UNIVERSITÉ DE FRIBOURG
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# Innovation @ UNIFR

## Knowledge and Technology Transfer Service

University of Fribourg, Switzerland


Knowledge and Technology Transfer Service (KTT)
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# Innovation @ UNIFR

## Examples

University of Fribourg's researchers collaborate with academia and industry, successfully applying for innovation funds such as the Swiss Innovation Agency Innosuisse, the BRIDGE program, Eurostars projects, as well as through Unifr Start-up and Proof-of-Concept grants.

## Support

KTT Service helps to transform research results into benefits for society. Be it through a start-up or a collaboration with an established company, the KTT Service supports you in understanding and forging a path, as well as with the drafting, negotiation and approval of research contracts and patent applications. The KTT Service manages the intellectual property of Unifr; we ensure your innovations are protected and positioned for success.

## Funding

The KTT Service supports you in setting up collaborations with industrial partners by identifying funding and by providing and negotiating the appropriate agreements. Collaborations can be directly financed by the industrial partners or co-financed with innovation agencies. The University provides support in the application processes and by protecting the intellectual property.

# Eco-friendly and safe plant protection

## Microorganisms for crop disease prevention

WHAT IS THIS ABOUT?

We are developing microorganism-based plant protection products that will help farmers produce healthy crops in an eco-friendly way. The microorganisms in our products can prevent disease development by directly inhibiting the pathogen and/or by inducing the plant's natural defenses. Our products aim to replace hazardous pesticides that are currently used to control economically important diseases in potatoes, tomatoes, and grapevine.

WHAT'S THE INNOVATION?

We use the innate abilities of plants to recruit beneficial microorganisms, capable of identifying and selecting microorganisms for biocontrol. These microorganisms, on top of their disease-inhibitory activities, are naturally well adapted to the plant and pose no risk to the environment or to human health. By combining different microorganisms with complementary abilities, we aim at developing biocontrol products that are efficient, reliable, and are not subjected to restrictions of use, unlike currently used pesticides.

WHAT ARE OUR PLANS?

We are currently conducting field trials to test our most promising microorganisms. We are developing the formulation of our best candidates. As a next step, field trials will aim at optimizing the formulation and application timing and methods, and developing a prototype product, thanks to a new SNF-BRIDGE grant allowing us to join forces with experts in formulation and biomass production from HE-ARC and Agroscope. Our goal is to develop the product as a spin-off of the University, once we have our first prototype.

WHO ARE WE?

This project was initiated by Mout De Vrieze, who worked for many years in Laure Weisskopf's group in the Department of Biology at the University of Fribourg, and recently became an independent project partner working at Agroscope. Together with our team members, our research group has assembled collections of biocontrol microorganisms and characterized their disease-inhibitory potential. For our field trials, we collaborate with Agroscope and the Institut Agricole de Grangeneuve.

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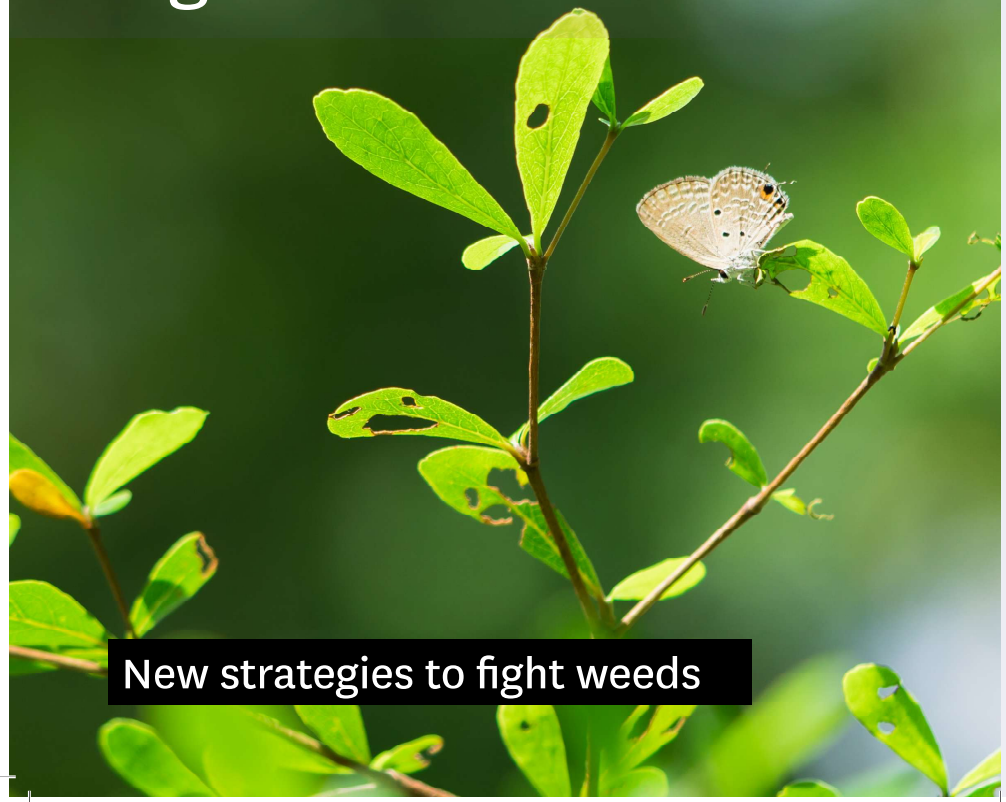
# Green technology for sustainable agriculture: Towards a new generation of organic herbicides



New strategies to fight weeds

WHAT IS THIS ABOUT?

We selected biological compounds that inhibit weed growth at nanomolar levels. Two of the compounds act broadly, and two of them selectively target eudicots. We are building production pipelines in plant and bacterial systems, testing setups and comparing yields. One compound shows promising results, and we aim to scale up the production. Granule application on soil-grown eudicots worked well; further testing will optimize field use. We aim to patent both bio-production and field application of these compounds.

WHAT'S THE INNOVATION?

Weed control is key to prevent crops from competing with unwanted plants for water, nutrients, and light. We target a conserved growth pathway and identified natural signals that suppress growth in flowering plants. Some compounds are species-specific, found only in grasses or eudicots, while others act broadly. We test their phytotoxic activity and potential as bio-herbicides. These compounds could revolutionize weed control and support sustainable farming.

WHAT ARE OUR PLANS?

We are currently testing plant responses to a selection of smart-herbicides in several grass and eudicot species. Based on the bioinformatics analysis and literature, we focused on two eudicots and four monocot-specific signal compounds that have a potential to be used as selective plant inhibitors. At the same time, we focus on compounds that strongly suppress growth in a non-selective manner. We test such unique signals and their inhibitory effect on plant growth with the aim to develop organic herbicides. In parallel, we will focus on obtaining a patent for this innovation and proceed with scaling up the production of these substances and applying them in the field.

WHO ARE WE?

Dr. Ora Hazak, Group Leader and plant molecular developmental biologist, has a strong track record in plant signaling and root development. Her laboratory at the University of Fribourg contributed significantly to plant peptide signaling. She initiated and supports the patenting of bio-herbicides. Dr. Salves Cornelis develops the peptide production pipeline and runs growth tests. Dr. Abdellatif Essahibi leads growth inhibition tests, including semi-field granule applications.

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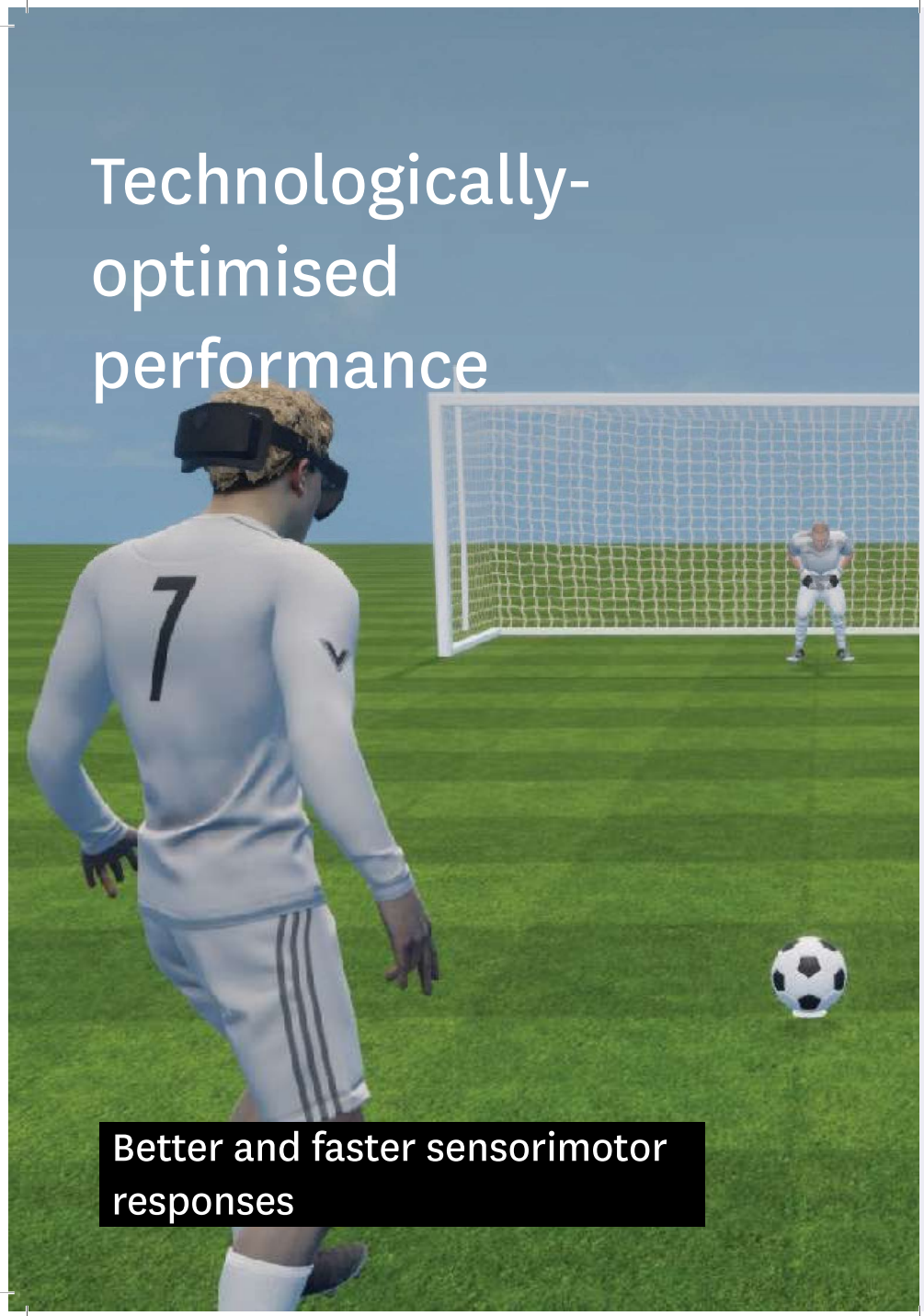
# Technologically-optimised performance



**Better and faster sensorimotor responses**

WHAT IS THIS ABOUT?

Professional sports represents a multi-billion-francs market where performance margins directly determine financial success. Despite massive investments, a critical gap remains in current training methodologies. While physical conditioning and technical skills have been optimized to the highest levels over decades, the systematic assessment and training of sensorimotor and cognitive abilities remain largely underdeveloped.

WHAT'S THE INNOVATION?

We develop unique solutions and training programs that transform performance assessment and improvement in sports. Our novel methodologies and approach enable precise, fast, and individualized quantification of athletes' abilities, leading to optimized training strategies. This multidisciplinary innovation integrates neuroscience, psychophysics, immersive technologies (VR/AR, human-avatar interactions), machine learning, and advanced analytics, validated for proven effectiveness.

WHAT ARE OUR PLANS?

The current solutions were primarily developed for team sports - such as football and ice hockey -and striking-based combat sports, serving professional clubs, athletes, and talent academies We aim to improve these solutions, while also expanding into new sports and physical activities. In the long-term, we aspire to become a leading consulting force, designing tailored solutions and innovative methods to meet the specific needs of customers.

WHO ARE WE?

Our group (Control and Perception Laboratory; CoPeLab) has interdisciplinary expertise in neuroscience, cognitive psychology, psychophysics, computer science and machine learning. The CoPeLab group is part of the Neuroscience & Movement Science department at the University of Fribourg.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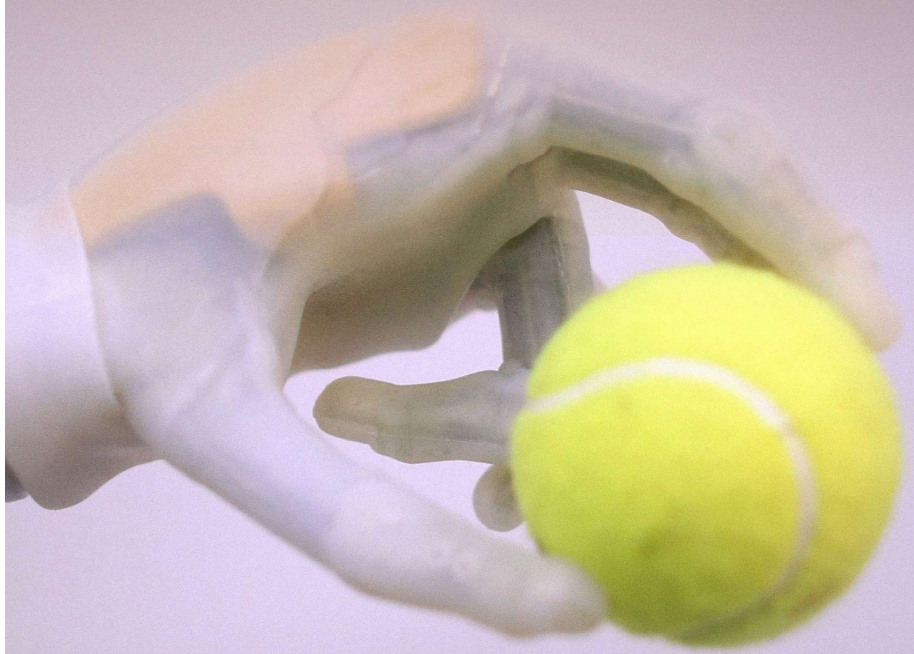
# Energy-autonomous soft robotic prosthetics



**INTEGRATE project**

WHAT IS THIS ABOUT?

The use of robotic prosthetic devices is a compelling strategy to reduce loss of mobility and functionality in patients suffering from amputations. Current devices are mostly designed using hard materials that are very different from biological tissues and rely on batteries that need to be continuously recharged. To overcome these limitations, we are striving to develop soft robotic prosthetics that draws on the body's own metabolic energy, no longer requiring an external recharge.

WHAT'S THE INNOVATION?

Our team will target two technological innovations. The first is the development of 3D-printed soft and biocompatible artificial muscles that precisely mimics human muscles. The second innovation is the creation of an artificial electric organ capable of converting metabolic energy into electricity. Combing these two technologies will allow construction of robotic prosthetic devices that are soft like human muscles and do not need to be recharged.

WHAT ARE OUR PLANS?

We are laying the technological foundations for both the artificial muscles and the artificial electric organ. Our plan is to develop a laboratory-scale demonstrator within the next four years and subsequently apply for further funding to bring the technology to the market.

WHO ARE WE?

The team comprises four research institutions (University of Fribourg, Eindhoven University of Technology, CNRS and University of Roma Tor Vergata) and a research association (Veltha IZV). Dr. Alessandro Ianiro of the Adolphe Merkle Institute (AMI), the scientific coordinator of the consortium, initiated the project with the collaboration of Dr. José Berrocal, Prof. Michael Mayer and Prof. Christoph Weder (all from AMI). The project received €3 million in funding in 2022 from the European Innovation Council under the prestigious Pathfinder program.

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# Protecting vision in aging eyes

## Neuroprotective compounds for degenerative diseases

WHAT IS THIS ABOUT?

Every year, millions of older adults around the world lose their vision due to age-related macular degeneration (AMD), a disease that slowly damages the central part of the retina needed for reading, recognizing faces, and maintaining independence. Other forms on retinal degeneration such as retinitis pigmentosa cause blindness. Effective treatments for the most common dry form of AMD or retinitis pigmentosa are still lacking.

WHAT'S THE INNOVATION?

We have developed and patented a novel family of neuroprotective compounds that showed remarkable ability to rescue vision and protect photoreceptors in a validated mouse model of retinitis pigmentosa. These compounds also safeguard retinal pigment epithelial cells – the first cells damaged in AMD – in a human cell model of this disease. These compounds act by stimulating selective removal of damaged mitochondria through autophagy, a natural cellular recycling process.

WHAT ARE OUR PLANS?

We aim to advance these promising compounds into models that closely resemble the human eye. Next steps include testing them in advanced human cell models and in pigs, whose eyes are anatomically similar to ours, as well as expanding the compound family through the design and evaluation of new derivatives. Our long-term goal is to develop an effective therapy that can reach patients via strategic partnerships with leading pharmaceutical companies.

WHO ARE WE?

The project is led by Prof. Patricia Boya, Faculty of Science and Medicine, an expert in neurobiology and translational research with over 20 years of experience. Her team studies how autophagy contributes to health and disease using cell and animal models. This work on neuroprotection could pave the way for novel therapies for retinal and other neurodegenerative conditions.


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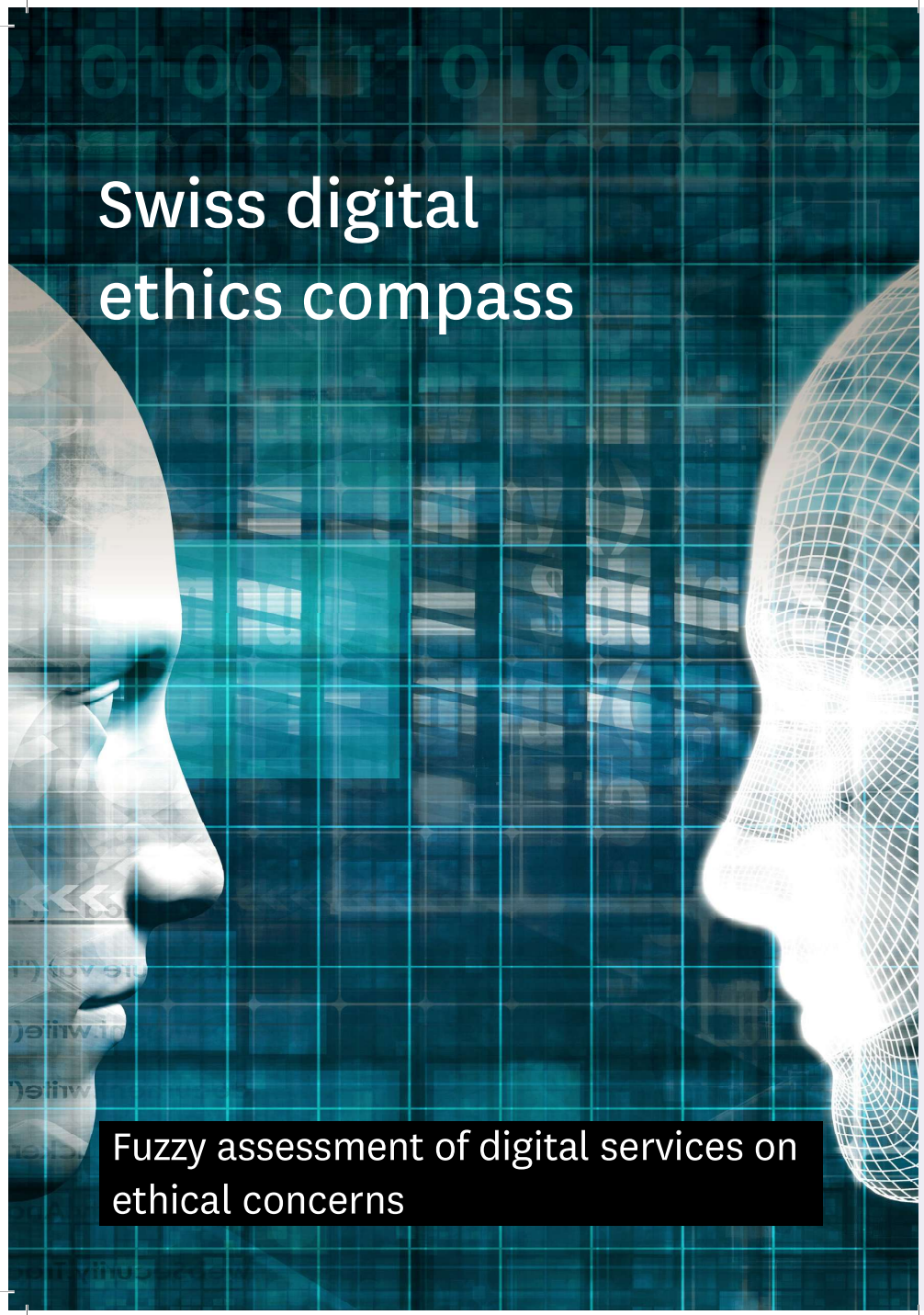

# Swiss digital ethics compass

## Fuzzy assessment of digital services on ethical concerns

WHAT IS THIS ABOUT?

As technology becomes integrated into our life it is necessary to adopt a balanced approach to ethics. Several models have been adopted to clarify the various challenges in digital contexts. A practical and integrated tool is required to meet the demand for sustainable digital transformation in our everyday lives. We need to address the growing number of challenges in handling our digital data. Our model is designed to address these challenges in data, machine learning, and artificial intelligence that are interconnected with concerns of justice, sustainability, and climate change. Our ultimate goal is to implement a user-friendly digital ethics radar.

WHAT'S THE INNOVATION?

The objective is to evaluate the sustainability and ethical dimensions of digital services. Thereby, we focus on computational ethics, an approach that seeks to quantify and measure ethical values. Collaboration among ethical researchers, computer scientists, and business practitioners is necessary to integrally define justice-based benchmarks as evaluation standards for digital services. Ethics contributes by defining norms to be used as evaluation standards, and computer science and engineering are required to establish criteria and algorithms for assessing digital services.

WHAT ARE OUR PLANS?

We work on developing a tool, where one of the components would be «digital ethics radar». In addition, an explainable and generative AI will function as a 'Digital Ethics Expert', delivering tailored recommendations. The Compass can be utilized by public service providers to make sure their practice aligns with ethical standards. The project's outcomes are expected to increase the value of our key partner, Swiss Post, which is interested in integrating our tools into the processes. Furthermore, the design is intended to be scalable for other types of companies and public service network industries (e.g., Swisscom, SBB, CKW). This project is supported by Innosuisse and Swiss Post.

WHO ARE WE?

The project is advanced by Narek Andreasyan, a PhD student at the Department of Informatics. Conceptualization and supervision of the project are performed by Prof. Edy Portmann, the co-director of the Human-IST Institute and head of the resilient system group, and Dr. Luis Terán, lecturer at the Lucerne University of Applied Sciences and Arts and senior researcher in cognitive computing at the Human-IST Institute. The project is supported by Christina Meyer, the digital ethics specialist at Swiss Post.


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# Smartphone-based fluorescence microscope for early diagnosis

Sensitive, affordable, and portable point-of-care device

WHAT IS THIS ABOUT?

Affordable and portable point-of-care devices are in high demand, particularly for on-field measurements. Benchtop fluorescence microscopes are highly sensitive but costly and require trained operators. In contrast, smartphone-based ones are accessible but are less sensitive and often designed for a single-phone model. We have successfully developed a smartphone-based fluorescence microscope that is inexpensive, portable, usable with multiple smartphone models, and capable of detecting a single fluo-rescent molecule like a benchtop microscope.

WHAT'S THE INNOVATION?

Our fluorescent microscope can directly detect a single molecule without the use of additional enhancement elements. Such sensitivity is similar to a state-of-art of bench-top microscope. Reaching this sensitivity helps to provide early disease diagnosis even before the development of symptoms. Moreover, our device can be used with different smartphone models without any modification or the need for realignment of optical components.

WHAT ARE OUR PLANS?

We have already developed a functional prototype of our microscope, which demonstrates a sensitivity comparable to current state-of-the-art microscopes used in fluorescence imaging. The next step is to develop and validate a complementary diagnostic assay to be used alongside the microscope. We are currently applying for Innosuisse funding to support this phase. Ultimately, we aim to establish a spin-off and bring the integrated solution to market.

WHO ARE WE?

The development of this microscope is a project of the Photonic Nanosystems group in the Department of Physics at the University of Fribourg. The portable and inexpensive version of the microscope is developed by Morgane Lorétan in the framework her PhD thesis under the supervision of Prof. Guillermo Acuña, and with the help of Nathan Fuchs, and two students: Theo Thomas and Salma Elmnouar. The project was first started as a benchtop version at LMU of München by Prof. Guillermo Acuña and continued at the University of Fribourg by Morgane Lorétan, and Dr. Mathias Lakatos.

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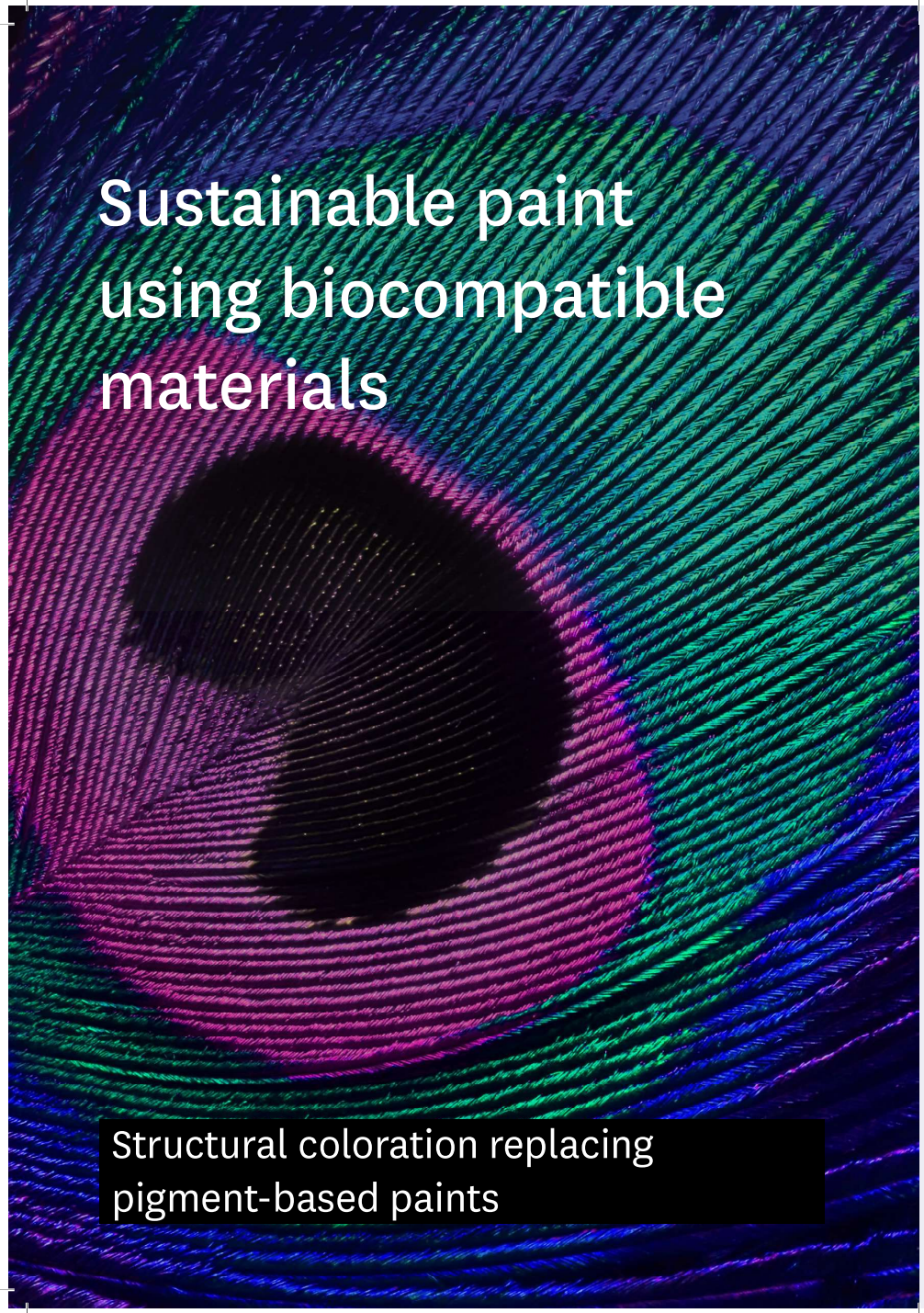

# Sustainable paint using biocompatible materials

## Structural coloration replacing pigment-based paints

WHAT IS THIS ABOUT?

Many colors fade with time. Among those that do not, we often find toxic substances based on metal oxides. We aim to create a novel type of long-lasting and environmentally-friendly paint based on light interference, without using pigments. With this type of 'structural colour' we can start from the same raw materials to make a range of different colours. This can be achieved by assembling the raw materials in different ways, thereby changing the way light is scattered by them. Our goal is to create prototypes of structurally colored objects that can be used in everyday life.

WHAT'S THE INNOVATION?

Instead of using pigments, we employ 'structural color', which is the color that arises from the interaction of light with a material's micrometric structure. Through this approach, we can create different colors using identical starting materials built with several distinct structural arrangements. We will focus on biocompatible materials. The absence of pigments will not only eliminate toxic substances from the production process but will also simplify recycling, because all colors will be composed of the same basic components, preventing the need for sorting during disposal.

WHAT ARE OUR PLANS?

Our strategy involves creating prototypes of structurally colored objects that are present in daily life. We have received support from the Centenary Research Fund of the University of Fribourg, which we will use to test the concept on a small scale. We further plan to apply for an Innosuisse grant with the aim to develop and refine the paint formulation, production and its application. We are engaged in discussions with representatives of several companies to develop collaborative projects centered around concrete problems and products.

WHO ARE WE?

The project is led by Dr. Sofia Magkiriadou, a postdoctoral researcher in the Soft Matter and Photonics Group under the leadership of Prof. Scheffold at the Department of Physics. The group has expertise in optical materials, both in theoretical understanding as well as in their hands-on preparation; these qualities are central to this project. As a physicist with a long-lasting interest in structural coloration, Sofia's goals are to better understand the optical phenomena that determine color quality and to find new ways of making structural color.


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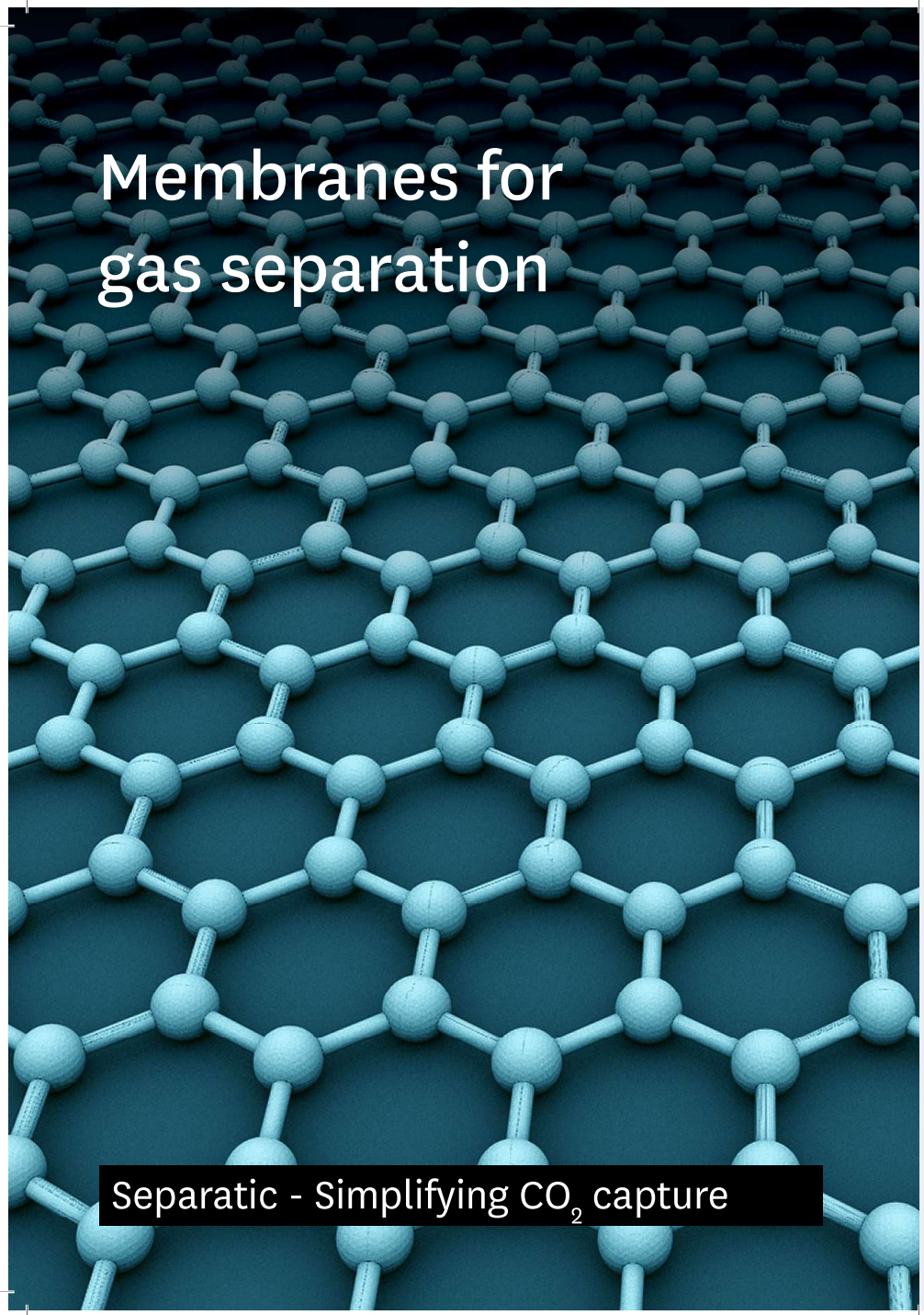

# Membranes for gas separation

## Separatic - Simplifying $CO_2$ capture

WHAT IS THIS ABOUT?

Separatic, a start-up incubated at the University of Fribourg, is developing and producing gas separation systems for direct $CO_2$ capture and hydrogen recovery. The start-up is developing gas separation solutions based on innovative, low-cost, and easy-to-implement graphene membranes, focusing on the capture and separation of carbon from industrial flue gas. It has also made hydrogen recovery an essential part of its strategy.

WHAT'S THE INNOVATION?

Separatic's key innovation is patent-pending spiral-wound graphene membranes that separate $CO_2$ from flue gases and recover hydrogen for fuel cells. The graphene membranes, developed during Timur Ashirov's PhD and coated with an adsorbent material, achieve a 5–9× reduction in energy consumption. Owing to their high permeation rate, the required membrane area is reduced by 100×, resulting in substantial cost savings. The modular design allows easy integration into existing systems.

WHAT ARE OUR PLANS?

Following successful laboratory tests in Denmark, Separatic is launching pilot projects with Swiss partners. Market entry is planned for early 2026, starting in the EU, then expanding to Asia. The technology is suitable for energy production and biogas treatment. Supported by BRIDGE, GRS Innobooster, PBS Grants, Innosuisse, and the University of Fribourg, Separatic is seeking more funding before engaging private investors.

WHO ARE WE?

We are a team of researchers led by Dr. Timur Ashirov, a maitre assistant at the University of Fribourg, Department of Chemistry, under the guidance of Prof. Ali Coskun. The results of this project were published in highly prestigious materials science and chemistry journals, Chem and Advanced Materials, and were also highlighted as a front cover for the September 2021 issue. To protect our invention, we filed an international patent application. The project has received numerous grants and prestigious awards for our innovation.


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# Seprify

## Replacing harmful white pigments with cellulose

WHAT IS THIS ABOUT?

Nowadays, white materials are present everywhere. Examples range from food, pharma, cosmetics, printing, paint, paper to coating industries. Current white enhancers are often metal-based, non-degrading materials and have recently raised serious health and environmental concerns leading to an EU wide ban.

WHAT'S THE INNOVATION?

We have developed a process to extract cellulose that can be used as white pigments or opacifiers. Cellulose is widely available, biocompatible and easy to process. Our patented, brilliantly white pigments from cellulose can be scaled with industry-proven processes and are safe to humans.

WHAT ARE OUR PLANS?

Seprify has successfully spun out of the University of Fribourg and has built up a pilot facility at the Marly Innovation Center, which was enabled by a successful Seed funding round in 2023. In 2025, the company successfully started producing material in tons scale through scale up partners. The commercial launch in health-related industries, focusing on cosmetics, food & pharma is planned for 2026. Expansion into new product grades for sun protection factor boosting and new markets such as coatings is already in planning.

WHO ARE WE?

Our technology has been developed by cellulose expert Prof. Silvia Vignolini at the University of Cambridge and was taken towards an innovation project at the University of Fribourg by Dr. Lukas Schertel supported by Innosuisse and in collaboration with the School of Engineering and Architecture of Fribourg. By now Seprify employes a team of 24 with experts from science, engineering and buisness.

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# Innovative antibacterial coatings

## Preventing infections and ensuring a fast recovery

WHAT IS THIS ABOUT?

Despite modern advances in medical devices, implant-associated bacterial infections remain a significant issue for some patients and are costly for society. While these bacterial infections are difficult to diagnose and treat due to bacterial biofilm formation and antibiotic resistance, our innovative antimicrobial coatings can prevent infections over months to ensure a healthy and fast recovery.

WHAT'S THE INNOVATION?

We developed antimicrobial coatings based on silver-filled inorganic nanocapsules and mesoporous capsules made of biocompatible silica, ceria, or titanium dioxide. After being tested *in vitro* and in vivo, silver release activities from capsules show that they can prevent infections of staphylococci strains during the healing phase and last for mid-to long-term use. Our biocompatible coatings can be adapted for different antimicrobial metals.

WHAT ARE OUR PLANS?

Financed by different Innosuisse, SNSF, and NCCR grants, we plan to fine-tune our active antibacterial coatings and upscale them with long-term performances. In collaboration with industrial partners, we plan to implement our technology for orthopedic, dental, and cardiovascular medical devices.

WHO ARE WE?

The team is composed of Prof. Katharina M. Fromm and senior and junior scientists with chemists, biochemists, and biology backgrounds. Prof. Fromm is internationally known for her work in bioinorganic chemistry of silver, silver compounds, and nanoparticles and their application as antimicrobial materials.


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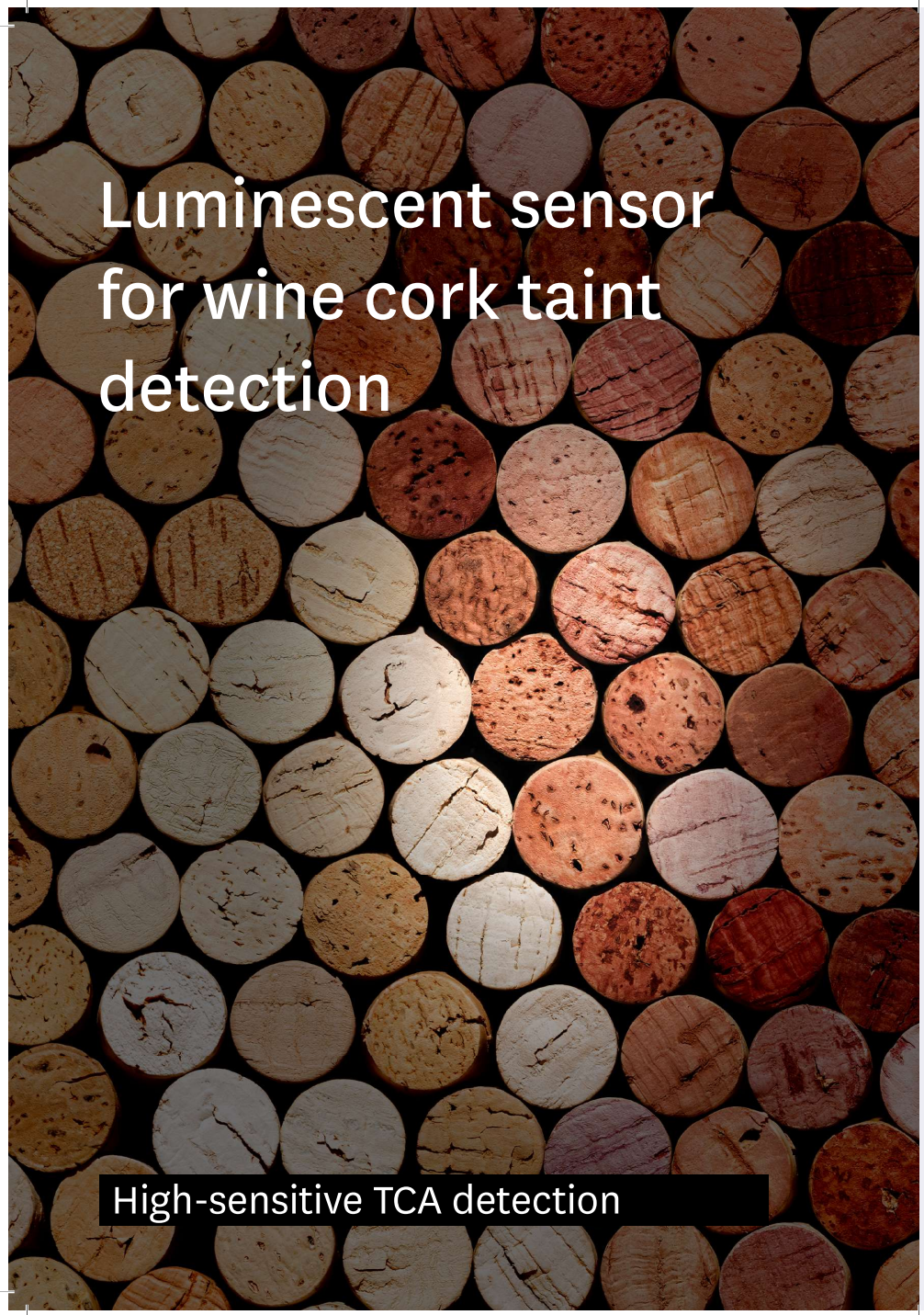

# Luminescent sensor for wine cork taint detection

High-sensitive TCA detection

WHAT IS THIS ABOUT?

One important challenge that the Europe wine sector faces is the alteration of wine aroma caused by the well-known 2,4,6 trichloroanisole (TCA) molecules which threatens its competitiveness. By using our luminescent sensor, producers of wines and corks as well as consumers would be able to detect TCA in a fast manner. This technology has higher sensitivity compared to traditionally instrumental gas chromatography techniques, which are expensive, time-consuming, and require skilled personnel.

WHAT'S THE INNOVATION?

We have developed functional active mesoporous coordination polymers based on anthracenes chromophores and transition metal ions as efficient luminescent sensors. Their physicochemical properties are tuned by modifying the surface area and the porosity to capture as much as possible TCA and other targeted molecules such as pesticides, explosives, and air pollutants.

WHAT ARE OUR PLANS?

We plan to implement industrial collaborations acting in different fields (Food, Environment, and Medtech) to better develop our luminescent sensor according to industrial needs. We also intend to submit Innosuisse projects for prototyping our smart sensor.

WHO ARE WE?

Prof. Katharina M. Fromm with her seniors and juniors' scientists have developed several inorganic coordination compounds with different applications in different fields. They have published multiples articles and reviews and presented their research at various international conferences.

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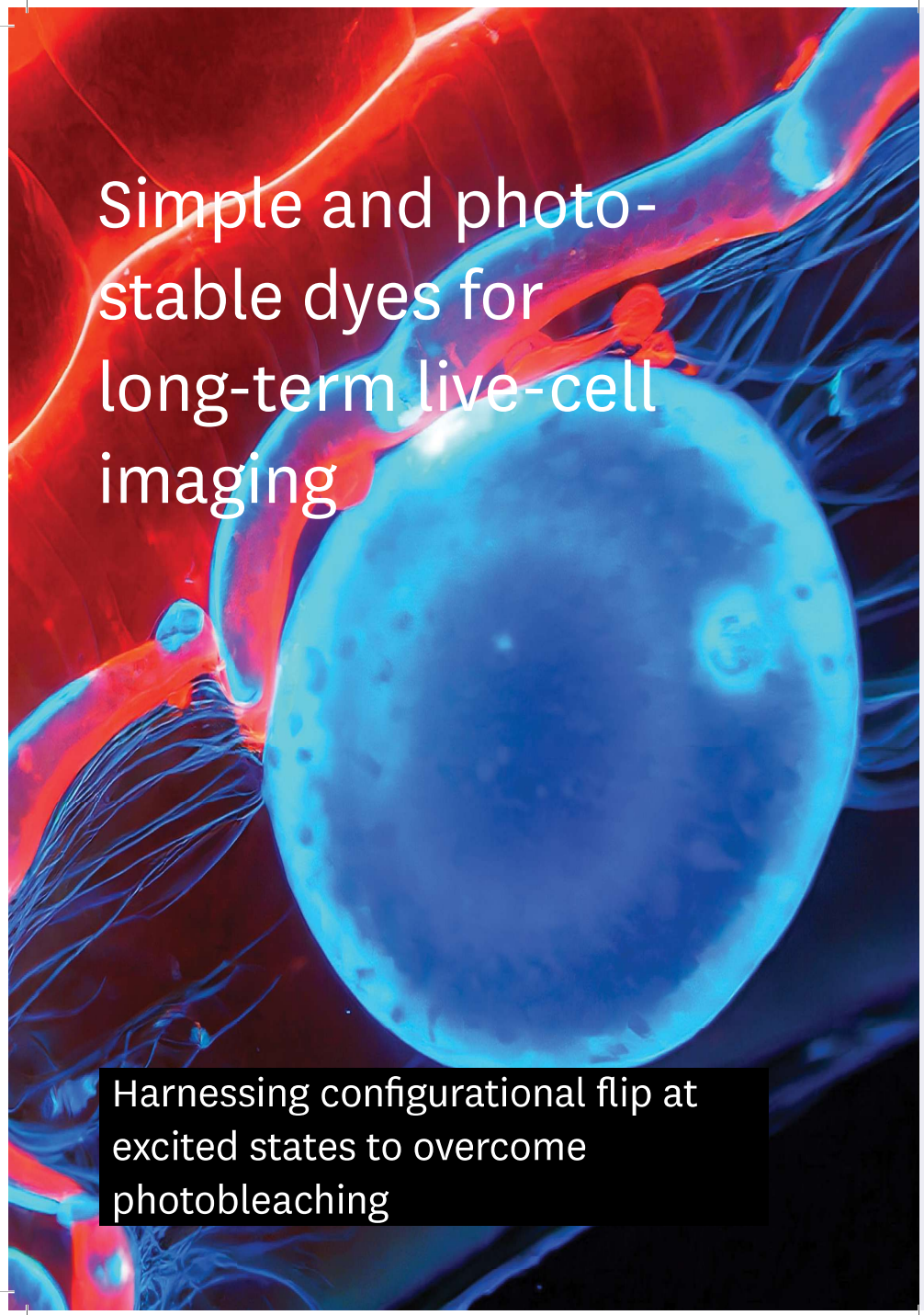

# Simple and photo-stable dyes for long-term live-cell imaging

## Harnessing configurational flip at excited states to overcome photobleaching

WHAT IS THIS ABOUT?

In the landscape of live-cell imaging, the demand for dyes that are both nontoxic and highly stable, especially in the blue and red spectrum, remains a significant hurdle. Many current fluorophores suffer from rapid bleaching and chemical degradation during laser irradiation, limiting their utility for long-term imaging and long recording periods. Additionally, the intricate task of staining different cell components with varied dyes, each absorbing at unique wavelengths, remains a challenge, compounded by the fact that their preparation usually involves laborious and expensive synthesis protocols. Our groundbreaking technology addresses these issues by introducing nontoxic and highly photostable blue- and red-emitting small dye molecules with a simple and cost-effective synthesis process.

WHAT'S THE INNOVATION?

We have successfully synthesized a family of simple, non-toxic blue and red-emitting pyrenyl-based dye compounds, characterized by excellent cell uptake, intense emission, and remarkable photo-stability. These compounds demonstrate negligible photobleaching over extended time scales of light irradiation, establishing them as excellent candidates for cytosol staining in live cells and long-term bio-maging.

WHAT ARE OUR PLANS?

We are completing our dyes offer with the aim to develop a «rainbow» kit for fluorescent microscopy. We are keen to bring our invention to the market via licensing opportunities and collaboration with the industry.

WHO ARE WE?

Prof. Katharina M. Fromm and her senior and junior scientists have developed several inorganic coordination compounds with different applications in different fields. They have published multiple articles and reviews, and presented their research at various international conferences. Dr. Serhii Vasylevskyi earned his PhD at the University of Fribourg in Fromm 's group with a research focus in the development of luminescent supramolecular assemblies from polyaromatic ligands.


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# Interactive decision-support tool to choose the best waste collection strategy

## Towards more efficient and sustainable waste collection strategies

WHAT IS THIS ABOUT?

In many Swiss municipalities, a door-to-door collection is often used to gather the non-recoverable waste. This comes with negative effects such as high fuel consumption, emissions and noise. We aim at making the non-recoverable waste collection process more efficient and more sustainable with the development of an interactive decision-support tool that helps municipalities to choose the strategy that best suits their needs.

WHAT'S THE INNOVATION?

To define a new collection strategy, we design and implement algorithms to optimize the related decisions, such as the location of collection points and the routes performed by the collection vehicles. The interactive tool enables municipalities to specify their characteristics (such as the street network and the expected generated waste). Then, it displays several efficiency, sustainability and cost indicators of the various strategies to assist the municipality in choosing one.

WHAT ARE OUR PLANS?

We have initiated a prototype of the interactive decision-support tool that accommodates the waste collection strategies and the algorithms that allow to characterize them. This has enabled us to gain valuable experience in the conception and development of a decision-support tool from scratch. Our idea is now to apply this knowledge to other transportation and logistical contexts. Proven in various Swiss cities and municipalities, this tool has resulted in considerable savings, and can also be used in other applications, such as simplifying or standardizing route planning and sizing new waste disposal systems.

WHO ARE WE?

This project is funded by Innosuisse and involves three parties. From the University of Fribourg, the Decision Support & Operations Research Group (DS&OR) handles the implementation of the interactive tool and its backend optimization algorithms, and the International Institute of Management in Technology (iimt) deals with the communication aspects of the tool from an innovation point of view. Schwendimann AG, the implementation partner, is responsible for the development of the innovative collection concepts and practical tests.


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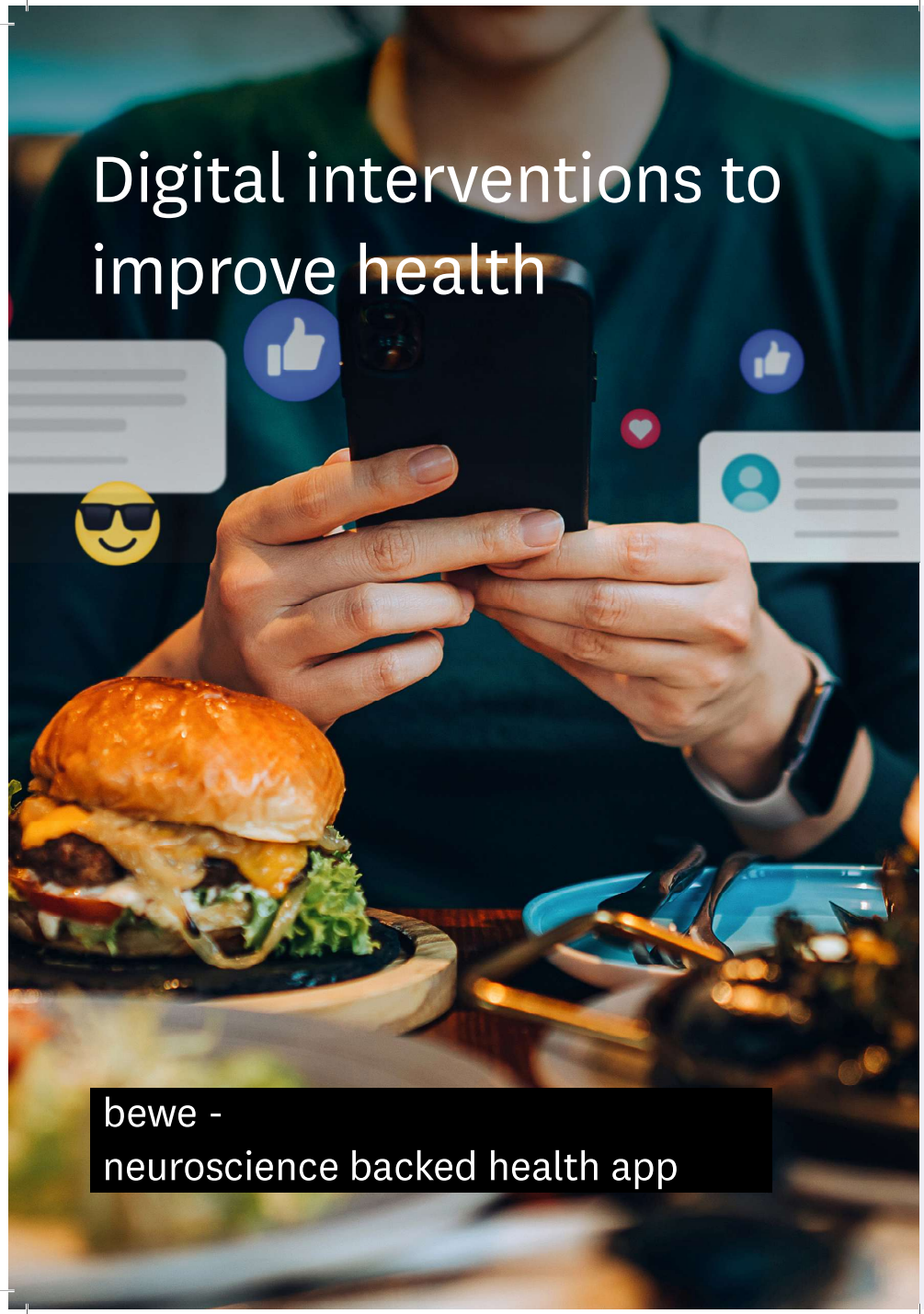


WHAT IS THIS ABOUT?

We propose digital interventions to improve health by restoring healthy eating behaviors. We design professional-level videogames that incorporate new, patented, brain training mechanisms allowing one to reduce their craving to targeted unhealthy foods, and in turn their consumption.

WHAT'S THE INNOVATION?

In contrast to conventional effortful dieting approaches based on maintaining self-control, our interventions improve eating habits without the person even realizing it. In our digital interventions, practicing the games implementing our mechanism of action automatically induce targeted brain and behavioral changes.

WHAT ARE OUR PLANS?

We are currently working on the prevention and treatment of excessive sugar, fat and salt intake, and developping new verticals to tackle alcohol, tobacco and cannabis overconsumption. We are offering our technology to insurance companies, pharmaceutical firms and research institutions. We are constantly working to improve our solutions, whether through research projects or product development.

WHO ARE WE?

We are an interdisciplinary team with expertise in neuroscience, psychology, programming arts and business. Originating from the Medicine Section of the University of Fribourg, our core value is to improve populations health at a large scale, with evidence-based digital therapeutics interventions. We are committed to providing high-quality, Swiss-made software and services. We are supported by Fri Up since 2021 as well as by Innosuisse, Promotion Economique Fribourg, Biopole, and other accelerators.

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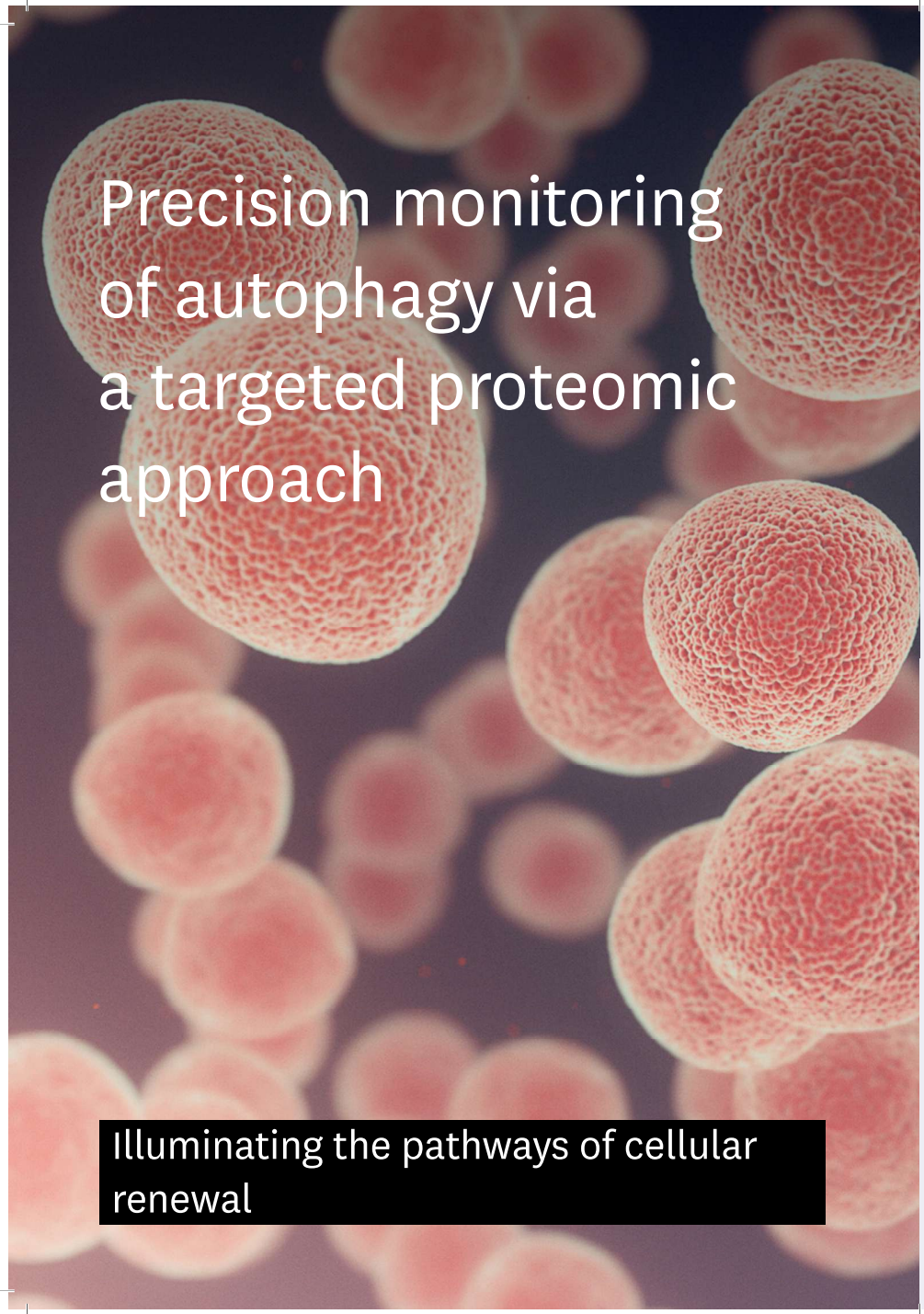
DEPARTMENT: Section of Medicine



# Precision monitoring of autophagy via a targeted proteomic approach

Illuminating the pathways of cellular renewal

WHAT IS THIS ABOUT?

Understanding the process called autophagy, the biological removal of superfluous components, has become increasingly important due to its direct implications in diseases, such as Alzheimer's and cancer. To address the complexity of autophagy regulation and activity in an unbiased manner, we have developed a targeted proteomic approach amenable to high throughput. This new technology will allow shedding light on this essential pathway, offering invaluable insights for developing targeted therapies and advancing human health.

WHAT'S THE INNOVATION?

Our invention introduces a cutting-edge approach employing mass spectrometry-based targeted proteomics. By using synthetic peptides as benchmarks, our method enables precise and absolute quantification of specific proteins known to be involved in diverse autophagy pathways. This technology provides researchers and pharmaceuticals companies with accuracy in monitoring autophagy activity and selectivity. By unlocking the intricacies of this process, our innovation lays the foundation for significant advancements in the field of autophagy research and drug development.

WHAT ARE OUR PLANS?

The assay will be benchmarked, standardized, and licensed to interested analytical or pharmaceutical companies which plan to target or monitor autophagy in (pre)clinical settings. This invention will be used by these companies to effectively understand the impact of new type of drugs that target autophagy in several diseases. We hope that the licensing will help in reaching the market faster, improving the invention and help in implementing it.

WHO ARE WE?

The project was established by Alexandre Leytens and Dr. Michael Stumpe in the group of Prof. Jörn Dengjel at the Department of Biology, University of Fribourg. For 20 years we have been working on autophagy and its role for human health. The discovery of selective autophagy pathways opened the opportunity to specifically target autophagy subtypes in diverse disease settings. Employing our extensive mass spectrometry expertise, we developed this assay in the last five years and are actively using it in academic research.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# Reclaiming antibiotics: A smart twist on an old treatment

From copper to cure: Repurposing trientine to fight harmful bacteria

WHAT IS THIS ABOUT?

Antimicrobial resistance (AMR) is a growing global threat, making life-saving antibiotics less effective. Resistant infections lead to longer hospital stays and higher death rates. A key concern is resistance to carbapenems, a powerful type of antibiotics. This is especially true for Gram-negative bacteria like E. coli, which produce enzymes called carbapenemases. A particularly dangerous type of these enzymes is called metallo-beta-lactamase (MBL).

WHAT'S THE INNOVATION?

We have discovered something exciting: trientine tetrahydrochloride, a drug for Wilson's disease, can also bind to zinc in MBL enzymes. This blocks their activity making antibiotics effective again. It's a repurposing strategy, using an old drug in a new way, to fight antimicrobial resistance. The approach is fresh and promising for developing treatments that target resistance mechanisms in bacteria.

WHAT ARE OUR PLANS?

We plan to (i) test how well trientine tetrahydrochloride and related compounds can block MBLs of Enterobacterales, Pseudomonas aeruginosa, and Acinetobacter baumannii, the main bacteria expected to cause AMR issues over the next 20 years; (ii) study the molecular mechanisms how these compounds work in stopping the enzymes, (iii) evaluate their effectiveness in living organisms using an infection worm model (Galleria mellonella); and (iv) develop a diagnostic test to identify infections responding to the inhibitors. Collaborations with biotech and pharma are underway, and a patent has been submitted.

WHO ARE WE?

Patrice Nordmann, Professor of Microbiology at the University of Fribourg, supports the project. He is the founder and Director of the Medical and Microbiology Laboratory and the Swiss National Reference Center for Emerging Antibiotic Resistance. With over 900 publications (ranked 1st and 5th in Microbiology in Switzerland and in the world, respectively), his research spans over genetics, biochemistry, and clinical applications such as development ofdiagnostic tests and screening media for identification of multidrug resistance, backed by ten patents and eight industrial products.

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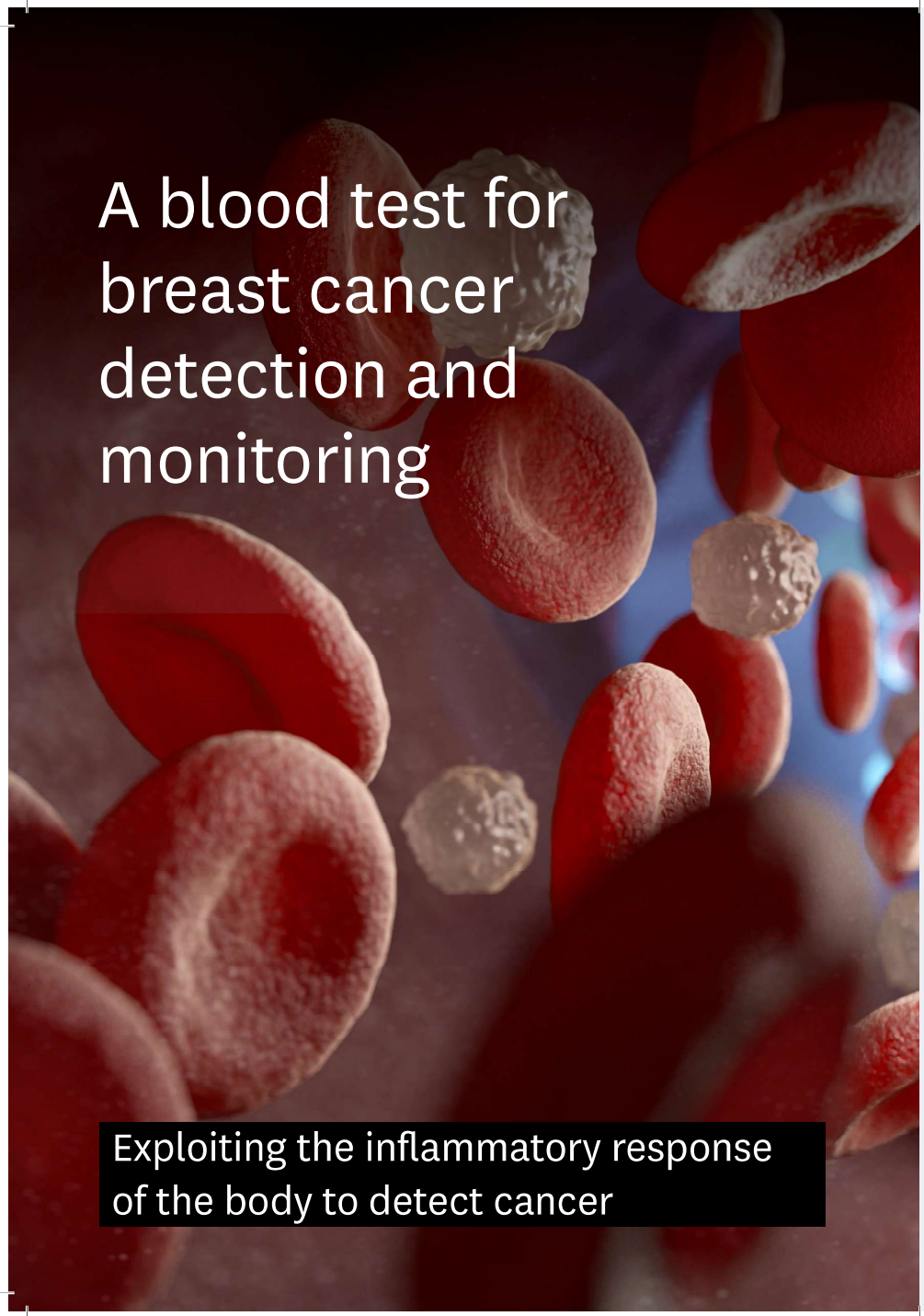

# A blood test for breast cancer detection and monitoring

## Exploiting the inflammatory response of the body to detect cancer

WHAT IS THIS ABOUT?

Breast cancer is the most frequent cancer in women worldwide. Mammography screening has significantly contributed to decreasing breast cancer mortality; however, it has some limitations including limited sensitivity and specificity, partial accessibility and it is not recommended for young women (<50 years). There is an unfulfilled need for better and more convenient breast cancer detection tests. To fill the need, we propose a first-in-class blood test for the early detection of breast cancer and active monitoring after treatment.

WHAT'S THE INNOVATION?

Our test exploits a patient's systemic immune response to the tumor and is fundamentally different compared to other blood-based tests in development. The test uses robust technology to monitor changes in white blood cells (leukocytes) induced by the tumor. This approach is more sensitive compared to mammography.

WHAT ARE OUR PLANS?

At the University of Fribourg (Unifr), we have conducted a clinical biomarker discovery and validation study in collaboration with CHUV, HFR, HNe, and other centers. A combination of cancer-associated biomarkers has been identified and protected. Next, we will produce a test kit to use in a large screening validation study performed by Xemperia, a spin-off company of Unifr incorporated in December 2023 in Fribourg. In parallel, we are developing DNA-based nanosensors for ultrasensitive biomarker detection to monitor patients after therapy to detect relapses as early as possible.

WHO ARE WE?

Project team members are Curzio Rüegg, MD with 25+ years of experience in cancer research and biomarker discovery; Sarah Cattin, PhD in Medical Science with 10+ years of experience in cellular and molecular analytics; Ivana Domljanovic, PhD in Medical and Material Sciences with 5+ years of experience in diagnostics DNA nanotechnology; Thibaud Spinetti, PhD in Immunology, with 8+ years of experience in clinical studies and regulatory affairs; Tuto Rossi, a Doctor of Law with 15+ years of experience in start-up creation and support. Scientific and strategic advisors are helping with the project.

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