AI tools to accelerate the translation of academic discoveries into tangible benefits for patients. The first project focuses on a neurological disorder, one in which researchers have identified a novel mechanism of action. They plan to use AI to analyse extensive -omics data to pinpoint potentially druggable targets, which will then undergo further experimental analysis in their lab. The second project looks at a promising new target for cardiac disease, supported by years of strong experimental and translational evidence. In this case, researchers will employ in silico screening combined with AI to initiate the drug discovery process, advancing towards the development of new therapeutic options.

2024 Highlights

59 Investigators with an active programme in 2024

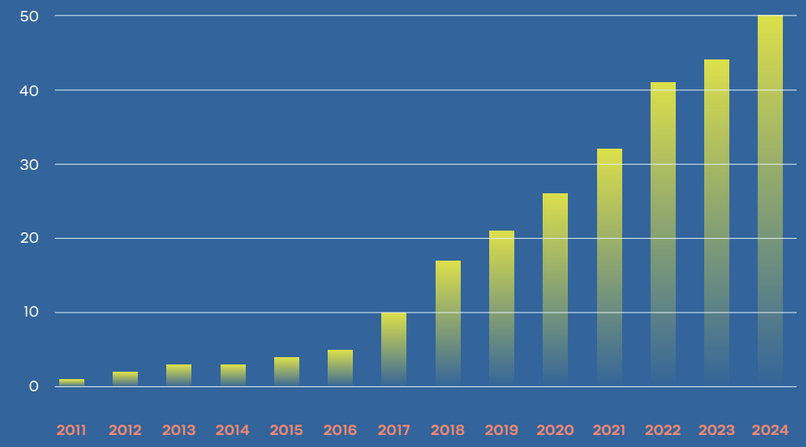


Supported staff in 2023

Our Governing Board is committed to promoting gender balance among Investigators at the WEL Research Institute.

ANNUAL REPORT 2024
02
HIGHLIGHTS OF 2024

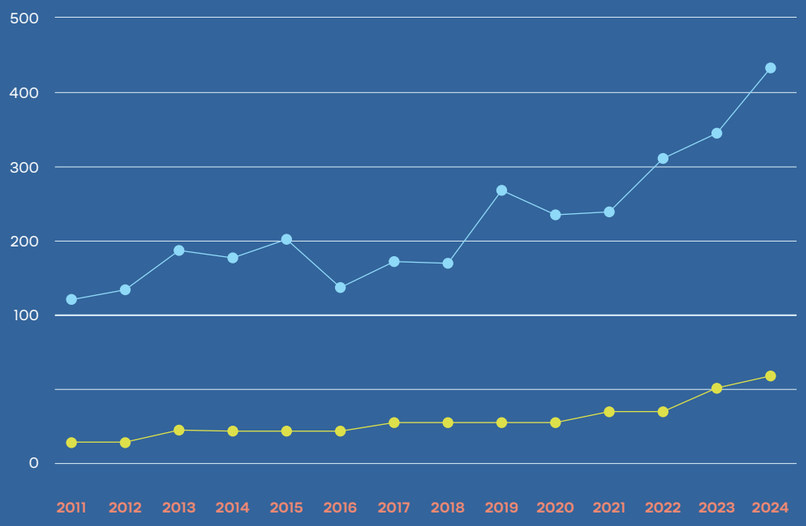
Cumulated number of filed patent applications



4 core values of the WEL Research Institute

- Excellence
- Boldness
- Collaboration and partnership
- Integrity and accountability

Growth of the scientific teams



Scientific excellence

Fundamental research is essential for building the intellectual foundation on which innovation thrives. Fundamental research is driven by scientific curiosity, with its outcomes deepening our understanding of the natural world and generating new knowledge. The history of innovation demonstrates that granting researchers the freedom to explore their creative ideas without constraints, has been crucial to countless discoveries. Many of these have led to ground-breaking technologies that have not only delivered significant societal benefits but also stimulated economic growth.

Investigators at the WEL Research Institute conduct cutting-edge research programmes, the results of which are published in top-tier journals such as Nature or Science, or in more specialised journals or conference proceedings in their field. In 2024, 151 scientific articles were published, bringing the total number of publications since the creation of the Institute to 986, with an average of 40% in prestigious journals.

National and international recognition through awards and grants are also key measures of scientific excellence. In 2024, our Investigators were honoured with 23 scientific awards and secured €25 million in funding from European (ERC, H2020, Marie Skłodowska-Curie Actions) and other international grants. Since the creation of the Institute, Investigators have been awarded a total of €55 million in European and other international grants.

Prestigious awards highlight the scientific impact of WELRI Investigators' research.

Patents
50
A TOTAL OF 50 PATENT APPLICATIONS HAD BEEN FILED BY 2024

Articles
986
IN 2024, 151 NEW ARTICLES BROUGHT THE TOTAL SINCE THE INSTITUTE'S FOUNDING TO 986.

Societal and economic impact

The WEL Research Institute provides its Investigators with a framework and proactive support to translate ground-breaking discoveries into tangible benefits for society and the economy. As strategic research is based on hypotheses and its outcomes are inherently unpredictable, the WEL Research Institute prioritises regular meetings with its Investigators, in close collaboration with representatives of the Knowledge Transfer Offices (KTOs). This approach ensures the identification and protection of unexpected results with the potential to drive innovation, while developing strategies to transferring intellectual property to industry for the ultimate benefit of society.

A total of 50 patent applications had been filed by 2024, including 6 new applications during the year, of which 35 patent families were still active. Almost half of these are in the field of oncology, a sector that has historically been strongly represented within the WELBIO department. It is also important to note that the first WEL-T programmes, launched on 1 October 2023, have already resulted in 4 patent applications. In addition, licences granted to industry have generated gross revenues of around €10 million.

A total of 6 spin-offs have been created based on results of the WELBIO research programmes. All of them are based in the Walloon Region, including at Brussels-South Charleroi, Louvain-La-Neuve and Liège. Together, these spin-offs have raised a total of €88 million in funding and created 55 jobs.

WELRI investigators work with industry in partnerships that may be based on patent applications and aim to test technologies before progressing to more advanced agreements, including licensing options. In other cases, industry looks to utilise the innovative technologies developed by the Investigator's lab, leading to service contracts. A total of 42 industrial collaborations have been established, including 6 in the past year, generating over €8 million in funding for the laboratories.

Intellectual property arising from strategic research may not always be technologically mature enough for direct transfer to an industrial partner. The Bridge Fund, a funding instrument managed by WEL Research Institute, aims to increase this level of technological maturity to improve the chances of transfer to industry. A total of nine Bridge Funds have been awarded for a total of €1.2 million. These funds have led to significant results, including strengthening of patent applications, confirming industry interest in new technologies and increasing attractiveness for investors in the creation of spin-offs. In 2024, the Governing Board approved funding for two Bridge Fund applications, totalling €300,000, aimed at leveraging AI tools to accelerate the translation of academic discoveries into tangible benefits for patients.

Growth of the Scientific Teams

The number of Investigators at the WEL Research Institute (WELRI) has grown significantly in recent years, thanks to the Walloon Government's decision to substantially increase its support for strategic research as part of the Walloon Recovery Plan. With an annual budget of €24.75 million since 2022, the funding allocated to WELBIO has more than doubled, and the WEL-T funding instrument has been created.

Over the years, a total of 124 Investigators have been, or are still, supported by the WEL Research Institute. The Institute was established in 2011 with just 15 Investigators, and today it has 59 (45 in the WELBIO department and 14 in the WEL-T department). Additional growth is anticipated by mid-2025, when the results of the second WEL-T call, launched in September 2024, will be announced. This expansion reflects the increasing recognition of the importance of strategic research in driving innovation.

Established in 2011 with 15 Investigators, the Institute now has 59.

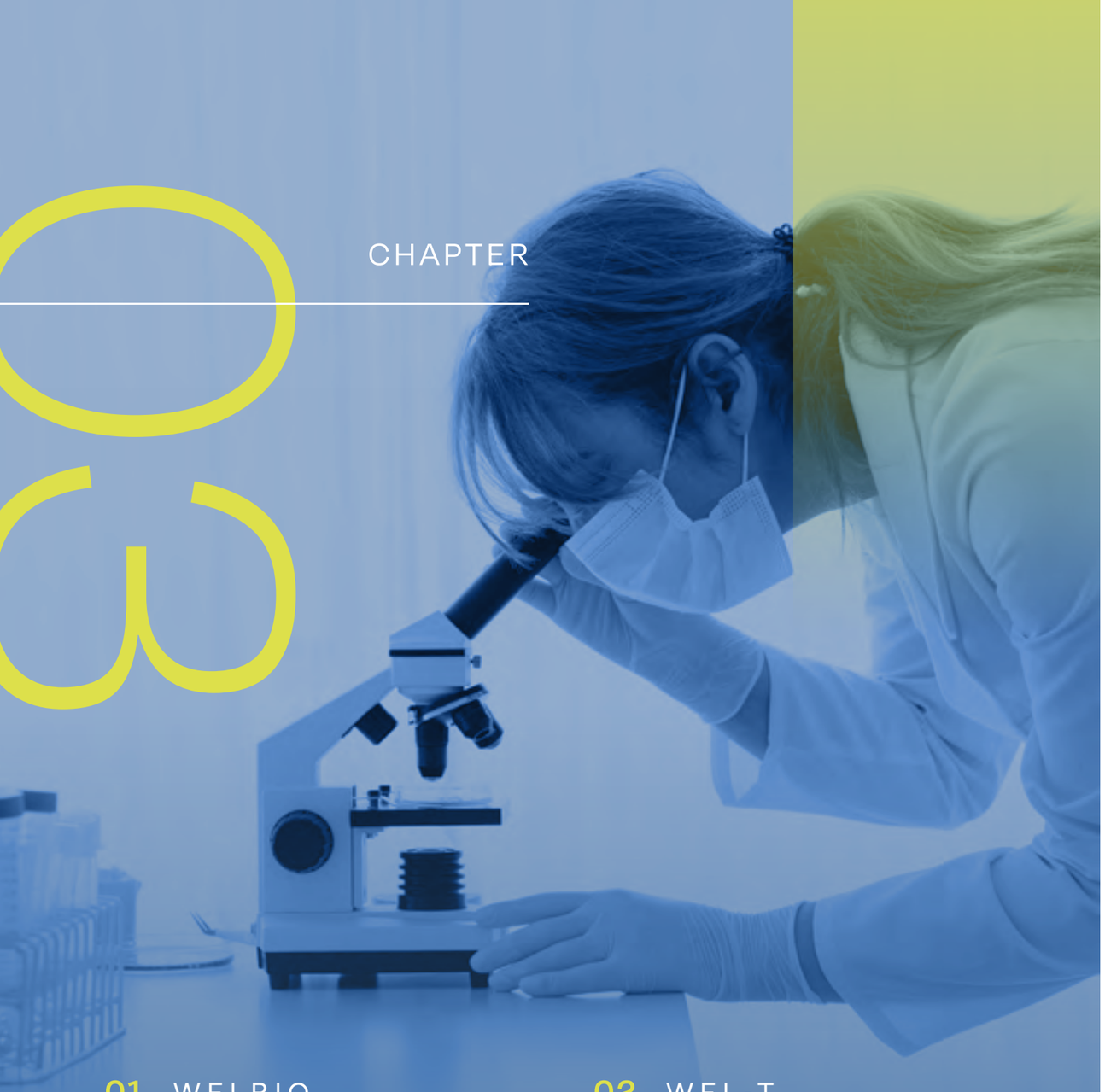
Two funding categories have been established to support Investigators based on their career progression. The Advanced Investigator category includes established researchers with a proven track record of significant achievements who are recognised leaders in their field due to the originality and significance of their research contributions.

The Starting Investigator category was introduced in 2013 as part of the second WELBIO call to offer a platform for early-career scientists to propel their research careers forward. This category targets Investigators who are in the early stages of building their own independent research teams. With up to 12 years of postdoctoral experience, these scientists have attained scientific independence and are launching innovative research programmes. Over the years, approximately one-third of the funded Investigators have been in the Starting category, making it a key opportunity to attract and support rising stars in the scientific community. Of the 30 Advanced Investigators currently in the WELBIO department, 8 began their careers as Starting Investigators at the Institute and have since advanced to become established researchers through subsequent calls.

Core values

The WEL Research Institute has defined its core values to further affirm the Institute's identity and establish a strong and cohesive foundation for its operations and decision-making processes. In an ever-evolving research landscape, these values reinforce the Institute's commitment to excellence, partnership, ethical standards, and the pursuit of ground-breaking solutions to address global challenges in health and sustainability.

- Boldness – Our Investigators tackle ambitious scientific challenges, exploring uncharted territories and taking calculated risks to drive breakthroughs. We pursue transformative solutions for global challenges in health and sustainability.
- Excellence – We are committed to ground-breaking research and academic rigour, thoughtful decision-making, learning from experience, and persistent effort to achieve optimal outcomes.
- Collaboration and partnership – We recognise the importance of working together across academic and industrial boundaries to achieve shared goals.
- Integrity and accountability – We are committed to acting with honesty and fairness, fostering trust and mutual respect, and ensuring transparent communication with our partners and collaborators.



CHAPTER 03

Scientific excellence

The cutting-edge work carried out by the Investigators and their teams is internationally recognised, as evidenced by the publication of their ground-breaking results in leading scientific journals.

The scientific advances achieved by WELRI Investigators are the culmination of many years of research and form the basis for securing highly competitive grants at both European and international levels. The excellence of their work is further underlined by the numerous prestigious scientific awards received by the WELRI Investigators.

In 2024:

- 151 articles were published, with around 40% appearing in prestigious journals such as Nature and Nature Communications.
- The Investigators secured around €25 million in European and international grants, including from the European Research Council (ERC) and other European funding initiatives such as Horizon 2020 and the Marie Skłodowska-Curie Actions.
- The excellence of the work instigated by the Investigators and their teams has been recognised by 23 major national and international scientific distinctions.

Here is a selection of scientific highlights to illustrate the internationally recognised ground-breaking work being carried out by WELRI Investigators in various fields of life sciences and technology

Life sciences
for impact in
health

WELRI

WELBIO

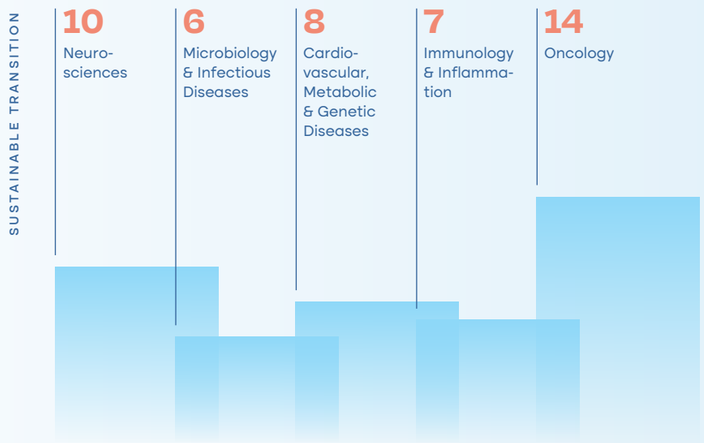
The WELBIO department

In 2024, the major societal challenges addressed by the 45 active programmes in the WELBIO department were oncology, cardiovascular, metabolic & genetic diseases, immunology & inflammation, neurosciences, and microbiology & infectious diseases.

Number of active WELBIO programmes in 2024

Grand Total
45

NUMBER OF ACTIVE WELBIO PROGRAMMES IN 2024



As of 2024, the WEL Research Institute has supported a total of 110 WELBIO research programmes. Oncology accounts for approximately 35% of the total portfolio of programmes supported to date.

Oncology

Oncology focuses on understanding the possible causes of various types of cancer, with the aim of discovering new treatments, enhancing diagnosis, and improving patient outcomes.

Investigators

Advanced

BLANPAIN Cédric - ULB
Uncovering and pharmacological targeting the mechanisms regulating key tumour states

CHARIOT Alain - ULiège
Translational reprogramming through tRNA modifications in health and diseases

CLOSE Pierre - ULiège
tRNA epitranscriptomics: a new vulnerability in cancer

CONSTANTINESCU Stefan - UCLouvain
Calreticulin and TpoR in Myeloid cancer

FERON Olivier - UCLouvain
Tumour acidosis: a new lens to study drug-tolerant persister cancer cells and associated ferroptosis sensitivity

MARINI Anna Maria - ULB
Mep-Amt-Rh transport proteins: control of membrane permeability to ammonium and proliferation

SONVEAUX Pierre - UCLouvain
Understanding the metabolic control of brain-specific cancer metastasis

VAN DEN EYNDE Benoît UCLouvain
Discovery of new immuno-oncology targets

Starting

BINDELS Laure - UCLouvain
Harnessing bacterial amino acid metabolites to tackle muscle wasting in cancer

CORBET Cyril - UCLouvain
Towards metabolic targeting of the minimal residual disease in head and neck cancers

EHX Grégory - ULiège
Immunoeradication of persister cells in AML

PASTUSHENKO Ievgeniia - ULB
Uncovering the role of H3K36 and H3K4 methyltransferases in cancer

RAPINO Francesca - ULiège
Translating into cancer: tRNA actors role in cancer stem cells establishment

VAN GASTEL Nick - UCLouvain
Defining the metabolic drivers of clonal haematopoiesis through integrative single cell profiling

Representative publications

WHEN THE ACIDITY OF TUMOURS BECOMES THEIR ACHILLES HEEL

Cancer cells within solid tumours are exposed to an acidic environment. These cells are more likely to resist treatments such as chemotherapy and to generate metastases. **Olivier Feron** and his team discovered that acidity in the extracellular environment of tumour cells could cause an increase in the frequency of tetraploidy and in the activation of the response to DNA damage, notably through activation of the ATM and ATR signalling pathways. In vitro, inhibition of the ATM and ATR signalling pathways preferentially killed tumour cells in acidosis and restored sensitivity to conventional chemotherapies. Some of these findings were confirmed in organoid culture models generated from biopsies of colorectal cancer patients. This study identified tetraploidy and the response to DNA damage as major vulnerabilities of tumour cells in acidosis.

Aubert et al (2024) EMBO Report

TRANSFER RNAS AT THE HEART OF MELANOMA RESISTANCE TO TARGETED THERAPIES

When melanoma is inoperable or diagnosed at an advanced stage, a therapy targeting the mutated BRAF gene, present in over 50% of patients, can be used. However, in most cases, the cancer cells develop resistance to this targeted therapy through mechanisms that have not yet been elucidated. The team of **Pierre Close** discovered that melanoma cells adapt to therapies targeting the mutated BRAF gene by modifying their protein production. The resistant cancer cells developed a dependence on certain transfer RNAs (tRNAs), essential players in protein synthesis and, more specifically, to the enzyme valyl-tRNA synthetase (VARS) which regulates the aminoacylation process by which amino acids are attached to tRNA. In cultured cells, genetic inhibition of VARS in cancer cells resistant to therapies targeting the mutated BRAF gene restored their sensitivity to treatment. These data suggest that factors such as VARS, involved in protein synthesis, could play a role in cell resistance to targeted treatments.

El Hachem et al (2024) Nat Cell Biol

ANNUAL REPORT 2024
WELBIO DEPARTMENT

TISSUE FLUIDITY DURING WOUND HEALING

Following a wound, the skin repairs itself through the activation, migration and division of skin stem cells. **Cédric Blanpain**'s laboratory discovered that wound healing is accompanied by a change in the physical properties of the skin, with a transition from the solid to the liquid state, a process essential for tissue repair. Using real-time imaging of fluorescent skin stem cells in vivo, the researchers discovered that the physical properties of the cutaneous epidermis were dynamically regulated during wound healing. A few days after the wound, the skin tissue underwent fluidisation, leading to the dispersion of stem cells. The tissue then returned to a solid state, which was associated with skin regeneration and repair. Activation of signalling pathways regulating dynamic changes in tissue fluidity during wound healing was essential for tissue repair. This work contributes to a better understanding of the mechanisms of wound healing, which could be critical for treating patients suffering from chronic wounds that do not heal spontaneously.

Sarate et al (2024) Cell

ROLE OF ELP3 IN THE INTESTINAL IMMUNE RESPONSE TO PARASITIC INFECTIONS

Following the intrusion of parasites into the intestine, tuft cells trigger an immune response to expel the pathogens. The molecular mechanisms controlling tuft cell differentiation remain poorly understood. Research conducted by **Alain Chariot**'s laboratory revealed that Elp3, a protein regulating the translation of messenger RNAs into proteins, plays a role in the differentiation of intestinal tuft cells. In a mouse model where Elp3 was no longer expressed, the scientists observed that tuft cells did not differentiate correctly, and that the immune response was compromised in the presence of a parasitic infection. The molecular mechanism of Elp3-dependent differentiation of intestinal tuft cells involved Nprl2, a negative regulator of the mTORC1 signalling pathway, which in turn regulated the expression of Atf4. This work provides new insights into the molecular players involved in tuft cell differentiation.

Wathieu et al (2024) EMBO J

Representative publications

A PROMISING STRATEGY TO ENHANCE THE EFFECTIVENESS OF CANCER IMMUNOTHERAPY

Adoptive cell therapy involves isolating immune cells, such as Tcells, from patients for in vitro expansion or engineering purposes, and then reinfusing them back into patients to fight cancer using their own immune system. While adoptive cell therapy has shown success in haematological malignancies, its potential against solid tumours is limited by poor infiltration, limited survival, and immunosuppressive tumour microenvironment. The laboratory of **Benoit Van den Eynde** studied the effect of manipulating the HIF (hypoxia-inducible factor) pathway on T cells. This pathway is known to enable highly energy-dependent processes, such as cellular growth and proliferation, to continue under hypoxic conditions. HIF pathway stabilisation by genetic deletion of PHD2 and PHD3 in activated T cells significantly enhanced their survival and efficacy. Upon transfer to mice, this improvement in T cell performance translated into an enhanced tumour growth inhibition across various tumour models, including those reported to be extremely resistant to immunotherapeutic interventions. This study paves the way for improving cancer immunotherapies.

Dvorakova et al (2024) Nat Commun

HEPATOCYTE METABOLIC REPROGRAMMING IN OBESITY AND HEPATOCELLULAR CARCINOMA

Obesity can result in the accumulation of lipids in hepatocytes, which can progress to metabolic dysfunction-associated steatohepatitis (MASH), liver cirrhosis and, eventually, hepatocellular carcinoma (HCC), one of the deadliest and fastest-growing cancers. Hepatic expression of protein tyrosine phosphatases is affected in steatotic livers and MASH, however their roles in regulatory mechanisms remain largely unexplored. The team of **Esteban Gurzov** discovered that the expression of receptor-type tyrosine-protein phosphatase kappa (PTPRK) was increased in obese human and mouse livers. Elevated hepatic expression of PTPRK triggered enhanced glycolysis, culminating in PPARγ activation and de novo lipogenesis stimulation. In mice, genetic deletion of PTPRK provided protection against the rapid development of fatty liver in an obesogenic diet and the development of liver cancer. This study highlights the role of PTPRK in the regulation of hepatic glycolysis, lipid metabolism, and tumour development in obesity.

Gilglioni et al (2024) Nat Commun

REGULATION OF THE MULTIPOTENCY OF GLANDULAR EPITHELIAL STEM CELLS BY THE EXTRACELLULAR MATRIX

The mammary gland and prostate are glandular epithelia composed of basal and luminal cells that maintain the renewal of their own lineages under physiological conditions. The differentiation potential of these stem cells can be activated by cancerous mutations, but the underlying molecular mechanisms that drive their expansion are still poorly understood. Using a combination of organoid culture, single-cell sequencing and functional experiments, **Cédric Blanpain**'s team established a molecular profile of stem cells under different conditions of rigidity and collagen abundance. This study revealed a conserved mechanism by which the composition and rigidity of the extracellular environment regulate the fate of mammary and prostate stem cells. It will be important to further investigate how these mechanisms contribute to tissue regeneration, tumour initiation and progression.

Jiang et al (2024) Nat Commun

ACID-EXPOSED AND HYPOXIC CANCER CELLS: DIFFERENT BUT INTERDEPENDENT

Cancerous tumours contain both acidic (acid-exposed) and oxygen-poor (hypoxic) zones. These environments are associated with increased resistance to treatments such as chemotherapy and radiotherapy and favour the formation of metastases. In a previous study, **Olivier Feron**'s team showed that acid-exposed cells in colorectal tumours favoured the use of lipids rather than glucose, suggesting a metabolism distinct from that of hypoxic cells (Aubert et al. EMBO Report, (2024)). In a new study based on transcriptomic and lipidomic analyses of tumour cells, researchers confirmed that acid-exposed and hypoxic cells follow distinct metabolic pathways. However, these pathways are interdependent via the SCD1 enzyme, which enables acidotic cells to produce certain fatty acids that are essential for the survival of hypoxic cells. By blocking SCD1, the researchers observed that the cells in acidosis died and deprived the hypoxic cells of their source of energy, compromising their survival.

Głowacka et al (2024) Nat Commun

Awards

CÉDRIC BLANPAIN

WEL RESEARCH INSTITUTE – ULB

Cédric Blanpain pursues research in stem cell biology and oncology to decipher the roles of cancer stem cells in the development, progression and metastasis of skin, breast and brain cancers. Cédric holds an **ERC Advanced grant** (2020-2025) to define the different tumour states at the single-cell level using a multidisciplinary approach. In 2024, Cédric was awarded the **Fondation ARC Léopold Griffuel Prize (FR)**, one of the most prestigious prizes in cancer research in Europe to reward work that led to major advances in basic cancer research. Cédric Blanpain was also elected a **member of the American Academy of Arts and Sciences (USA)**, whose mission is to honour excellence and leadership in all disciplines.

Immunology and Inflammation

Immunology and Inflammation study the body's immune response and the complex processes underlying inflammation in order to develop treatments for autoimmune and inflammatory diseases, as well as immunotherapies against cancer.

Investigators

Advanced

DEWALS Benjamin - ULiège

Deciphering the mechanisms regulating the effector functions of virtual memory T lymphocytes during helminth and viral coinfections

GEORGES Michel - ULiège

Systematic eQTL and CMap based identification of IBD predisposing genes and interacting drugs

LUCAS Sophie - UCLouvain

Targeting TGF-β1, β2 or β3 activation in auto-immunity and graft-versus-host disease

MARICHAL Thomas - ULiège

Deciphering the contribution of the myeloid-epithelial crosstalk to viral-induced exacerbations of chronic airway diseases (asthma or COPD)

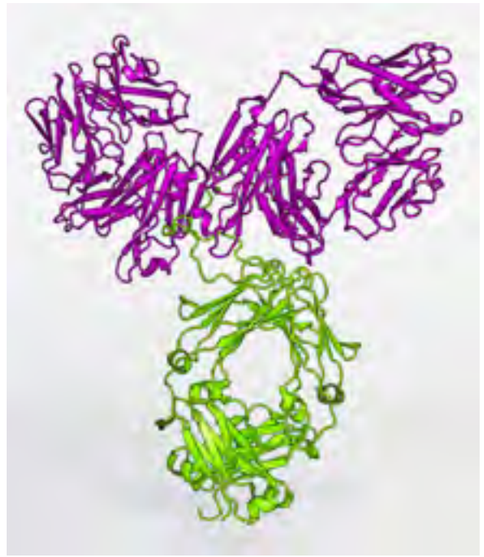
VERMIJLEN David - ULB

The third way of immune protection in human: development and function of γδ T cells in early life

Starting

MACHIELS Bénédicte - ULiège

Pneumovirus infections lead to lasting alterations in host immunity, promoting the development of lung cancer



Representative publications

THE IMMUNE SYSTEM OF NAKED MOLE RATS OFFERS NEW PERSPECTIVES IN THE FIGHT AGAINST CANCER

The naked mole-rat, a small mammal with a subterranean lifestyle, is known for its longevity and resistance to cancer. Out of thousands of animals followed for decades in laboratories and zoological colonies, only six cases of tumours were detected. It has been suggested that the immune cells of the naked mole rat could play a major role in its resistance to cancer. Curiously, however, naked mole rats lack natural killer T cells, a population of lymphocytes capable of killing tumour cells in humans. **David Vermijlen** and his team identified a specific subpopulation of γδ T cells in the naked mole rat, known as Vg4-2/Vd1-4, which are thought to exert antitumour activity similar to human natural killer cells. The continuous production of Vg4-2/Vd1-4 γδ T cells in the thymus of the naked mole rat could contribute to its natural resistance to cancer. This discovery opens new therapeutic avenues to be explored in the context of cellular immunotherapy of cancer.

Sanchez Sanchez et al (2024) Nature Commun

ATYPICAL MACROPHAGES TO REGENERATE LUNGS DAMAGED BY VIRAL INFECTIONS

Severe respiratory virus infections, such as Covid-19, can cause lung damage leading to a permanent reduction in lung capacity, chronic fatigue and exercise intolerance. In multiple mouse models of lung damage caused by viral infections, the laboratory of **Thomas Marichal** identified a population of atypical macrophages expressing the specific marker Ly6G. They observed that these Ly6G+ macrophages appeared transiently during the initial phase of tissue repair. A population of macrophages expressing a marker homologous to Ly6G was also identified in patients suffering from the severe form of Covid-19 or pneumonia. The researchers then investigated the role of these atypical macrophages and showed, in mouse models with virus-induced lung lesions, that they played a beneficial role in the regeneration of pulmonary alveoli, in a process dependent on the interleukin-4 receptor signalling pathway. This study highlights the reparative potential of these atypical macrophages. The mechanisms by which they could contribute to lung regeneration in humans remain to be investigated.

Ruscitti et al (2024) Sci Immunol

Awards

THOMAS MARICHAL

WEL RESEARCH INSTITUTE – ULIÈGE

Thomas Marichal conducts research in immunological responses and diseases, with a particular focus on understanding the environmental triggers of asthma and allergies. He holds an **ERC Consolidator Grant** (2023-2029) to continue his research into the mechanisms of lung regeneration following respiratory infections such as Covid-19 or influenza.

Neurosciences

Neuroscience explores the intricate workings of the brain and nervous system to advance our understanding of neurological disorders, with the aim of developing treatment and diagnostic strategies for conditions such as Alzheimer's disease, Parkinson's disease and drug addiction.

Investigators

Advanced

CREVECOEUR Frédéric - UCLouvain

Quantitative evaluation of movement disorders: theory and experimental validation

DE KERCHOVE D'EXAERDE Alban - ULB

Maged1 in the thalamus, a key gateway to understanding drug addiction and improving its treatment

NGUYEN Laurent - ULiège

Cell migration shapes cerebral cortex morphogenesis and function

VANHOLLEBEKE Benoit - ULB

Molecular and cellular control of brain angiogenesis and blood-brain barrier formation

Starting

BOURGUIGNON Mathieu- ULB

The state of sensorimotor cortical oscillations at hand

EL TAHRY Riem - UCLouvain

Optimisation of VNS in refractory epilepsy

HANSEEUW Bernard - UCLouvain

Beyond amyloid and tau pathology: Towards clinical trials modulating synaptic function in preclinical and symptomatic Alzheimer's disease

Representative publications

COCAINE ADDICTION: ROLE OF MAGED1 BEYOND THE CEREBRAL REWARD CIRCUIT

Addiction to drugs results in an artificial increase in dopamine, the neurotransmitter linked to the brain's reward system. In a previous study, **Alban de Kerchove d'Exaerde**'s team discovered the central role of an unexpected gene, Maged1, in cocaine addiction using various mouse models. In this new publication, the team showed that the region of the brain where the Maged1 gene played an essential role in addiction lay outside the reward circuit generally associated with drug addiction, which was completely unexpected. The mechanisms underlying Maged1's significant impact on cocaine addiction involved specific epigenetic modifications with a major influence on the expression of many other genes. In mouse models, inhibition of one of the new genes identified as a partner of Maged1 for these epigenetic modifications, USP7, abolished addictive behaviours. A polymorphism of Maged1 and USP7 was identified in cocaine-dependent patients, suggesting a correlation with vulnerability to addiction-related behaviours in response to cocaine.

Cheron et al (2024) Nat Commun

KEY ROLE OF A SMALL POPULATION OF NEURONS IN MOTOR CONTROL

The neurotransmitter dopamine influences the activity of the striatum via two distinct populations of dopaminergic neurons that act in concert to regulate motor activity. However, a third less abundant population of dopaminergic neurons exists, whose role has remained unknown until now. The team of **Alban de Kerchove d'Exaerde** studied this minority population of neurons and highlighted its essential role in the functioning of the striatum, ensuring motor control under physiological conditions and modulating the hyperactivity induced by psychostimulant drugs. This discovery opens new avenues for understanding neurological and psychiatric disorders associated with alterations in the striatum including addiction, autism, schizophrenia, ADHD, and obsessive-compulsive disorders, as well as the motor symptoms of Parkinson's disease. The neurotransmitter dopamine influences the activity of the striatum via two distinct populations of dopaminergic neurons that act in concert to regulate motor activity. However, a third less abundant population of dopaminergic neurons exists, whose role has remained unknown until now. The team of Alban de Kerchove d'Exaerde studied this minority population of neurons and highlighted its essential role in the functioning of the striatum, ensuring motor control under physiological conditions and modulating the hyperactivity induced by psychostimulant drugs. This discovery opens new avenues for understanding neurological and psychiatric disorders associated with alterations in the striatum including addiction, autism, schizophrenia, ADHD, and obsessive-compulsive disorders, as well as the motor symptoms of Parkinson's disease.

Bonnavion et al (2024) Nature

Awards

LAURENT NGUYEN

WEL RESEARCH
INSTITUTE -
ULIÈGE

Laurent Nguyen specialises in the molecular mechanisms underlying brain development and neurological disorders, with a focus on how neural circuitry is organised during developmental conditions. He holds an **ERC Synergy Grant** (2023-2028) to lead an interdisciplinary project, uniting 4 European laboratories to study the mechanisms driving the mechanical folding of the cerebral cortex during embryonic development.

ALBAN
DE KERCHOVE
D'EXAERDE

WEL RESEARCH
INSTITUTE – ULB

Alban de Kerchove d'Exaerde studies the mechanisms underlying neuropsychiatric diseases, such as addiction, attention disorders and hyperactivity. In 2024, he was the laureate of the **AXA Chair awarded by the AXA Research Fund**, the AXA Group's global scientific philanthropy initiative launched in 2008 to address some of our planet's most pressing challenges.

BENOIT
VANHOLLEBEKE

WEL RESEARCH
INSTITUTE – ULB

Benoit Vanhollebeke's research aims to better understand the formation of the blood-brain barrier, which supplies the brain with oxygen and nutrients while blocking the infiltration of potentially toxic cells and compounds. He holds an **ERC Consolidator Grant** (2019-2024) to study the complex regulation of the blood-brain barrier. In 2024, Benoit Vanhollebeke was the winner of the **Simone and Pierre Clerdent Foundation Prize**, a triennial award supporting medical research in the field of human neurology. He also received the **Lambertine Lacroix Foundation Prize, a biennial** award that alternates between research into cardiovascular disease and cancer.

Cardiovascular, Metabolic & Genetic Diseases

This area investigates the underlying physiological and/or genetic factors that contribute to cardiovascular, metabolic and genetic diseases, with the aim of developing treatment strategies for conditions such as heart failure, diabetes and cystic fibrosis.

Investigators

Advanced

BALLIGAND Jean-Luc - UCLouvain

Structural and functional characterisation of Aquaporin-1 as a "peroxiporin" in cardiovascular tissue

CANI Patrice - UCLouvain

Identifying novel gut microbes and their active compounds to tackle diseases

CNOP Miriam - ULB

Mechanisms of β cell failure and recovery to identify therapeutic targets for β cell preservation in type 2 diabetes

EVERARD Amandine - UCLouvain

Use of gut microbes to modulate host compulsive eating behaviours and host food reward and deciphering related mechanisms of interactions

GILON Patrick - UCLouvain

Study of the control of glucagon secretion and of its dysregulation in diabetes, and search for new therapeutic targets to restore a normal control in diabetes

GOVAERTS Cédric - ULB

Capturing alternatives conformers of CFTR with nanobodies to understand the pathogenesis of Cystic Fibrosis at the molecular level and to delineate new therapeutic routes

VIKKULA Miikka - UCLouvain

Towards novel treatments for primary lymphoedema: from identification of genetic causes to in vivo modelling and preclinical trials

Starting

BELOQUI GARCIA Ana - UCLouvain

Oral delivery of biologics for the treatment of gastrointestinal diseases

FORRESTER Alison - UNamur

Identification of compounds that target ERES and anterograde trafficking, and their application in disease models of aberrant secretion

MARTIN Maud - ULB

Mechanistic understanding of microtubule function during angiogenesis

Representative publications

LIPID-BASED NANOCAPSULES FOR FINE-TUNING INTESTINAL HORMONE SECRETION

The laboratory of **Ana Beloqui Garcia** developed lipid-based nanocapsules for the oral delivery of a glucagon-like peptide-1 (GLP-1) analogue used to treat diabetes, which is typically administered subcutaneously. Oral delivery of the nanocarrier with a GLP-1 analogue in diabetic mice improved glucose tolerance and reduced insulin resistance (Xy et al, Gut (2020)). Interestingly, this novel nanosystem not only enabled intestinal delivery of a GLP-1 analogue but also stimulated the endogenous production of GLP-1 secretion. In this study, the team demonstrated that when formulated as lipid nanocarriers, commercial lipid excipients can induce the release of hormones such as GLP-1, GIP, and PYY which are essential for metabolic regulation. Studies in various mouse models demonstrated that the effect exerted by lipid nanocarriers could be modulated by varying the type and quantity of excipients, the formulation methodology, and the size and composition of the nanocapsules.

Xu et al (2024) Sci Adv

AN IN SITU BIOADHESIVE FOAM FOR DELIVERING ANTIBODY FRAGMENTS TO TREAT INFLAMMATORY BOWEL DISEAS

Biologics are commonly used as injectables for inflammatory bowel disease treatment but balancing systemic and local concentrations of biologics is key for effective treatment. Current formulations struggle to achieve this balance. The laboratory of **Ana Beloqui Garcia** developed a new rectally delivered foam, that generates CO2 through a reaction between potassium bicarbonate and citric acid without the need for an external device. The foam, loaded with an anti-TNF-α antibody fragment, enhanced colon retention and Fab distribution in mice. Plasma Fab concentrations were higher with the foam than a Fab solution. Foam efficacy was tested in various colitis mouse models, showing promise for overcoming current limitations in biologic delivery to inflamed colonic tissue.

Zhang et al (2024) J Control Release

Representative publications

LOSS-OF-FUNCTION MUTATIONS IN TIE1 CAUSE LATE-ONSET PRIMARY LYMPHEDEMA

Primary lymphedema is caused by defects in lymphatic vessels or valves, often due to genetic mutations. Pathogenic variants have been identified in only about 30% of primary lymphedema cases. **Miikka Vikkula** and his colleagues screened 755 individuals with primary lymphedema and identified two missense and one truncating variant in the TIE1 gene, which are predicted to be pathogenic. TIE1, in complex with TIE2, regulates blood and lymphatic vessel formation. The truncating mutation produced an inactive TIE1 fragment, while missense variants reduced TIE1 signalling. Mouse models with these variants showed oedema and lethality in homozygous mice. These findings highlight the role of TIE1 loss-of-function variants in primary lymphedema and emphasise the importance of the ANGPT2/TIE1 pathway in lymphatic function.

Brouillard et al (2024) J Clin Invest

HEPATOCYTE METABOLIC REPROGRAMMING IN OBESITY

Obesity can lead to the accumulation of lipids in hepatocytes, which may progress to metabolic dysfunction-associated steatohepatitis (MASH), liver cirrhosis and, eventually, hepatocellular carcinoma, one of the deadliest and fastest-growing cancers. Hepatic expression of protein tyrosine phosphatases is affected in steatotic livers and MASH but their roles in regulatory mechanisms remain largely unexplored. **Esteban Gurzov** and his team discovered that the expression of the receptor-type tyrosine-protein phosphatase kappa (PTPRK) was increased in obese human and mouse livers. In mice, genetic deletion of PTPRK protected against the rapid development of fatty liver on an obesogenic diet and the development of liver cancer. This study highlights the role of PTPRK in the regulation of hepatic glycolysis, lipid metabolism and tumour development in obesity.

Gilglioni et al (2024) Nat Commun

Awards

ANA BELOQUI GARCIA

WEL RESEARCH INSTITUTE - UCLOUVAIN

Ana Beloqui Garcia focuses on the development of oral delivery methods for biological drugs, a more patient-friendly approach than the daily intravenous injections usually required to administer biological drugs. In 2024, Ana was awarded an **ERC 'Proof of concept' grant** to explore the innovative potential of the results generated from her ERC Starting grant. She was also the winner of the "**Rising Women in Science" prize awarded by the Controlled Release Society (USA)**. This prize recognises a woman scientist with less than 10 years' post-doctoral experience who is internationally recognised for her contributions to the science and technology of drug formulation.

PATRICE CANI

WEL RESEARCH INSTITUTE – UCLOUVAIN

Patrice Cani leads research to understand the role of our intestinal bacteria in the development of various diseases, including type 2 diabetes associated with overweight and obesity, and certain cancers. For the ninth consecutive year, Patrice has been named a **Highly Cited Researcher** by Clarivate (2024), in recognition of the significant and widespread influence of his work in this field of research.

AMANDINE EVERARD

WEL RESEARCH INSTITUTE – UCLOUVAIN

Amandine Everard studies how intestinal bacteria can influence eating behaviour, and the role of the gut-brain axis in eating disorders such as binge-eating. For the second year in a row, Amandine has been named a **Highly Cited Researcher** by Clarivate (2024) for her publications ranked in the top 1% of citations in this field of research over the last decade.

Awards

MIIKKA
VIKKULA

WEL RESEARCH
INSTITUTE –
UCLOUVAIN

For almost 30 years, Miikka Vikkula's laboratory has studied vascular anomalies, including lymphatic malformations and lymphedema. The group has identified the genetic causes and molecular mechanisms of several of these disorders, laying the groundwork for new therapeutic approaches for patients with vascular anomalies. In 2024, Miikka received the **Lifetime Achievement Award in Lymphatic Research (USA)** awarded every two years by the Lymphatic Education and Research Network (LE&RN).

MIIKKA
VIKKULA &
LAURENCE
BOON

Special story

Miikka Vikkula is Professor of Genetics at UCLouvain and Investigator at the WEL Research Institute; Laurence Boon is Clinical Physician and Coordinator of the Vascular Malformations Centre at the Cliniques Universitaires Saint-Luc in Brussels.

They have been working and living together for 30 years, and their vocation is to improve the daily lives of patients suffering from orphan vascular diseases. Vascular malformations affect 3 people in a thousand and are 80% genetic in origin. Patients affected by these malformations suffer from deformities, severe pain, functional impotence, muscular weakness and bleeding. Their quality of life is considerably impaired. Thanks to their complementary research teams, Miikka Vikkula and Laurence Boon have understood the origin and mechanism of most of these vascular anomalies, improving diagnosis and opening the way to new therapeutic approaches. In one remarkable case, they successfully repurposed a cancer drug to treat, in utero, a vascular lesion that was threatening the life of the foetus. Now aged 6, the child is doing well and growing normally (Seront et al, 2023, Nat Cardiovasc Res). In another case, through a clinical trial with a different repurposed drug, they were also able to save the hand of a 19-year-old girl who had been scheduled for amputation.

The study of rare diseases requires the existence of national and international networks. Miikka Vikkula and Laurence Boon are part of VASCERN, the European Reference Network for Rare Multisystemic Vascular Diseases, established in 2017 to improve the lives of patients across Europe with rare vascular diseases. In 2012, they founded VASCAPA (Vascular Anomaly Patient Association), an organisation that supports patients with vascular anomalies and their families.

In 2024, their work was recognised with the Gagna & Van Heck International Prize for Incurable Diseases – awarded for the first time to a Belgian team.

Microbiology & Infectious Diseases

Research in Microbiology and Infectious Diseases explores the mechanisms of pathogens, such as bacteria and viruses, and host responses, with a focus on developing treatments to improve global health outcomes.

Investigators

Advanced

ALSTEENS David - UCLouvain

Probing the molecular interactions: Unravelling the role of o-acetylated sialic acid in respiratory viruses

COLLET Jean-François - UCLouvain

Exploring the cell envelope of Escherichia coli, a compartment that is an attractive target for innovative biotechnological and bio-pharmaceutical approaches

DE BOLLE Xavier - UNamur

Lipopolysaccharide O-chain biosynthesis in Brucella abortus: from fundamental knowledge to synthetic microbiology

GARCIA-PINO Abel- ULB

Dissecting Acinetobacter baumannii stringent response network to target novel metabolic effectors

SMEESTERS Pierre- ULB

A host-pathogen strategy for delivering a new vaccine formulation combining both conserved and variable antigens against Streptococcus pyogenes

VANDERPLASSCHEN Alain - ULiège

Using herpesvirus-fish models to unravel host-pathogen-environment interactions: a new paradigm in disease mitigation for aquaculture

Starting

JURENAS Dukas - ULB

R-zymes: peptide rolls for the immobilisation of therapeutic proteins or enzymes

LALOUX Géraldine - UCLouvain

Revealing the molecular arsenal of predatory bacteria

Representative publications

MOLECULAR INSIGHTS ON THE RAPID EVOLUTION OF COVID-19 VARIANTS

During the global COVID-19 pandemic, the rapid mutation rate of the SARS-CoV-2 virus led to the emergence of worrisome variants. These variants, identified by changes in the spike protein in regions critical for binding to human cells, developed an increased ability to infect and evade antibodies. By combining atomic force microscopy with molecular dynamics simulations, **David Alsteens**' team studied the strength and energy dynamics of the interaction between the spike protein of SARS-CoV-2 and the angiotensin-converting enzyme 2 (ACE2) receptor on human cells, at the single-molecule level, with a particular focus on newer variants of concern. In collaboration with Laurent Gillet's team (ULiège), they also explored the molecular basis of neutralisation by selected sera from vaccinated and (non-) infected patients. These studies underscore the need for continued vigilance and research to monitor the evolution of the SARS-CoV-2 virus and its potential impact on vaccine efficacy.

Ray et al (2024) ACS Nanosci Au

ONE BACTERIAL IMMUNITY PROTEIN TO THWART TWO DIFFERENT VIRAL PROTEINSPROTEINS

Bacteria have an immune system to defend themselves against infection by viruses known as bacteriophages. Individual bacterial immunity proteins use pattern recognition receptors (PRRs) to detect molecular signatures associated with bacteriophages, triggering an immune response. Until now, individual bacterial immunity proteins have only been found to sense a single trigger during infection, suggesting a one-to-one relationship between bacterial PRRs and their ligands. **Abel Garcia-Pino** and collaborators demonstrated that the antiphage defence protein CapRel in Escherichia coli can detect and bind two completely unrelated and structurally distinct phage proteins using the same PRR. These findings reveal a previously unknown versatility of a bacterial immunity protein, which may be a common property of antiphage defence systems, allowing bacteria to keep pace with their rapidly evolving viral predators.

Zhang et al (2024) Nature

Representative publications

SPATIAL CONFIGURATION IN VIRUS–HOST INTERACTIONS

Reovirus infections are common in humans. Although typically benign or subclinical, rare cases of neurological disease caused by reoviruses have been reported. The mechanisms by which reoviruses spread in the central nervous system remain poorly understood. **David Alsteens**' laboratory explored how reoviruses enter nerve cells and identified a novel interaction with the Nogo-receptor 1 (NgR1) receptor in neuronal cells. Using a combination of experimental and computational methods, the group demonstrated how NgR1 specifically binds at the interface between adjacent heterohexamers on the reovirus capsid, arranged in a well-defined structural pattern. Unlike previous research that primarily focused on isolated viral components, or lacked precise spatial configurations, this study highlights the importance of the geometric layout and curvature of the virus in the infection process and opens new avenues for therapeutic interventions against viral infections.

Dos Santos Natividade et al (2024) Nanoscale Horiz

Awards

DAVID ALSTEENS

WEL RESEARCH INSTITUTE - UCLOUVAIN

David Alsteens conducts research in nanobiophysics of the cell surface machinery, focusing on the interactions at a nanoscale level between biological molecules and viruses to improve our understanding of cellular mechanisms in viral infections. He holds an **ERC Consolidator Grant** (2022-2027) to apply nanotechnology in virology and unravel the complex interaction between viruses and host cells.

ABEL GARCIA-PINO

WEL RESEARCH INSTITUTE – ULB

Abel Garcia-Pino studies bacterial stress responses, antibiotic resistance and the development of new therapeutics against bacterial infections. He holds an **ERC Consolidator Grant** (2019-2024) to investigate the role of RSH enzymes in the stress response of bacteria and to decipher their structure and organisation.

GÉRALDINE LALOUX

WEL RESEARCH INSTITUTE – UCLOUVAIN

Géraldine Laloux investigates the mechanisms by which predatory bacteria attack and consume other bacteria to survive. A deeper understanding of these mechanisms could inform new approaches to tackling antibiotic-resistant bacteria. In 2024, she was awarded an **ERC Consolidator Grant** (2024-2029) to lead the VAMPIRE research project, building on her ERC Starting Grant from 2018.

WELRI

Engineering sciences, chemistry and physics for an impact in sustainable transition

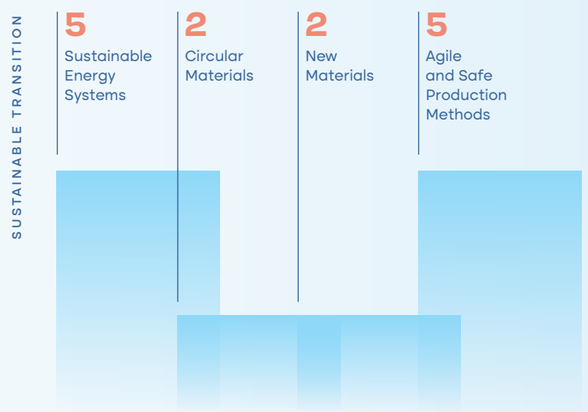
The WEL-T department

The WEL-T department was created in 2023 following a decision by the Walloon government to support strategic research aimed at driving breakthrough innovations in sustainable transition. The first call for researchers to join this new department was issued at the end of 2022. On 1 October 2023, the 14 selected Investigators began their WEL-T programmes, focusing on sustainable energy, circular materials, new materials and sustainable production methods. The department is expected to grow further by mid-2025, when the results of the second WEL-T call, launched in September 2024, will be announced.

Number of active WEL-T programmes in 2024

Grand Total
14

NUMBER OF ACTIVE WEL-T PROGRAMMES IN 2024



Sustainable Energy Systems

Research into sustainable energy systems plays a crucial role in advancing clean and renewable energy sources while promoting energy efficiency and environmental sustainability.

Investigators

Advanced

BONAVENTURE Olivier - UCLouvain
Sleepable and energy-efficient Internet protocols

PARENTE Alessandro - ULB
Lifelong-learning digital twins for sustainable combustion technologies

Starting

CAUDRON Corentin - ULB
Towards 4D monitoring of geothermal operations in 4D using passive-based seismic approaches

FRANCI Alessio - ULiège
Embodied Excitability: a principle for designing neuromorphic adaptive agents

TROIAN-GAUTIER Ludovic - UCLouvain
Fe(II/III) photosensitizers for dye-sensitized photoelectrochemical cells (DSPECs) application

Representative publications

IRON, A SUSTAINABLE ALTERNATIVE TO RARE METALS FOR SOLAR FUELS

The storage of electricity generated from solar energy, so that it can be used independently of the diurnal cycle, remains a challenge. Batteries have some limitations, including storage capacity, lifespan and environmental impact. Alternatively, solar energy can be stored in chemical bonds by forming "solar fuels" such as hydrogen. Hydrogen production can be photo-induced but can also be obtained through the splitting of halohydric acids (HX). The latter is advantageous because it simultaneously generates a second solar fuel in the form of the corresponding halogen (X2). However, the oxidation of halides often requires the use of photosensitisers based on rare metals such as ruthenium and iridium, which severely limits its implementation. **Ludovic Troian-Gautier**'s team and colleagues developed a photosensitiser based on iron, one of the most abundant elements in the Earth's crust, to enable the oxidation of halides. Using various spectroscopic methods, they demonstrated that it is possible to oxidise halides (iodide, bromide and chloride) using the energy stored in the excited state of this iron-based photosensitiser. In addition to measuring the efficiency of this process, the team determined that ~90% of stored energy led to the regeneration of the initial reactants, pointing to a wide range of opportunities for optimising these photo-induced processes.

De Kreijger et al (2024) J Am Chem Soc

INTERPRETATION OF SENSORY INFORMATION BY THE BRAIN

Alessio Franci and collaborators combined neuroscience and engineering to study how the brain processes sensory information. They discovered the coexistence of two types of signals that did not interfere with each other: a raw signal representing unprocessed sensory information (small pulses applied to the tip of a finger) and a transformed signal representing abstract properties of the stimulus (representations such as the type of rhythm with which the pulses were applied). Mathematical modelling showed that these signals were distributed in different neural subspaces known as "orthogonal", which would allow the brain to activate or deactivate each representation without interference. For example, if the animal does not need to pay attention to the rhythmic properties of the stimulus, the abstract representation is deactivated, while the raw representation remains active. These results could contribute to the development of artificial systems such as neuromorphic circuits, the design of intelligent sensors and, in biological terms, to the exploration of attention-related mental disorders such as ADHD.

Bayones et al (2024) Proc. Natl Acad Sci USA

ANNUAL REPORT 2024
WEL-T DEPARTMENT

OPTIMISING THE USE OF PHOTONS IN PHOTOREDOX CATALYSIS

Photochemistry, which involves using light energy to initiate chemical reactions, is the foundation of solar fuel production. Its application requires a photosensitiser to store the energy of light radiation and transfer it to another molecule within a complex isolated in a 'cage' formed by solvent molecules. This photoreaction (electron transfer) generates geminal radicals, which must then escape from the solvent cage to trigger subsequent chemical reactions. The parameters that control the yield of geminal radicals that escape from the solvent cage are currently not well understood. **Ludovic Troian-Gautier** and colleagues studied 11 different solvents in combination with typical photosensitisers, based on rare metals such as ruthenium and iridium, and with photosensitisers based on iron, one of the most abundant elements in the Earth's crust. By combining experimental and theoretical approaches, the researchers proposed that the spin of the geminal radical pair largely controls the process of exiting the solvent cage and identified the parameters that influence its efficiency. This study sheds light on key factors influencing photoreactions with typical photosensitisers, as well as with iron-based photosensitisers, a sustainable alternative to rare metals.

Ripak et al (2024) J Am Chem Soc

SECURING THE INTERNET: TOWARDS SAFER ROUTING

Border Gateway Protocol (BGP) is a system used by the Internet to help different networks communicate with each other. BGP helps the Internet find the quickest or most reliable path for data, ensuring that messages, websites and other information reach their destinations. However, BGP has not benefited from the same level of security as web or smartphone applications. To tackle this issue, **Olivier Bonaventure** and colleagues proposed securing BGP connections using modern encryption protocols such as TLS and QUIC, instead of the traditional, unprotected TCP method. This approach would strengthen BGP against cyberattacks while preserving its current functionality. Additionally, the security certificates used in TLS could help routers configure themselves securely, reducing human error and improving efficiency. This research proposes a straightforward and practical method to enhance the safety of Internet routing by using existing security technologies to protect both BGP messages and router configurations.

Wirtgen et al (2024) Proc ACM Netw

Awards

ALESSANDRO PARENTE

WEL RESEARCH INSTITUTE – ULB

Alessandro Parente's research aims to develop digital twins, integrating theory, experiments, simulations and machine learning, to help reduce the carbon impact of industrial combustion systems. In 2024, Alessandro was awarded an **ERC 'Proof of Concept' grant** (2024-2026) to explore the innovative potential of the results generated from his ERC Starting grant. He was also designated a **Fellow of The Combustion Institute**, a lifetime honorary title awarded for his pioneering advances in data-intensive frameworks for the development of sustainable combustion technologies

ANNUAL REPORT 2024

WEL-T
DEPARTMENT

Circular Materials

Circular materials are designed to enable the complete recycling of resources and to support novel synthesis strategies that are free from toxic precursors or by-products, allowing the regeneration of raw materials.

Investigators

Advanced

RAQUEZ Jean-Marie - UMons

Continuous solid-state modification of plastic waste via upcycling approach

SIMAR Aude - UCLouvain

Recycling healable aluminium waste by circular solid state additive manufacturing

New Materials

Thanks to their unique properties and superior performance, new materials can replace traditional ones and contribute to environmental protection.

Investigators

Advanced

PARDOEN Thomas - UCLouvain

Novel nanolaminate coatings and ultra-miniaturised test instrumentation for extreme nuclear environments

Starting

PONCÉ Samuel - UCLouvain

Computationally-driven improvements in lead-free halide perovskite photovoltaics

Representative publications

ENHANCING CHARGE MOBILITY IN SILICON: THE IMPACT OF HIGH STRAIN

Silicon is commonly used in electronics, but its ability to conduct electric charges is limited by tiny vibrations in its structure. Applying strain (stretching) can enhance this conductivity. While regular silicon can handle small amounts of strain (around 0.3%), this study explored the impact of up to 2% of strain, combining theoretical research by **Gian-Marco Riganese** and **Samuel Poncé** with experimental observations from their colleagues. The researchers observed unexpected patterns in how electrons moved, and confirmed their predictions through experiments at 1% strain, which nearly doubled the movement of positive charges (holes). If these findings are further confirmed, they could pave the way for improved infrared sensors and faster transistors.

Roisin et al (2024) npj Comput Mater

ANNUAL REPORT 2024
WEL-T
DEPARTMENT

ACTUAL CHARACTERISTICS OF GRAPHENE REVEALED BY ON-CHIP NANOMECHANICS

Graphene is considered to be the most resistant material available; this is based on fundamental studies on perfect samples and on approaches that are not entirely reliable, due to the inherent complexity of testing a single atomic layer. **Thomas Pardoen** and colleagues used an extension of the on-chip nanomechanical approach patented by UCLouvain to determine the actual strength and toughness of graphene. This approach made it possible to prepare samples with a thickness of a single atom - i.e. 150,000 times thinner than a hair - with or without cracks, and to simultaneously test hundreds of micro- or nanosamples a sufficiently large number of times to generate statistically significant data, and ultimately establish a link with defects in the microstructure. In particular, the results showed that the ultimate toughness of single-layer graphene was 20 J/m2, which is 20 times greater than conventional surface energy, and that the specific elastic energy that could be stored was 6 GJ/m3 – a world record for specific elastic energy, and comparable to that of TNT explosives. This breakthrough in determining the strength and toughness of graphene sheds important light on the application of this material in various technologies.

Jaddi et al (2024) Nat Commun

Awards

THOMAS PARDOEN

WELRESEARCH INSTITUTE – UCLOUVAIN

Thomas Pardoen focuses on understanding and improving the durability and strength of materials used in the aerospace, energy and electronics industries, with a strong emphasis on innovation in materials design and testing methodologies. Thomas holds an **ERC Advanced Grant** (2023–2028) to study the strength and toughness of materials, with the aim of improving their performance.

Agile and Safe Production Methods

Research aims to increase efficiency, reduce waste and identify opportunities for sustainable innovation across a range of manufacturing processes.

Investigators

Advanced

DETREMBLEUR Christophe - ULiège

Cascade exotherms to stimulate self-foaming of Isocyanate-free polyurethane formulations at ambient temperature

EVANO Gwilherm - ULB

Catalytic deoxygenative functionalisation reactions for the synthesis of alkanes, alkenes and arenes

GEERTS Yves - ULB

A fresh look on the polymorphism of active pharmaceutical ingredients

MONBALIU Jean-Christophe - ULiège

Intelligent flow systems for advanced chemical manufacturing

RIGNANESE Gian-Marco - UCLouvain

Towards a materials informatics active-learning platform to design new electrocatalysts

Representative publications

OPTIMISING REACTIONS IN CONTINUOUS FLOW ORGANIC CHEMISTRY

Optimising the preparation of high added-value organic compounds involves iterative processes which are time-consuming, resource-intensive and waste-generating. **Jean-Christophe Monbaliu**'s team combined quantum chemistry and artificial intelligence to generate optimised process conditions within minutes and completely waste-free. In silico conditions were then instructed to an automated lab-scale flow synthesis system, which executed them within record time. In other words, reactions and conditions for which no previous knowledge existed, could be modelled in advance, without the need for experimentation. This tool was successfully applied to electrophilic aminations, a class of reactions particularly relevant to pharmaceutical compound manufacturing. This research holds both fundamental and applied significance, as evidenced by its use in physical organic chemistry to understand reactivity and its application for industrial collaborations.

Bianchi et al (2024) Angew. Chem. Int. Ed

A SUSTAINABLE PROCESS TO PRODUCE POLYURETHANE FOAMS

Polyurethane foams, commonly made with toxic isocyanates, are widely used in insulation and comfort products like mattresses and car seats. However, recycling these foams is challenging, and there is growing demand for non-isocyanate, bio-sourced alternatives. New methods for making non-toxic, isocyanate-free foams (NIPU) have been developed, however, they have failed to self-blow at room temperature. The lab of **Christophe Detrembleur** developed a solution to accelerate NIPU foam formation at room temperature. By adding a highly reactive triamine and an epoxide to the water-induced self-foaming process, the team generated cascade exotherms that raised the temperature quickly, allowing foams to form in just five minutes. These foams can be made with up to 90% bio-based materials and can be recycled into new products. This affordable and efficient process is a promising solution for creating environmentally friendly foams.

Bourguignon et al (2024) J Am Chem Soc

Representative publications

RHODIUM-CATALYSED DIRECT ATTACHMENT OF AROMATIC GROUPS TO ANILINES

Gwilherm Evano and colleagues developed a new and efficient method for directly attaching aromatic groups to anilines using a rhodium catalyst, with the help of readily available aminophosphines as directing agents. This approach is highly versatile, as it works with a wide range of aminophosphines and aryl iodides, including complex ones. The process yields high-quality products without unwanted side reactions and ensures precise control over where the aromatic groups are added. Additionally, aryl bromides and triflates can also be used, and the process can be extended to create diarylated products. Mechanistic studies highlighted the important role of amino phosphines, which not only act as reactants but also help guide the rhodium catalyst.

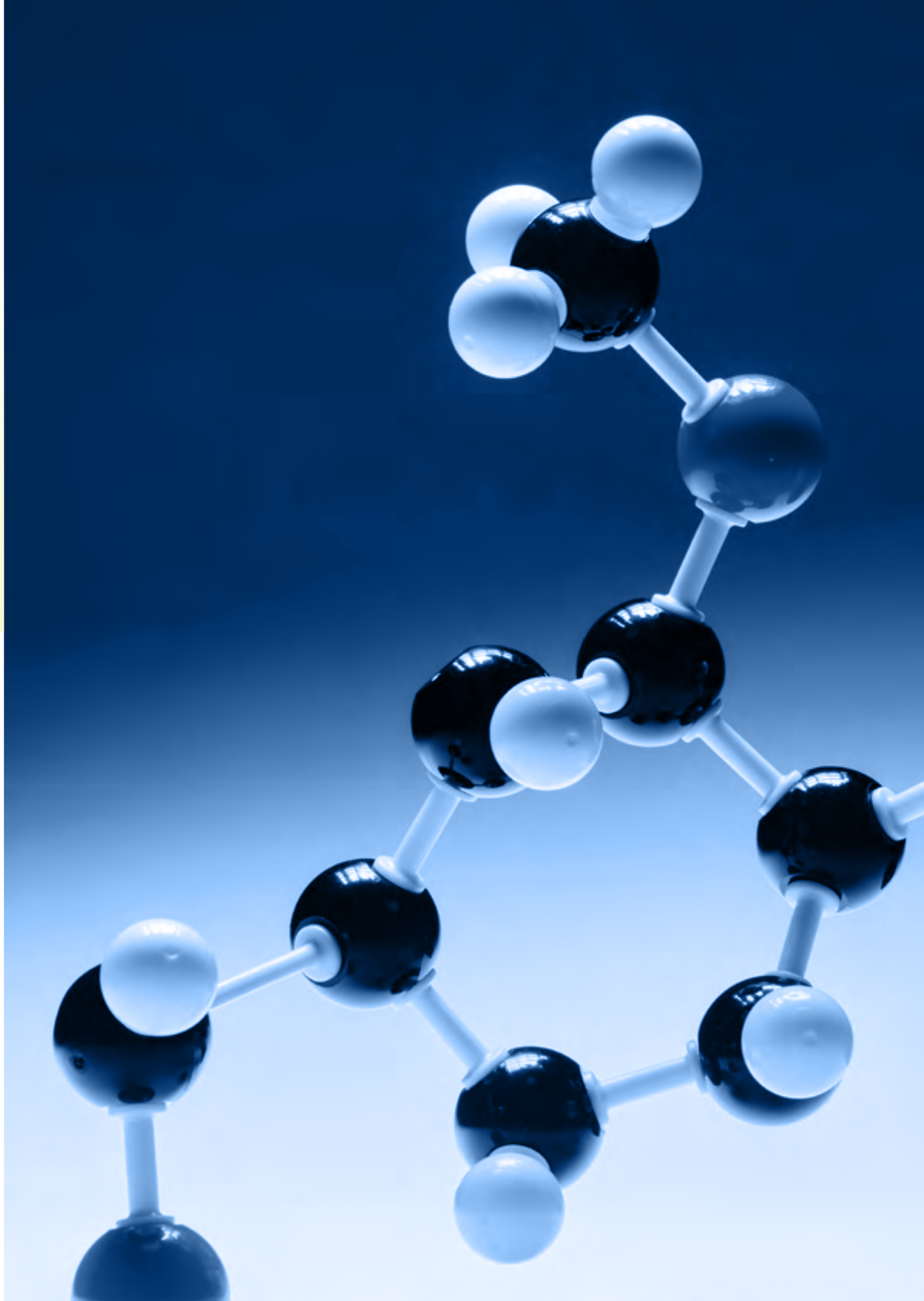
Jacob et al (2024) Angew Chem Int Ed

Awards

JEAN-CHRISTOPHE MONBALIU

WEL RESEARCH INSTITUTE - ULIÈGE

Jean-Christophe Monbaliu is a pioneer in the widespread adoption of fluidic technologies for organic synthesis with reduced environmental impact. In 2024, Jean-Christophe received the **Corning International Prize for Outstanding Work in Continuous-Flow Reactors and Chemistry for a Greener and Safer World (France**). Corning is one of the world's leading innovators in materials science, and this prize has only been awarded once before, in 2018, to Prof. Klavs Jensen of the Massachusetts Institute of Technology (USA).



CHAPTER

04

Societal and economic impact

Translating academic discoveries into real-world solutions is essential for generating tangible societal and economic impacts, but the process is both lengthy and complex. Initially, fundamental research focuses on uncovering new knowledge, and discoveries often require years of refinement and further investigation before they can be translated into viable solutions.

Achieving this transformation demands collaboration between researchers and industry professionals to identify potential applications and overcome challenges related to scalability, cost and integration with existing systems. While the journey from discovery to application is gradual, it ensures that the solutions are robust, reliable and poised for long-term impact.

The WEL Research Institute offers its Investigators a robust framework and proactive support system designed to help translate ground-breaking discoveries into tangible benefits for society and the economy. Recognising that strategic research often starts with hypotheses, and that its outcomes are inherently unpredictable, the Institute fosters an environment where flexibility and adaptability are prioritised

To support this process, the WEL Research Institute places strong emphasis on regular, structured meetings with its Investigators, in close partnership with representatives from the Knowledge Transfer Offices (KTOs), to identify emerging opportunities and unforeseen results that could have significant potential for innovation. The process involves identifying commercially viable discoveries, securing patents, analysing market needs and decision-making parameters, and establishing pathways that bring innovations to market.

Intellectual Property

By 2024, a total of 50 patent applications had been filed under WELRI-supported research initiatives, including six new submissions that year alone. Of these, 35 distinct patent families remain active. Notably, nearly half are related to oncology, reflecting WELBIO's longstanding expertise in this area.

Further illustrating the dynamic innovation pipeline, the first WEL-T programmes – launched on 1 October 2023 – have already led to four additional patent applications. This early outcome highlights the strong translational potential of the field.

In parallel, partnerships with industry have translated scientific advances into tangible outcomes: licensing agreements have generated approximately €10 million in gross revenue.

WELBIO

Grand Total
46

CUMULATIVE NUMBER OF FILED PATENT APPLICATIONS

WEL-T

Grand Total
4

CUMULATIVE NUMBER OF FILED PATENT APPLICATIONS

Spin-offs

A total of six spin-offs have been created based on results generated by WELBIO research programmes. All of them are based in the Walloon Region, including in Brussels South Charleroi, Louvain-la-Neuve and Liège. Collectively, these spin-offs have raised €88 million in funding and created 55 jobs.

Industrial Collabo-rations

WELRI investigators collaborate with industry in partnerships that may be based on patent applications and aim to test technologies before progressing to more advanced agreements, including licensing options. In other cases, industry directly seeks the expertise of investigators for specific projects, resulting in service contracts.
A total of 42 industrial collaborations have been established, including six within the year, generating over €8 million in funding for the laboratories.

Bridge Fund

Intellectual property arising from strategic research may not always have a sufficient level of technological maturity for direct transfer to an industrial partner. The Bridge Fund, a funding instrument managed by WEL Research Institute, aims to increase this level of technological maturity in order to enhance the chances of transfer to industry.

In 2024, the Governing board approved funding for two Bridge fund applications, totalling €300,000, aimed at leveraging AI tools to accelerate the translation of academic discoveries into tangible benefits for patients.

By the end of 2024, a total of nine Bridge Funds had been awarded, amounting to €1.2 million in total. These funds have led to significant results, including strengthening patent applications, confirming industry interest in new technologies, and enhancing attractiveness to investors during the creation of spin-offs.

CHAPTER

05

Management report

This report covers the 14th financial year, from 1 January to 31 December 2024.

Since 2022, the WEL Research Institute has been composed of two departments: WELBIO (life sciences for health impacts) and WEL-T (engineering, chemistry and physics for impact on the sustainable transition).

WELBIO and WEL-T correspond to the strategic axes defined by the Walloon Government within the Fonds de la Recherche Fondamentale Stratégique (FRFS), one of the associated funds of the F.R.S.-FNRS.

The WEL Research Institute and the FRFS complement each other in carrying out the mission entrusted to them by the Walloon region. The WEL Research Institute defines the overall strategy for the "Investigator programmes" calls and drives the translation of the scientific discoveries resulting from the 'Investigator programmes' into societal and economic impact. The FRFS manages the selection process of the 'Investigator programmes' that make up the WELBIO and WEL-T departments and is responsible for the financial and administrative management of the research contracts.

This is reflected in the financial flow as follows:

- Subsidies from the Walloon Region for strategic research within WELBIO and WEL-T are paid to the FRFS, of which 90% are dedicated to the research contracts selected through the "Investigator programmes" calls.
- The WEL Research Institute receives an annual grant (the 'WELRI amount') equal to 10% of the total subsidies from the Walloon Region, after deduction of the sums earmarked for the operating costs of the FRFS/F.R.S.-FNRS.

For the 2024 financial year, the agreement signed by the FNRS and the WEL Research Institute on 4 November 2022 governs the management of the funding allocated to the WEL Research Institute, as follows:

- The total 'WELRI Amount' for 2024 was €2,413.125.
- The WEL Research Institute submitted a claim to the FNRS for €800,000 to cover its operating costs for the period from 1 January to 31 December 2024. The amount was estimated based on the provisional balance sheet drawn up on 30 September 2024 and presented to the WELRI Board of Directors on 29 November 2024.
- The 'WELRI BALANCE', corresponding to the difference between the 'WELRI Amount' and the statement of claim, is €1,613,125. This balance, which will remain in the FNRS account, will be distributed in proportion to the initial allocation as follows:
  - FRFS-WELBIO: €977,652 (61% of the balance)
  - FRFS-WEL-T: €635,473 (39% of the balance)

The WEL Research Institute has published its annual accounts with the National Bank of Belgium since the 2017 financial year. Although the WEL Research Institute can be considered a micro not-for-profit organisation, it has not opted for a simplified accounting system and has chosen to maintain the publication of its annual accounts with the National Bank of Belgium.

Assets

Tangible fixed assets amounted to €2,087.66 and consist of computer equipment.
Financial fixed assets amount to €7,497.00 and related to the guarantee for the rented offices in Wavre.

Receivables due within one year amounted to € 800,459.30 and comprise subsidies granted by the region for 2024.

Cash investments amounted to €2,044,448.32 in the form of two reserves to distribute the remaining liquidity of the WEL Research Institute.

These liquid cash sums have been allocated as follows:

Operating costs (2025):

€712,668.00

Bridge fund:

€1,331,780.32

A BPAID account was created to cover various small expenses and the remaining balance is €259,30.
Adjustment accounts amounted to €6,901.65 and relate to expenses to be carried forward of €12,688.62 and accrued income of €703.14.

Total assets amounted to:

€2,868,143.34

Liabilities

The balance on 31 December 2023, under the heading of "other allocated funds", amounted to €2,543,122.29.
The result for the fiscal year was a profit of €116,257.68.
The balance on 31 December 2024, for other allocated funds, amounted to €2,659,379.97.
Supplier debts amounted to €153,122.39.
The estimated tax liability for 2024 was €970.25.
Provisions for holiday pay amounted to €50,217.49.
Other debts amounted to €129.93 – these relate to an administrator's current account of €129.93.

Total liabilities amounted to:

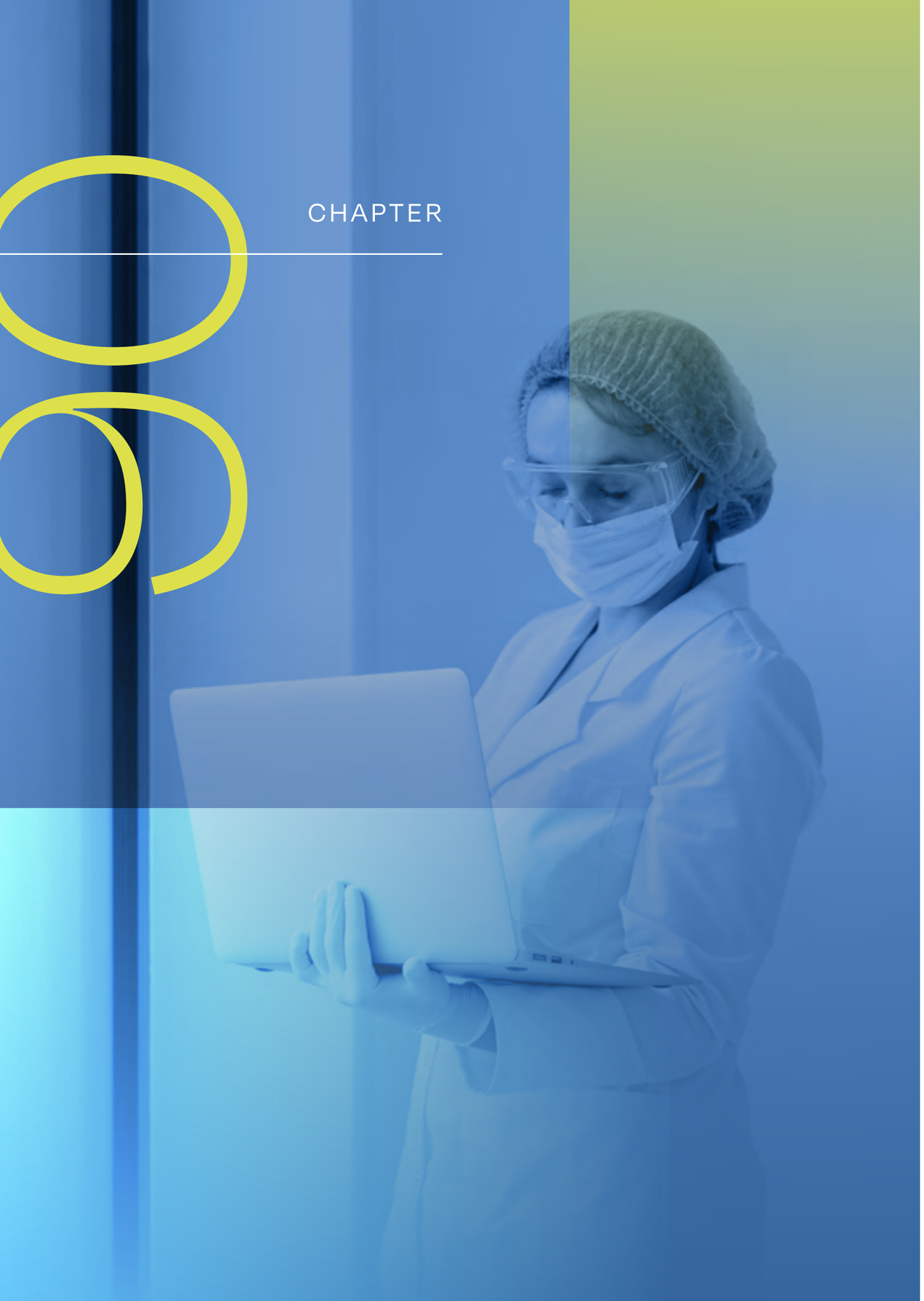
€2,868,143.34

Result

The grant for 2024 operating costs amounted to €800,459.30.
Miscellaneous services and assets amounted to €132,077.26 and primarily consisted of operating costs, rent and fees.
Salaries and social contributions amounted to €425,081.68.
The estimated tax liability amounted to €970.25.
Net bank interest, after withholding tax, amounted to €11,365.73.
Financial charges amounted to €52.64.

The result for the fiscal year is a profit of:

€116,257.68



CHAPTER

06

Administrative and financial resources

GOVERNANCE

The Board of Directors of the non-profit organisation (asbl) WEL Research Institute is composed of representatives from industry, academia and Ministers of the Walloon Region.

Board of Directors

President: Philippe Denoël
Vice-President: Pierre Lekeux

Representatives of the Ministers of the Walloon Region

Vinciane Grimard,
(until 29 November 2024),
Jean-François Corbisier,
(since 29 November 2024), representing the Minister for the Economy

Catherine Dath,
(until 29 November 2024),
Nathalie Leboeuf,
(since 29 November 2024), representing the Minister for Research

Christopher Sortino,
(until 29 November 2024), representing the Minister-President. In the spirit of administrative simplification, the Minister-President Dolimont decided not to appoint a new representative. The bylaws of the WEL Research Institute were modified accordingly on 10 March 2025.

Representatives of the financial and industrial sectors

Philippe Denoël,
Head of External Vaccines R&D at GSK

Gwenaëlle De Keyser,
Head of Public Private Partnerships, UCB BioPharma

Joëlle Van Malderen,
Head of AWA Benelux and Head of AWA Switzerland, AWA

Marc Van Den Neste,
Founder and Administrator, EKOSYS

Academic experts

Pierre Lekeux, Professor, ULiège

Philippe Lambin, Professor, UNamur

Representatives from the universities in the French Community

Jean-Christophe Renauld,
Vice-Rector Research, UCLouvain

Marius Gilbert,
Vice-Rector Research and Development, ULB

Ruddy Wattiez,
Vice-Rector Research, UMons

Secretary General of the Fund for Scientific Research (F.R.S.-FNRS)

Véronique Halloin, Secretary General

Representative of the Walloon Public Service

Jean-François Heuse, Inspector General

VINCIANE GAUSSIN

MANAGING DIRECTOR

The WEL Research Institute team

Vinciane Gaussin has more than 25 years of experience in life sciences in academic, biotech and non-profit organisations. She was the Managing Director of the WEL Research Institute from 2010 to 2015 and resumed this position in March 2021, after several years at a biotech company in California. Vinciane has a degree in bioengineering, obtained her PhD in 1996 (Belgium) and did her post-doctoral work at the Baylor College of Medicine (USA).

LAURENCE BORGS

WELBIO BUSINESS DEVELOPMENT MANAGER

Laurence Borgs is a neurobiologist, obtained a PhD in Biomedical and Pharmaceutical Sciences in 2009 and completed a post-doctoral fellowship in partnership with UCB Pharma. Combining scientific expertise and commercial leadership in various biotech life science companies, Laurence joined the WEL Research Institute in August 2022 as Business Development Manager for the WELBIO department.

PERRINE CALVEZ

WEL-T BUSINESS DEVELOPMENT MANAGER

Perrine Calvez is a chemical engineer. She obtained a PhD in materials chemistry in 2009, which led her to the global steel industry, where she held various positions: research and development, process engineer, marketing and environmental manager. In 2023, Perrine obtained an Executive Master's in Management from the Solvay Business School. Perrine joined the WEL Research Institute in October 2023 as Business Development Manager for the WEL-T department.

Contact

Headquarters

WEL Research Institute asbl
Avenue Pasteur, 6
1300 Wavre (Belgium)

Tel.: +32 (0)10 68 63 55
E-mail: info@welri.org

Trade register n° 0812 367 476

Managing Director

Vinciane Gaussin, Ir, PhD
Tel.: +32 (0)10 68 63 55

Website

http://welri.org

WEL Research Institute