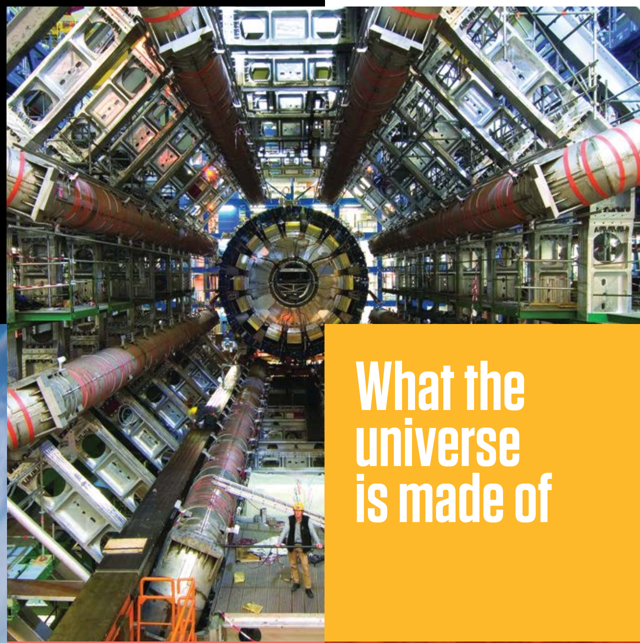
STORIES OF FRENCH-AUSTRALIAN INNOVATION



What the universe is made of

Creating living cell factories

Reef rescue

L'Astrolabe opens up Antarctica

The hunt for shapeshifting cancer cells

Australia CRÉATIVE FRANCE

Welcome to Stories of French-Australian Innovation

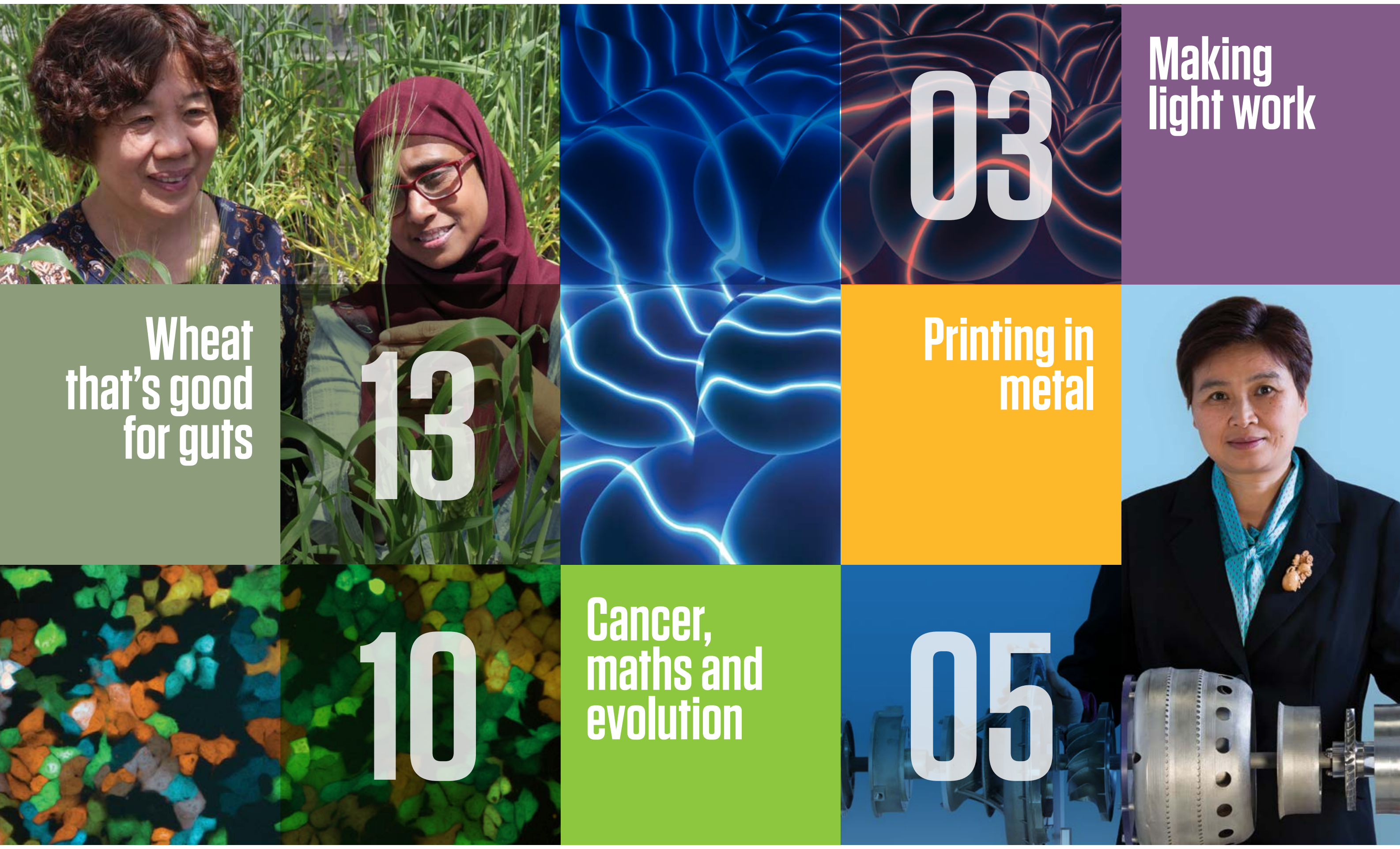
A note from the Ambassador

France and Australia have a longstanding tradition of joint collaboration in both science and innovation.

Today these collaborations have created a number of partnerships that come in many different forms: from business ventures, like 3D printing jet engines, growing wheat that decreases the risk of bowel cancer, and building the quantum computers of tomorrow; to research into our planet's changing shape and glacial history, how cancers evolve and how they resist treatment, finding the Higgs boson, and hunting dark matter; and tackling shared challenges such as developing hydrogen for renewable energy, keeping coral reefs healthy, and managing water as the climate changes.

The following stories are just a select few of the huge number of projects that French and Australian researchers are working on together. They highlight the many benefits produced and the positive impact created as a result of both our nations combining their research skills and knowledge together. In turn and above all, this demonstrates that there is certainly no shortage of opportunities and avenues for mutual support and learning.

Christophe Penot
Ambassador of France to Australia



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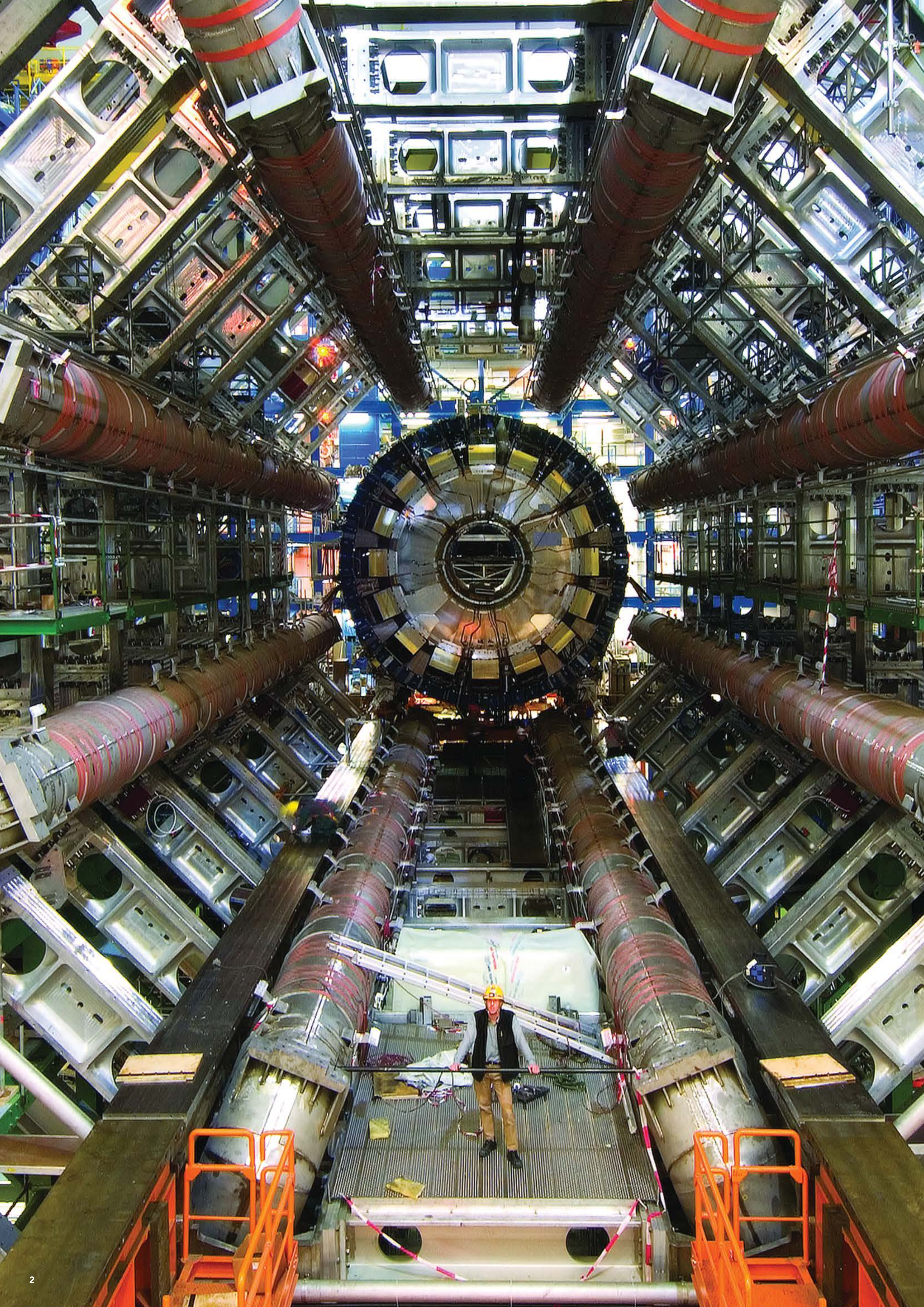
Australia CRÉATIVE FRANCE



What the Universe is made of

The massive team that helped discover the Higgs boson is now hunting more exotic particles, including dark matter.

The ATLAS collaboration involves more than 3,000 physicists from around the world. In 2012, results from ATLAS were vital to the discovery of the Higgs boson, the particle that gives mass to everything in the Universe.

The 7000-tonne ATLAS detector at the Large Hadron Collider on the border of France and Switzerland tracks up to a billion collisions between high-energy protons each second. French and Australian physicists are at the forefront of efforts to decipher this torrent of data.

> **"We learn about the Universe at a fundamental level"**

Professor Elisabetta Barberio at The University of Melbourne is one of the key researchers in the ATLAS collaboration.

"We learn about the Universe, what it is made of and how it all fits together at the fundamental level," Elisabetta explains.

Elisabetta worked closely with Dr Marumi Kado and Dr Louis Fayard, both of the LAL Orsay particle physics lab run by CNRS and the Université Paris-Sud, in the Higgs discovery.

"Marumi was the Higgs combination coordinator and a very big player in the discovery," Elisabetta says.

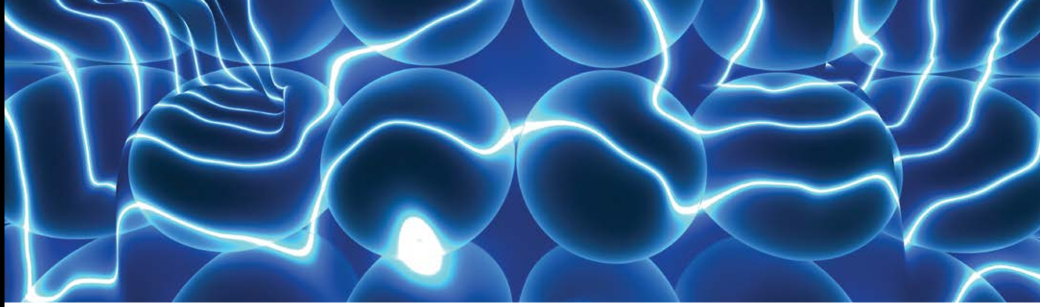
"And Louis has been one of the main proponents of ATLAS since the beginning in the early '90s."

Elisabetta collaborated with Dr Sara Diglio, formerly of CPPM Marseille and now at Ecole des Mines de Nantes, on a study of possible connections between the Higgs boson and dark matter.

While the logistics of international collaboration can be complex, the results are well worth the effort.

"We share ideas, equipment and computer code," she explains.

"Day-to-day interactions are done via video conference, but also face-to-face at CERN—so I travel a lot to France."



Making light work

Australian and French researchers are teaming up to use photonics—the quantum technology of light—to build better environmental sensors and high-speed data transmitters, and enable sharper MRI scans.

The ALPhFA initiative (Associated Laboratory for Photonics between France and Australia) is a collaborative network of nine leading photonics labs: at CNRS joint research units INL-Lyon, C2N-Paris, Fresnel-Marseille, and FEMTO-ST-Besançon in France; and at Macquarie University, the Australian National University, RMIT University, The University of Sydney, and Swinburne University in Australia.

The collaboration is focused on three areas of research. Mid-infrared photonics offers ways of sensing gases in the atmosphere and in the environment, while functional silicon photonics is used for high-speed communications, data transfers and bio sensing, and metamaterials can drastically improve conventional MRI clinical imaging.

Distinguished Professor Arnan Mitchell, Director of the MicroNano Research Facility at RMIT, heads up the Australian side of the project, while the French effort is run by CNRS researcher Dr Christian Grillet of the Ecole Centrale de Lyon and INL.

"Our goal is to build a substantial, ongoing engagement between French and Australian photonics researchers," Arnan says.

In December 2018, Arnan hosted around 50 researchers in Melbourne at the first annual ALPhFA workshop.

Better sensors, faster data and sharper scans

RMIT and Ecole Centrale de Lyon will also jointly teach PhD students, who will work between France and Australia with industry partners including the French multinationals STMicroelectronics, one of the world's largest semiconductor manufacturers, and Thales Group, who make electronics for defence and aerospace.

Photos: Sydney Opera House, inside front cover, credit: Leah-Anne Thompson/Shutterstock; The enormous ATLAS detector, credit: CERN; The MicroNano Research Facility at RMIT in Melbourne plays a key role in the ALPhFA collaboration, credit: RMIT University

Cooking with hydrogen

A hydrogen-powered barbeque could be a taste of the low-emissions future.

The need to shift from fossil fuels to cleaner energy technologies is becoming more urgent, and Australia's trading partners are demanding low-emission energy sources. Electricity production from renewables can be variable, and any excess electricity must be stored for use on days with less wind or sun. Battery systems are used for storage, but they have limitations.

An alternative is to store energy in the form of hydrogen. Materials such as magnesium can act like a sponge to absorb large amounts of hydrogen and then release it again under certain conditions. As a gas, hydrogen is highly explosive, but these materials bind the hydrogen for safe storage.

Professor Kondo-François Aguey-Zinsou from the University of New South Wales, with colleagues from CNRS (France's national research agency) and the University of Montpellier are working to develop and improve these materials.

"The technologies to generate and use hydrogen are well established, but storage is not. Our EnergyH project is developing hydrogen storage in a safe, compact and economical way," François says.

He sees a future in which hydrogen is produced at home as a fuel for numerous consumer products. It could be particularly important in supporting the economic growth of developing nations while the world moves to decarbonised energy systems.

"A solar panel can generate electricity to produce hydrogen from water. The hydrogen can then be stored in our materials and used later to power a cooking device, heat water or generate electricity," François says.

A safe, compact and economical way to store energy

"We have already developed a barbeque that uses this storage technology, and soon we will develop an integrated system for real-world residential testing on the island of La Réunion."

Quantum computing in silicon

A French-Australian collaboration is setting out to make silicon quantum computing a practical reality.

"I'm excited by our technology because it has the potential to change the world," says Professor Andrew Dzurak of the University of New South Wales, the quantum computing expert who leads the Australian side of the partnership.

Andrew and his colleagues hope that their work will enable computing capabilities that are out of reach today and perhaps also result in the first universal quantum computer.

Using the quantum properties of fundamental particles like single electrons or atoms, a working quantum computer could tackle problems—in areas spanning from pharmaceutical design to machine learning to defence—that can't be solved by any current supercomputer.

IT companies and governments around the globe are investing in research, but a useful quantum computer remains elusive.

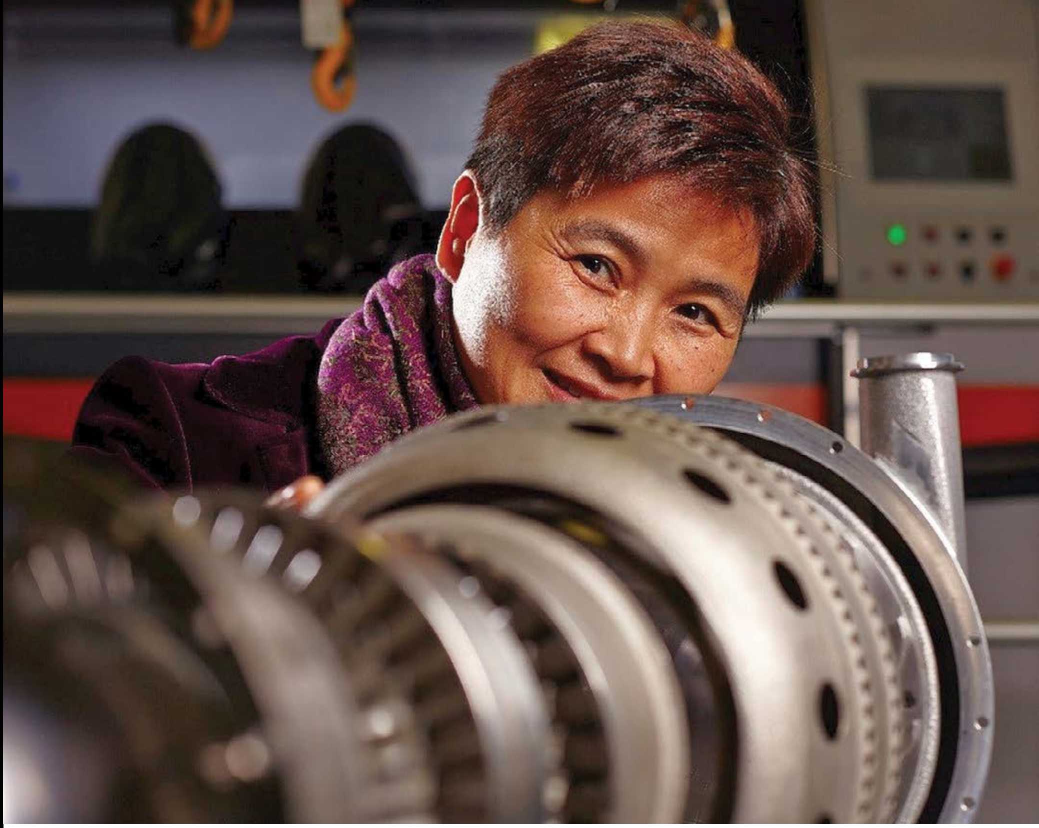
There are many different approaches, Andrew explains, but silicon has natural properties that make it a robust way of storing and processing quantum information. Working as part of the Australian Centre of Excellence for Quantum Computation and Communication Technology, his team at UNSW has already developed qubits that are modified versions of the transistors comprising modern silicon processor chips.

> **"Our technology has the potential to change the world"**

The UNSW researchers are now working with Australia's first quantum computing commercialisation company, Silicon Quantum Computing, and are teaming up with the French research and development organisation CEA (Commissariat à l'Energie Atomique et aux Energies Alternatives) to advance this technology.

By combining the core scientific concepts patented by Andrew's team with SQC's commercial focus and funding and CEA's world-class expertise in the development of innovative integrated circuits, the collaboration aims to accelerate the development of the technology and also create commercial opportunities.

"I don't believe that we could hope to build a quantum computer without each other's unique capabilities," Andrew says. "Our sum is very much greater than our parts."



Printing in metal

Australia's pioneering 3D metal printing technology is now at work in Toulouse, printing components for the French aerospace company, Safran Power Units.

3D printing has the potential to transform manufacturing, allowing rapid prototyping of components, and the creation of lighter and more efficient components that would be impossible to make using traditional casting technologies. But there are many challenges to overcome to ensure that the components meet the intense engineering and regulatory requirements of the aerospace industry.

> **3D printing could transform manufacturing**

In 2015 Australian engineers gained international attention when they revealed the world's first printed jet engine at the Melbourne International Airshow. The engine was a Safran Power Units gas turbine from a business jet and it was printed by a consortium of Monash University, Safran Power Units, CSIRO, Deakin University, and Amaero, a company spun out of Monash University to bring the new technologies to business.

The team started the qualification process for production in 2017 and have now achieved qualification. This is a major step in commercial production of components for auxiliary power units and turbojet engines.

"Safran Power Units supported us from the beginning of our journey. We proved that our team were world leaders," says Professor Xinhua Wu, Director of the Monash Centre for Additive Manufacturing.

"I'm delighted to see our technology leap from the laboratory to a factory at the heart of Europe's aerospace industry in Toulouse," Professor Wu says.

> **"I'm delighted to see our technology leap from the laboratory to the heart of Europe's aerospace industry"**

Photos: Researchers use beams of electrons to draw tiny circuits, credit: ANFF/University of NSW; Professor Kondo-François Aguey-Zinsou, credit: EnergyH; The H2Q is a portable hydrogen-powered barbeque that creates heat without burning, credit: EnergyH; Professor Xinhua Wu and her team are 3D printing jet engines, credit: Monash University

Reef rescue

French and Australian scientists are working together to understand how climate change is affecting reef sharks in French Polynesia, why corals in New Caledonia can survive extremes of temperature and acidity, and what fish markets mean for reef health.

Hope for coral

A reef system in New Caledonia may hold the secret of survival for coral in a warming world. In the shallow mangroves off the island of Bourake, researchers are studying corals that survive in "climate change-like conditions".

"We have found more than 50 species of coral thriving here in seawater conditions like what we expect for the end of the century: more acidic, warm, oxygen-depleted water," says Dr Riccardo Rodolfo-Metalpa of the Institut de Recherche pour le Developpement (IRD). "We want to understand if this ability to survive is genetic and, most importantly, if other corals will be able to survive climate change."

Riccardo and his IRD colleague Dr Fanny Houlbreque are working in collaboration with Associate Professor David Suggett and others at the University of Technology Sydney in a project funded through the French government's Fond Pacifique. What they learn will help New Caledonians manage their reefs into the future, as well as offering lessons for reefs in Australia and around the world.

"This will fundamentally change our understanding of how climate change will impact coral reefs in the next 50 years and even beyond," says Riccardo.

Market forces

Being close to a fish market is one of the most important factors in overfishing of coral reefs, Professor Joshua Cinner from James Cook University and Professor David Mouillot from the University of Montpellier have found.

"The bigger the market and the closer to the reef, the greater the pressure on fish stocks," says Joshua.

Understanding the social, economic and cultural needs of the people who use reefs is the key to influencing their behaviour to sustain healthy reefs, says David.

"It's only by drawing together human geography, common property, anthropology, conservation policy and ecology that we have been able to tease these factors out."

Baby sharks

On Mo'orea in French Polynesia, Dr Jodie Rummer leads a project studying baby sharks to see how they will cope with climate change.

"Healthy reefs need healthy predators," Jodie says. "And healthy predators need healthy reefs."

After overfishing, climate change is the greatest threat to sharks. Because they take a long time to mature and produce relatively few young, they will be slow to adapt to warmer oceans, greater acidity and less oxygen.

The Physioshark project is a collaboration of Jodie and colleagues at James Cook University with Dr Serge Planes and other researchers at the Centre of Island Research and Environmental Observation (CRIOBE) in French Polynesia.

Recently they have been conducting experiments on newborn blacktip reef and sicklefin lemon sharks to study their response to stressful events such as being chased by predators or getting caught in nets.

> **"Healthy reefs need healthy predators"**

The project also involves outreach and education to communities in French Polynesia, where sharks play a significant role in local culture and healthy marine ecosystems are vital for fishing and tourism.

L'Astrolabe opens up Antarctica

For French and Australian explorers

Without the help of icebreaking ships, all-terrain vehicles and tough machinery, most Antarctic science could not happen. The French ship *L'Astrolabe* is a crucial facility for scientists exploring the Earth's climate, oceans, atmosphere and ecology.

Every year, the ship and its crew, managed by the French Navy for the Institut polaire français Paul-Émile Victor (IPEV) from Hobart, support approximately 50 French and international scientific projects based out of the French stations Dumont d'Urville and Concordia. *L'Astrolabe* also transports food, supplies, logistics officers and scientists to and from Australia's Macquarie Island base.

IPEV also supports the high priority Australian-led project Aurora Basin North, which drills down into the ice to collect frozen records of how our planet has evolved and changed to provide information on what might be in store for the future. Scientists are currently working towards the 'holy grail' of a million-year-old ice core.

In 2013/14 the French team led the 15-day traverse from Dumont d'Urville to the Aurora site and back, which was a 2,500 km round trip. As a result of this expedition scientists could, for the first time, look back in time 3,000 years by collecting 400-metre deep ice cores.

According to Dr Jérôme Chappellaz, Director of IPEV, the French-Australian Antarctic cooperation agreement optimises the investments made in research and operations for both countries.

"Working in Antarctica is all about cooperation. France and Australia have a collaborative history that started several decades ago," Jérôme says.

"Through our spirit and our joint logistic and scientific interests, this relationship will be even stronger in the future. And during the French President Emmanuel Macron's visit to Australia in May 2018 he and Australian Prime Minister Malcolm Turnbull reiterated their commitment and desire for continued collaboration."

Hundreds of students have participated in satellite design workshops at the ANCDF

Mission design at rocket speed

Planning space missions is traditionally a time-consuming and costly process. But the new Australian National Concurrent Design Facility (ANCDF), housed at UNSW's Canberra campus, speeds things up so a mission can be planned in weeks rather than months.

Harnessing the expertise, design processes and software of the French Space Agency CNES (Centre National d'Etudes Spatiales), the UNSW team has created Australia's first concurrent design facility. The ANCDF allows engineers and scientists—both professionals and students—to design different parts of a mission in parallel rather than one after the other, which is the traditional approach.

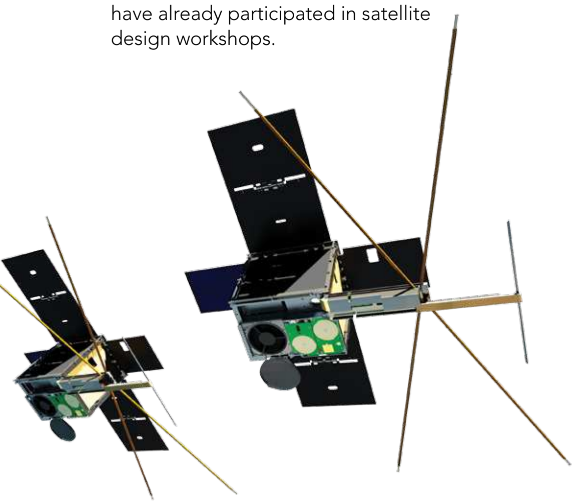
Better communication and consistency means fewer errors

According to Jan-Christian Meyer, ANCDF Manager and Space Systems Engineer with UNSW, bringing together experts from different domains allows for better communication and greater consistency. This means fewer errors, a greater variety of options, and ultimately more suitable designs and less uncertainty for customers.

"Engineers are eager to run studies in the ANCDF because they see the value of this new, agile approach," Jan-Christian says.

"This is an exciting opportunity for UNSW Canberra Space because as a relatively young group we can more easily change the way we work. That's a lot more difficult for a large enterprise with long-existing processes," he says.

Since becoming fully operational in June 2018 the ANCDF has already been used by engineers and scientists to prepare for missions launching in 2019. Plus, hundreds of school students and undergraduates have already participated in satellite design workshops.



Photos: Fish market image, credit: Shutterstock.com; Studying baby sharks in French Polynesia, credit: Tom Vierus; The ANCDF makes planning space missions much faster, credit: University of New South Wales; The icebreaker *L'Astrolabe* runs the Tasmania-Antarctica route carrying scientists and supplies, credit: Marine Nationale

Balloons over the Red Centre

A perfect view of the Milky Way

On a series of calm, cool mornings in April 2017, 70 French scientists (from the French space science agency CNES, CNRS IRAP, and the Université Paul Sabatier de Toulouse) launched three enormous balloons into the sky above the heart of Australia.

CNES was using the Alice Springs Balloon Launching Centre (ASBLS) to send three precision scientific instruments up to altitudes of 30-40 kilometres to make observations that are impossible from the ground.

CLIMATE studied the concentration of greenhouse molecules in the upper atmosphere; CARMEN provided imagery of the stratosphere to measure aerosols, cloud, smoke and dust; and PILOT mapped the magnetic polarisation of dust clouds in our galaxy.

"The helium-filled balloons carrying the instruments can be the size of the Melbourne Cricket Ground, about a million cubic metres in volume, when at float altitude. They are expensive to make, and very complicated to launch, but they can achieve science that cannot be done on the ground," says Dr Ravi Sood, Director of the ASBLS.

Australia is great for observing the centre of our galaxy

"X-rays and gamma rays emitted from neutron stars and black holes are almost totally absorbed in the top of the atmosphere so we cannot observe them from the Earth's surface. The only way to do this kind of astronomy is by sending detectors to the edge of space and stratospheric balloons are perfect for the job."

The ASBLS is run by NASA, CSIRO and University of New South Wales, but organisations such as CNES also use the facility.

Ravi says that Alice Springs is a special place.

"Australia is great for observing our Milky Way galaxy because its centre passes almost directly overhead, and you cannot see it from the Northern Hemisphere. Combined with predictable weather, vast tracts of open land and great infrastructure such as downwind tracking stations, there are few places in the world like this."

"We make bacteria do amazing things"

Creating living cell factories

Researchers at the University of Adelaide and the Pasteur Institute in France are creating biological factories within cells to make and detect molecules for a wide range of uses in health, environmental monitoring and industry.

Synthetic biology—the application of engineering principles to build new biological parts, circuits and devices—has been used to build tumour-killing bacteria, for example, and has great potential for green chemistry that uses fermentation rather than petrochemicals.

Custom biological "circuits" can create proteins and polymers

According to Associate Professor Keith Shearwin at the University of Adelaide, the team has developed new tools to speed up 'synbio' science and biosensors that can detect molecules in the environment.

"We make bacteria do amazing things by integrating biological pathways, which we call circuits, into the bacterial genome. These circuits can be custom designed to create proteins, polymers or other molecules," he says.

"We've recently been able to increase the number of integration positions where circuits can be installed in the *E. coli* genome. Plus, we've sped up the construction of these cell factories, so scientists can create new molecules faster," Keith says.

The collaboration has been successful so far and currently consists of four researchers and a PhD student involved across the two institutions.

"Synthetic biology has a valuable philosophy of sharing and open access, which is great. But organised international collaboration and cooperation is vital for efficient and exciting scientific progress," Keith says.

In other projects, the team has constructed circuits that monitor whether DNA-binding proteins are performing efficiently or not, and circuits that cause bacteria to glow red when they encounter particular substances, such as vitamin B7.

This could allow bacteria to become living diagnostic tools sensing and responding to the presence of substances in a range of environments, including the human gut.

Peptides to fight pain

A new approach to the global chronic pain problem

Chronic pain affects around 20 per cent of the world's population at any one time. It is the most common reason people seek medical help in Australia. Chronic pain often goes hand in hand with anxiety and depression.

Short chains of amino acids—known as peptides—may offer hope. A collaboration between neurobiologists at The Florey Institute of Neuroscience and Mental Health at The University of Melbourne and CNRS units affiliated with the Universities of Bordeaux and Strasbourg has made significant progress towards an entirely new approach to treating pain.

They have shown that chronic pain and related anxiety can be reduced by stimulating particular neurochemical pathways in the brain. Using specific peptides, they activate neural membrane receptors to create an analgesic effect.

The team has completed studies on the cholecystokinin and oxytocin receptor systems in areas of the brain including the amygdala. A new project aims to determine the role of relaxin-3 receptor signalling in the plasticity of descending circuits associated with inflammatory pain and related anxiety. The goal is that the research will lead to novel treatment strategies.

According to Professor Andrew Gundlach from The Florey Institute, there are substantial benefits from the international links.

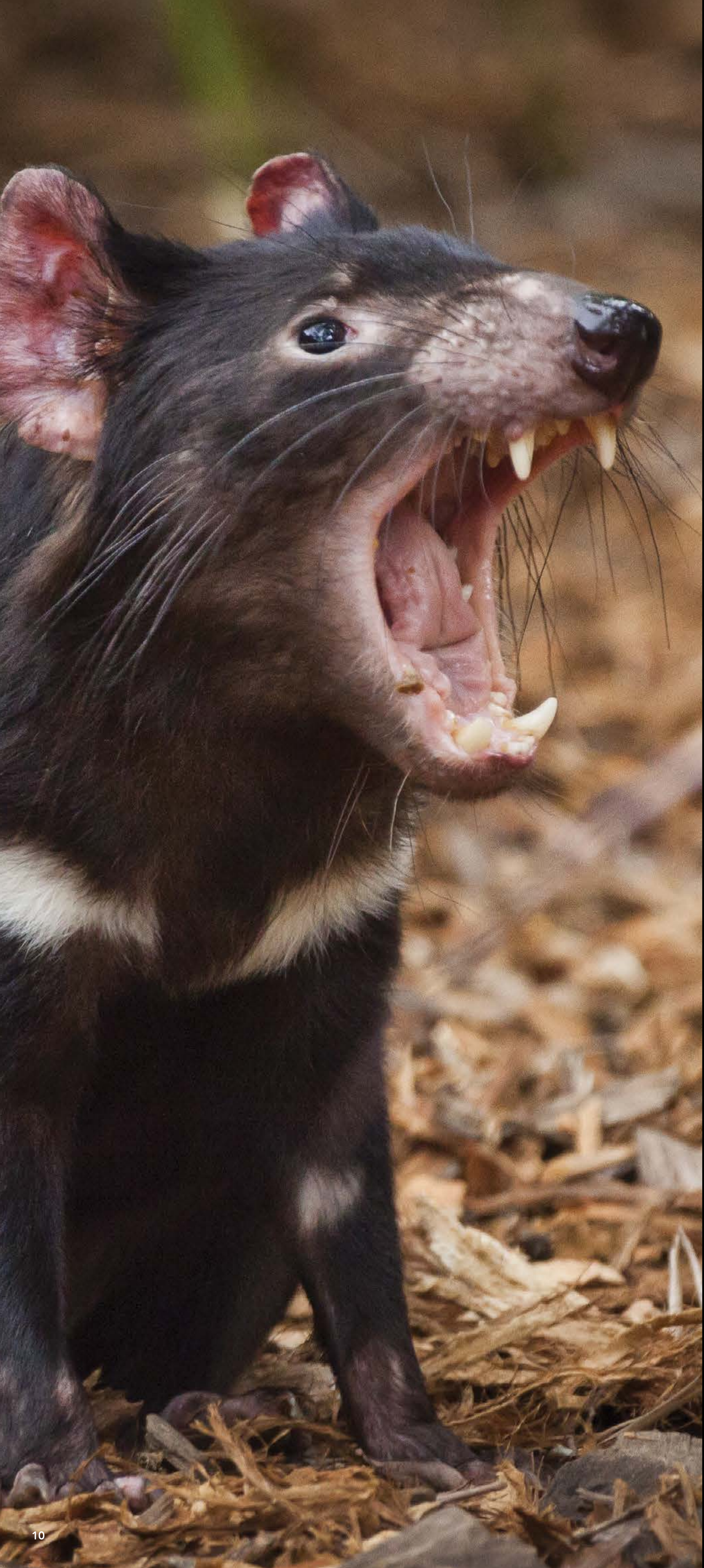
Research will lead to novel treatment strategies

"It's exciting to see the additional intellectual and technical resources that have been brought together to find solutions for this major burden of disease," Andrew says.

"This collaboration has so much potential. We have obtained promising results so far, and with additional funding our studies might progress all the way to clinical trials," he says.

The collaboration has been supported through a memorandum of understanding between The Florey and the University of Bordeaux.

Photos: The PILOT balloon being readied for launch, credit: CNES/OMP/IRAP/UT3/CNRS/Sebastien Chastanet



Cancer, maths and evolution

Shifting the cancer battleground

A new French-Australian joint cancer laboratory is forging a new way to study cancer by joining experts from different fields including mathematics, cell biology, evolutionary biology, and behavioural ecology.

Cancer is not only a major cause of human death worldwide, but also a disease that affects all multicellular organisms. Despite this, oncology and other biological sciences such as ecology and evolution have developed in relative isolation, according to Dr Beata Ujvari from the Roles of Cancer in Ecology and Evolution International Associated Laboratory at Deakin University.

Cancer has evolved together with life on Earth

"We know that there is a clear reciprocal interaction between malignant cells and their hosts, with malignant cells evolving in response to the organism's defence mechanisms," Beata says.

"Cancer also directly and indirectly impacts the physiology, immunology and behaviour of organisms. But very little is actually known of the evolutionary impact of these complex relationships. We are changing that with this type of research, which has rarely been explored before," Beata says.

The goal is to transform the understanding of cancer, its origin, how to halt its progression, and to prevent therapeutic failures. At the same time, the role of cancer in ecosystem functioning is something that ecologists need to consider.

Researchers say that cancer's impact on ecosystems could be significant. It can influence an individual's competitive and dispersal abilities, susceptibility to pathogens and vulnerability to predation. In some cases, such as the facial tumour disease that afflicts Tasmanian devils, it can heavily impact a species.

The joint laboratory is a collaboration between: Dr Frederic Thomas of the Centre for Ecological and Evolutionary Cancer Research at the National Scientific Research Centre (CNRS) in France; Deakin University; and the University of Tasmania, Australia. In Australia, the team has partnered with the Tasmanian Government's Save the Tasmanian Devil Program and Zoos Victoria.

The hunt for shapeshifting cancer cells

Outwitting rogue cancers that defy treatment

For a long time, doctors and patients have dreamed of precision oncology, a process that allows specific, effective treatments for individual tumours.

In the past, the complex nature of tumours has made this impossible.

"Within a tumour, there are many different cell populations, each doing different things and behaving in different ways. Most cells will be killed by chemotherapy, but some are not," says Associate Professor Frederic Hollande of The University of Melbourne.

"Cell plasticity is the ability of cancer cells to change and regrow after treatment, and we are investigating the influence of genetics and the environment on this process."

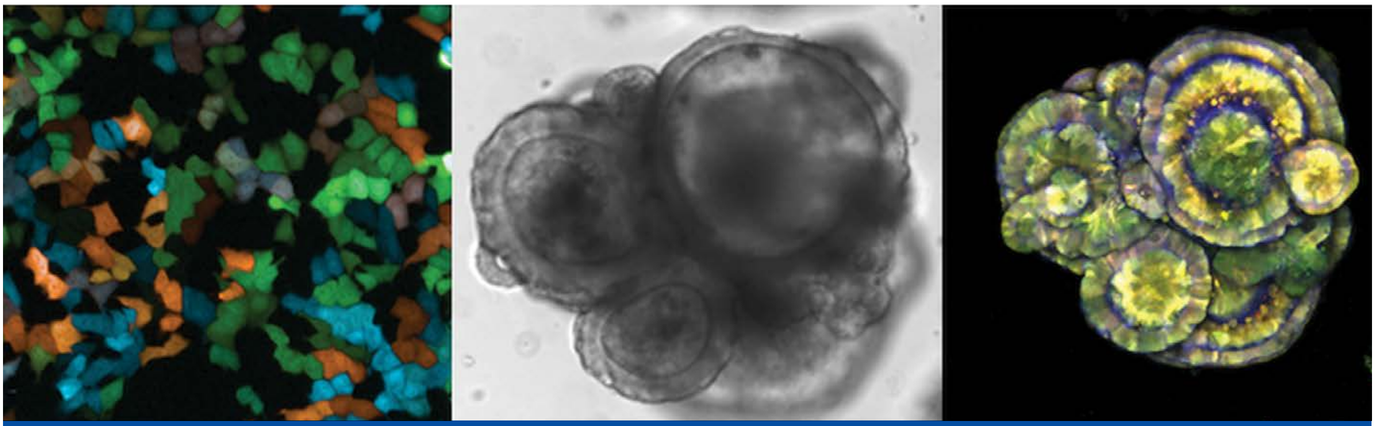
He is collaborating with Professor Alain Puisieux, Director of the Cancer Research Centre of Lyon (Université de Lyon), to understand these processes, especially in cells that have migrated away from their original site. This knowledge will enable treatments to be tailored to attack specific tumours.

The French-Australian collaboration, which gave birth to the first joint research lab between the French National Institute of Health and Medical Research (INSERM) and Australia, complements the skills and strengths of each laboratory and Frederic believes international collaborations like this one are vital for research.

"It makes us more efficient, but also means that we can share our expertise and goals and ultimately share the benefits across both countries," Frederic says.

Treatments could be tailored to attack specific tumours

"Our knowledge of bowel and pancreatic cancer is being applied to melanoma and breast cancer in Lyon. We are certain that this will broaden the spectrum of treatment and make our results more generalisable across patient populations."



Optically barcoded cells, tumour organoids and other innovative tools are unlocking the secrets of metastatic cancer

Photos: Cancer can have a significant impact on species—such as the Tasmanian devil—and even whole ecosystems, credit: Shutterstock; Frederic Hollande looking at liver metastasis samples, credit: University of Melbourne Centre for Cancer Research/Peter Casamento; Optically barcoded cells and tumour organoids, credit: Frederic Hollande

Planetary changes

Discovering our changing planet: a perfect France-Australia partnership

Professor Kurt Lambeck is one of Australia's most eminent scientists—a geophysicist who revealed how the Earth changes shape and how these changes are tied to sea levels, the movement of continents, and the orbits of satellites. Vital to his career have been French collaborations that now span almost half a century.

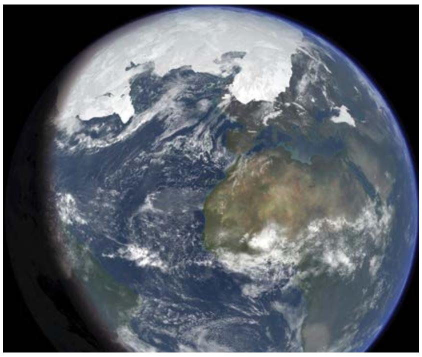
In 1970 Kurt took a position at the Paris Observatory (Université Paris Sciences et Lettres), after working at the Harvard and Smithsonian Observatories on NASA-supported programs for measuring the Earth's shape and gravity field. He helped to expand the then-emerging French program using satellites to study the Earth and for navigation. He had planned to visit France for a single year; in the end he stayed for eight.

"I quickly learned there was little I could teach them about satellite geodesy, but I could define new application areas," Kurt says.

So, he steered the program towards geophysics, measuring: the slow deformations in the planet and in its gravity field; the planetary tides; Earth's irregular rotation; and the changing oceans and ice caps. France is still a leader in these areas today.

"Ultimately—through my students and colleagues—this early work has led to major new developments in these areas of global geophysics."

In 1977, Kurt returned to Australia to take up a position at the Australian National University in Canberra, where he still works today. He has maintained his connection with French satellite projects, though now primarily as an end user of the results.



"Once I could no longer be involved in collecting and analysing the data, I started looking in more detail at what it said about the interactions between the solid planet and its oceans and atmospheres. And that turned out to be surprisingly complex."

For example, Kurt realised that measuring small changes in Earth's shape and gravity field could reveal how the planet's crust is still bouncing back from the weight of icecaps that existed in ancient ice ages. This opened a new window into the planetary ice history that could only be understood by integrating the information with work from other kinds of geoscience as well as historical and archaeological records.

"The basic science, the field evidence, and the earlier satellite work came together. You can model sea levels and reconstruct what coastal environments looked like and think about what that meant for prehistoric humans."

Kurt's work was recognised in France when he was named a Chevalier de l'Ordre National de la Legion d'Honneur in 2013, and in Australia with the award of the 2018 Prime Minister's Prize for Science.

Water for life

Changing how communities think about water in Oceania

Water is a fundamental necessity of life, and managing water—who uses it and how—is a key challenge in developing countries.

Decisions about how to use scarce freshwater for drinking, agriculture, industry, and the environment can lead to conflict. In Oceania, this is often complicated by questions of who should make the decisions—governments, landholders, industry or others.

Associate Professor Katherine Daniell of the Australian National University led a multi-partner program to better understand the issues and build tools for improved water governance, working with colleagues from France's National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA), National Research Institute for International Development (IRD), the Centre for International Cooperation in Agricultural Research for Development (CIRAD), and the New Caledonian Institute for Agricultural Research (IAC).

Decisions about how to use water can lead to conflict

In a project funded by the French Government's Fond Pacifique, they looked at water management in the VKP region of New Caledonia, Tarawa in Kiribati, and the Mardoowarra or Fitzroy River in the Kimberley region of Australia.

"We took different approaches to find out what was happening," Katherine says.

"For instance, we used a game designed by colleagues at IRSTEA and CIRAD called Wat-A-Game that lets people model their water system using cardboard and pebbles, to show how water moves and how people use it. In Kiribati, even the local water management organisation didn't know about all the different ways people were using water."

The project also arranged meetings between water managers from different countries to share stories and exchange knowledge.

"One important result was to raise the profile of water governance research in the French part of the Pacific. We're starting to build toolkits to improve water planning and get more views represented. This was just a beginning."

Photos: A water workshop in Kiribati, credit: Nils Ferrand/IRSTEA; Earth's crust is still rebounding from ancient ice ages, credit: Daein Ballard; CSIRO researchers Suzhi Li and Regina Ahmed with the new variety of wheat, credit: CSIRO

Partnering with France

If you are a researcher interested in partnering with France, get in touch with AFRAN, the Australian-French Association for Research and Innovation Inc.

AFRAN's goal is to connect Australian and French researchers, R&D managers, industry players, innovators and policy makers for collaboration, cooperation and innovation.

For more information and to get involved visit afran.org.au or contact afran.org@gmail.com

Katherine Daniell
AFRAN President

Wheat that's good for guts

A new kind of wheat high in resistant starch can improve intestinal health

Bowel cancer is the world's third most common cancer. A diet that includes more resistant starch, a kind of fibre that feeds good bacteria in the large intestine, can make it less common. Resistant starch helps improve gut health and reduces the risk of conditions such as diabetes, obesity, heart disease and cancer.

Since 2006, CSIRO scientists have been working in a joint venture with French company Limagrain Céréales Ingrédients and the Grains Research and Development Corporation to develop wheat with more resistant starch.

> **"People can have a higher fibre diet without changing their habits"**

"Wheat is the major source of dietary fibre in many countries, so we created a type that's high in an important component of starch called amylose. When we turn it into flour, it retains the resistant starch, and we can use it in bread, noodles and other staple foods," says Dr Tony Bird from CSIRO Health and Biosecurity. "We are not seeing any differences in food taste or texture, which means people can have a much higher fibre diet without changing their eating habits."

CSIRO and Limagrain formed a company called Arista Cereal Technologies to commercialise high amylose wheat (HAW). Arista is now working with Bay State Milling in the United States to grow and distribute HealthSense High Fibre Wheat Flour. Products made from high amylose wheat contain more than ten times as much resistant starch as those made from regular wheat.

"Bay State Milling has produced commercial amounts of high amylose wheat since the northern spring of 2018, and the first products will arrive on the market in the northern spring of 2019," says Eric Vaschalde of Arista Cereal Technologies.

"In Australia, we are working with Woods Foods to grow and distribute high amylose wheat grain for breakfast cereals and bars. We expect significant commercial production in 2020."

About AFRAN

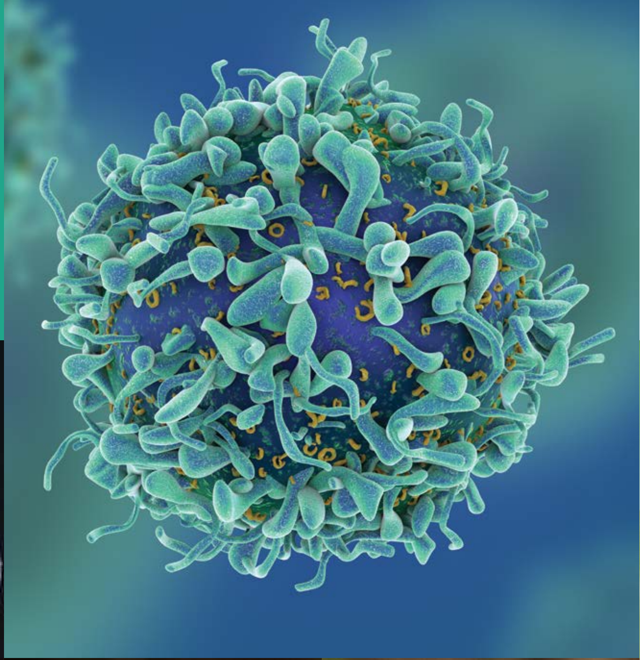
AFRAN was formed in 2016 from the merger of a group for French researchers in Australia (the French Researchers in Australia Network) and a group for Australian science and technology professionals who had worked in France (the Australian-French Association for Science and Technology [AFAS] Inc.).

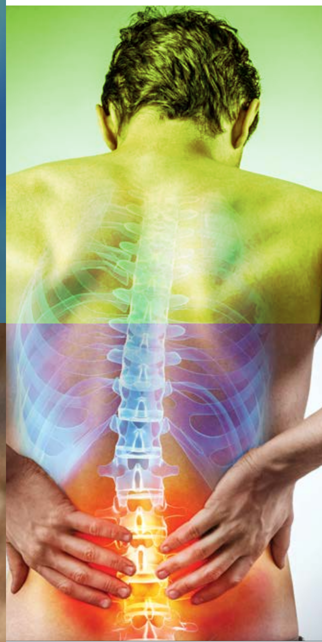
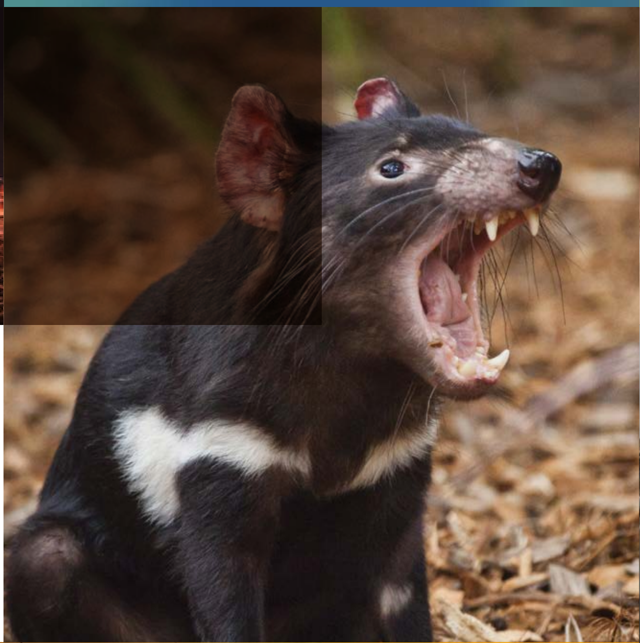
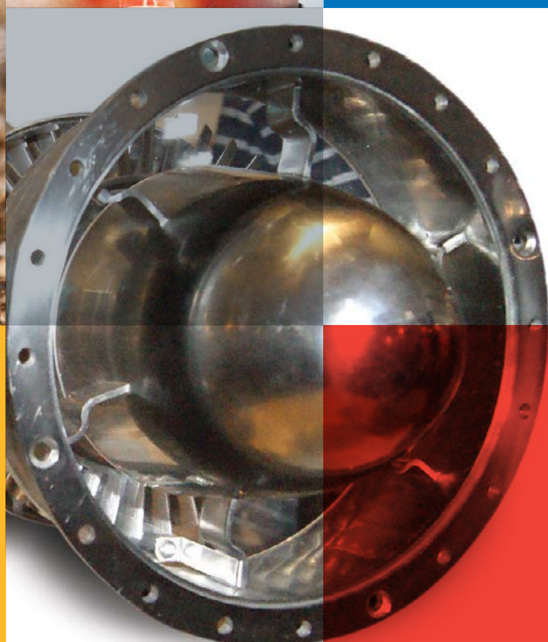
The Association organises networking events and conferences, coordinates a network of experts and supports innovation in the research and technology communities, including industry.

AFRAN is also building a bilateral platform on energy transition to foster connections between academia and industry, with a view to develop and promote disruptive technologies.

With around 500 members, AFRAN is growing quickly and has hubs running local events in most Australian capital cities. About a quarter of members are based in France, and plans are afoot to open a branch in Metropolitan France.

afran



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