LA TROBE UNIVERSITY

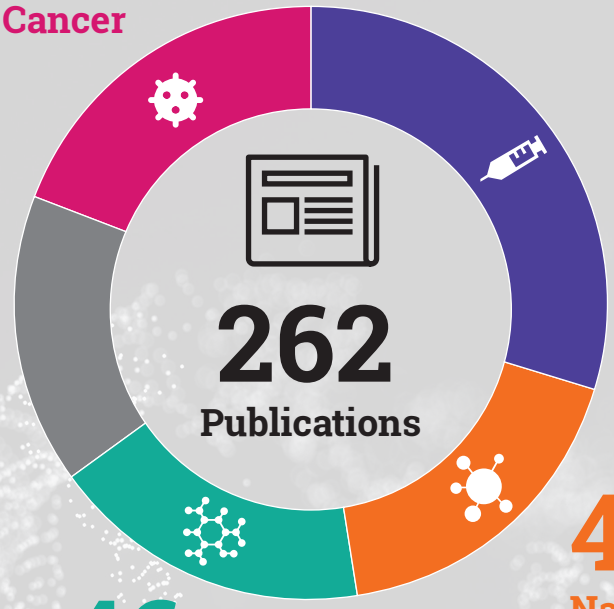
LA TROBE INSTITUTE FOR MOLECULAR SCIENCE

LIMS ANNUAL REPORT 2021

La Trobe Institute for Molecular Science

latrobe.edu.au/lims

LIMS 2021



50
Cancer

78
Infection & Immunity

41
Cross theme

47
Nanoscience

46
Molecular Design

2656
Followers

1003
Followers

3450
Followers

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CONTENTS

#1
for Gender Equality in Australia [1]

42%
Women lab heads

Workplace Gender Equality Agency

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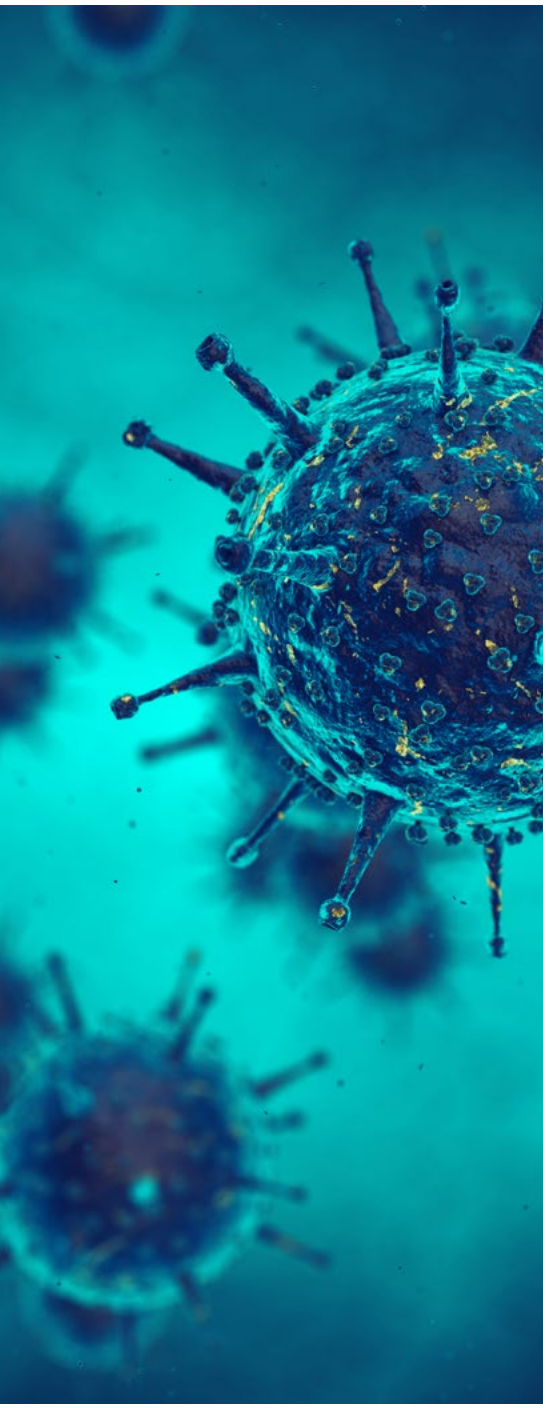
1 Times Higher Education Impact Ranking for La Trobe University 2021

TRANSLATABLE MOLECULAR DISCOVERIES



THE LA TROBE INSTITUTE FOR MOLECULAR SCIENCE (LIMS) BRINGS TOGETHER LA TROBE UNIVERSITY'S LEADING RESEARCHERS.

THROUGH RESEARCH AND EDUCATION, WE ARE WORKING TOWARDS SOLVING SOME OF THE WORLD'S MOST CRITICAL PROBLEMS AT THE INTERFACE OF HEALTH AND SCIENCE.

The La Trobe Institute for Molecular Science vision of excellence is achieved through four thematic areas of research strength: Cancer, Infection and Immunity, Molecular Design and Nanoscience.

The research agenda of LIMS is supported by a collaborative culture and modern facilities, where scientists in diverse disciplines work together to achieve remarkable outcomes that would not be possible in traditional academic settings. Our high impact research generates collaborations and partnerships across the globe.

Within LIMS are three embedded biotech companies. Hexima is a biotech company with a novel topical treatment for fungal nail infections in Phase IIb clinical trials. AdAlta is an innovative, clinical stage biotech company developing a unique range of new drug treatments. And in 2021 Imunexus became the latest biotech company to be embedded at LIMS.

LIMS has outstanding links with the Australian Synchrotron. Several of the Institute's physicists design and build synchrotron components to extend the synchrotron's capabilities.

And an important collaboration with the Olivia Newton-John Cancer Research Institute facilitates the sharing of knowledge, skills, training and facilities in the area of cancer research.

These mutually beneficial partnerships raise our research capabilities to new levels of national and international significance.

LIMS
AT A GLANCE

>400
ACADEMIC STAFF AND POSTGRADUATE STUDENTS

>60
LABORATORY HEADS

5
1 ARC FUTURE FELLOW
4 DECRA FELLOWS

3
NHMRC FELLOWS

1
VCA MID-CAREER FELLOWSHIP

1
TRACEY BANIVANUA MAR FELLOW

262
ARTICLES AND REVIEWS (2021)

1.98
SCOPUS FIELD WEIGHTED CITATION IMPACT

ERA RANKINGS:

5
BIOCHEMISTRY AND CELL BIOLOGY; ANALYTICAL CHEMISTRY; OPTICAL PHYSICS; CONDENSED MATTER PHYSICS; GENETICS; MEDICINAL AND BIOMOLECULAR CHEMISTRY

4
INORGANIC CHEMISTRY; PHYSICAL CHEMISTRY

>$44M
EQUIPMENT ACROSS 3 CAMPUSES

>900
INDIVIDUAL PIECES OF EQUIPMENT

LIMS RESEARCH THEMES:

CANCER
INFECTION AND IMMUNITY
MOLECULAR DESIGN
NANOSCIENCE

FACILITIES:

HISTOLOGY
COMPREHENSIVE PROTEOMICS PLATFORM
BIOIMAGING PLATFORM
STORE

RESEARCH CENTRES:

MATERIALS AND SURFACE SCIENCE
MOLECULAR CANCER PREVENTION
EXTRACELLULAR VESICLES
BIOMEDICAL AND ENVIRONMENTAL SENSOR TECHNOLOGY

EMBEDDED BIOTECHNOLOGY COMPANIES:

ADALTA LTD
HEXIMA LTD
IMUNEXUS LTD

The LIMS Building, La Trobe University

DIRECTOR'S REPORT

COVID-19 CONTINUES ITS GLOBAL OCCUPATION OF HEARTS, MINDS, AND BODIES. WE ARE THANKFUL FOR THE PROTECTION OFFERED TO US ALL BY VACCINATIONS.

Throughout last year we weren't sure what would be available, and when, and what would be the likely outcomes of vaccination. Because of the work of scientists like those in LIMS, seeking to unlock biomedical enigmas and solve scientific riddles, we can now face a future where the impact of the pandemic has been minimised and lives can take on a more normal hue.

While more vaccines are being developed, antiviral treatments are likely to be the big winner in reducing hospitalisations and death in those who are at high risk of progressing to severe illness. Not every discovery will make it through clinical trials. This is a clear expression of the rigour which potential treatments undergo. And even those that are successful must still be reviewed by the Therapeutic Goods Administration before release to the Australian population. There are no shortcuts in science but the speed at which vaccines have been created is an indication of how much can be achieved through collaboration, focus, and determination.

Despite the remarkable take-up of vaccinations across the country, there remain vulnerable communities requiring protection from serious illness. We know vaccination will likely become an annual event, tying in with flu shots, and we're grateful to live in a time when we have such options.

Some LIMS researchers continue to explore the challenge that this coronavirus presents. Professor Stephanie Gras moved to LIMS in late December 2020 and continues her focus on understanding how to combat viral infections. In addition to the Influenza and HIV viruses, Stephanie's team is now looking at COVID-19. Meanwhile, Professor Marc Kvansakul has extended his X-ray crystallography research to studying the long-term effects of COVID.

Many LIMS researchers remain focused on work that has consumed them for years, with great effect. Dr Christine Hawkins, Associate Professor in Biochemistry, has used funding from Tour de Cure and found a potential treatment for osteosarcoma that has spread to the lungs of teenage sufferers. This possible cure, using SMAC mimetics in conjunction with chemotherapy, is gearing up to trial, and was announced as Tour de Cure's 50th breakthrough in cancer research.

Similarly, Professor Brian Abbey (Physics) has had enormous success working a cross-disciplinary project with Dr Belinda Parker (formerly LIMS, now Peter Mac) and Dr Jacquie Orian (Biochemistry). Brian, with LIMS colleague Dr Eugeniu Balaur, has developed a microscope slide that promises to revolutionise medical imaging after demonstrating it can be used to accurately detect early-stage breast cancer cells in patients. Brian acknowledges that this invention might never have seen the light of day were it not for the focus in LIMS on cross-disciplinary work.

In Albury-Wodonga, Dr James Van Dyke (Biomedical Sciences) encouraged local communities to help save turtles in the Murray-Darling Basin as part of the 1 Million Turtles project. "Citizen scientists" have been encouraged to identify turtle nests and report them to the TurtleSAT mobile app and website. This allows intervention using extensive conservation methods, with the aim of helping one million juvenile turtles survive to help secure the future of the species. The work is supported by funding from the Australian Government.

Professor Coral Warr and her team from the University of Tasmania in Hobart joined LIMS mid-2021. Coral is a leading molecular geneticist and world expert on cell signalling in the Drosophila nervous system. Coral brings with her an extensive series of research outputs and some highly influential collaborations, and I believe she will have an important impact on the work of the institute.

La Trobe University underwent a transformation during the second year of COVID, 2021. As an upshot, the School of Molecular Sciences has been dissolved, with disciplines being realigned into new Schools. This will not, however, have anything but a positive impact on LIMS and its activities. It will provide access to new collaborative possibilities while staff retain old ones. I believe we will have a stronger Institute.

2021 was my final year as LIMS Director, and at La Trobe. I thank the LIMS leaders and the Advisory Board for their support.

I'm pleased to announce that Professor Patrick Humbert has been appointed LIMS Director for the three years 2022-2024. Patrick has been a senior member of the La Trobe School of Molecular Sciences and LIMS teams for several years, and I can think of no finer choice to take on this role. I wish him every success, and look forward to LIMS prospering under his leadership. I have no doubt that the impact of his leadership will be profound.

Emeritus Professor Brian Smith
LIMS Director 2019-2021

LIMS **ADVISORY BOARD**

THE LIMS ADVISORY BOARD PROVIDES STRATEGIC ADVICE ON THE INSTITUTE'S RESEARCH AGENDA.

Professor Fiona Cameron (Chair)

Professor Cameron is a molecular geneticist with a PhD from Macquarie University. A 20-year career with the CSIRO encompassed gene regulation, gene delivery, drug formulation and gene therapy. Professor Cameron has held management roles with the CSIRO Nanotechnology Centre and the National Flagship for Food Futures, as well as running the Innovation and Consulting unit at the University of Western Sydney. Her subsequent roles were Executive Director for Biological Sciences and Biotechnology, and Senior Executive Director at the Australian Research Council.

Professor Marilyn Anderson AO

Professor Marilyn Anderson AO FAA FTSE is Professor of Biochemistry at La Trobe University and the Chief Scientist of Hexima Limited. She is a Fellow of the Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering. She was awarded the Lemberg Medal from the Australian Society of Biochemistry and Molecular Biology in 2014 and the Leach Medal from the Lorne Protein Society in 2017.

Professor Susan Dodds

Professor Dodds is the Deputy Vice-Chancellor (Research and Industry Engagement) and Professor of Philosophy at La Trobe University. A La Trobe University alumnus, having completed her PhD in 1993, she has held senior roles at multiple institutions including the University of New South Wales. Professor Dodds is recognised internationally for her leadership in research ethics and public policy development related to emerging medical technologies, and is an active researcher in applied ethics and political philosophy.

Professor Matthias Ernst

Professor Ernst is the Head of the School of Cancer Medicine at La Trobe University and the Director of the Olivia Newton-John Cancer Research Institute. He obtained his PhD from the ETH Zurich (Switzerland), is a member of the Ludwig Institute for Cancer Research and an Investigator of the NHMRC.

Dr Megan Fisher

Dr Fisher is the Pro Vice-Chancellor (Industry Engagement) at La Trobe University. She has over 20 years experience in executive management and leadership positions in higher education and research-based organisations in the public and private sector, most recently as Director of Research, Innovation and Commercial Engagement at the University of Melbourne. Dr Fisher has a PhD in Organic Chemistry and a Bachelor of Science (First Class Honours) from the University of Sydney, as well as qualifications in business and executive management. Megan has extensive experience in leading and advising on a broad range of commercial transactions.

Professor Andrew Hill

Professor Hill was Director of LIMS from 2017 to 2019 before moving to Associate Provost Research and Industry Engagement for the College of Science Health and Engineering. He obtained his PhD at Imperial College London in 1998. He joined La Trobe University in 2015 as Head of the Department of Biochemistry and Genetics. His research specialises in molecular studies of neurodegenerative diseases and in the application of extracellular vesicles for diagnostics and therapeutics.

Professor Helen Irving

Professor Irving obtained her PhD in Biochemistry from the University of Melbourne and conducted post-doctoral work at Vanderbilt University (USA) and the University of Kentucky (USA) before returning to Australia to take up an ARC Post-Doctoral Fellowship at La Trobe University. For most of her career she has been a teaching/research academic based at the Faculty of Pharmacy and Pharmaceutical Sciences at Monash University. Helen moved to the La Trobe Institute for Molecular Science in 2017 where she has established an active lab investigating inflammatory mechanisms.

Mr Stephen May

Stephen May has more than 20 years experience working in strategic marketing and development roles across the higher education, not for profit and healthcare sectors. He has an MBA from Mt Eliza/ Melbourne Business School and a Bachelor of Education from Deakin University and brings extensive expertise and knowledge around philanthropy and international alumni programs. Stephen is currently the Chief Advancement Officer at La Trobe University where he is responsible for delivering the $100M Make the Difference Campaign.

Professor Andrew Peele

Professor Peele is the Director of ANSTO's Australian Synchrotron. He is an adjunct Professor of Physics at La Trobe University and was seconded to the Australian Synchrotron from La Trobe University in 2011. He is a Fellow of the Australian Academy of Technological Sciences and Engineering and a past president of the Australian Institute of Physics. His research improves the versatility and quality of x-ray imaging.

Professor Robert Pike

Professor Pike is Provost of the College of Science, Health and Engineering at La Trobe University. He has extensive experience in academic and research leadership roles, and is a former Director of LIMS. Professor Pike is a biochemist specialising in enzymes.

Dr Tony Radford AO

Dr Radford AO is a Director of ASX listed Genetic Signatures Ltd. He was previously a Director of Ellume Ltd, Nucleus Networks and was CEO of ASX listed Cellestis, from its founding until its acquisition by QIAGEN NV in 2011. For his contributions to tuberculosis diagnosis and enterprise, he received the Clunies Ross Award for the application of technology and is a Distinguished Alumnus of La Trobe University.

Professor Brian Smith

Professor Brian Smith is Director of LIMS and the Dean and Head of the School of Molecular Sciences. After completing his PhD in Chemistry at the University of Melbourne he held various research positions before being appointed as La Trobe's inaugural LIMS Principal Research Fellow in 2011. He specialises in the determination of protein structure by X-ray crystallography.

LEADERSHIP TEAM

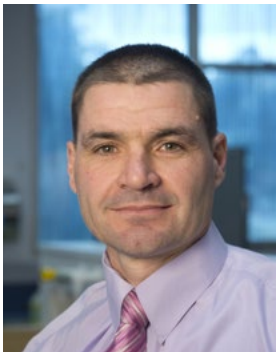
LIMS IS LED BY AN EXPERIENCED TEAM THAT UNDERSTANDS THE IMPORTANCE OF SCIENTIFIC INNOVATION AND TRANSLATABLE RESEARCH OUTCOMES.

Professor Brian Smith

Professor Brian Smith is the Director of LIMS and the Dean and Head of School of Molecular Sciences.

Professor Brian Abbey

Professor Brian Abbey is Deputy Director of LIMS and the school's Research Director.



Professor Michael Angove

Professor Michael Angove is Head of the Department of Pharmacy and Biomedical Sciences, and Academic Director of Transnational Education for PSB Academy.

Professor Mark Hulett

Professor Mark Hulett is Head of the Department of Biochemistry and Genetics.

Associate Professor David Wilson

Associate Professor David Wilson is Head of the Department of Chemistry and Physics.

Mrs Denise Strong

Mrs Denise Strong is School Manager for the School of Molecular Sciences. Mrs Strong holds a ACMA and CGMA.

LIMS **FELLOWS**

THE LIMS ENDOWMENT FUND WAS ESTABLISHED TO CREATE NEW AND SUSTAINABLE OPPORTUNITIES FOR SCIENTISTS WITH OUTSTANDING POTENTIAL.

The inaugural Bruce Stone Fellowship in Chemical Biology and the Nicholas Hoogenraad Fellowship in Molecular Sciences were awarded in 2015.

Both fellowships are named after two long-serving leaders: Professor Bruce Stone was the foundation professor of Biochemistry from 1972-1989, succeeded by Professor Nicholas Hoogenraad, who later became the first Director of LIMS. Professor Hoogenraad AO retired in 2014.

Nicholas Hoogenraad Fellowship

Dr Nick Reynolds

Dr Nick Reynolds graduated with a PhD from the University of Sheffield in 2009 before undertaking postdoctoral fellowships and research positions at the University of Zurich, CSIRO and the ARC Training Centre for Biodevices (Swinburne University of Technology). His research focuses on the design, discovery and characterisation of self-assembled nanomaterials. These materials have applications in tissue engineering, biosensing, drug delivery and understanding the molecular origins of disease.

Dr Reynolds works closely with biotech companies and hospitals to promote the translation of fundamental research into devices and commercial products that have real-world impact. Dr Reynolds has published 38 research papers (12 first, 11 corresponding author, > 1500 citations) in high impact journals including *Nature Communications, Chemical Society Reviews, The Journal of the American Chemical Society* and *ACS Nano*. He joined LIMS in 2019.

Donations

For over a decade LIMS has been supporting mid-career scientists to bring their research to the next level. The LIMS fellowships provide the security and support our elite scientists require in advancing research within their specialist fields including cancer and disease prevention. We are actively seeking to broaden the number of fellowships we offer.

If you would like to find out how you can help by way of a donation or bequest visit **www.latrobe.edu.au/lims/about/support-us**

or please get in touch for more information.

DISCOVERY **HIGHLIGHTS**

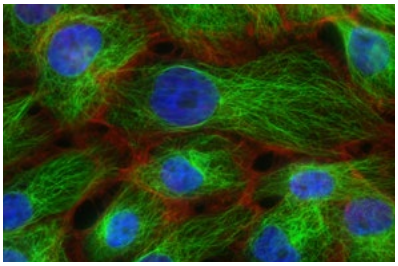
Australia's first My Green Lab

A LIMS laboratory became the first Australian research laboratory to receive certification from My Green Lab, considered the gold standard for laboratory sustainability best practice. A reduction in energy use, a minimisation of water usage, and the recycling of almost all waste materials are among some of the measures implemented by the Hill Lab. These measures will lead to better environmental outcomes, something other labs at LIMS and La Trobe University are now working towards.

LIMS SCIENTISTS PUBLISH IN HIGH IMPACT JOURNALS INCLUDING *NATURE*, *ANGEWANDTE CHEMIE INTERNATIONAL*, *PNAS* AND *IMMUNITY*.

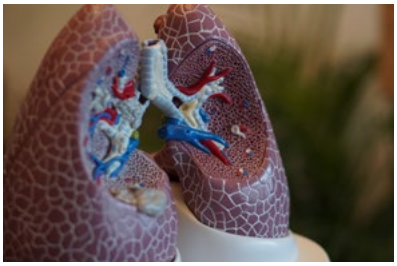
Damaged DNA

In a world first Dr Donna Whelan mapped specific molecular interactions that repair DNA double strand breaks that cause cancer, genetic abnormalities, and other types of neurodegeneration and immune disease. Leading an international collaboration Dr Whelan demonstrated, in *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, how they used advanced microscopy techniques to visualise the first responding proteins at the damaged site and their critical role in the repair process.



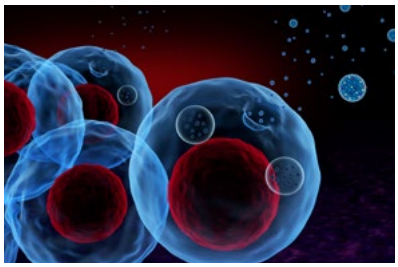
Cancer biology

Remnants left from cell division play an unexpected role in cancer biology. Research by Distinguished Professor Richard J Simpson and Dr Alin Rai, published in *Nature Communications Biology*, describe how information is communicated during cell division. Their research showed that midbody remnants in the extracellular environment not only carry mutated proteins that are found in cancer cells but also transfer them to non-cancer cells. These remnants may play a role in conferring cancer-supporting features to non-cancer cells.



COVID-19 & lungs

The effects of COVID-19 can extend well beyond the acute phase of the disease and long-term lung damage is a concern. Professors Patrick Humbert and Marc Kvansakul were the first in the world to characterise how COVID-19 attacks lung tissue through the mechanisms that specify the architecture of organs. Using powerful beams of light at the Australian Synchrotron they were able to show how SARS-CoV-2 E binds to tissues and hijacks Pals1, a key protein found in human tissue. Published in *Communications Biology*.

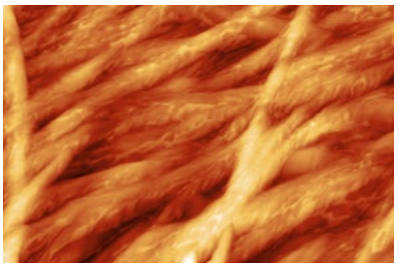


CJD early diagnosis

Creutzfeldt-Jakob disease (CJD) is a degenerative brain disorder that leads to dementia and ultimately death. Currently, CJD can only be definitively diagnosed through a brain biopsy or at autopsy. In a *Communications Biology* paper Professor Andy Hill and Dr Lesley Cheng identified cell particles in the blood, known as extracellular vesicles, containing distinct markers that aid in the earlier diagnosis of CJD. Earlier identification of prion diseases, like CJD, could lead to therapies that might slow or halt disease progression.

Herbicide hope

Weeds are a big problem. And they're becoming increasingly resistant to existing herbicides, posing a significant threat to agricultural production. Research led by Dr Tatiana Soares da Costa has identified inhibitors of lysine biosynthesis with an unexplored mode of binding that have herbicidal activity. The findings, published in *eLife*, highlight the potential of lysine biosynthesis inhibition as a novel herbicide mode of action to address the global issue of herbicide-resistant weeds.



Crossing borders

An international collaboration led by Professor Adam Mechler yielded a new class of nanostructured materials. The multi-national team succeeded in the development of molecular building blocks for a flexible platform technology, opening new avenues towards a range of nanotechnological applications such as molecular electronics and functional surface coatings. Researchers from A*STAR Institute in Singapore and Helmholtz-Zentrum in Berlin, with Monash University and The University of Queensland in Australia, collaborated with La Trobe University to publish in *Materials Advances*.

WHERE RESEARCH MEETS COMMERCIALISATION

A 'SMART' MICROSCOPE SLIDE SET TO REVOLUTIONISE EARLY-CANCER DIAGNOSES AND A MOBILE PHONE THAT CAN BE USED TO TEST FOR SULPHUR DIOXIDE IN WINE… JUST SOME OF THE RESEARCH THAT LIMS IS TAKING FROM THE LABORATORY TO THE 'REAL' WORLD.

For six years Professor Brian Abbey and Dr Eugeniu Balaur spent countless hours in laboratories at LIMS and the Melbourne node of the Australian National Fabrication Facility (ANFF), refining their microscope slide invention.

Revealed in 2021 their NanoMslide significantly enhances existing pathology techniques to diagnose early-stage breast cancer.

'Rather than invent a new microscope we were able to modify a standard microscope slide,' said Professor Abbey.

Part of the success of the NanoMslide was the inventors' ability to find a "pain point". Existing techniques for detecting breast cancer have their limitations, particularly in the early stages of the disease. Professor Abbey's team is determined to find a better way. Detailed in *Nature*, the resulting NanoMslide is a proven success, offering a cost effective mechanism for cancer detection with potential for widespread use in pathology laboratories.

The NanoMslide is one among several inventions to come out of LIMS with scalable commercial viability.

Within the chemical and nanoscience space, Professor Conor Hogan develops portable, low-cost biosensors that tap into existing mobile phone technology.

Teaming up with La Trobe University electronic engineer, Darrell Elton, collaborating under La Trobe's Research Centre for Biomedical and Environmental Sensor Technology (BEST), Professor Hogan recently partnered with a major international instrument manufacturer to commercialise a mobile phone powered electrochemical biosensor for winemakers.

Sulphur dioxide is a necessary component of wine. Too little sulphur dioxide and the wine will quickly spoil. Too much and it destroys subtle flavours and character.

'Adding sulphur dioxide for a winemaker can feel like practicing the dark arts,' said Professor Hogan. Traditional methods for sulphur dioxide testing are complex and labour intensive, occurring at several stages between grape picking and bottling.

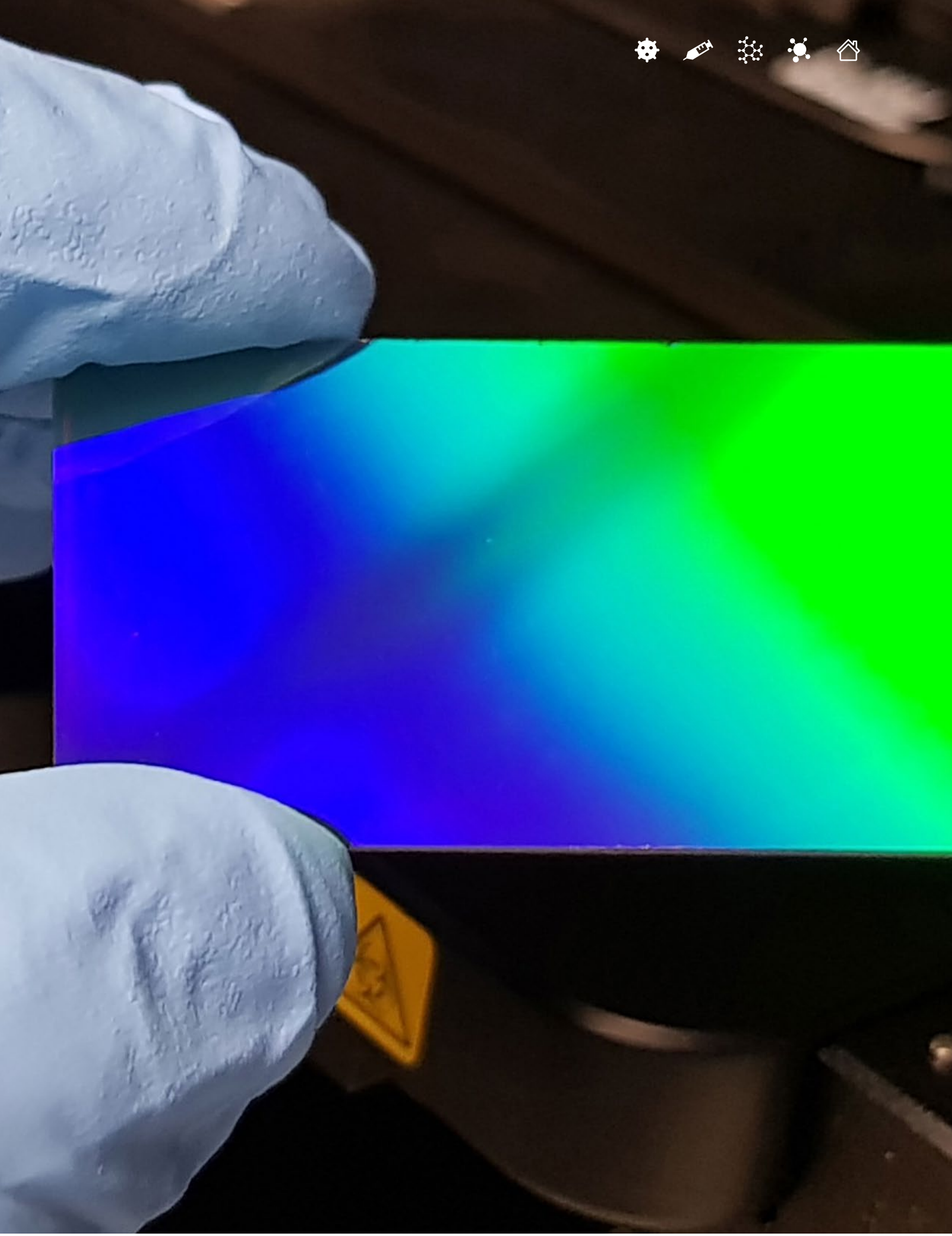
'Borrowing from other biosensing work I've done, I was able to design a small, cost-effective solution using an electrochemical probe that connects to a mobile phone,' explained Professor Hogan.

'Now all the winemaker need do is position the probe in a sample of wine and read the output on their phone. The process becomes a quick 20 second test, compared to the arduous 20 minute titration method.'

Professor Hogan and his team are extending their biosensing technology to other "real world" applications – including water quality testing and the development of a simple platform for various medical diagnostic and health tests.

The work of La Trobe Institute for Molecular Science may begin in a science laboratory but extends far beyond the boundaries of fundamental science. When discoveries translate into "real world" solutions they not only improve the life of people, society and the environment, they have the potential of becoming commercially viable.

NanoMslide invention is in association with Associate Professor Belinda Parker at Peter MacCallum Cancer Centre.



CANCER

Our Cancer researchers are investigating the molecular basis of cancer initiation and progression, how cancer cells communicate with their surrounding environment and the discovery of new therapeutic approaches to combat the disease.

Theme leader

Erinna Lee
Principal Research Fellow

Apoptosis, autophagy, cancer, drug discovery, cell biology, biochemistry, structural biology
Examines cell death/survival by apoptosis and autophagy, using biochemistry, cell biology and structural biology approaches. Uses this information to understand normal physiology and to develop therapeutics targeting these pathways.

Members

Doug Fairlie
Associate Professor

Apoptosis, autophagy, cancer, drug development and peptides
Uses biochemical, cell biology and structural biology to understand the molecular mechanisms underlying cell death and survival processes. Studies new strategies for killing cancer cells by targeting the apoptotic pathways and how autophagy regulates gastrointestinal homeostasis.

David Greening
Associate Professor

Functional proteomics, extracellular vesicles, cell reprogramming, nanotechnology
Specialises in quantitative proteomics and circulating extracellular vesicles in cardiometabolic disease and normal physiology. Investigates the molecular basis of cell signalling, models of cardiovascular disease, identifies deliverable therapeutic targets for cell-free therapy, and engineers nano-carriers for targeted delivery.

Christine Hawkins
Associate Professor

Cell death regulation in cancer and viral infection
Studies apoptotic regulation in normal, cancerous and virally-infected cells. Explores the potential for molecularly targeted therapies to improve outcomes for patients with the bone cancer osteosarcoma.

Nick Hoogenraad AO
Emeritus Professor

Development of therapeutic antibodies against cachexia
Specialises in cancer cachexia, a serious wasting condition and a major complication of cancer. Investigates the molecular basis of this condition and therapeutic intervention using monoclonal antibodies, with the aim of discovering biomarkers for early diagnosis and monitoring the outcome of treatment.

Patrick Humbert
Professor

Cancer biology, cell polarity and tissue architecture
Determines how cell asymmetry and tissue organisation can regulate cancer initiation, progression and metastasis. Examines how the cell polarity genetic program may be involved in tissue regeneration as well as developmental processes such as blood cell production and function.

Mihwa Lee
Tracey Banivanua Mar Fellow

Structural biology in gene regulation and DNA damage repair pathway
Uses a multidisciplinary approach combining molecular biology, protein chemistry, cell biology and X-ray crystallography. Characterises the macromolecular complexes (protein-protein and protein-nucleic acid complexes) in the nucleus to understand their fundamental roles in gene regulation and the DNA damage repair pathway.

Suresh Mathivanan
Professor and ARC Future Fellow

Exosomes, secretome and systems biology
Explores the role of extracellular matrix components (soluble secreted proteins and extracellular vesicles) in cancer and intercellular communication using proteomic, genomic and bioinformatics methodologies. Undertakes basic science projects including the biogenesis of exosomes and the role of exosomes in intercellular communication.

Helena Richardson
Associate Professor

Cell polarity, cell signalling and cancer lab
Uses the vinegar fly, *Drosophila*, to determine how regulators of cell shape (polarity) and the cell skeleton (actin cytoskeleton) impact on cell signalling and cancer initiation and progression, and to identify novel pathways that cooperate with the Ras oncogene in cancer.

Richard Simpson
Distinguished Professor

Extracellular vesicles, exosomes, shed midbody remnants and cancer biology
Uses an integrated proteomic, RNA profiling, bioinformatics and live-cell imaging strategy to understand the seminal role of extracellular vesicles in cell-cell communication in the extracellular environment during cancer progression and cancer plasticity.

Sarah Stewart
ARC DECRA Fellow

Unconventional protein secretion, extracellular vesicles and intercellular communication
Investigates alternative pathways for protein secretion from mammalian cells. Focuses on describing mechanisms of unconventional protein secretion including secretion of extracellular vesicles and their role in cellular homeostasis and disease.

Kaye Truscott
Senior Lecturer

Mitochondrial protein homeostasis
Studies the function of proteins engaged in the biogenesis and maintenance of mitochondria, the cell's power plant and manufacturer of essential biomolecules. At a molecular level investigates mitochondrial factors contributing to the development of human diseases including rare neuroendocrine tumours.

Donna Whelan
ARC DECRA Fellow

Biophysics, DNA damage, fluorescence, single molecule imaging
Applies state-of-the-art techniques to biological questions. Uses microscopic and spectroscopic methods to visualise the compositions and ultrastructures of individual cells and their subcomponents.

CAN DRINKING MILK IMPROVE CANCER OUTCOMES?

GROUND-BREAKING RESEARCH FROM SCIENTISTS AT LIMS MAY LEAD TO THE DEVELOPMENT OF NEW OPTIONS FOR CANCER TREATMENTS, PARTICULARLY FOR ADVANCED CANCER PATIENTS WHO HAVE UNDERGONE SURGERY TO REMOVE THE PRIMARY TUMOUR.

Extracellular vesicles (EVs) are tiny vesicles released by cells that contain important proteins, nucleic acids and lipids. EVs can facilitate communication between cells and play an important role in cancer development and progression.

For years there had been speculation that if EVs present in food like cow's milk could be ingested by a cancer patient, then the EVs could deliver important "cargo" to the body's organs and regulate cancer progression. Until 2021 this remained unproven.

Research published in *Nature Communications*, from Professor Suresh Mathivanan's Laboratory at LIMS, shows it is indeed possible.

"We discovered that cow milk-derived EVs were able to withstand the gut conditions, be absorbed and reach distant organs in the body," said Professor Mathivanan.

"These milk EVs were found to have a functional role. The milk EVs were able to control the growth of the primary tumour, which is very positive. However, there were occasions this led to accelerated cancer metastasis."

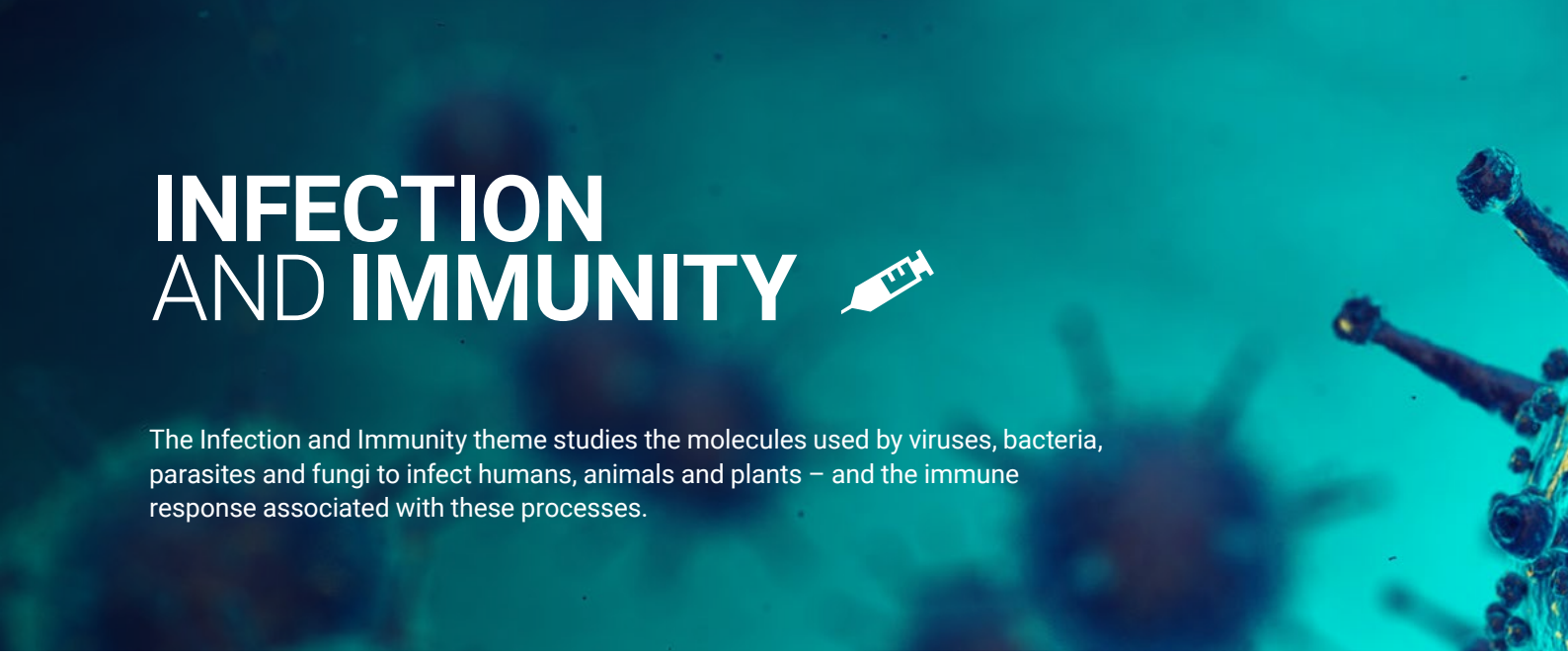
The key to successfully utilising this for cancer therapy, according to PhD researcher Rahul Sanwlani, is in the timing. "We found the timing of administering cow's milk EVs was critical. Administration of cow's milk EVs after surgically removing the primary tumours resulted in reducing metastasis and improved the survival rates."

This research defines a novel role of cow milk EVs in cross-species communication and their context-dependent activity in cancer progression.

"Our research paves the way for developing novel therapeutic alternatives to more efficiently treat and manage patients by combining existing standard-of-care therapy with milk EVs," said co-researcher, Dr Pamali Fonseka.

Rahul Sanwlani *(PhD researcher)*

INFECTION AND IMMUNITY



The Infection and Immunity theme studies the molecules used by viruses, bacteria, parasites and fungi to infect humans, animals and plants – and the immune response associated with these processes.

Theme leader

Begoña Heras
Associate Professor

Structural Biology of Bacterial Pathogenesis
Studies the molecular mechanisms underlying Gram-negative bacterial infections. Uses a multidisciplinary approach combining X-ray crystallography, molecular biology and biochemistry to investigate the structure-function relationships in proteins involved in bacterial pathogenesis and develop antibacterial drugs with novel modes of action.

Members

Marilyn Anderson AO, FAA, FTSE
Professor

Plant innate immunity proteins
Specialises in protection of humans and crops from pathogens by studying natural defences of plants and the biology of the pathogens themselves. Identifies insecticidal and antifungal molecules in native plants for commercial applications in crop protection and human antifungal therapeutics. Chief Science Officer of the biotechnology company Hexima, which is embedded in LIMS and involved in the R&D of plant derived proteins and peptides.

Amy Baxter
NHMRC Peter Doherty Fellow

Extracellular vesicles in cell death
Focuses on the role of endothelial cell derived apoptotic bodies in intercellular communication and clearance during vascular inflammation, using both *in vitro* and *in vivo* models of disease.

Katrina Binger
Lecturer

Macrophage metabolism in biology and disease
Investigates the role of the physical and chemical composition of the tissue microenvironment on immune cell function. Focuses on innate immune cells, macrophages, and how metabolites and electrolytes modulate metabolic pathways.

Weisan Chen
Professor

Cellular immunity to virus and transplant antigens
Specialises in CD8+ T cell biology and antigen processing and presentation by various cell types, such as dendric cell subsets. Investigates interactions between T cells and antigen-presenting cells, and their impact on viral pathogenesis.

Mick Foley
Professor

Use of single domain antibodies as therapeutics in fibrosis and other chronic diseases
Uses a library of single domain antibodies derived from sharks to identify antibodies that bind and block the function of proteins shown to be involved in human pathological conditions such as fibrosis of the lung, kidney and eye as potential therapies for these diseases. Chief Founding Scientist of AdAlta, a LIMS embedded company.

Emma Grant
ARC DECRA Fellow

Antiviral immunity
Assesses the magnitude and the quality of the immune response towards viral infections including influenza virus and SARS-CoV-2. Uses a range of techniques including cellular assays, flow cytometry and single-cell RT-multiplex PCR.

Stephanie Gras
Professor & NHMRC Fellow

Viral and structural immunology
Seeks to understand the first key event in T cell-mediated immunity towards pathogens: the antigen recognition mechanism. An internationally recognised leader in the field of T cell Immunology and Structural Biology with a sustained record of high-quality publications.

Andrew Hill
Professor

Neurodegenerative diseases, extracellular vesicles and noncoding RNA's
Uses *in vitro* and *in vivo* models to look at how abnormal proteins and RNA travel from cell to cell and are involved in neurodegenerative diseases. Studies the biology of extracellular vesicles.

Mark Hulett
Professor

Innate defence and inflammation
Investigates molecular mechanisms that drive inflammatory disease, innate immunity and tumour progression. Focuses on the function of innate defence peptides and the heparan sulphate-degrading enzyme heparanase in order to develop novel therapeutics to treat infection, inflammatory disease and cancer.

Helen Irving
Professor

Proteins in the innate immune system
Studies unusual mechanisms that proteins in the innate immune system use to signal processes in cells to control inflammatory responses. Uses a multidisciplinary approach involving protein molecular, cell biology and protein chemistry supplemented by bioinformatics and systems approaches.

Cristina Keightley
Senior Lecturer

Myeloid development and disease
Seeks to discover and understand molecular pathways controlling myeloid cell development and disease. Focuses on haematopoietic stem cells and the innate immune response. Informs the design of pharmaceuticals, including stem cell therapies.

Christine Kettle
Lecturer

Autonomic and central nervous system regulation of metabolism
Examines the physiology of metabolism to find novel drug targets that activate brown adipose tissue (BAT) thermogenesis. Activation of BAT is a possible pathway to target obesity.

Marc Kvansakul
Professor

Structural biology of cell death and host pathogen interactions
Examines how viruses hijack cellular defence systems to ensure their own proliferation and survival. Understands the role of small proteins that act as a first line of defence against microbial targets and the mechanisms they use to destroy target cell membranes.

Ronan O'Toole
Associate Professor

Infectious diseases and antimicrobial resistance
Applies genomic epidemiology to track the origin and spread of healthcare-associated pathogens such as *Enterococcus faecium*, to map the acquisition of antibiotic resistance by *Mycobacterium tuberculosis* in relation to treatment outcomes and to correlate genotypes of non-typeable *Haemophilus influenzae* strains with chronic obstructive pulmonary disease presentations.

Jacqueline Orian
Senior Research Fellow

Neurodegenerative diseases
Investigates mechanisms underlying blood brain barrier damage and neuronal loss in Multiple Sclerosis (MS). Uses the experimental autoimmune encephalomyelitis (EAE) MS model to generate proof of concept for pathological and molecular neurodegenerative mechanisms. The long-term view is to develop novel therapeutics that will delay entry into progressive MS.

Ivan Poon
Associate Professor & NHMRC Fellow

Apoptotic cell disassembly and clearance
Studies the machinery that controls how dying cells can disassemble into smaller pieces. Specialises in the importance of cell disassembly in disease settings, such as influenza A infection and atherosclerosis to identify new drugs to control this process.

Hamsa Puthalakath
Associate Professor

Regulation of apoptosis by Bcl-2 family proteins
Studies the role of newly identified immunomodulatory receptor TREML4 in various inflammatory pathologies using *in vivo* mouse models. Also studies innate immune memory in Candidaemia and developing hemodynamically neutral therapy for dilated cardiomyopathy.

Joseph Tucci
Associate Professor

Bacteriophage as alternatives to antibiotics, pharmacogenomics and pharmacy practice
Examines the personalisation of medicine to fit a patient's genetic profile, particularly in traditional and Indigenous populations. Studies the use of bacteriophage as an alternative to antibiotics and how these can be delivered clinically.

James Van Dyke
Senior Lecturer

Integrative Physiology
Studies how vertebrate physiology interacts with environment to determine reproductive success. Focuses on the physiology and evolution of placentation as a model for complex trait evolution. Also applies physiological and citizen-science approaches to solving environmental problems in the Murray-Darling catchment.

Lakshmi Wijeyewickrema
Senior Lecturer

Proteases, inhibitors and receptors: relationship to disease states
Without enzymes human life would be impossible. Enzymes play an essential role in the immune system, including the reduction of inflammation. Understanding how enzymes work is integral in understanding how we can prevent and fight disease.

THE COMMON COLD AND COVID-19

AUSTRALIAN RESEARCHERS ARE LEADING INVESTIGATIONS INTO SARS-COV-2 AND DISCOVERING HOW THE COMMON COLD MIGHT HELP IMMUNE CELLS SEE THE VIRUS.

The battle for COVID-19 is not yet over. Currently available vaccines are effective at minimising severe illness but the road ahead remains somewhat uncertain.

A team from LIMS, in collaboration with other Australian researchers, is leading the way in research on SARS-CoV-2, the coronavirus responsible for the disease we know as COVID-19.

Their significant finding, published in the journal *Immunity*, reveals that catching the common cold might help our immune cells to "see" the SARS-CoV-2 virus before catching it.

Lead researcher, Professor Stephanie Gras, said that exposure to a winter cold may increase our chances of developing an immune response against SARS-CoV-2.

'We have shown that specific molecules within our immune system can present small parts of the coronaviruses similar to those responsible for COVID-19 and the common cold.

'Similar parts of the viruses could trigger a very strong immune response in individuals recovering from COVID-19. The immune cells that we are studying are called killer T cells, which are able to kill cells infected with the virus. We even saw some response against SARS-CoV-2 in people that were not infected with it, this is called pre-existing immunity.

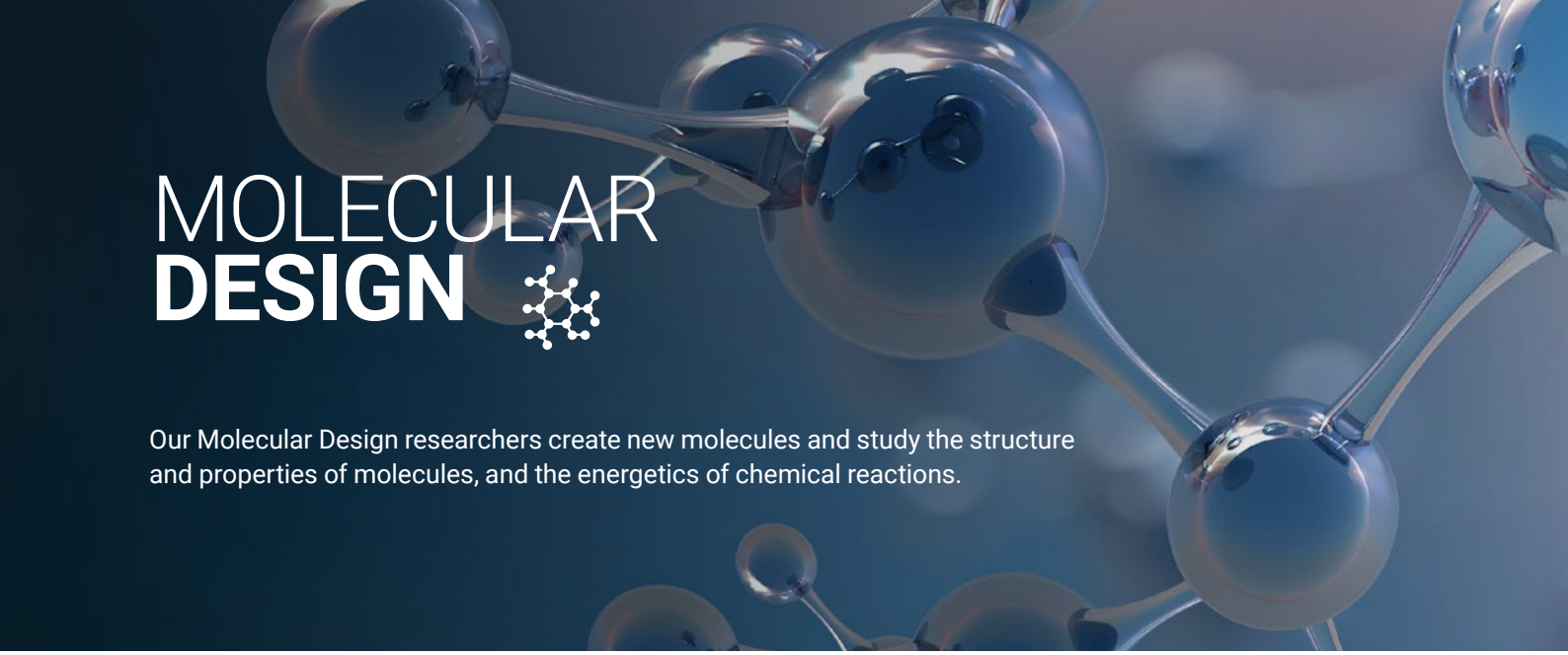
This research will help scientists better understand how immune cells recognise this coronavirus and how a response could be manipulated to boost immunity, and potentially explore a new vaccine strategy.

As SARS-CoV-2 mutates and new variants appear, it becomes even more critical to understand how T cells respond. According to Professor Gras, 'T cells are as important as antibodies in our immune repsonse to COVID-19 and are less likely to be affected by changes that occur in emerging variants.'

Professor Gras warns that mutations of the virus could result in decreases in the efficacy of current vaccines, emphasising the need for continuing research into new diagnostic or vaccine targets to combat COVID-19.

This research was done in collaboration with QIMR Berghofer, Monash University, University of Queensland, Australian Synchrotron, Fiona Stanley Hospital and the University of Western Australia.

Professor Stephanie Gras



MOLECULAR DESIGN

Our Molecular Design researchers create new molecules and study the structure and properties of molecules, and the energetics of chemical reactions.

Theme leader

Yuning Hong
ARC Future Fellow

Fluorescent probes, cell imaging, protein misfolding and neurodegenerative diseases
Develops fluorescence-based tools for understanding and manipulating fundamental biological processes. Designs and synthesises new luminescent molecules in combination with advanced fluorescence spectroscopy and microscopy for monitoring protein conformational transitions associated with neurodegenerative diseases.

Members

Belinda Abbott
Associate Professor

Medicinal chemistry and synthetic organic chemistry
Uses synthetic organic chemistry to make novel compounds for testing in biological assays in order to study the structure-activity relationships of how the compounds interact with the target. Develops treatments for bacterial infection, malaria, cardiomyopathy and motor neurone disease.

Carmel Abrahams
Senior Lecturer

Supramolecular chemistry and single crystal X-ray diffraction characterisation of small molecules
Investigates the design, synthesis and characterisation of supramolecular systems. Studies the use of the biodegradable porous compound Zn saccharate and its ability to act as a host for molecules such as small aromatic hydrocarbons.

Peter Barnard
Senior Lecturer

Synthetic organic and inorganic chemistry
Synthesises coordination complexes for diagnostic imaging applications and sensor development. Specialises in small molecule organic and inorganic synthesis in combination with analytical techniques for the generation and characterisation of new compounds.

Jason Dutton
Professor

Organic, organometallic and inorganic chemistry from synthetic and theoretical perspectives
Examines the fundamental chemistry of a wide variety of systems (literally spanning the periodic table from beryllium to iodine) using both synthetic and computational approaches. Discovers new structures, bonding and reactivity for a variety of elements.

Cathryn Hogarth
Senior Lecturer

Sperm development and maturation
Investigates the role that retinoic acid plays in the differentiation and maturation of sperm within the testis and epididymis. Focuses on how the production of retinoic acid is controlled within these organs and the downstream molecular targets of retinoic acid signalling. The ultimate goal is to develop new strategies for the treatment of male infertility and novel male contraceptives.

Matthew Perugini
Associate Professor

Rational drug design targeting infection and age-related diseases
Studies the structure, function, regulation and inhibition of essential oligomeric enzymes such as dihydrodipicolinate synthase from the lysine biosynthesis pathway of bacteria. Characterises the role of apolipoprotein E in cardiovascular and Alzheimer's diseases.

Pallavi Sharma
Senior Lecturer

Synthetic organic chemistry
Develops new synthetic methodology that delivers structurally diverse and complex chemical entities via rapid fusion of short lived reactive species. Using under-represented reagents, explores their latent reactivity for heterocycles, spirocycles, natural products and analogue synthesis.

Brian Smith
Professor

Modelling molecular interactions
Uses computational tools to explore the structure and function of proteins and how molecules interact. Uses X-ray crystallography to determine the structures of complexes of proteins, polypeptides and small molecules.

Tatiana Soares da Costa
ARC DECRA Fellow

Antibiotic and Herbicide Discovery
Examines the structure, function and regulation of essential proteins in bacteria and plants to guide the development of novel classes of antibiotics and herbicides. Focuses on targets involved in cell wall and amino acid syntheses and employs techniques encompassing biochemistry, bacteriology, biophysics, chemistry and plant biology.

Coral Warr
Professor

Neural cell signalling
Uses the powerful approaches for studying gene function in Drosophila to study how cells detect signals from the environment, including in chemosensation and growth. Leads several collaborations in biomedical research and is currently using fly genetics to understand the role of neuronal excitability in Motor Neuron Disease.

David Wilson
Associate Professor

Computational chemistry and quantum chemistry
Uses computational quantum chemistry to model molecular structures, properties and spectroscopies, as well as the energetics of reactions. Focuses on understanding the fundamental properties of chemical bonding and electronic structure in the design of new chemistry and new materials.

David Winkler
Professor

Computational molecular design and AI
Uses computational methods to study the interaction of molecules and complex materials. Expertise in the application of AI, machine learning and evolutionary computational methods to design bespoke materials with novel properties. Designs small molecules and peptides as drug leads, novel 2D hybrid materials for energy applications, biomaterials and coatings to control immunity and cell behaviour, and advanced informatics methods for surface science.

HOPE FOR EARLY NEURODEGENERATIVE DIAGNOSIS

CELLS ARE THE BASIC BUILDING BLOCKS OF ALL LIVING ORGANISMS – WITHIN YOUR OWN BODY THERE ARE MORE THAN ONE TRILLION CELLS.

Each cell is powered by proteins, which in turn are regulated by proteostasis. Proteostasis is essential to maintain cell health, and the organism itself.

As organisms age, proteostasis dysfunction can occur and is often the result of protein misfolding. Proteostasis dysfunction is associated with a range of disorders, from Parkinson's Disease (and other neurodegenerative disorders) to Type 2 diabetes and cancers.

Previous research suggests that evidence of protein unfolding may be a precursor to the clinical presentation of neurodegenerative disease (ND). The challenge facing medical professionals is determining protein folding and the state of proteostasis.

A cross-discipline team from LIMS – including chemists, biochemists and cell biologists, across four separate laboratories – collaborated on a way to better determine protein folding and proteostasis.

Project lead, Dr Yuning Hong, specialises in the development of organic luminescent molecules as probes and imaging tools for understanding biological processes.

'In this work we suggested a newly designed fluorescent tool that showed potential for use in proteome quality control,' said Dr Hong. 'Our hope was that having a better understanding of proteostasis, and finding a way to measure it, would lead to earlier diagnoses of neurodegenerative diseases.'

To measure proteostasis the LIMS research team used fluorescent lifetime measurements. According to Dr Hong, 'This technique enabled us to obtain a more precise understanding of microenvironmental alterations in the cell and estimate proteome unfoldedness or aggregation.'

A number of PhD students, including first author Soheila Sabouri, made significant contributions to the paper, which was published in *Advanced Healthcare Materials*. 'Our work reports a new platform based on a peptide-conjugated thiol-reactive AIE for labelling and tracking unfolded proteins in cells,' explained Ms Sabouri.

Neurodegenerative diseases are progressive, debilitating conditions related to brain function. As yet there is no magic bullet cure. This platform offers a potential tool to diagnose neurodegenerative diseases in their early stages, which may lead to earlier intervention and better patient outcomes.

This work was a collaboration between four cross-discipline LIMS Labs – the Hong Lab, Heras Lab, Poon Lab and Hogan Lab.

Soheila Sabouri *(PhD researcher)* and Dr Yuning Hong *(Project lead)*

NANOSCIENCE

The Nanoscience theme uses a broad range of methods to characterise molecular structure and function, and to identify and quantitate key chemical and biochemical species in the environment and in the human body.

Theme leader

Grant van Riessen
Senior Lecturer

Experimental condensed matter and materials physics, and coherent X-ray imaging development
Develops new ways of characterising and manipulating materials using coherent synchrotron light sources, with the aims of realising *in situ* imaging of nanoscale dynamics and enabling the next generation of lithographic patterning technology.

Members

Brian Abbey
Professor

Coherent X-ray science and optics
Combines elements of optics, nanofabrication and X-ray free-electron lasers to develop new approaches to imaging materials and structures at the atomic, molecular and cellular level. Develops techniques for interpreting patterns of coherently scattered light.

Russell Anderson
Senior Lecturer

Quantum enhanced sensing based on atom-light interactions
Develops next-generation quantum technologies with defence, medical and commercial applications. These include quantum-assured position, navigation and timing (PNT), and new perspectives on optical atomic magnetometry. A leader in software control and automation of quantum technologies.

Michael Angove
Professor

Colloid, environmental and pharmaceutical science
Uses colloid chemistry to research environmental and agricultural soil systems so that we are better placed to manage soil environments and even rehabilitate damaged or contaminated soils. Studies pharmaceutical products that utilise colloidal particles and systems.

Narelle Brack
Associate Professor

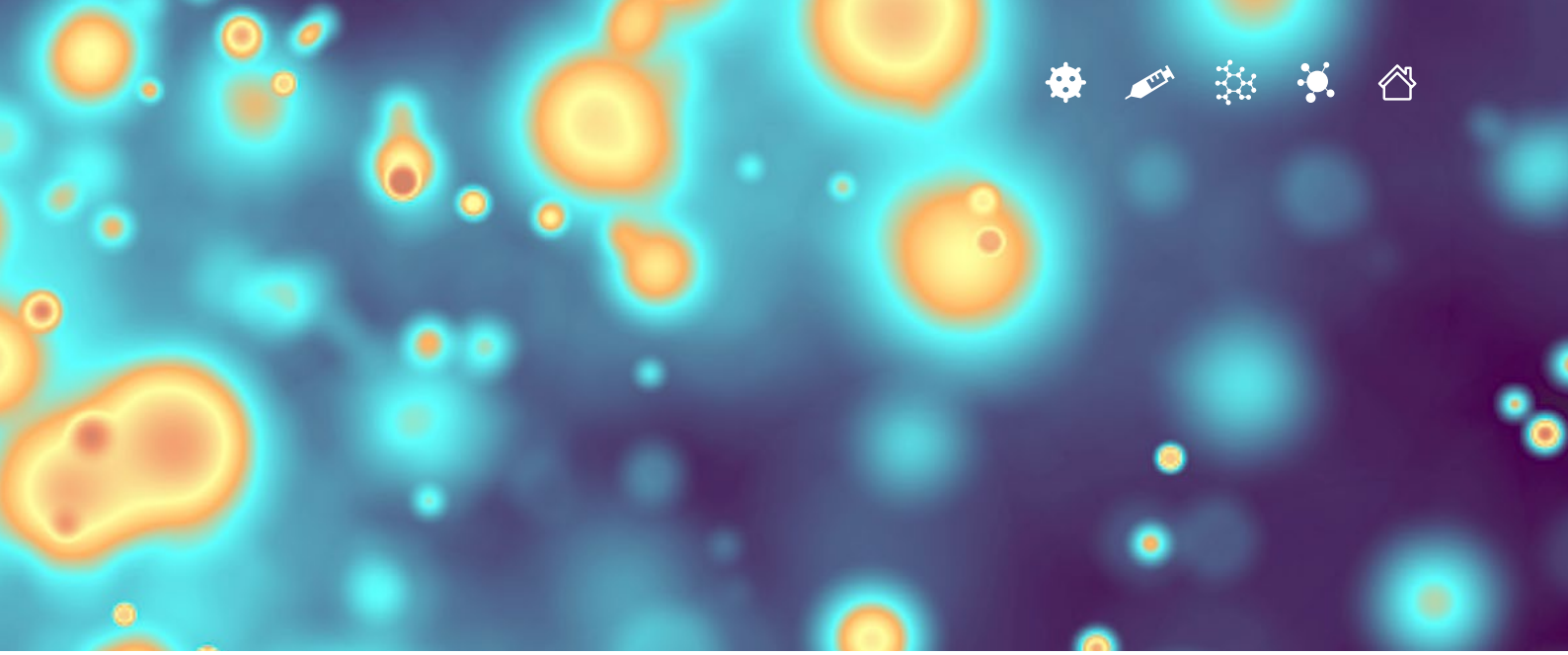
Surface modification and characterisation of advanced materials
Creates materials at the nanometer scale. Explores chemical and molecular properties and processes at surfaces and at interfaces. Develops surface modification strategies for material systems including next generation aircraft materials and carbon nanofibers.

Conor Hogan
Professor

Electrochemistry, photochemistry, chemical sensing and biosensing
Conducts fundamental and applied multidisciplinary research with the aim of expanding the bounds of analytical science and translation for real-world applications. A world leader in ultrasensitive electrochemiluminescence (ECL) based detection and the use of mobile phones and other personal electronic devices for low-cost chemical / biochemical analysis.

David Hoxley
Senior Lecturer

Biosensing applications of wide bandgap semiconductors
Studies the surfaces of semiconductor crystals, particularly diamond, and how they react to the world around and within us. Researches ways of making coaching possible in the tertiary education system, primarily through combining modern educational psychology with information technology.



Shanshan Kou
Lecturer

Bio-imaging and bio-photonics, optical micro- and nano-scopy, and biomedical instrumentation
Studies the interactions between light and biological matter to explore and discover the complex mechanisms behind cellular and sub-cellular events and processes. Develops novel bio-imaging modalities and instrumentation to be used in new diagnostic and therapeutic tools.

Adam Mechler
Professor

Bioinspired self-assembling nanostructures
Studies the mechanism of antimicrobial peptide-membrane interactions, the formation of metallosupramolecular assemblies and the reaction pathways of antioxidant activity. Applies principles of self-assembly in the development of novel peptide antibiotics, antivirals and the design of oligoamide-based metamaterials.

Chris Pakes
Professor

Quantum materials for quantum computing, low-power spintronics and biosensing
Examines the functionalisation of diamond via chemical modification of the surface and surface transfer doping. Focuses on atom-scale engineering of diamond devices for next-generation digital technologies enabling low-power and secure information processing.

Paul Pigram
Professor

Interactions at surfaces
Creates, understands and controls materials at the nanometer scale. Focuses on surface science, in particular exploring chemical and molecular properties and processes at surfaces and at interfaces, understanding molecular interactions at surfaces, and bio-surface characterisation.

Nick Reynolds
Nicholas Hoogenraad Fellow

Self-assembled nanomaterials
Translational research into the design, discovery and characterisation of self-assembled nanomaterials with applications in fields including tissue engineering, drug delivery, antibacterial materials, biosensing and understanding disease.

Evan Robertson
Associate Professor

Optical spectroscopy of atmospheric and biological molecules
Uses powerful light sources, such as lasers and the Australian Synchrotron's infrared beamline, to study the shape of neurotransmitter molecules relevant to pharmaceuticals, greenhouse gas molecules, ice cloud particles and even molecules in the interstellar medium.

Chanh Tran
Lecturer

Interactions of X-rays with matter, optical coherence and X-ray imaging
Specialises in various forms of X-ray imaging, precision determination of the interaction cross-sections between X-rays and a range of elements and compounds. Developing phase spectroscopy and imaging of dynamic systems.

STEM CELL GOLD

THE ABILITY TO GROW HUMAN AND ANIMAL CELLS IN LABORATORIES HAS LED TO GROUNDBREAKING DISCOVERIES AND VAST IMPROVEMENTS IN THE TREATMENT OF DISEASE SINCE THE EARLY 20TH CENTURY.

Human and animal cells are grown in laboratories for a wide variety of reasons and applications. From garnering a more accurate understanding of basic biology to developing cell based therapies for diseases including cancers. More recent discoveries in the field of cell culture have provided the basis for regenerative medicine, which treats injury and disease by harnassing the body's own regenerative capabilities.

Common cell culture practice is to grow cells on plastic dishes or flasks. Once the optimal number of cells is reached they are detached from the dish or flask for further study – or for processing or implantation.

Regular methods of detaching cells from surfaces uses harsh enzymes, which can damage or even destroy the cells being grown.

A team of scientisits, led by Dr Nick Reynolds – the Nick Hoogenraad Fellow at LIMS – developed an enzyme free method of detaching cells from culture substrates.

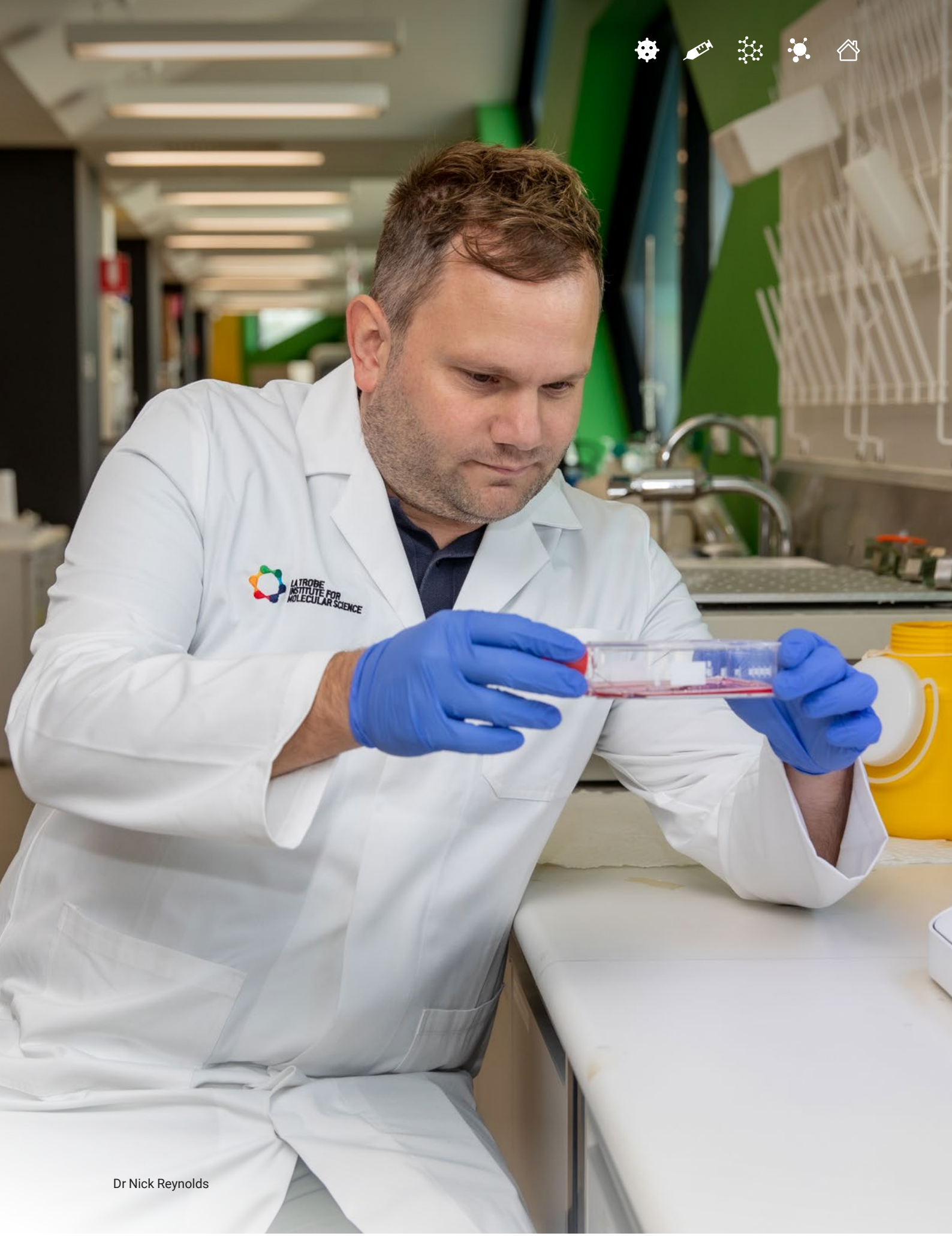
'We grew cells on surfaces coated with inexpensive gold nanorods,' explained Dr Reynolds. 'We discovered that under normal circumstances the cells will grow on these gold nanorod coated surfaces. When we illumunated the surfaces with infrared light it caused tiny fluctuations in temperature near the surface of the gold nanorods, which resulted in cells detaching.'

Dr Reynolds was then able to selectively detach cells from cell culture surfaces without the need for harsh, toxic enzymes.

'This enzyme free method of cell detachment means there is far less risk that cells will be damaged or destroyed,' said Dr Reynolds.

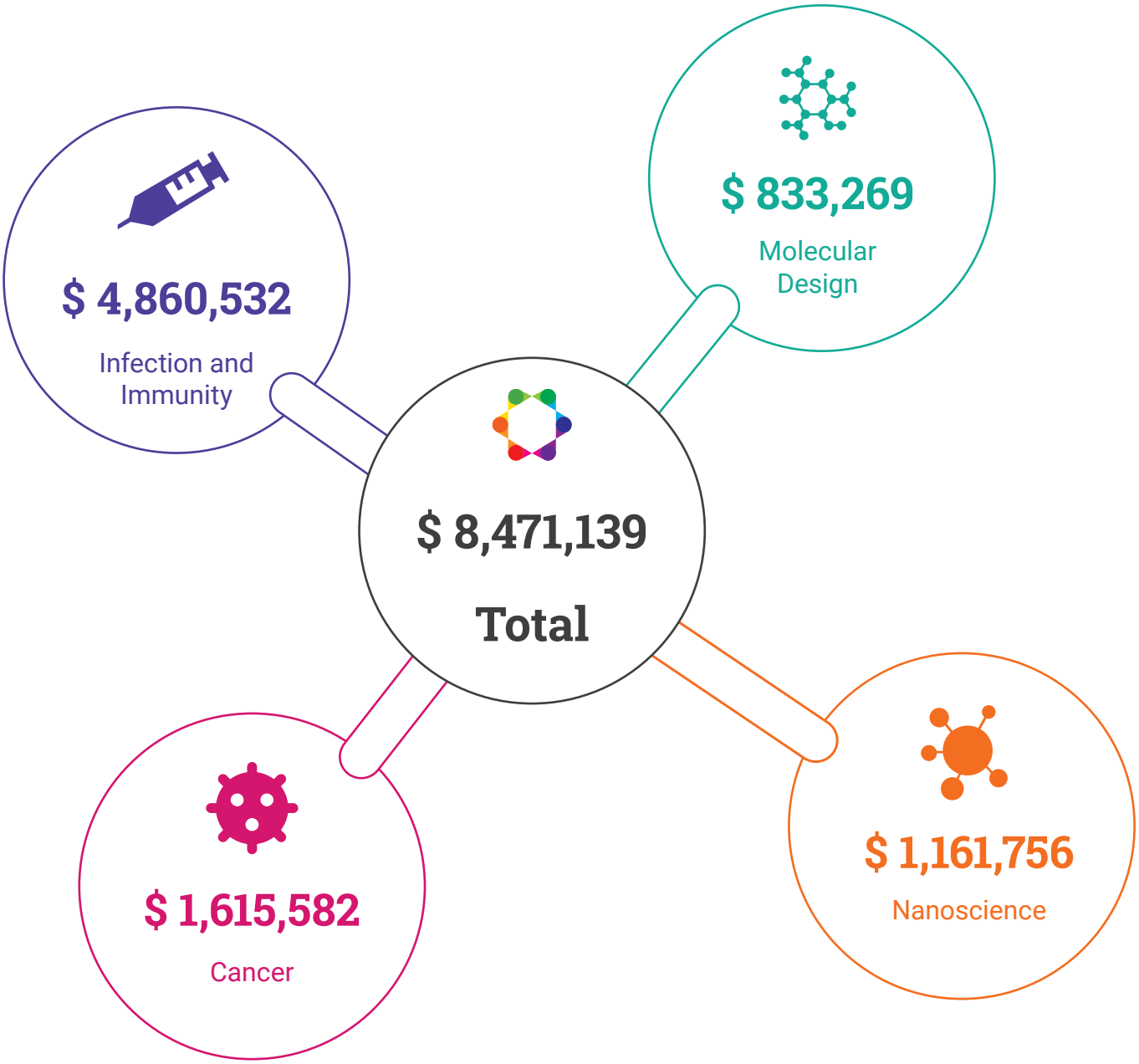
Their investigations show it is possible to harvest stem cells grown on gold nanorod coated surfaces that transform into either bone or fat tissue. This alternative to toxic enzyme-based cell harvesting may improve processes in bone and soft tissue engineering, providing the basis for better patient outcomes for a wide variety of conditions.

Published in Acta Biomaterialia, this work was completed at the La Trobe Institute for Molecular Science and Swinburne University of Technology.



Dr Nick Reynolds

EXTERNAL **FUNDING**



- Cancer
- Infection and Immunity
- Molecular Design
- Nanoscience

Project		2021 Revenue
AdAlta		
Provision of Research Services for AdAlta Pty Ltd (Michael Foley)	●	807,539.00
Australian Research Council		
C-H to C-F using electrochemistry and a touch of gold (Jason Dutton)	●	137,282.00
Complexity to clarity: detecting, identifying and analysing complex materials systems at the molecular level with machine learning (Paul Pigram)	●	112,114.00
Design and Fabrication of 2D Hybrid Materials (Dave Winkler)	●	5,000.00
Extracellular vesicles in the pathogenesis of fungal plant disease (Marilyn Anderson)	●	147,842.00
How did the red blood cell lose its nucleus? (Patrick Humbert)	●	179,000.00
Mechanism and function of cell asymmetry during cell death (Ivan Poon)	●	180,006.00
Mechanisms by which Beclin1 regulates intestinal homeostasis (Erinna Lee)	●	124,335.00
Molecular mechanisms of bacterial aggregation and biofilm formation (Begoña Heras)	●	151,978.00
Molecular Mechanisms of Novel Bacterial Copper Defense Proteins (Begoña Heras)	●	69,657.00
New biosensing strategies based on bipolar electrochemiluminescence (Conor Hogan)	●	137,282.00
The Structural Basis For Defensin-Mediated Membrane Attack (Marc Kvansakul)	●	141,485.00
Understanding the biogenesis of exosomes (Suresh Mathivanan)	●	235,304.00
DNA Replication Stress: Charactering ground zero for genomic instability (Donna Whelan)	●	148,678.00
How do extracellular vesicles fuse with cells to deliver messages? (Sarah Stewart)	●	150,347.00
The investigation of an unconventional Human Leukocyte Antigen molecule (Emma Grant)	●	151,631.00
Towards herbicide cocktails with a new mode of action to avert resistance (Tatiana Soares da Costa)	●	148,782.00
Australian Research Council Centre of Excellence		
ARC Centre of Excellence in Advanced Molecular Imaging (Brian Abbey)	●	11,110.00
Hexima		
Antifungal activity implant defensins; discovery of novel insecticidal proteins; interaction between matriptase and proteinase inhibitors (Marilyn Anderson)	●	1,384,625.00
National Health and Medical Research Council		
Biomarkers to aid clinical trials for neurodegenerative disease (Andrew Hill)	●	426,088.00

EXTERNAL **FUNDING**

Project		2021 Revenue
Conologues: Ultra-fast-acting therapeutic insulins based on cone snail venom insulin principles (Brian Smith)		17,041.00
DsbA foldases from multidrug resistant pathogens as targets for new antimicrobia (Begoña Heras)		90,134.00
Regulation of cell signalling and tumourigenesis by Lgl (Helena Richardson)		264,378.00
The metastability of proteome foldedness in neurodegenerative disease (Yuning Hong)		39,781.00
Elucidating the mechanism and function of extracellular vesicle formation during cell death (Amy Baxter)		85,148 .00
Molecular basis of apoptotic cell disassembly and the function of this process in infection and chronic inflammation (Ivan Poon)		319,663.00
T cell-mediated responses to influenza and Human Immunodeficiency virus (HIV) (Stephanie Gras)		124,207.00
Other		
1 Million Turtles - Conservation through community science and action (James Van Dyke)		124,933.00
A cutting-edge and high-throughput nuclear magnetic resonance platform (Jason Dutton)		278,086.00
AMSI 2021 internship (Christopher Pakes)		15,000.00
Assessing the impact of SARS-CoV-2 mutations on peptide HLA presentation (Emma Grant)		10,000.00
Australia-China Centre for Personal Health Technologies (Yuning Hong)		135,000.00
Australian National Fabrication Facility (Paul Pigram)		641,557.00
Boosting the cancer-killing capacity of immune cells with dying cell fragments (Georgia Atkin-Smith)		25,000.00
Boron Molecular Industry PhD scholarship (Peter Barnard)		21,600.00
Building capacity for biomedical research at the Bendigo Campus (Donna Whelan)		265,000.00
Characterisation of SARS-CoV-2 peptides presented by HLA molecules (Christopher Szeto)		10,000.00
Combating the Resistance Crisis: Towards New Antibiotic and Herbicide Targets (Tatiana Soares da Costa)		15,000.00
Controlling immune responses in blood cells (Helen Irving)		1,898.00
CSIRO - La Trobe Early Research Career Postdoctoral Fellowship (Paul Pigram)		133,857.00
Defining SARS-CoV-2 immune maintenance in the Australian Population (Stephanie Gras)		191,950.00
Development of herbicide cocktails with a novel mode of action (Tatiana Soares da Costa)		35,697.00
Development of High Purity BNNT Thin Films for Energy Storage Scholarship (Narelle Brack)		34,364.00
ElecTrobe: Voltammetric sensors for sulfite and other analytes (Conor Hogan)		41,113.00
Evaluating Smac mimetics for metastatic osteosarcoma (Christine Hawkins)		50,000.00
Exploiting cell survival pathways for cancer treatment (Erinna Lee)		10,500.00

- Cancer
- Infection and Immunity
- Molecular Design
- Nanoscience

Project		2021 Revenue
Extracellular vesicles-based drug delivery for pediatric cancer therapy (Pamali Fonseka)	●	69,695.00
Investigation of features of T cell response in HIV controllers (Dimitra Chatzileontiadou)	●	10,000 .00
Margaret Middleton fund for endangered Australian native vertebrate animals (James Van Dyke)	●	17,510 .00
Molecular mechanisms underlying the cytoplasmic aggregation (Mihwa Lee)	●	40,000 .00
Next-generation antibiotics to fight antimicrobial resistance (Andrew Hill)	●	118,783.00
Novel inhibitors of extracellular vesicle formation in prion disease (Eduard Willms)	●	20,000.00
Protein modification in Alzheimer's Disease cortical extracellular vesicles (Jereme Spiers)	●	16,363.00
Quantum Brilliance Start-up project (Christopher Pakes)	●	11,900.00
Regional Land Partnerships Program - Werai forest turtle monitoring project (James Van Dyke)	●	18,000.00
Research Services (Paul Pigram)	●	23,460.00
Targeting activated platelets as a novel neuroprotective therapeutic approach (Jacqueline Orian)	●	55,000.00
Targeting tumour metabolic reprogramming by Fn14 as a driver of cancer cachexia (Laura Murray-Rust)	●	25,000.00
Understanding Extracellular Vesicles in Human Embryo Implantation (David Greening)	●	28,345.00
Vivazome La Trobe 2021 Research Program (Andrew Hill)	●	186,091.00
Total		**8,471,139.00**

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Abbott, R.C., Verdon, D.J., Gracey, F.M., Hughes-Parry, H.E., Iliopoulos, M., Watson, K.A., Mulazzani, M., Luong, K., D'Arcy, C., Sullivan, L.C., Kiefel, B.R., Cross, R.S., Jenkins, M.R. (2021). Novel high-affinity EGFRvIII-specific chimeric antigen receptor T cells effectively eliminate human glioblastoma. ***Clinical and Translational Immunology***, 10(5) [C]

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La Trobe University acknowledges that our campuses are located on the lands of many Traditional Custodians in Victoria and New South Wales. We recognise their ongoing connection to the land and value their unique contribution to the University and wider Australian society.

La Trobe University is committed to providing opportunities for Aboriginal and Torres Strait Islander people, both as individuals and communities, through teaching and learning, research and community partnerships across all our campuses.

The wedge-tailed eagle (Aquila audax) is one of the world's largest, and the Wurundjeri people – Traditional Owners of the land where our Melbourne campuses are located – know the wedge-tailed eagle as Bunjil, the creator spirit of the Kulin Nations.

There is a special synergy between Bunjil and the La Trobe University logo of an eagle. The symbolism and significance for both La Trobe and for Aboriginal people challenges us all to gamagoen yarrbat – to soar.

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