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#1/2026

Imaging

High-precision insights into bones, the brain and cell nuclei

Therapy

Taking the fear out of cancer

The magazine of the Paul Scherrer Institute PSI

Research for healthy ageing

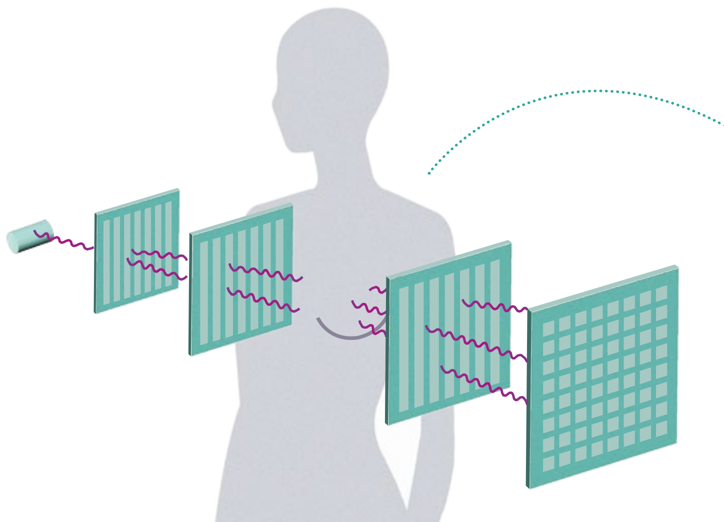
Dementia, cancer, osteoporosis – certain diseases become more prevalent in old age. PSI researchers are investigating the nanostructures of our brain and bones and developing ground-breaking cancer therapies.

PSI

Key topic

Healthy ageing

Switzerland ranks among the top countries for life expectancy: women currently live to 86 and men to 82. In the future, we will live even longer – and we will want to spend the extra years in the best possible health. PSI researchers are making valuable contributions to fighting diseases that are increasingly prevalent in an ageing society.



Background

Taking the fear out of cancer

The probability of being diagnosed with cancer increases significantly with age. Researchers at PSI are improving proton therapy, developing ground-breaking radiopharmaceuticals and a novel breast cancer imaging technique, and analysing what happens at the atomic level during chemotherapy.

Page 8

Interview

Modern science is helping medicine

Philipp Schütz is head of the University Medical Clinic at the Aarau Cantonal Hospital and vice president of an association that promotes the transfer of knowledge between medical research and practice.

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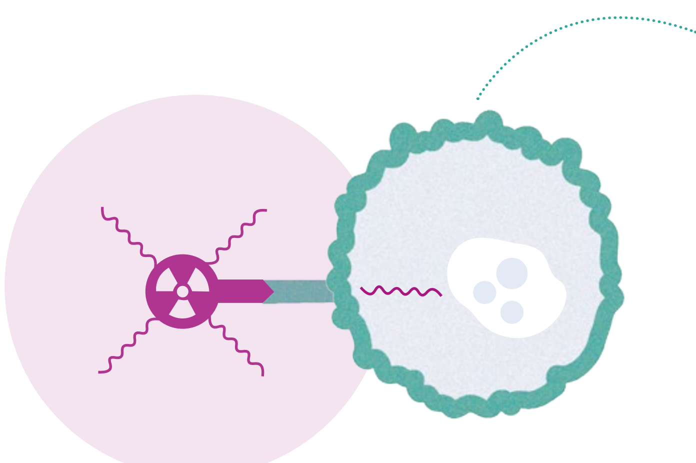

Infographic

Radiopharmacy – from fundamental research to cancer drugs

Radiopharmaceuticals allow some types of cancer to be targeted with tailor-made therapies. The current state of the art was preceded by decades of intensive research – and the future promises even better treatment options.

Page 12

Background

High-precision insights into bones, the brain and cell nuclei

Our bones not only become less dense with age, but also change their structure on the nano-scale. Our brains often perform less efficiently – and must contend with protein deposits. And the precise shape in which our DNA is packaged in cell nuclei can tell us something about age-related diseases.

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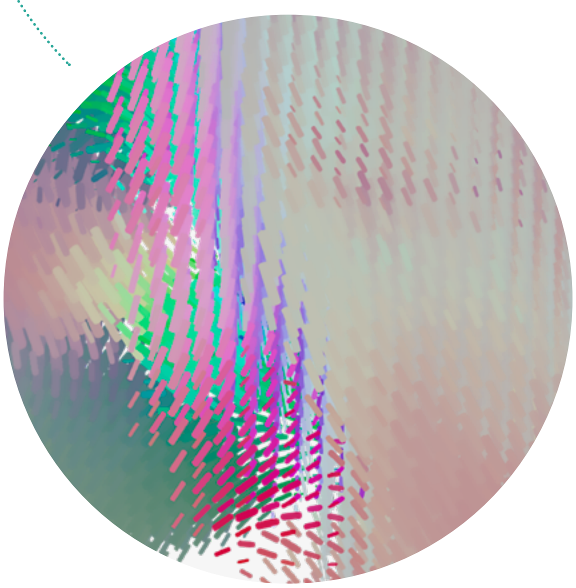


Contents

From molecules to people

You probably don't want to be reading this, but – you're ageing. And so am I, of course. Some people try to slow this process down as much as possible in pursuit of longevity. Others don't think much about tomorrow. And most of us probably take a middle path: exercise, healthy food and fulfilling friendships – but also the occasional large slice of chocolate cake. At the same time, we see older people around us falling ill – with osteoporosis, dementia or cancer. You may even be affected yourself.

We are indeed living longer than ever before – thanks in part to science. But no one can promise you that these diseases, which become more prevalent with age, will ever be completely eradicated. What cutting-edge research at PSI can do, however, is to help us understand them better – down to the level of cells and molecules. And in some cases, we are also investigating practical therapies and treatments: in the laboratories behind me, for example, researchers at the Center for Radiopharmaceutical Sciences are developing active ingredients that are particularly effective in fighting cancer cells. The text and infographic starting on page 8 will tell you more.

At PSI, we are also very proud of our large research facilities. We often describe them as giant microscopes, which are used by PSI researchers as well as visiting researchers from Switzerland and around the world. The Swiss Light Source SLS, which resumed operation last August after a comprehensive upgrade, gives us unique insights: from page 15, we explore the nanostructure of bones and the astonishing density of connections between brain cells. Every therapy developed is preceded by decades of in-depth fundamental research. At PSI, this research is often conducted in collaboration with industry and hospitals.

At the same time, we always keep in mind whom we want to serve: people. That's why our researchers have invited friends and relatives who are personally affected – or just particularly curious about our research – to visit PSI. The photos taken during these visits accompany the cover story of this issue.

Other people come to our campus for a somewhat different reason: to attend courses at the PSI Education Center. Did you know that it's open to all four research institutes in the ETH Domain and that many courses are even designed for professionals – for example, in the healthcare sector – from across Switzerland? Find out more, starting on page 22.

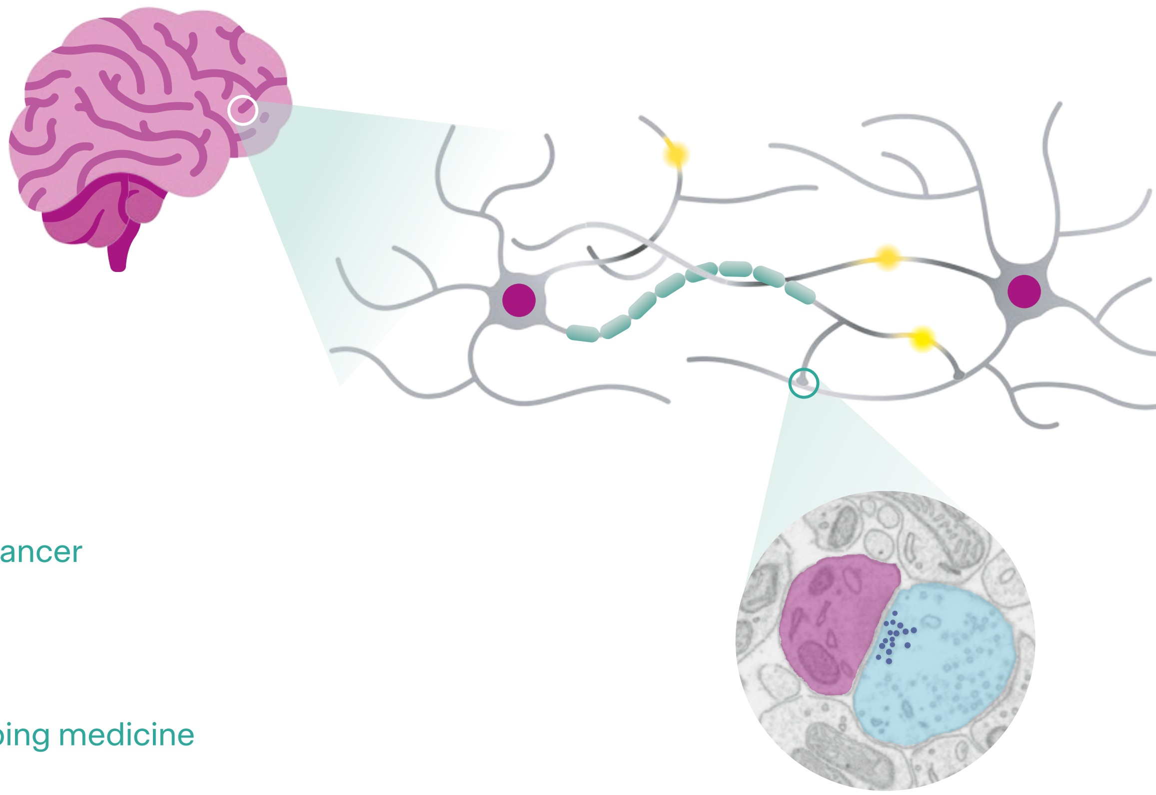
I hope you enjoy reading our magazine.
Sincerely yours, Christian Rüegg, PSI Director


PSI

Healthy ageing

Thanks to advances in science and medicine, not only is our life expectancy increasing, but so is the hope of remaining healthy for a long time. PSI researchers are working to understand better, detect earlier, and treat more effectively age-related diseases such as cancer, Alzheimer's and osteoporosis – for a better quality of life in old age.

Text: Jan Berndorff



Our brain contains an unimaginably dense network of brain cells interconnected via synapses. Using an electron microscope, PSI researcher Adrian Wanner achieves a resolution of four nanometres – one ten-thousandth of the diameter of a human hair. Thus, even the tiniest vesicles with neurotransmitters (false-coloured dark blue) become visible – in this case communicating information between two cell processes (light blue and pink) at a synapse.

When cells, molecules or nanostructures are studied at PSI, the overarching aim is always to help people. Four researchers have therefore invited friends or relatives to PSI. This series of photographs is a record of those encounters.

Enrico Capaci

Retired electrical engineer with Parkinson's disease. He lives near PSI, where neuroscientist Adrian Wanner works

"I used to go jogging in this forest almost every day, ten kilometres. I can't do that any more. But the fact that I did so much exercise in my life helps me a lot as I get older. Apart from the Parkinson's, I'm healthy, according to my family doctor. I was diagnosed ten years ago. The medication I take helps somewhat with the symptoms. I'm not in pain, which is good. I notice that my brain isn't the same as it used to be. Sometimes I want to take a step, but my body just won't move my leg forwards. The images Adrian captures of the structures in the brain are fascinating. We still know far too little about the brain. And so far there is no cure for my disease. Adrian's research is very important to help us understand all of this better."

Adrian Wanner (left) is a researcher at the PSI Center for Life Sciences. In the woods surrounding PSI, he met Enrico Capaci for a walk.

Taking the fear out of cancer

Researchers at PSI are developing new technologies and drugs to eliminate tumours more effectively: with greater precision and personalised approaches.

The human rib cage rises and falls approximately 15 times per minute as we breathe. The same goes for the patient resting on a couch in the Center for Proton Therapy at PSI. She is here to receive radiation therapy for her lung tumour, and the motion caused by breathing presents a challenge. PSI researchers have developed a new method to ensure that the tumour is nevertheless always targeted with pinpoint accuracy.

Proton therapy at PSI is unique in Switzerland and has a history spanning more than 40 years. It represents an important complement to traditional radiation therapy in hospitals: the accelerated protons can be directed with extreme precision. This offers better protection for healthy tissue. And that's precisely why every millimetre counts.

Custom-tailored proton therapy

The Swiss Cancer League estimates that there are currently around 450,000 cancer survivors in Switzerland. The patient at the Center for Proton Therapy hopes to join their number. To target her tumour optimally despite her breathing movements, the PSI researchers are using two methods. First, a narrow proton beam scans the tumour in all three dimensions – not just once but multiple times, each with a lower dose. This way, small changes in position during individual scans have less of an impact. Second, special cameras track the patient's breathing. Radiation is only administered during the brief period of rest after exhalation.

An ongoing project at the Center for Proton Therapy goes a step further and addresses tumours in all regions of the body. Proton therapy is administered in numerous individual sessions, typically spread over several weeks. During this time, the tumour can shift or change shape, or there can be alterations in the intervening tissue. To cope with this, medical physicist Francesca Albertini and her team have developed a new treatment plan, which they have already successfully applied to patients with tumours in the skull: Daily Adaptive Proton Therapy, or DAPT for short. Each day of treatment begins with a low-dose computed tomography (CT) scan, which is used to determine the optimal radiation dose (see also page 30). The significant gain in precision more than offsets the additional radiation dose from the CT scan, explains Albertini: "In many cases, the DAPT plan can reduce the dose to sensitive structures by about ten to fifteen percent compared with the previous method. This can make a big difference for the patient." The researchers have largely automated the process, so that each session only takes a few minutes longer overall. Next, they will test DAPT on tumours in other parts of the body, such as the abdomen.

Piggybacking to the tumour cells

Cutting-edge cancer treatment methods are also being investigated at the PSI Center for Radiopharmaceutical Sciences. Radiopharmaceuticals are used when cancer has already spread and formed metastases. While chemotherapy attacks all rapidly dividing cells in the body – including healthy ones – radiopharmaceuticals act more selectively and thus place less stress on the body.

A radiopharmaceutical consists of a radionuclide – an atom that emits ionising radiation – and a molecule that binds specifically to the tumour cells. Initially, a radionuclide is selected that emits gamma radiation, for diagnostic purposes. The actual treatment is then carried out using a closely related radionuclide that emits a suitable form of beta radiation. Unlike gamma radiation, this has a shorter range of only a few millimetres, but it is significantly more intense. This means that it specifically targets and destroys the tumour cells to which the radiopharmaceutical binds rather than the surrounding healthy tissue.

This principle has been established for several decades in the treatment of thyroid cancer, using radionuclides of the element iodine, which the thyroid gland naturally absorbs. "Unfortunately, not every organ affected by cancer has a natural affinity for a suitable element," says Roger Schibli, head of the Center for Radiopharmaceutical Sciences. For this reason, PSI researchers are developing molecules known as ligands, which bind specifically to the respective tumour cells. The researchers then attach the radionuclide to the ligand, which carries it piggyback-style to its target. A substance developed in Cristina Müller's research group, which utilises the radionuclide terbium-161, uses this approach to destroy even micrometastases, down to individual tumour cells, with remarkable effectiveness.

PSI is planning to build a new facility to ensure that significantly larger quantities of a wide variety of radionuclides are available in the future. Construction of TATTOOS (Targeted Alpha Tumour Therapy and

Rahman Bajrami

Has metastatic prostate cancer. A patient in the PROGNOSTICS study, which is led in part by PSI researcher Roger Schibli

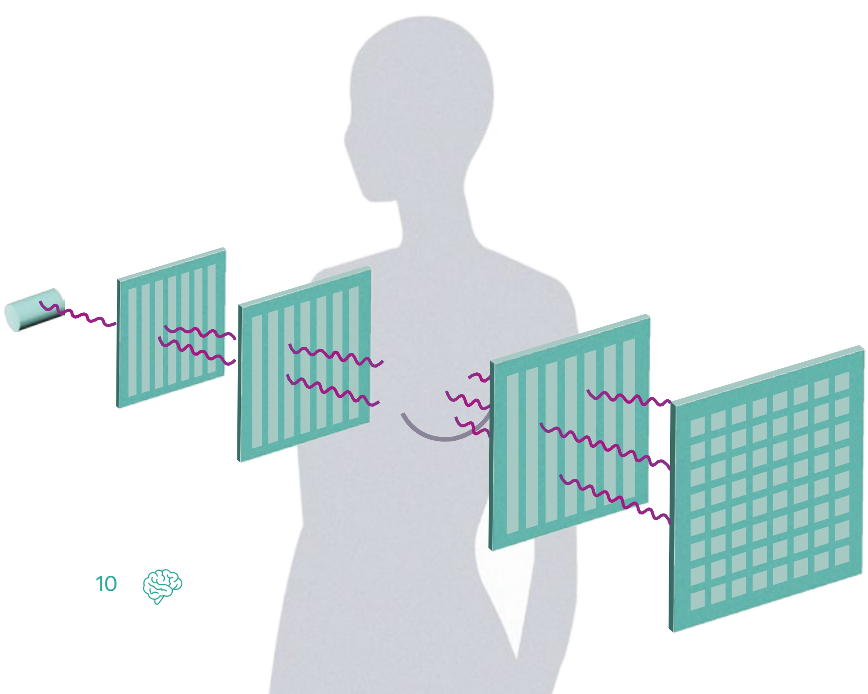
"I'm convinced that positive thinking helps the body and the immune system. So it's better not to think about the illness all the time. I was diagnosed with prostate cancer in 2006. I had surgery and radiation therapy. A few years later, the cancer returned – with metastases. I was weak. I had back pain and couldn't get up without help. At Basel University Hospital, I received a radiopharmaceutical: lutetium-177. And then they asked if I would participate in the PROGNOSTICS study using terbium-161, and I agreed. Terbium-161 will help so many people, and I want to contribute – I think that's very important. I can now get up without pain and walk a few kilometres. My appetite is back. I go to the stadium to watch football. I'm back to living a completely normal life."

Roger Schibli (left) is head of the PSI Center for Radiopharmaceutical Sciences. He met Rahman Bajrami during the PROGNOSTICS radiopharmaceutical study (see also page 13). They had a joyful reunion in the PSI cafeteria.

Other Oncological Solutions; see also the infographic on pages 12–13) will begin in 2029. This is part of the major PSI upgrade project IMPACT (Isotope and Muon Production with Advanced Cyclotron and Target Technologies). "TATTOOS will open up entirely new possibilities," says Cristina Müller. "In the future, we will investigate many more radionuclides for the treatment of various types of cancer, enabling more effective therapies while simultaneously protecting healthy organs." This will benefit older people in particular, as well as those who have already received prior treatment, since their bodies are often less able to tolerate demanding therapies.

The long-term goal of radiopharmacy is personalised treatment, with a suitable radiopharmaceutical for each type of cancer, every stage of the disease and the individual condition of the patient. TATTOOS will enable researchers to take a major step in that direction.

Grating interferometry could improve the detection of breast cancer. In this technique, X-rays pass through two optical gratings, then through the breast tissue and finally through a third grating before striking a sensor, revealing additional information.



More precise mammography

But the best approach is to detect cancer early on. Marco Stampanoni and his team at the PSI Center for Photon Science are working on the early detection of breast cancer. Around 6,800 women in Switzerland are diagnosed with this disease every year. The mammography technique commonly used today measures the absorption of X-rays by tissue. Tissue nodules and calcifications, which can be precancerous, appear as bright spots. The images are not perfect, however: nearly half of all suspected cases turn out to be false alarms during the subsequent biopsy. Conversely, one in five real tumours goes undetected.

Stampanoni's research group uses a technique called grating interferometry. It is based on information obtained not only from the absorption but also from the refraction and scattering of radiation by the tissue. This leads to significantly sharper images with higher contrast. "Small objects, in particular, can be measured precisely – even in soft tissues that would otherwise remain invisible," says Stampanoni. "It may even be possible to tell from the scattering pattern whether a change is benign or malignant."

In the long term, the method should enable precise three-dimensional examinations without the need for painful breast compression. And grating interferometry could also be helpful in other types of cancer, such as lung cancer, because the alveoli affected scatter X-rays differently than in a healthy person.

The molecules of chemotherapy

Last but not least, PSI researchers are also working on improving conventional chemotherapy. A team led by Michel Steinmetz, interim head of the PSI Center for Life Sciences, has examined proteins known as tubulins with atomic precision using imaging techniques such as X-ray crystallography at PSI's Swiss Light Source SLS. Tubulins are the cellular molecules to which most cancer drugs bind.

Among other things, the researchers succeeded in identifying numerous new so called binding pockets and precisely characterising others that were previously known. The active substances nestle into these tubulin pockets. The more precisely they fit, the longer they adhere and the more effective they are. "And the more precisely we know the structure of the binding pockets, the more accurately we can design new drugs that bind optimally," says Steinmetz.

A research group led by Jörg Standfuss, who works with Steinmetz at the PSI Center for Life Sciences, has also used the X-ray free-electron laser SwissFEL at PSI to measure to within 100 femtoseconds – that's one tenth of a trillionth of a second –

how the drug and binding pocket deform when they separate. This is particularly helpful for improving novel photoactive drugs. These are medications that can be switched on and off by a pulse of light – giving them the potential to make chemotherapy significantly gentler.

From Francesca Albertini to Jörg Standfuss – they are all united by the patience and passion with which they have developed and refined their methods over many years. Together, they share the goal of taking the fear out of cancer. ●

Modern science is helping medicine

In 2024, the Aarau Cantonal Hospital, the Baden Cantonal Hospital and the Hirslanden Clinic Aarau, together with ETH Zurich, Empa and PSI, founded the Association for Medical Research and Innovation in the Canton of Aargau. Vice President Philipp Schütz from the Aarau Cantonal Hospital talks about their joint projects, which also contribute to research on healthy ageing.

Professor Schütz, why is this association necessary? Would there be no successful exchange between hospitals and research institutions without it?

Philipp Schütz: Collaborations have existed before, of course. But unlike hospitals in Bern, Basel and Zurich, for example, those in Aargau lack their own university, where close exchange is practically a given. The association connects us more closely with the region's research institutes, such as PSI. The idea is to build a bridge "from bench to bedside", meaning from the lab bench to the patient's bedside. Working together, we can develop new methods far more effectively.

The association has established the ForME programme. What is that about?

The programme primarily gives young doctors time to conduct research. They apply for a project they would like to carry out together with a team, for example, from the Paul Scherrer Institute PSI, and are given one day per week off from their hospital duties. This time off is funded from project resources.

How does this lead to greater knowledge transfer?

The doctors gain practical experience with what modern science has to offer for solving medical problems. Conversely, researchers learn about the clinical needs they should be addressing. Together, they arrive at solutions more quickly. Often, new ideas arise in conversation – over coffee, for instance – even ideas beyond the project that weren't previously considered because the other perspective was missing.

The second round of ForME projects is already under way. Can you tell us about one of the previous collaborations?

One example is the project of my colleague Tician Schnitzler, a radiologist at the Aarau Cantonal Hospital. Together with PSI experts, he is developing an AI-based method for interpreting lung X-rays. Artificial intelligence holds enormous potential for diagnostics, which unfortunately has barely been tapped in practice so far. Specifically, this project is about the early diagnosis of bronchiectasis – abnormal dilation of the bronchi, which causes chronic suppuration and pneumonia. It occurs primarily in older people with pre-existing lung conditions. The project aims to train the AI tool with documented case histories so that it can recognise, from an X-ray image, when something is amiss – much earlier than we doctors can.

Which research areas at PSI are particularly relevant from a medical perspective?

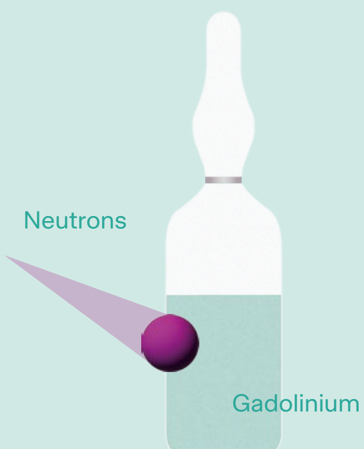
PSI is not only very strong in developing new diagnostic methods, but also in therapy. The Center for Proton Therapy, for example, enables very precise cancer treatments. PSI's nuclear medicine and radiopharmacy departments are also world-class. This expertise is being drawn on in another ForME project by my colleague Sabin-George Pop from the Baden Cantonal Hospital. Together with PSI experts, he is developing AI tools to optimise radioligand therapy for prostate cancer, which primarily affects older men.

Have you also done a lot of research yourself?

Yes, my focus is on personalised nutritional therapy. As people age, many suffer from multiple conditions, loss of appetite and weight loss. My team and I are investigating how this can be counteracted through individualised nutritional therapy – from protein-rich foods and oral nutritional drinks with specific amino acids to intravenous administration of nutrients when necessary. Nutrition can effectively slow physical decline in old age. We are doing research into the pathophysiological causes of malnutrition and searching for biomarkers for its early detection – a field that still holds considerable potential. ●

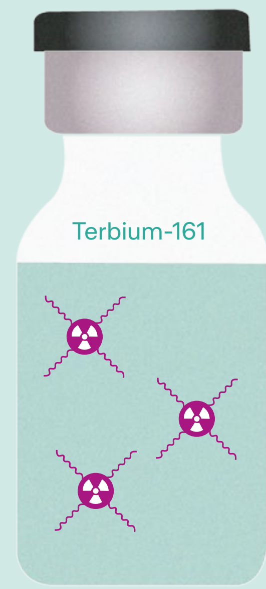
Radiopharmacy – from fundamental research to cancer drugs

Modern radiopharmacy is based on more than a century of scientific knowledge and continuous research. Radiopharmaceuticals – custom-tailored compounds consisting of a radionuclide and a molecule that binds to cancer cells – now allow an increasing number of cancers to be targeted with precision. With TATTOOS, PSI will in the future be able to produce many more radionuclides and in significantly larger quantities: for the development of state-of-the-art, individualised cancer therapies.



Terbium-161 as an active agent: a question of time

In radiopharmacy, it's essential to work efficiently and rapidly. Terbium-161, for example, loses half its activity within a week due to radioactive decay. The researchers must factor this in precisely.



Day 1

A glass ampoule containing the precursor material gadolinium-160 has been irradiated with neutrons over the past six days, producing terbium-161 in the process. PSI collaborates with partners worldwide for this purpose. The ampoule is then prepared for transport to PSI.

Day 2

A delivery service brings the ampoule to the PSI Center for Radiopharmaceutical Sciences in a lead-shielded package. Here, the terbium-161 is chemically purified, meaning that other substances produced during irradiation are removed.

Day 3

The PSI experts further process the now-pure terbium-161 to qualify it for use in humans.

Day 6, morning

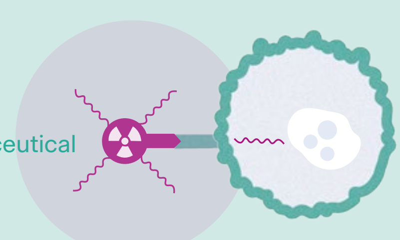
The radionuclide is coupled to the appropriate ligand in the laboratory's cleanroom – the result is a sterile injection solution.

Day 6, afternoon

Quality control and release of the radiopharmaceutical.

Day 7

Transport to the hospital and immediate administration. A medical professional administers the drug as an infusion directly into the bloodstream of the cancer patient.



1896
Henri Becquerel and Marie Curie independently discover radioactivity, laying the foundation for radiopharmacy.

1946
First success in radiopharmacy: radioiodine (I-131) is successfully used to treat metastatic thyroid cancer.

1960
The Swiss Federal Institute for Reactor Research, a predecessor of PSI, begins producing medical radionuclides.

2000
The Center for Radiopharmaceutical Sciences is founded at PSI in collaboration with ETH Zurich. Researchers in radiochemistry, radiopharmacy, biochemistry and pharmacology jointly drive forward the development of new radiopharmaceuticals.

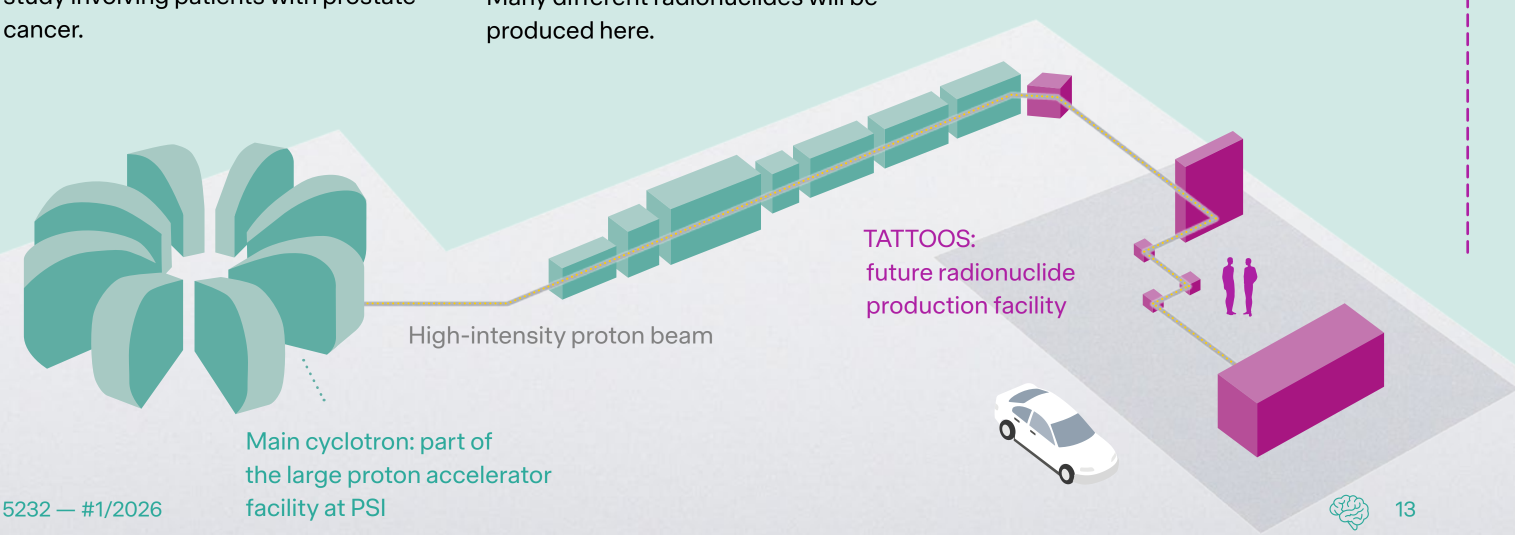
2000s
Theranostics is introduced into radiopharmacy. Radioisotopes of the same chemical element are used, combining diagnosis and therapy optimally. This not only allows the tumours to be located during diagnosis but also enables the therapeutic dose to be planned.

2018
PSI licenses a radiopharmaceutical developed in-house to the Swiss pharmaceutical company Debiopharm. The drug Debio1124 consists of the nuclide lutetium-177 and a matching ligand and is used in the treatment of medullary thyroid carcinoma.

2024
PSI researchers develop radiopharmaceuticals based on terbium-161 that are successfully used in two theranostics studies at the University Hospital of Basel. One of these is the PROGNOSTICS study involving patients with prostate cancer.

2029–2032
Construction and commissioning of TATTOOS at PSI – the future radionuclide production facility is a joint project of PSI, the University of Zurich and the University Hospital of Zurich. Many different radionuclides will be produced here.

2040s
The new radionuclides produced with TATTOOS could benefit many cancer patients.



Barbara Wiget-Liebi

Physiotherapist. Older sister of PSI researcher Marianne Liebi

"Staying active – in my view, that's absolutely crucial for healthy ageing. Perhaps with a pair of dumbbells like these. Unlike medication, injections or surgery, exercise is free and quite easy to do. And it's better to do it preventively, not just when you have a problem. We know that sport and exercise improve bone quality. In Marianne's research, this could no doubt be seen directly in the nanostructure. Maybe one day she'll be able to compare bone samples from physically active and inactive people. Showing this to people would definitely motivate them."

Marianne Liebi (right) is a researcher at the PSI Center for Photon Science. Barbara Wiget-Liebi is showing her some good exercises for keeping fit in PSI's gym. Their perspectives on bone health complement each other perfectly.

High-precision insights into bones, the brain and cell nuclei

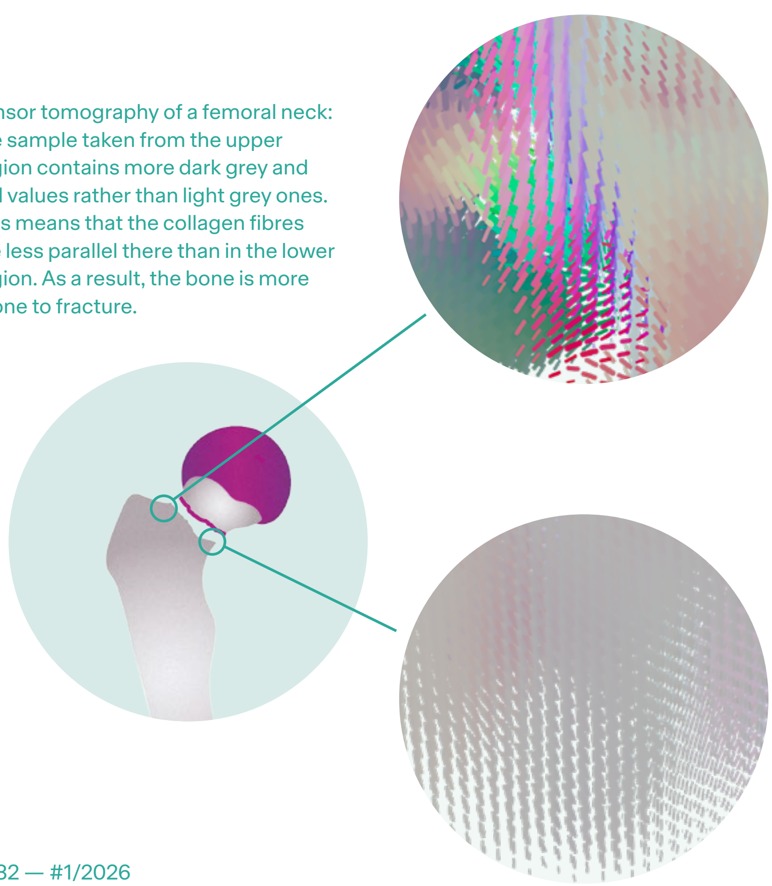
Some cells and structures in our bodies undergo particularly marked changes with advancing age: bone fractures become more frequent, and the brain usually doesn't perform as well as it used to. Fundamental research at PSI provides insights at the nanoscale, yielding information that could help improve quality of life.

Why do older people's bones break so easily? Bone density is typically measured using a special X-ray scan to assess the risk of a fracture. "But that alone is a relatively poor indicator," says Marianne Liebi, a researcher at the PSI Center for Photon Science. Bones don't just become more porous with age. Other factors also play a role. And a method that Liebi's team has refined for this purpose can now measure these changes in small individual samples. This fundamental research is giving the scientists insights into the structure of bones and how it changes with age. Their findings are helping to design better implants that stabilise bones optimally.

Liebi's research group uses the special X-ray light from the Swiss Light Source SLS, one of the five large research facilities at PSI. For more than ten years, she and her colleagues have been perfecting a method called small-angle X-ray scattering tensor tomography, or SAXS-TT for short. This allows the researchers to obtain high-resolution 3D images and, in particular, it reveals a factor that has a major influence on bone stability: the orientation of the collagen fibres that make up the bone material. "The fibres are a thousand times finer than a human hair and form an organic matrix, so to speak," says Liebi. "In the femural neck, they are aligned more or less parallel to each other, to cushion the forces acting upon them. In some other areas of the bone, however, they criss-cross one another like the wood fibres in chipboard for maximum static stability."

While SAXS-TT doesn't resolve these nanostructures individually, it provides information on their shape and orientation across different regions by analysing X-ray scattering. "This allows us to see the quality of the bones and how well they are fusing with a bone substitute," says Liebi. In a project with the University of Bern, her team is investigating the circumstances associated with femoral neck fractures – a common problem among older people. Bone density is known to decrease with age, particularly on the upper side of the femoral neck. Now, the measurements taken by Liebi's team show for the first time that the collagen fibres on this fracture-prone side are less ordered and that the bone platelets are a different shape. These tiny lamellae of calcium phosphate sit between the collagen fibres and stabilise them.

"Our method also allows us to examine the orientation of the smallest structures in other parts of the body," says Liebi. For example, PSI researchers have mapped the orientation of dentinal tubules in human teeth. "We have also used SAXS-TT to examine the myelin sheath that surrounds the nerve fibres of brain cells," Liebi reports.



Tensor tomography of a femoral neck: the sample taken from the upper region contains more dark grey and red values rather than light grey ones. This means that the collagen fibres are less parallel there than in the lower region. As a result, the bone is more prone to fracture.

A circuit diagram of the brain

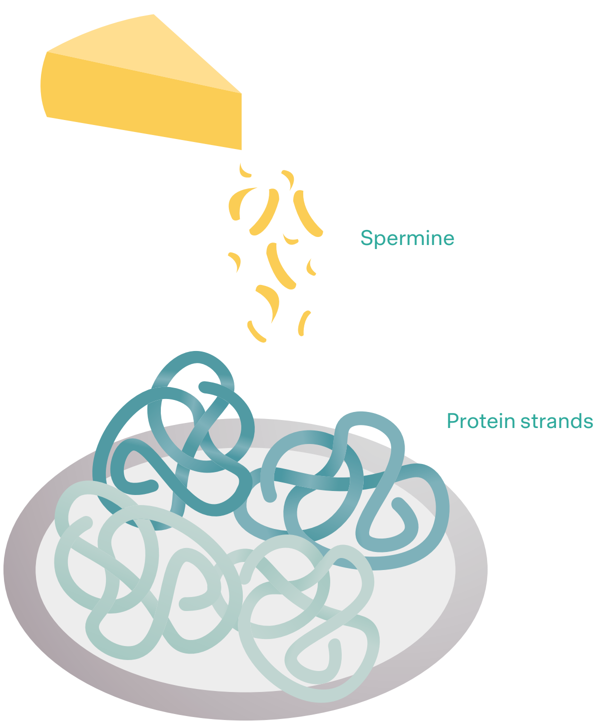
When carrying out high-precision measurements of the brain, Liebi's team sometimes collaborates with the group of PSI neurobiologist Adrian Wanner, who works at the PSI Center for Life Sciences. His aim is to decipher how the countless brain cells, known as neurons, are interconnected and how memories are retrieved. The ultimate goal is to create a detailed circuit diagram of the brain, not least to help pinpoint the exact causes of neurodegenerative diseases such as Alzheimer's and Parkinson's.

"A single cubic millimetre of brain contains 100,000 neurons," says Wanner. Each of these brain cells has thousands of connections with other neurons, meaning that this cubic millimetre contains several hundred million synapses and approximately four kilometres of nerve pathways. Wanner's hypothesis is that, in order to understand the processes within this dense tangle, the synaptic connections and the organisation of neurons must be captured at high resolution within a large-scale context – ideally, the entire brain.

The team is tackling this challenge from two angles. On the one hand, the researchers are examining dead brain tissue using an electron microscope – where they achieve a resolution of four nanometres in the tissue sections – as well as SAXS at the SLS. This allows them to obtain ultrahigh-resolution 3D images of the brain's neural connections. On the other hand, they are observing live mice trained to navigate a virtual maze. Using a technique called calcium imaging, the researchers track which individual brain cells are activated when the mouse remembers the correct path. When the cells fire, the flow of calcium ions stimulates certain proteins to fluoresce. "So, as the mouse scurries through the corridors, its brain lights up here and there like a Christmas tree," says Wanner.

This activity varies slightly from mouse to mouse, of course. Nevertheless, certain neural pathways for specific tasks can be identified and thus applied to the human brain. "And that's what we're aiming for," says Wanner. "We want to derive the principles by which a healthy brain operates – in humans as well as in mice."

Wanner's team then repeats the experiments with genetically modified mice that have developed Alzheimer's disease at various stages. The researchers then compare the patterns: what prevents the brain from retrieving memories? And to what extent is this related to the "plaques", the deposits of harmful proteins in the brain to which Alzheimer's is generally attributed? It might be possible to find an explanation as to why some people with Alzheimer's are hardly affected despite having plaques, while others are affected long before the plaques appear. "Perhaps we'll even discover entirely different factors – for example, that certain cell organelles are missing when synapses are defective," says Wanner. "That could open up new avenues for treatment."



The cheese-and-pasta principle: protein deposits are implicated in Alzheimer's and Parkinson's disease. To prevent these from arising, the body must break down protein strands that resemble spaghetti in shape. The small molecule spermine can bind these protein strands together – like melted cheese on pasta. This makes it easier for the cell to eliminate them.

Using the cheese-pasta principle to combat Alzheimer's and Parkinson's

Meanwhile, a group led by biophysicist Jinghui Luo, who also works at the PSI Center for Life Sciences, is pursuing a different approach. The researchers want to better understand the disordered protein clumps associated with Alzheimer's and Parkinson's disease.

Luo's team has conducted biophysical in vitro and cell culture studies as well as experiments on the nematode *Caenorhabditis elegans*, which is frequently used as a model organism in ageing research. Spermine, a molecule naturally produced by our body, can protect neurons and mitigate age-related memory loss. Luo wanted to find out exactly why this happens. To this end, like Liebi and Wanner, he performed SAXS measurements at SLS. This allowed him to unravel spermine's mechanism of action. In a degradation process called autophagy, our body is constantly working to break down harmful or unnecessary proteins, thus preventing their clumping and deposition, among other things. The molecule spermine supports this process in a way that is as simple as it is effective. "Spermine acts like cheese on spaghetti: it binds individual protein strands together to form a flexible network," Luo explains. "It is easier for the body to break down this type of network than if the proteins form large, rigid clumps."

Kristin Kernland Lang

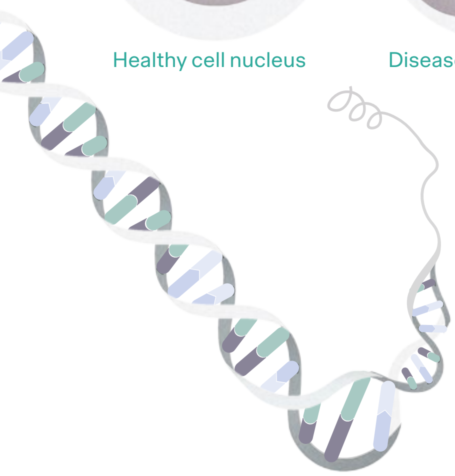
Paediatric dermatologist. Neighbour of PSI researcher G. V. Shivashankar

"My work puts me at the opposite end of the age spectrum. As a paediatric dermatologist, I see patients from birth to the age of 18. I find Shivashankar's research at PSI incredibly exciting. His method will allow us to diagnose age-related diseases much more easily and at an early stage. For me, this is a paradigm shift in medicine. We can all, as individuals, become aware of health risks early on and react accordingly. I consider this a very timely development because it emphasises personal responsibility. We should all do our utmost to stay healthy for a long time."

G. V. Shivashankar (right) had told Kristin Kernland Lang about his research. She was delighted to accept his invitation to the laboratories at the PSI Center for Life Sciences.


Healthy cell nucleus


Diseased cell nucleus


Chromatin – the packed form of DNA in the cell nucleus – changes as a result of disease: not only in shape but also in texture and spectral properties. A new AI-based imaging technique could detect such changes at an early stage.

Luo hopes this finding could lead to new drugs against Alzheimer's and Parkinson's. Perhaps even more, because spermine also has an impact on other diseases such as cancer. In addition to spermine, many other molecules from the class known as polyamines also perform important functions in the body and are therefore of medical interest. Research in this area has considerable untapped potential. "If we better understand the underlying processes," says Luo, "we could find even better recipes for our cheese sauce, so to speak." In this search, Luo's team is also using a special artificial intelligence tool that can draw on all the available data to calculate promising combinations of "ingredients for the sauce" much more quickly.

Detecting age-related diseases early on with AI

At the PSI Center for Life Sciences, another expert is using artificial intelligence for biomolecular research. G. V. Shivashankar and his team have developed an AI-based method for the early detection of various age-related diseases. "Most organs and tissues deteriorate with age because cells divide less frequently and therefore don't regenerate as effectively," says Shivashankar. "It is crucial to detect this as early as possible so we can intervene and age more healthily."

His team focuses on blood cells: "In almost every disease, characteristic metabolic products or fragments of genetic material from the diseased tissue end up in the blood," says Shivashankar. "The blood cells, as key components of the immune system, respond to this by initiating countermeasures."

The idea, therefore, is to create high-resolution images of a special molecular tangle inside the cell nuclei: chromatin. Chromatin is, so to speak, the packaged form of our genetic material, DNA. It changes every time the cell is activated, as the genes are unpacked to be read. Shivashankar's team has determined that blood cells are activated differently in each disease, leading to disease-specific changes in the chromatin.

"However, to detect these subtle changes, hundreds of characteristics have to be compared –such as shape, texture, and light spectrum," Shivashankar acknowledges. To do this, Shivashankar's team has developed an artificial intelligence tool in collaboration with researchers at the Massachusetts Institute of Technology in the US. "It is much faster and more reliable than any human at comparing such patterns." In tests, the AI tool has already achieved an accuracy rate of more than 85 percent in distinguishing the chromatin of cancer patients from that of healthy individuals. "Through further improvements, we aim to increase this rate even further and achieve the accuracy required for approval by Swissmedic," says Shivashankar.

To get there, the researchers are first creating a database of healthy chromatin patterns – because their appearance is affected by age, sex and ethnic background. The goal is to collect more than ten thousand profiles. "First we need to define which chromatin patterns should be considered healthy, so that the system has a sound reference," says Shivashankar. Once this atlas has been created, clinical trials could begin.

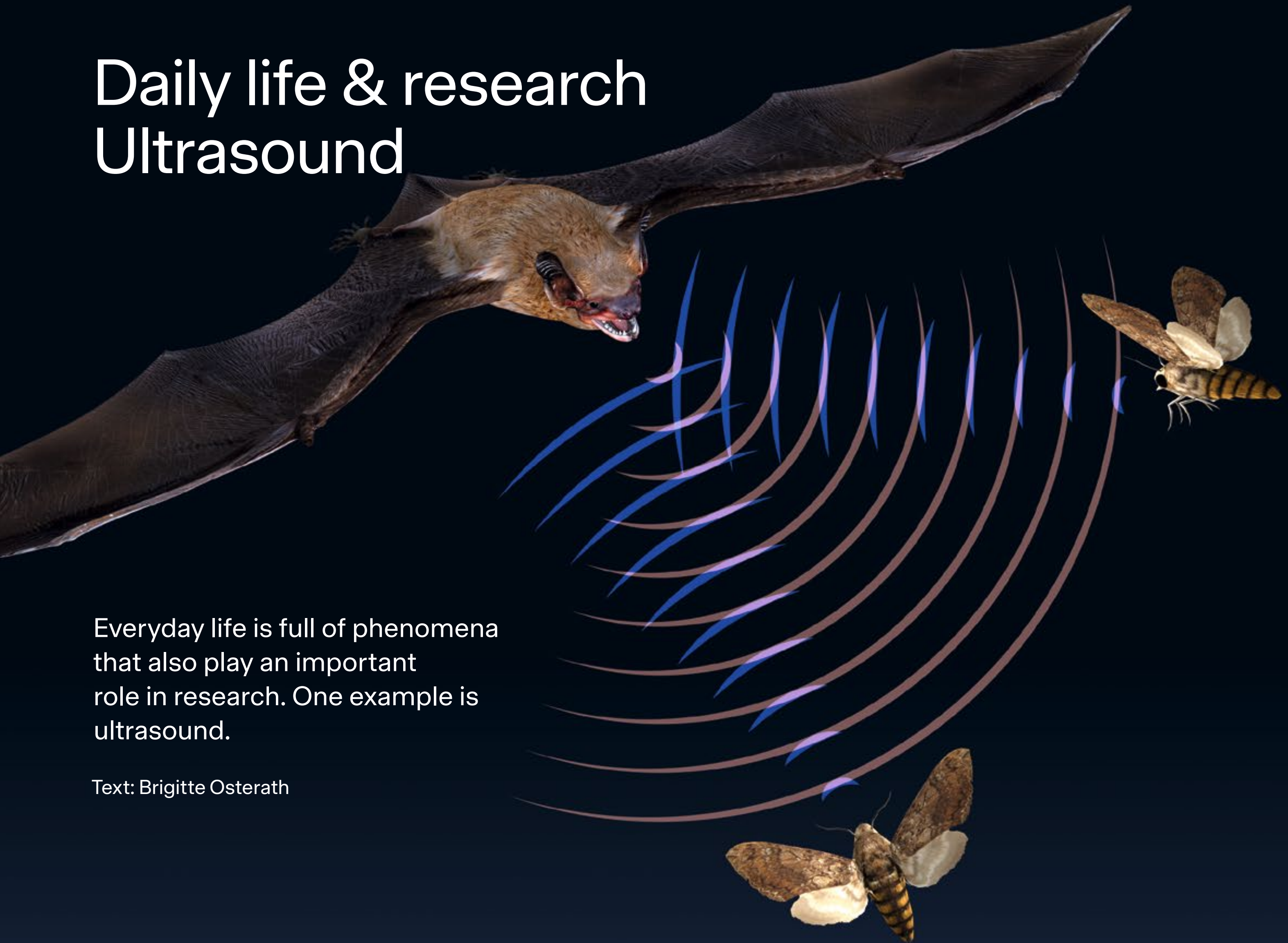
One day, the early detection of a wide variety of diseases could become a straightforward routine test in clinics and doctor's practices. "We have already developed a device that only needs a few drops of blood for the analysis and a microscope that simply connects to a smartphone. The detection program then runs on that," reports Shivashankar. "The technology will therefore be very fast, inexpensive and easy to use – ideal also for regions with limited medical infrastructure."

Ultimately, it is about understanding diseases more precisely and detecting them earlier. "PSI is a special place where wide-ranging, high-quality research into healthy ageing converges," says Shivashankar. And sometimes the path from fundamental research to practical applications can be surprisingly short: industry partners such as Roche are already interested in Shivashankar's method. ●

Properties in flux

Viviane Lütz Bueno investigates soft matter using neutrons at the Swiss Spallation Neutron Source SINQ, one of the five large research facilities at PSI. Soft matter refers to substances such as shampoo, liquid crystals or blood that are easily deformed by temperature changes or applied stresses. Her research focuses on how the structure of macromolecular architectures changes under complex flow conditions – for example, when injecting a vaccine through a needle. Her findings are key to fundamental research in materials science and are being directly applied in the food, chemical and pharmaceutical industries.

Daily life & research
Ultrasound



Everyday life is full of phenomena that also play an important role in research. One example is ultrasound.

Text: Brigitte Osterath

Daily life

Silent roar

When bats fly, they are constantly calling out – sometimes at the volume of a pneumatic drill. The fact that these creatures are almost silent to us humans is due to the very high pitch of their calls – mostly in the ultrasound range above 20 kilohertz and thus higher than what humans can hear.

A common pipistrelle, for example, emits around ten ultrasonic calls per second – and nearly 200 just before snatching an insect. With its large ears, a bat listens intently to whatever is reflected back by its surroundings – in other words, the echoes. Its brain then interprets these echoes as three-dimensional information. This makes it possible for the bats to get their bearings even in complete darkness.

And why ultrasound? Quite simply because the high frequency and correspondingly short wavelength produce high resolution. Bats can use echolocation to detect even very small objects – down to insects less than a millimetre in size.

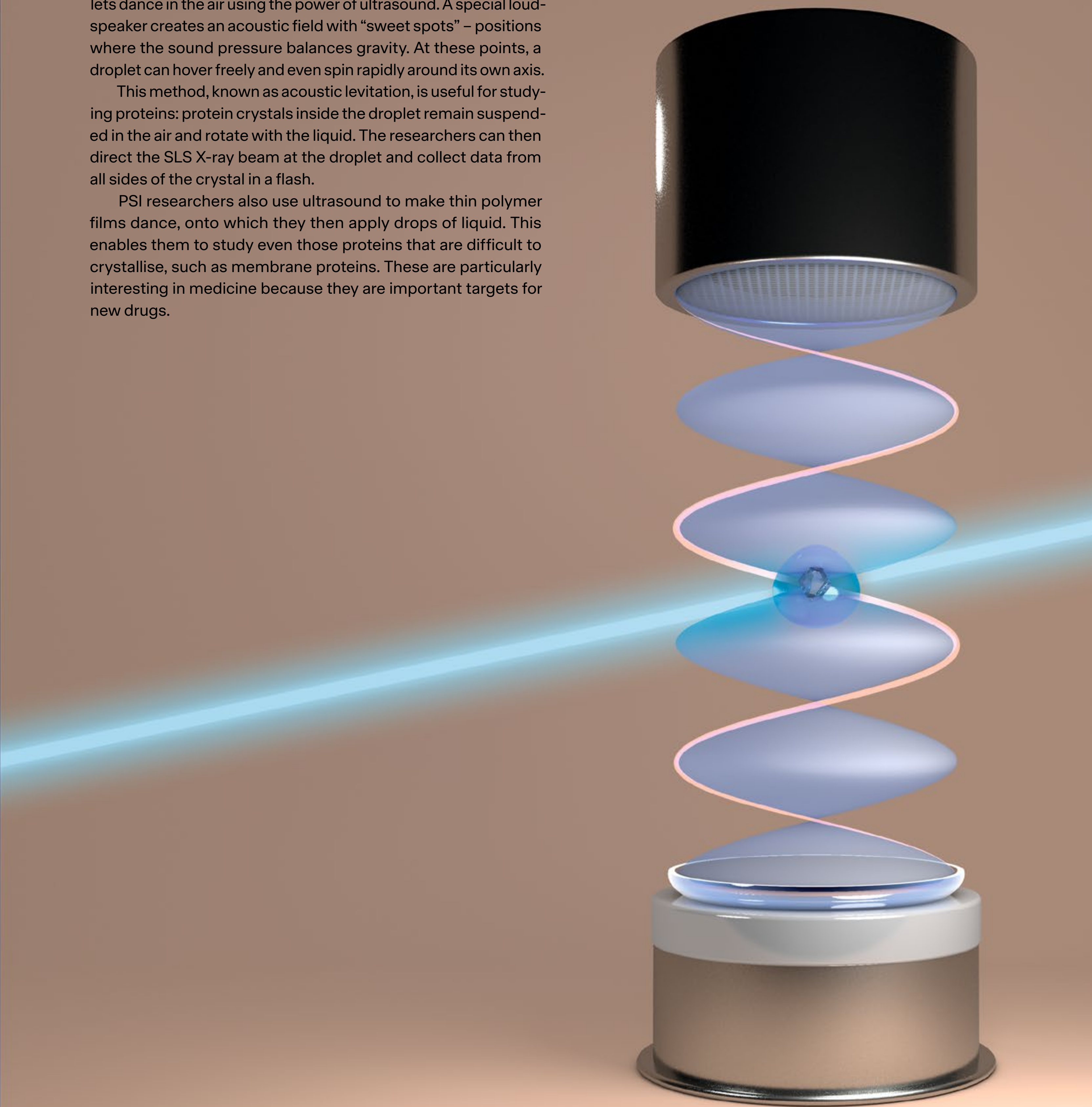
Research

Levitating droplet

At the Swiss Light Source SLS, PSI researchers make liquid droplets dance in the air using the power of ultrasound. A special loudspeaker creates an acoustic field with “sweet spots” – positions where the sound pressure balances gravity. At these points, a droplet can hover freely and even spin rapidly around its own axis.

This method, known as acoustic levitation, is useful for studying proteins: protein crystals inside the droplet remain suspended in the air and rotate with the liquid. The researchers can then direct the SLS X-ray beam at the droplet and collect data from all sides of the crystal in a flash.

PSI researchers also use ultrasound to make thin polymer films dance, onto which they then apply drops of liquid. This enables them to study even those proteins that are difficult to crystallise, such as membrane proteins. These are particularly interesting in medicine because they are important targets for new drugs.



The PSI Education Center: Expertise for all of Switzerland

David Sprenger heads the PSI Education Center and the lead campus, which offers training and professional development for employees of all four research institutes within the ETH Domain. Maya Keller is the head of the associated School for Radiation Protection. In the brick OSGA building, they welcome specialists from across Switzerland – from medicine and Swiss nuclear power plants to radiation protection emergency responders.

Progress happens when knowledge is shared and developed collaboratively. That's why the professional development courses of all four research institutes of the ETH Domain have been collected at the PSI Education Center. The School for Radiation Protection is also open to the entire country, ensuring that emergency responders and specialists working in medicine, industry and energy supply receive outstanding training and professional development.

Text: Jolanda van de Graaf

It's a Tuesday morning in December, the first rays of sunlight are filtering through the treetops, throwing patterns on the road that winds through the expansive PSI campus. A few latecomers hurry along the pavement towards a brick building: the OSGA training centre. Three courses are taking place here today: Accredited Radiological Protection Training for Laboratory Personnel, a practical course in X-ray physics and the course Communicating in Science. In the training rooms, physicists sit next to environmental scientists, laboratory staff meet dangerous goods officers, and aspiring radiology professionals encounter radiation protection personnel.

"This is about far more than just transferring knowledge," says David Sprenger. "A shared language of research is taking shape – a cultural foundation that transcends disciplines and boundaries." Sprenger has a doctorate in digital learning technologies and is the head of the PSI Education Center. Since spring 2024, the lead campus has offered a joint course programme for all four national research institutes belonging to the ETH Domain: PSI, Empa, Eawag and WSL. The programme comprises around 200 courses. Courses cover topics such as research data management (RDM), geographic information systems (GIS), the Python programming language and Quarto reporting software, and participants not only learn methods and regulations but also embrace the vision of ETH research: openness, precision and the courage to innovate.

Focusing on learning and development

From the outset, exchanging ideas and consciously cultivating the shared ETH research culture were declared goals, David Sprenger explains: "The acronym 'lead' is composed of 'learning' and 'development.'" In other words, the continuous pursuit of improvement that underlies all research.

Thanks to the existing PSI Education Center, the lead campus got off to a solid start. "The infrastructure was already in place," Sprenger explains. "At PSI, we have attractive classrooms, modern laboratories and a fully equipped area for emergency response

Maya Keller also teaches at the School for Radiation Protection. Her course, Accredited Radiological Protection Training for Laboratory Personnel, includes a practical component in a dedicated physics laboratory.

training – in radiation protection, for example." Firefighting courses, tailored to the specific conditions found in laboratories, are also held in a specially equipped area.

Courses have been standardised wherever the four research institutes share common ground. There are courses on presentation skills in the scientific environment, successfully applying for research funding, communicating one's own research to a broad audience and a module that shows early-career researchers how to successfully publish their results in international journals.

According to David Sprenger, online learning has gained considerable importance since the pandemic years of 2020–21. Where appropriate, however, professional development courses are held on-site. This promotes social exchange between the institutes and simplifies practical exercises.

Sprenger's team regularly reviews the individual courses. They assess the participation rate and the popularity of each course. "Depending on the results, we expand certain modules or remove them. This keeps the programme dynamic." Each of the four research institutes has a contact person to identify professional development needs. The languages of instruction are German and English. Researchers at the ETH institutes come from all over the world.

The early verdict on the shared learning platform is positive: in the first two years of the lead campus, there have already been 4,500 course attendances – across all in-person courses. "If we also include the mandatory online courses, the total rises to around ten thousand," says David Sprenger. To put this in context, the four ETH research institutes together have approximately 4,600 employees, 2,300 of them at PSI alone.

Career development for research and industry

An academic career differs from a professional career in the private sector – the Career Center takes this into account. It is another part of the PSI Education Center and is available to doctoral candidates and postdoctoral researchers at ETH Domain research institutes.

Young researchers who want to move into industry are also prepared for this. The numerous spin-off companies that have already established themselves at all four research institutes testify to the business acumen of some former researchers. “The economic success of these spin-offs owes much to how confidently researchers navigate the economic landscape of the private sector,” David Sprenger explains. “Our courses help pave the way.”

“For many years, our training programme has reliably contributed to the required safe handling of ionising radiation in Switzerland.”

Maya Keller, Head of the School for Radiation Protection at the PSI Education Center

The School for Radiation Protection – a national responsibility

For more than 60 years, training in radiation protection has been an integral part of PSI and is open to participants from all over Switzerland. As Switzerland’s competence centre for nuclear energy and safety, the institute bears a key responsibility for ensuring that expertise in handling ionising radiation is continuously developed and passed on to future generations. Having grown out of PSI’s own nuclear research activities, the School for Radiation Protection is financially self-sufficient and is now part of the PSI Education Center. Course participants come from many different fields: for example, emergency responders in the event of a malfunction or emergency, medical professionals in radiology or nuclear medicine, researchers in the pharmaceutical industry or people working in nuclear research, at Swiss nuclear power plants or at the Zwilag interim storage facility.

In Switzerland, training to handle radiation safely is legally enshrined in the Radiation Protection Act and the Radiation Protection Training Ordinance; 70 professional groups are covered by these regulations. Occupationally exposed personnel are subject to strict legal regulations and are supervised by the Federal Office of Public Health, the Swiss Federal Nuclear Safety Inspectorate (ENSI), and the Federal Department of Defence, Civil Protection and Sport.

“PSI is the only institute mentioned in the Radiation Protection Ordinance, meaning we have a direct mandate from the federal government,” says Maya Keller, head of the School for Radiation Protection. “We are the largest school of its kind in Switzerland and offer the broadest range of courses. For many years, we have reliably contributed to ensuring the safe handling of ionising radiation in Switzerland. I am proud of that.” Maya Keller grew up in Ticino and the US and holds a master’s degree in radiation protection, as well as the highest US certification.

Later that Tuesday, she is teaching the course Accredited Radiological Protection Training for Laboratory Personnel in English. The participants come from the University of Basel, among other places; others work at Novartis, and a small number are also from PSI. “These people are attending this one-week course because they all work in a laboratory with what are known as open radioactive sources.”

With 60 different courses, ranging from half a day to three months, the School for Radiation Protection covers the entire spectrum. And it achieves this with just seven instructors, who together cover 6.2 full-time equivalents (FTEs). “In addition, changes in legal requirements necessitate further training modules,” explains Maya Keller.

The needs in the medical field are constantly evolving. Flexibility is essential. Maya Keller: “To meet the needs of our clients, we also offer customised training programmes. For example, instructors go directly to a hospital to teach its medical staff about radiation protection and enable them to practise it in the operating theatre.”

A tailored training course for handling malfunctions and emergencies is also part of the PSI School for Radiation Protection’s portfolio. “We work directly with cantonal organisations to develop realistic emergency drills.”

Instruction in Switzerland’s largest X-ray laboratory

The School for Radiation Protection addresses the growing needs in the field of X-ray diagnostics, among other things with the largest X-ray laboratory in Switzerland. A total of nine X-ray systems and one fluoroscopy device allow a wide variety of experiments and exercises to be conducted, giving future radiographers and physicians hands-on preparation.

The X-ray laboratory is rented out to third parties approximately 65 days a year. During these times, schools for medical practice assistants use the facilities. This allows the School for Radiation Protection to offset the cost of its modern equipment.

Practical course units are also held in the physics and chemistry labs, where participants learn how to use measuring instruments, for example. Safety is always a top priority. “Consistently safety-conscious behaviour in the work environment is essential, precisely because ionising radiation is undetectable by our five senses,” Maya Keller explains. “That’s exactly what we teach in our courses.” ●

Latest PSI research news

39 trips through Sarajevo were taken by PSI researchers in their measuring vehicle to map the sources of particulate matter in the city for the first time.

Around **2⁄3** of the particulate matter concentrations measured exceeded the WHO 24-hour guideline value.

Up to **60** percent of the organic particulate matter measured in the evenings in the city's residential areas originates from wood-burning stoves.

1 The sources of Sarajevo's smog

Sarajevo, the capital of Bosnia and Herzegovina, suffers from very high levels of air pollution during the winter months. The city in southeastern Europe lies in a valley where cold air and exhaust fumes accumulate.

An international research team including scientists from PSI has been studying Sarajevo's air pollution systematically. Using a specially equipped measuring vehicle, the researchers analysed the chemical composition of particulate matter directly on site. This allowed them to clearly determine, for the first time, which sources dominate the smog and how they are spatially distributed.

They found that wood and coal stoves in residential areas are the biggest contributors. In the city centre in particular, emissions from kitchens and restaurants play a significant role alongside expected sources such as traffic. The study thus shows where targeted action can be taken against smog.

Further information:
psi.ch/en/node/73944

2 A stable path to solid-state batteries

Lithium-metal solid-state batteries are considered the next generation of energy storage devices. They are particularly safe because they do not contain a flammable liquid electrolyte. Instead, a solid material transports the lithium ions – significantly reducing the risk of fire. At the same time, they promise higher energy densities and a longer lifespan than today's lithium-ion batteries.

Despite this potential, solid-state batteries have often failed due to unstable interfaces and mechanical stresses that can trigger the growth of needle-like lithium dendrites. A new manufacturing process from PSI research combines a mild compaction of the electrolyte with an ultrathin intermediate stabilising layer. This reduces mechanical stresses and makes the cells significantly more robust.

In laboratory tests, the PSI batteries retained around 75 percent of their original capacity even after 1,500 charge and discharge cycles – an outstanding result for lithium-metal solid-state batteries. The energy-efficient manufacturing process also opens up realistic prospects for scalable industrial production.

Further information:
psi.ch/en/node/73855

3 The hidden dance of electrons

Electrons determine how materials conduct electricity, react chemically, or emit light – yet their mutual interactions usually remain hidden from direct observation. At the X-ray free-electron laser SwissFEL, researchers have now succeeded in making these interactions visible. The experiments provide new insights into fundamental processes that span fields from chemistry to quantum technology.

To achieve this, the researchers used a specialized X-ray laser technique known as X-ray four-wave mixing. Several ultrashort X-ray pulses interact with a material and selectively excite its electrons. From the resulting signal, it becomes possible to determine how electrons correlate with one another and exchange energy – a process that has so far been largely inaccessible experimentally. The method makes it possible for the first time to directly access the collective behaviour of electrons, rather than inferring it from indirect measurements. This opens up new ways to understand and ultimately control electronic processes in materials.

Further information:
psi.ch/en/node/73924

4 Magnetic landscapes made to measure

What happens when you use a high-tech laser device for something completely different from what it was designed to do? Using a commercial laser system originally developed for photolithography, PSI researchers are creating extremely fine magnetic structures. This makes it possible to change magnetic properties locally and continuously – even creating complex patterns such as spirals.

The process is called direct-write laser annealing (DWLA). A laser is used to precisely heat a material locally for a very short time, changing its magnetisation continuously and with pinpoint accuracy – in two dimensions and with high spatial resolution.

Being able to control magnetic landscapes opens up new applications. In data storage, information could be written and read electrically – entirely without magnetic fields or moving parts. The method is also of interest for novel computer chips that process information similarly to the brain. It also allows optical properties to be precisely adjusted, for example, for high-precision sensors or photonic components.

Further information:
psi.ch/en/node/72932

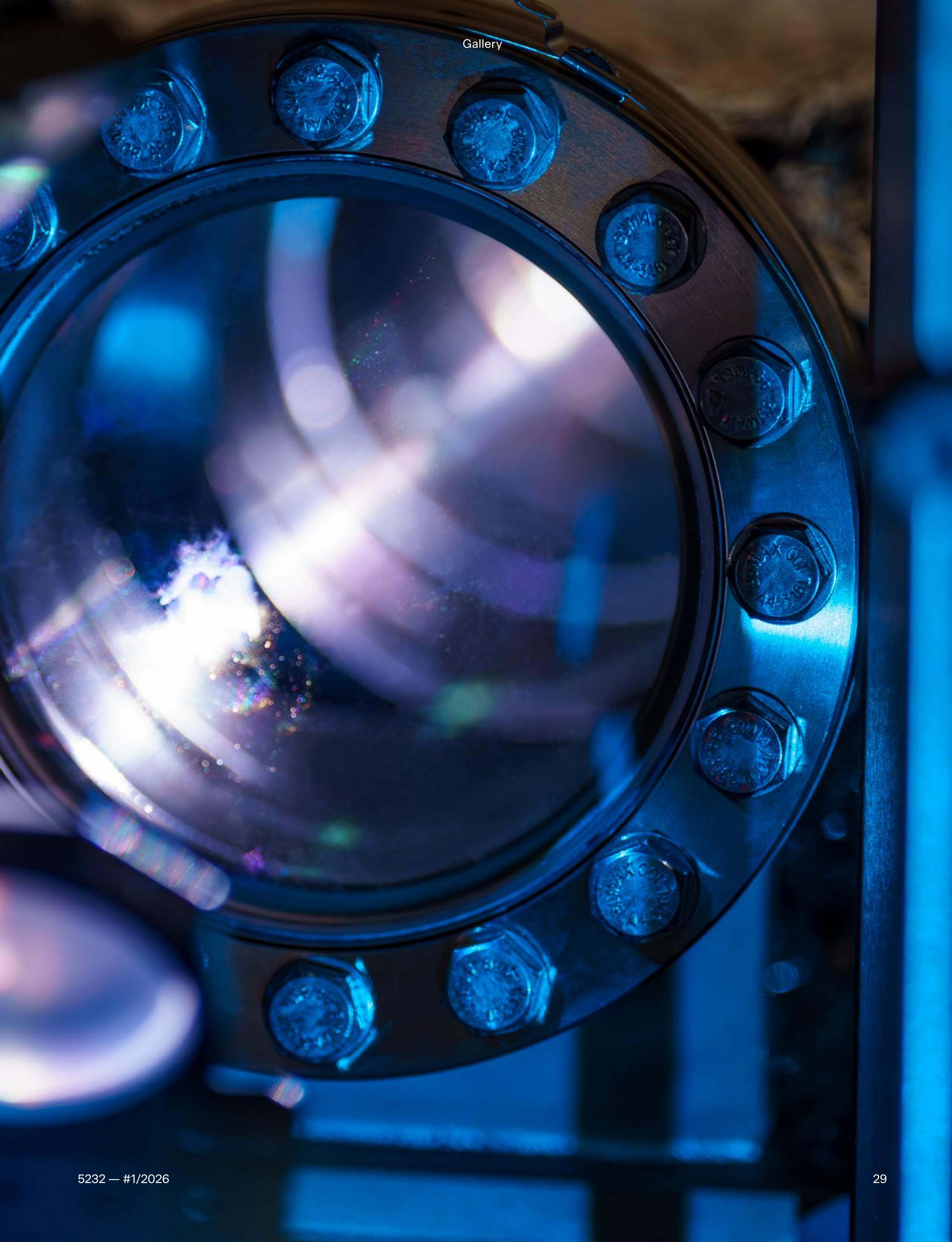
Light in research

Light plays an important role in research at PSI, whether as a laser that triggers ultrafast processes in biological molecules, special illumination in cleanrooms or the glow of gas atoms when protons hit them. In this gallery, we highlight five different spectral colours.

Text: Christian Heid

Blue

The Swiss Light Source SLS uses accelerated electrons to generate X-rays of extremely high brilliance. It is used for research in fields including physics, materials science, biology, chemistry and environmental science. This versatility stems from the fact that synchrotron light is polychromatic. At around 20 experimental stations, the wavelengths required for specific experiments are selected from the spectrum. Synchrotron light predominantly lies outside the visible range; the blue light shown here belongs to the smaller portion that is visible. At the diagnostic beamline, the light is analysed to determine key machine parameters – to optimise the accelerator's performance and ensure it is operating reliably.

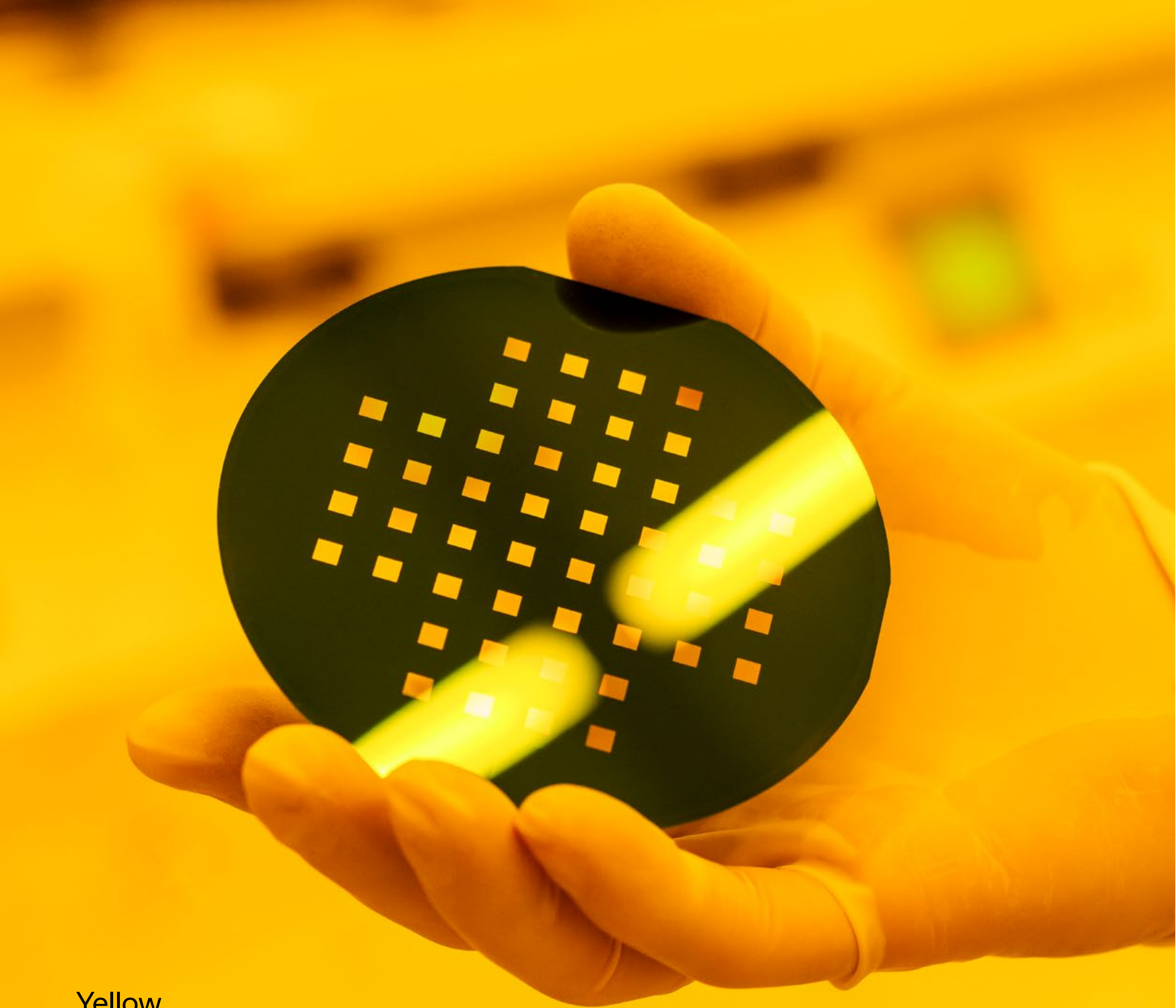


Green

The green laser light is used at the PSI Center for Proton Therapy, where cancer patients receive treatment. Proton beam radiation therapy is particularly gentle on surrounding healthy tissue. Since the shape and location of a tumour can change during the course of the multi-week therapy, low-dose computed tomography (CT) provides the basis for optimising radiation delivery. The reference lines projected onto the patient's body by green laser light allow patients to be positioned accurately and reproducibly before each CT scan.

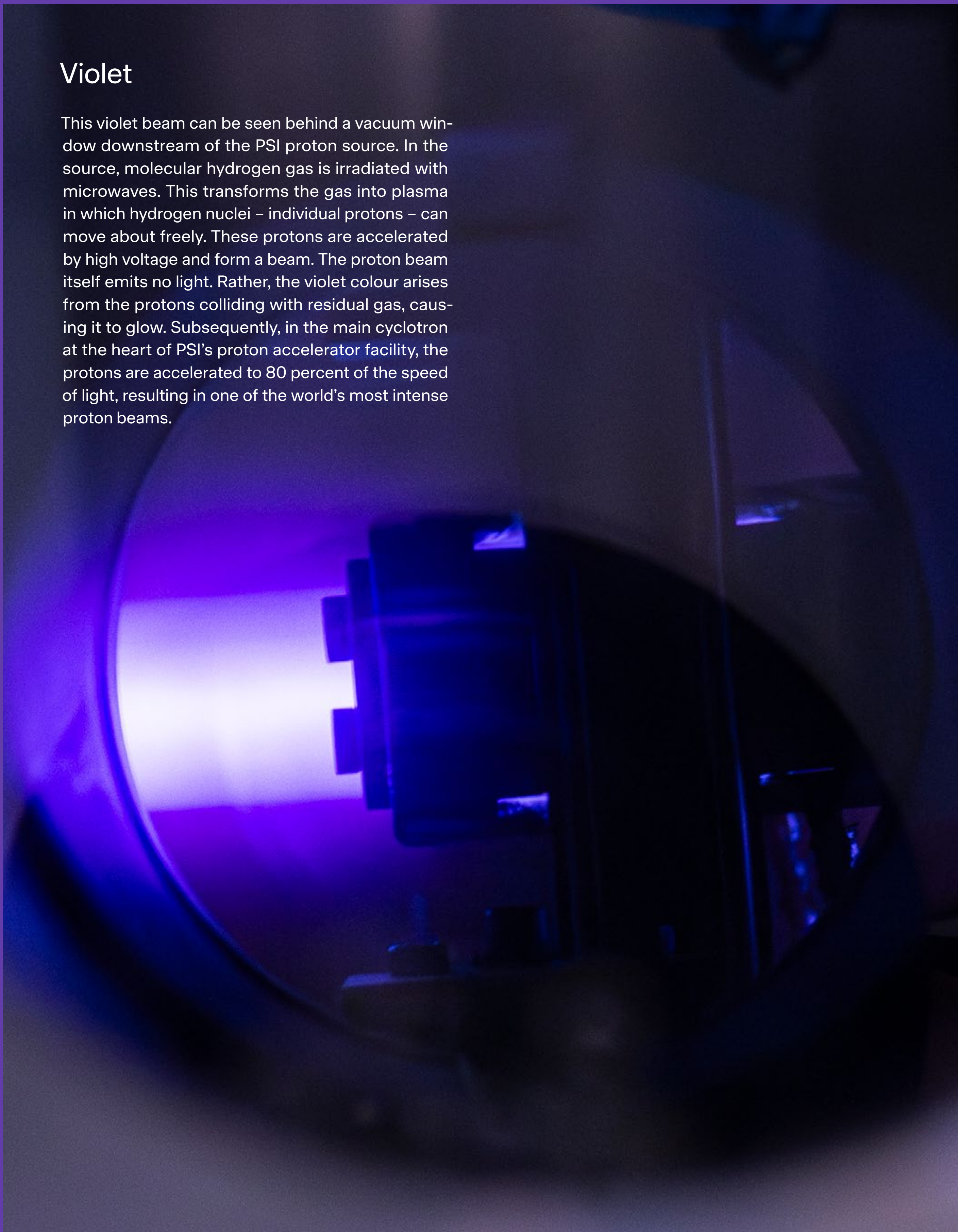
Red

The red laser light is used here at PSI's newest large research facility, the X-ray free-electron laser SwissFEL. Mirrors direct it onto samples, such as biomolecules, to put them in an excited state. The extremely rapid processes thereby induced are recorded by very short pulses of exceedingly brilliant X-rays. The result is an extreme slow-motion film of the triggered dynamics, vividly illustrating the atomic movements of these important building blocks of life. This fundamental research leads, for example, to new insights into light-harvesting proteins and processes involved in photosynthesis.



Yellow

Yellow light is essential when preparing to transfer microstructures onto wafers – circular discs made of a semiconductor material such as silicon that are used to manufacture microchips. First, the wafers are cleaned, and foreign atoms are introduced to improve their electrical properties. Afterwards a photosensitive resist layer is applied, into which circuits will be etched using masks and light. During the application of the photoresist, no blue or ultraviolet light may be present. This is why lighting fixtures in the PSI cleanrooms at the adjacent Park Innovaare have been coated with filter films, producing the yellow light you see reflected off the wafer.



Violet

This violet beam can be seen behind a vacuum window downstream of the PSI proton source. In the source, molecular hydrogen gas is irradiated with microwaves. This transforms the gas into plasma in which hydrogen nuclei – individual protons – can move about freely. These protons are accelerated by high voltage and form a beam. The proton beam itself emits no light. Rather, the violet colour arises from the protons colliding with residual gas, causing it to glow. Subsequently, in the main cyclotron at the heart of PSI's proton accelerator facility, the protons are accelerated to 80 percent of the speed of light, resulting in one of the world's most intense proton beams.

“We are responsible for one another”

Hanke Nobbenhuis saves lives – as a first responder on the ground and as a Samaritan who trains hundreds of people every year to take the right action in emergencies. Her path also took her to the Paul Scherrer Institute PSI: to the chemistry department and the on-site fire brigade, where she learned about taking responsibility for one another.

Text: Benjamin A. Senn

“Ah, ah, ah, ah, stayin’ alive” – the Bee Gees classic from the 1970s not only gets you dancing, but also helps you perform CPR. The disco hit from the John Travolta film Saturday Night Fever provides around 100 beats per minute – exactly the rhythm needed to supply the body with blood, and thus oxygen, during chest compressions. “The song helps you keep time during CPR – and its lyrics are also a perfect fit,” explains Hanke Nobbenhuis.

The Dutch-born woman leans over the training dummy with her entire body. Using the heels of both hands, she presses the plastic sternum down by up to six centimetres deep – 100 to 120 times per minute. “It’s extremely strenuous – but it can save lives in the event of cardiac arrest,” she adds, audibly gasping for breath.

Hanke Nobbenhuis is an instructor with the Samaritan Association and a first responder in the canton of Aargau – a specially trained volunteer outside the regular emergency services. Saving lives is a very real part of her job: if a call comes in to an official emergency service and she is nearby, she is alerted via an app and can respond. “I almost always keep my equipment in the car. When I get the alarm, I provide first aid – until the ambulance arrives.” Even now, she would be prepared to respond immediately to an emergency.

The fact that Hanke Nobbenhuis now wears a Samaritans’ uniform, saves lives in Aargau, Switzerland, and trains laypeople to do the same, is by no means a given. Rather, it’s thanks to chance, love – and one outspoken remark. But first things first.

Joining the fire brigade with “Dutch directness”

Our story begins in the Netherlands, in the eastern city of Enschede, where Hanke Nobbenhuis completed her studies in technical chemistry at the local university. Her boyfriend at the time was also a university graduate. On the threshold of transitioning from student life to a shared future, the couple began actively making plans.

For Hanke Nobbenhuis’s partner, this future soon became very concrete: a doctoral programme at ETH Zurich drew him to Switzerland. Initially, Hanke Nobbenhuis commuted between Enschede and Zurich – until 1990, when she finally found a job in the vicinity: as a chemist at the Paul Scherrer Institute PSI, in the ultrapure water chemistry group. “Our task was to monitor the water quality in nuclear power stations,” she explains.

Water in nuclear power stations fulfils a range of functions: cooling, transporting heat and protecting materials from corrosion. Corresponding stringent requirements apply to its chemical composition. “We regularly checked various parameters, such as its pH value and metal or isotope content, and we analysed the data statistically,” says Nobbenhuis. The aim was to detect any changes in plenty of time – long before they could become relevant to the operation or safety of the station.

At the same time, Hanke Nobbenhuis also began to take an interest in a completely different area of the institute: its fire brigade. “What surprised me most was that there weren’t any women there at all,” she says. “So with my typical Dutch directness, I complained loudly – and shortly afterwards I was one of them myself.”

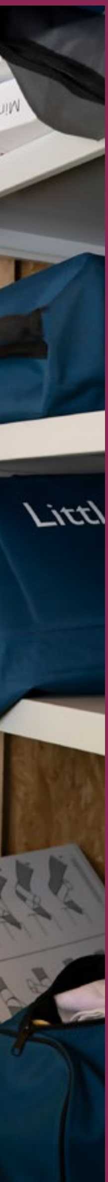
Unlike in the Netherlands, the PSI fire brigade required its members to be thoroughly trained in first aid – so Nobbenhuis began with a first aid course. “That was my introduction to the Samaritan movement – after that, I was hooked!”

In an emergency

Around 8,000 cardiac arrests occur in Switzerland every year. The critical window for survival is only three to five minutes, after which there is a risk of irreversible brain damage due to oxygen deprivation. Time and distance can therefore decide between life and death. This makes a well-distributed network of first responders and other trained first aid providers all the more important.

“You want to help people and save lives – that’s the true Samaritan spirit.”

Hanke Nobbenhuis



In Switzerland, these are primarily laypersons. Anyone wanting to obtain a driving licence here must first become familiar with first aid and complete a first aid course: CPR, artificial respiration, recovery position, pressure bandage, traffic light triage system… it all seems familiar. And yet, people often lack practice. “At the Samaritan Association of Aargau, we offer introductory and refresher courses to keep these skills fresh,” says Nobbenhuis. The Samaritan Association of Aargau is the cantonal umbrella organisation for local Samaritan groups and coordinates training and continuing education in the canton.

Laypeople are often the first to arrive at the scene of an accident, call emergency services and administer first aid. That’s when the first responders come into play: “Currently, there are about 1,200 of us in the canton of Aargau. We take over from the laypeople and bridge the gap until the ambulance arrives.” The first responders therefore form a link between laypeople and professional help. Anyone aged 18 and over can join, provided they have training in basic life support and have completed a mandatory introductory course.

Nobbenhuis has been a first responder since 2024. “During this time, I’ve had seven call-outs – be prepared is our motto. You want to help people and save lives – that’s the true Samaritan spirit.” But saving lives is also inevitably linked to death; not every call-out has a happy ending, and some experiences stay with you for a long time.

When asked about her longest resuscitation, Hanke Nobbenhuis pauses briefly. “That was with my father,” she says after a pause. A sudden heart attack. “My sister-in-law and I took turns performing CPR – unfortunately, it was not to be.” Such experiences are formative. And yet they are part of being a Samaritan. Nobbenhuis finds support in her family: “Above all my two daughters, both doctors. I can talk to them about things like this.”

It was the birth of her first daughter that prompted Hanke Nobbenhuis to leave PSI after three years and focus more on her family. At the same time, she used her newfound flexibility to expand her involvement with the Samaritan Association. “I had time in the evenings to fully concentrate on Samaritan work – and to diligently attend courses.”

Putting down roots

When she took the position at PSI, Hanke Nobbenhuis and her partner felt it was time to finally settle permanently in Switzerland. Their journey took them through Schaffhausen and Zurich, later to Rieden in the canton of Aargau and finally to the Fricktal region – from Mumpf to Wallbach, where they live today. “We also got married along the way,” Nobbenhuis says with a smile. Commuting became routine, the temporary arrangement became a home – and a family.

Despite many changes at the professional and personal level, one thing remained constant: Hanke Nobbenhuis’s commitment to the Samaritan movement. “As a young woman and student, I wasn’t really aware of it – I was probably more focused on myself,” she says, looking back. “With the PSI fire brigade, the first aid course and my immersion in the world of the Samaritans, it gradually became clear to me that we are not alone in society – we are responsible for one another.” An interest developed into a conviction and from that into a very personal code of ethics.

Today, Nobbenhuis is not only active as a first responder and instructor, but also holds a leadership position in the Aargau Samaritan Association. She is responsible for training and is thereby shaping the next generation of Samaritans. In addition, the Wallbach resident works as a librarian at the Möhlin municipal library – a calmer setting that suits her well, in some respects the complete opposite of emergency services. “In the Samaritan movement, you learn to remain calm in stressful situations, to get a clear picture and act,” she says. “That helps – not only in emergencies, but sometimes even in a library.”

Anyone who feels inspired to refresh their first aid skills or become part of the Samaritan movement themselves will find numerous courses offered by the Aargau Samaritan Association. “If the disco hit Stayin’ Alive isn’t your cup of tea for CPR,” Nobbenhuis says with a smile, “there are plenty of alternatives: Highway to Hell or Atemlos durch die Nacht (Breathless Through the Night) – depending on your musical taste or how dark your sense of humour is.” The main thing is that it has the right rhythm. ●

From our base in Aargau we conduct research for Switzerland as part of a global collaboration.

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With 2,300 employees and an annual budget of CHF 450 million, PSI is the largest research institute for natural and engineering sciences in Switzerland. As part of the ETH Domain, PSI is a key pillar of the Swiss research landscape and conducts cutting-edge research in the fields of future technologies, energy and climate, health innovation and fundamentals of nature. It thus serves Swiss society, industry and politics.

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In the next issue: Energy technologies for the future

Switzerland’s energy future is being shaped today – where PSI is driving progress. The goal is clear: Switzerland aims to be climate-neutral by 2050. This means in the long term we must not emit more greenhouse gases than can be stored naturally or by artificial means. At the same time, our future energy supply must be guaranteed – reliable, safe and affordable.

How do we achieve this?

PSI research is at the forefront of various developments. The power-to-X concept focuses on storing surplus energy generated from solar, wind and hydropower, for example using gases as energy carriers. Battery materials and technologies are being studied at PSI, as is the production of climate-neutral aviation fuels. And should nuclear technologies continue to be part of Switzerland’s energy mix, PSI will bring its national competence to bear with cutting-edge expertise: together with industrial partners, PSI is breaking new ground, from molten salt reactors to fusion technology.

5232 – the address for research

The Paul Scherrer Institute PSI is the largest research institute for natural and engineering sciences in Switzerland. 5232 is the institute's own postal code – and also the name of the PSI magazine. In it we share stories about the science done at PSI, report on the people who work here and show how research leads to progress.

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