LA TROBE UNIVERSITY

LA TROBE INSTITUTE FOR MOLECULAR SCIENCE

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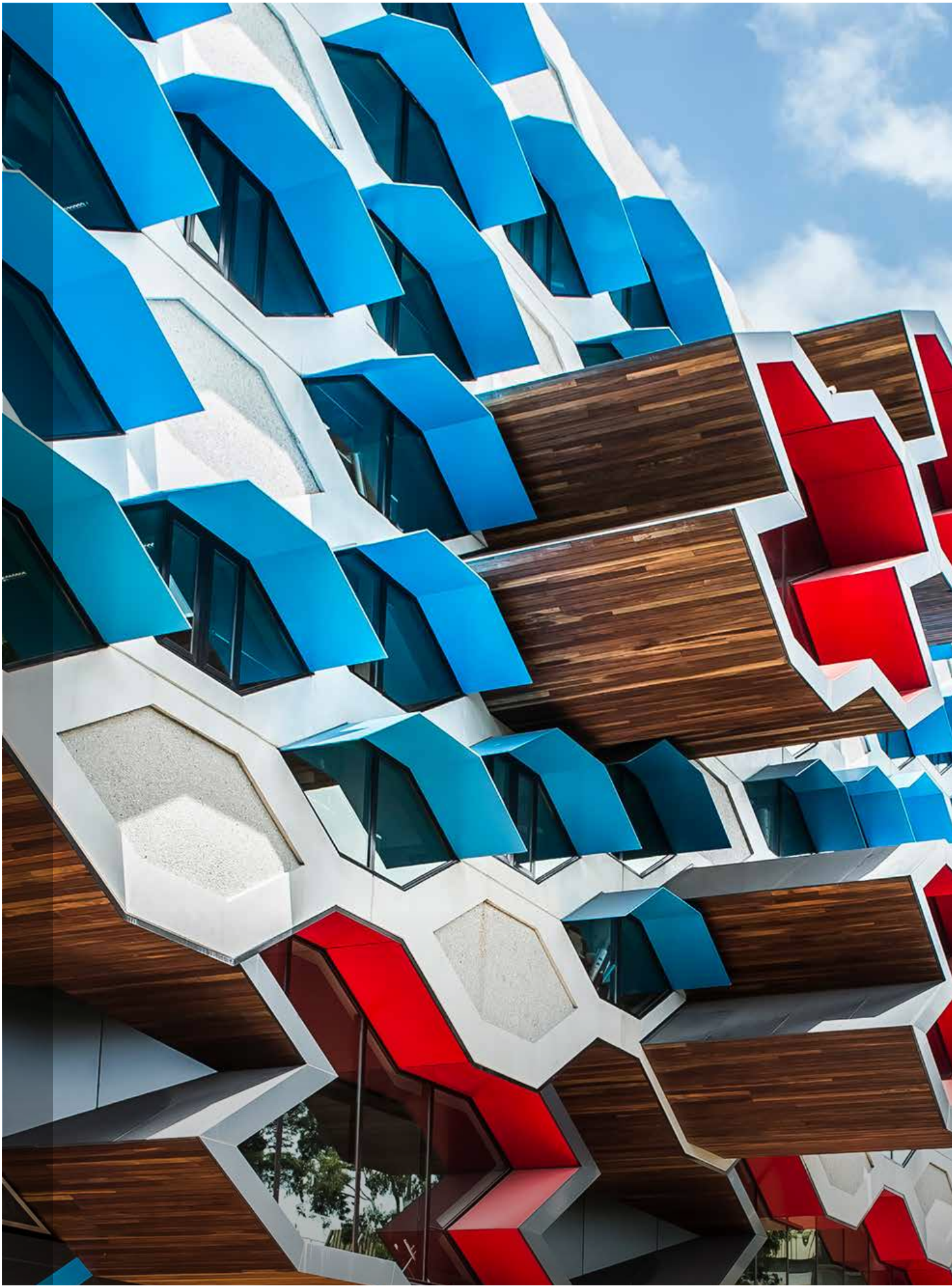
EXPLORE LIMS

Translatable Molecular Discoveries

latrobe.edu.au/lims



FROM THE DIRECTOR

Launched in 2009, the La Trobe Institute for Molecular Science (LIMS) brings together La Trobe University's leading researchers to work on some of the most critical problems at the interface of health and science.

The Institute's vision is achieved through excellence in six areas of research strength: cancer, infection and immunity, neurobiology, molecular design, molecular imaging and molecular sensing.

Its research agenda is supported by a state-of-the-art facility where scientists in different disciplines work together in well equipped, shared work-spaces to achieve outcomes that would not be possible in traditional academic settings.

LIMS also has two embedded biotech companies: Hexima Ltd, who are developing plant-derived proteins and peptides for application as human therapeutics and the genetic modification of crops; and AdAlta Ltd, who are developing the next generation antibody platform, the i-body, to deliver high affinity and specific biologics against a variety of therapeutic and diagnostic targets.

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

Game changing partnerships also enhance the Institute's efforts to raise its research capabilities to new levels of national and international significance. An important collaboration with the Olivia Newton-John Cancer Research Institute facilitates the sharing of knowledge, skills, training and facilities.

Professor Andrew Hill

EXPLORE LIMS

Translatable research

To conduct high quality basic research at the interface of health and science. To recruit and retain leading scientists in areas of strength, and build upon existing platform technologies to support a multi-disciplinary research environment.

Outstanding students

To recruit and train the next generation of Australian scientists. To provide postgraduate students and early career researchers with exposure to high impact research projects, access to the latest equipment and integrated workplace learning with a focus on employability.

Game changing partners

To develop game changing partnerships to raise research capabilities to new levels of national and international significance. To build upon existing partnerships with the Olivia Newton-John Cancer Research Institute and the Australian Synchrotron in the sharing of knowledge, skills, research training and facilities.

Industry connections

To support and collaborate with embedded biotech companies and develop new industry partnerships. To become the interface between local and global biotechnology companies.

* Based on field receiving a top rating at two-digit level and the number of top-rated fields at the supporting 4-digit level.

LIMS

AUD $100 MILLION
RESEARCH HUB.

....

56
RESEARCH AND SUPPORT LABORATORIES.

....

3000
SQUARE METRES OF TEACHING FACILITIES.

....

400
ACADEMIC STAFF AND POSTGRADUATE STUDENTS.

....

REGIONAL NODE
IN BENDIGO.

RESEARCH

AUSTRALIA'S BEST UNIVERSITY
FOR BIOLOGICAL SCIENCES
(EQUAL WITH THE AUSTRALIAN NATIONAL UNIVERSITY AND THE UNIVERSITY OF QUEENSLAND).*

....

VICTORIA'S BEST UNIVERSITY
FOR ANALYTICAL CHEMISTRY AND BIOCHEMISTRY AND CELL BIOLOGY.

....

EQUAL FIRST
IN VICTORIA FOR PHYSICAL SCIENCES INCLUDING CONDENSED MATTER PHYSICS AND OPTICAL PHYSICS.

....

TOP THREE
IN VICTORIA FOR INORGANIC CHEMISTRY AND GENETICS.

Murri Totems is a sculptural work by contemporary Indigenous artist Reko Rennie, commissioned for LIMS. The bright, geometric sculptures draw on traditional indigenous culture, contemporary art and Western science.

FACILITIES

COMPREHENSIVE PROTEOMICS PLATFORM

A SUITE OF SYNERGISTIC CAPABILITIES FOR THE CHARACTERISATION OF PROTEINS.

....

CENTRE FOR MATERIALS AND SURFACE SCIENCE

AUSTRALIA'S MOST COMPREHENSIVE SUITE OF SURFACE SCIENCE AND SURFACE ANALYSIS EQUIPMENT.

....

BIOIMAGING

A SUITE OF CONFOCAL AND CONVENTIONAL WIDEFIELD MICROSCOPES FOR OPTICAL IMAGING OF LIVE CELL DYNAMICS AND FIXED BIOLOGICAL SPECIMENS.

....

FLOW CYTOMETRY

SOPHISTICATED EQUIPMENT FOR CELL ANALYSIS AND CELL SORTING.

....

HISTOLOGY

A SUITE OF PRECISION INSTRUMENTS FOR HIGH QUALITY SPECIMEN PREPARATION AND SECTIONING.

Training the next generation of Australian scientists

Through LIMS, La Trobe University offers one of Australia's largest teaching programs in biotechnology, nanotechnology and molecular sciences.

LIMS prides itself on its simultaneous pursuit of excellence and inclusiveness, providing students with integrated workplace learning and a focus on employability. Students have access to the latest equipment and exposure to high impact research projects.

Solid growth in student recruitment is also achieved through a partnership between La Trobe and PSB Academy – one of Singapore's largest education providers – to deliver bachelor degrees in biomedical sciences, pharmaceutical sciences, chemistry and molecular biology.

ONE OF AUSTRALIA'S
LARGEST TEACHING PROGRAMS IN BIOTECHNOLOGY, NANOTECHNOLOGY AND MOLECULAR SCIENCES.

....

EDUCATING 1500+
UNDERGRADUATE STUDENTS.

....

EDUCATING 180+
POSTGRADUATE STUDENTS.

....

OUR COURSES INCLUDE WORK PLACEMENTS
SO STUDENTS CAN APPLY THEIR SKILLS TO INDUSTRY-BASED PROJECTS.

....

STUDENTS HAVE ACCESS TO THE LATEST SCIENTIFIC EQUIPMENT
AND EXPOSURE TO HIGH-IMPACT RESEARCH PROJECTS.

Gender equity and diversity

Women comprise more than half of science PhD graduates and early career researchers, but only make up 17 per cent of senior academic positions in Australian universities and research institutes.

LIMS is a proud contributor to the SAGE Athena Swan Charter, a national program promoting gender equity and gender diversity in science, technology, engineering, mathematics and medicine.

La Trobe is one of forty Australian universities, medical and publicly-funded research agencies taking part in this prestigious program. However, La Trobe is one of only two institutions that have committed to apply the Charter's principles of gender equity, diversity and inclusion ofunderrepresented groups across all disciplinary areas.

LIMS representatives serve on La Trobe University's SAGE Self-Assessment Team (SAT), comprising more than fifty academic and professional staff members. SAT will undertake research and develop action plans to provide practical solutions to the issues around gender equity.

LIMS has also established a Special Assistance Travel Award to enable researchers with young families or other special needs to attend conferences and grant review panels, or undertake technical training at international facilities.

Athena SWAN Member

RESEARCH THEMES

Cancer

The Cancer theme investigates the mechanisms of cancer initiation and progression, the crosstalk between cancer cells and the surrounding environment, and the potential of novel therapeutic approaches for combating disease.

Research spans the fields of cancer metastasis, cancer cell crosstalk with the microenvironment, tumour architecture, pro- and anti-tumour immunity, and therapeutic sensitivity and resistance.

Members have expertise in confocal microscopy, *in vivo* bioluminescent and fluorescent imaging, fluorescence-activated cell sorting, 3D cell cultures, *Drosophila* genetics, proteomic profiling, gene knockout/overexpression, DNA damage assessment, monitoring immune cell infiltration, activation and impact, stem cells, cancer cell invasion, EMT, metastasis assays and DNA/RNA sequencing.

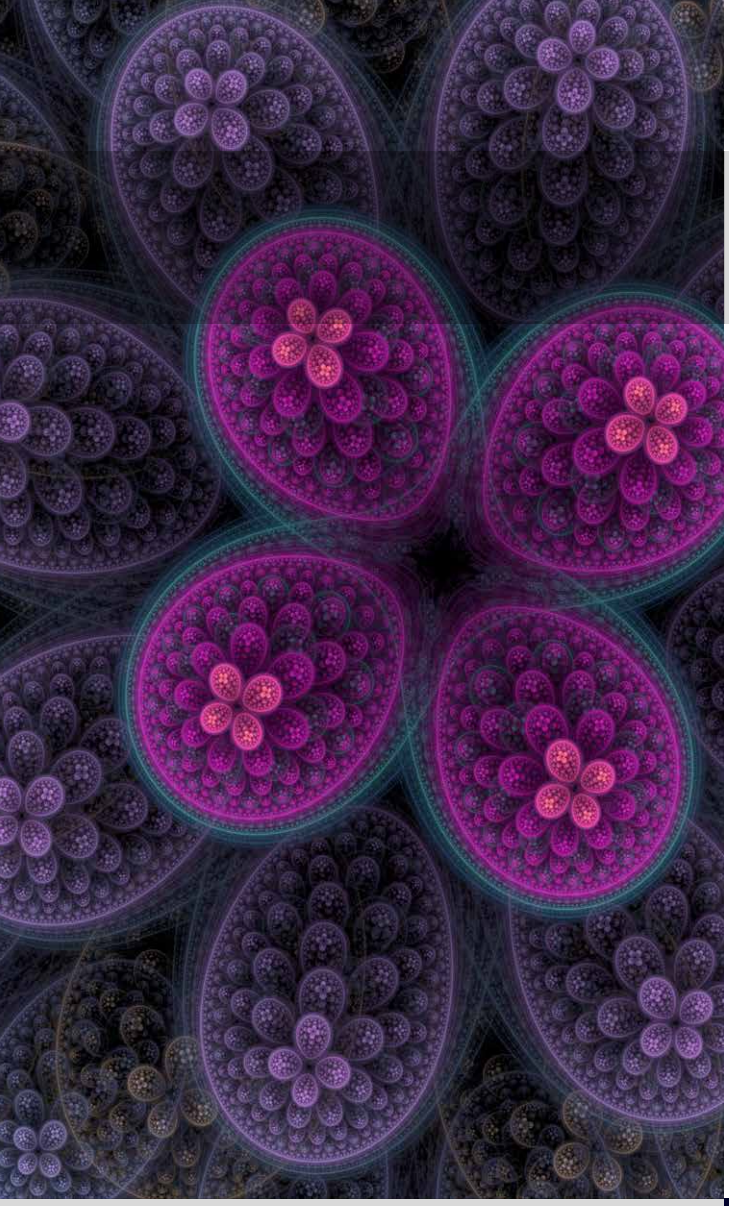
Current projects work to identify key drivers of cancer progression including secreted or exosomal factors, and loss of cell polarity; the targets, mechanisms of resistance and side effects of therapeutics; development of novel biomarkers for predicting cancer spread; and identification of ways that cancer cells co-opt the immune system to promote progression.

DISCOVERY HIGHLIGHT:

Identifying a breast cancer preventing protein

With current screening methods, 25% of breast cancer patients are diagnosed in the very early stages of the disease, when cancer is still inside the breast ducts. Of those patients, it is difficult to predict who will go on to develop invasive cancer.

Dr Belinda Parker and PhD student Hendrika Duivenvoorden discovered a cancer suppressor protein in the cells that surround the breast duct. This marker could eventually be used to classify cases into high risk and low risk categories, sparing some patients from radiotherapy or mastectomy.



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 this and other immunological/cell biological events, such as stress and programmed cell death.

The overarching aim is to develop the next generation of antibiotic molecules to fight infection and to develop molecules that regulate cell death and combat inflammatory and autoimmune diseases.

Members have expertise in X-ray crystallography, mass spectrometry, enzymology, protein-protein interactions, gene transfection/transduction systems, cell phenotyping, flow cytometry and multi-colour cell sorting, confocal imaging, transgenic and gene-knockout models, human T cell culture and cloning, and monoclonal antibody production and generation.

Current projects include the role of complement and defensins in fighting bacterial and fungal infections; design of novel molecules to combat autoimmune conditions; migration and death of white blood cells in sepsis; and infection by viruses such as influenza and cytomegalovirus, and the immune response to them.

Neurobiology

The Neurobiology theme investigates the biology and diseases associated with the nervous and musculoskeletal systems. Members have research interests ranging from anatomical and physiological studies, to biophysical studies of proteins, cellular and molecular analyses, and the use of *in vivo* models to study the pathophysiology of neuronal biology.

Researchers focus on the interaction of exercise in health and disease, and the general biology of disorders of the nervous system including Alzheimer's, Parkinson's and prion diseases, and Multiple Sclerosis.

Members have technical expertise in analytical ultracentrifugation, molecular interaction analysis, histology, the use of yeast and *Drosophila* models, next generation sequencing and bioinformatics, cell biology, molecular biology and single cell biochemistry.

Current projects include the study of protein-protein interactions in Alzheimer's disease; the development of new diagnostics for neurodegenerative diseases; investigating the pathogenesis of Multiple Sclerosis; understanding how cells deal with misfolded proteins; and changes that occur in the musculature with exercise, in diseases such as osteoarthritis and with ageing.

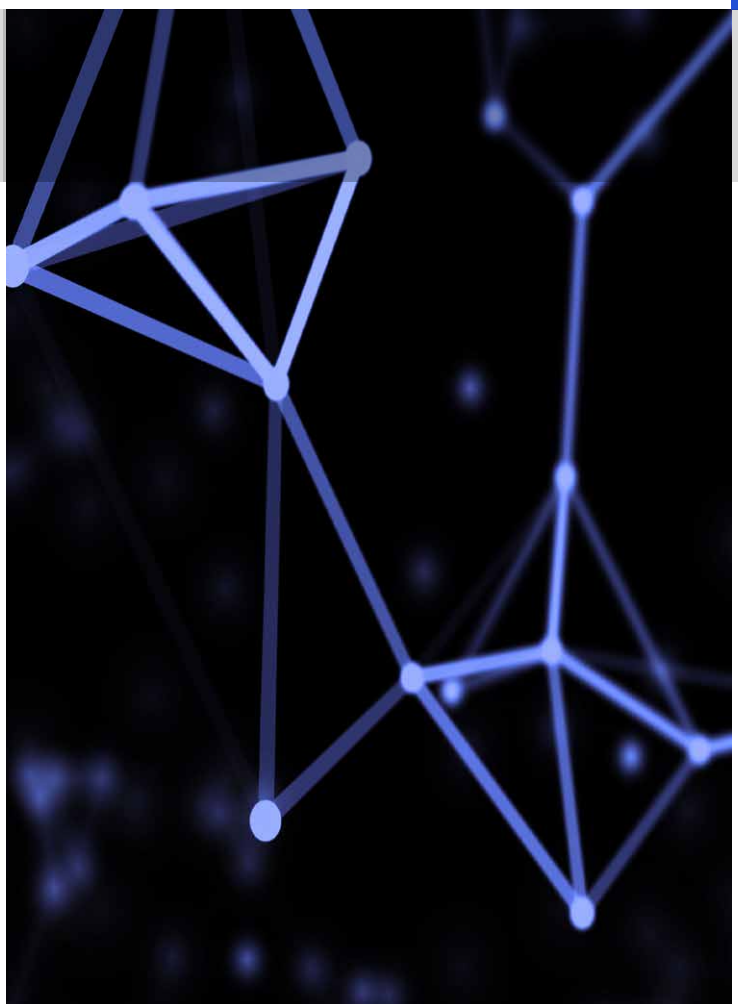
Molecular Design

The Molecular Design theme uses molecules to solve real world problems across a broad range of disciplines.

Researchers have diverse interests ranging from computational studies on the interaction of drugs with proteins, to molecular synthesis, and surface and material science.

Members have expertise in NMR spectroscopy, X-ray crystallography, mass spectrometry, chemical synthesis and separations, computational analysis of systems (ranging from species as large as proteins to as small as a single proton) and analysis of surfaces using advanced techniques such as atomic force microscopy.

Current projects include the design of new metal-based radiopharmaceuticals; synthesis of drugs targeting resistant strains of malaria and hospital borne "superbacteria"; generation of antimicrobial surfaces using peptides; small molecule platelet inhibitors; and the design of metal catalysts to form difficult bonds, such as the C-F bond found in many pharmaceuticals.



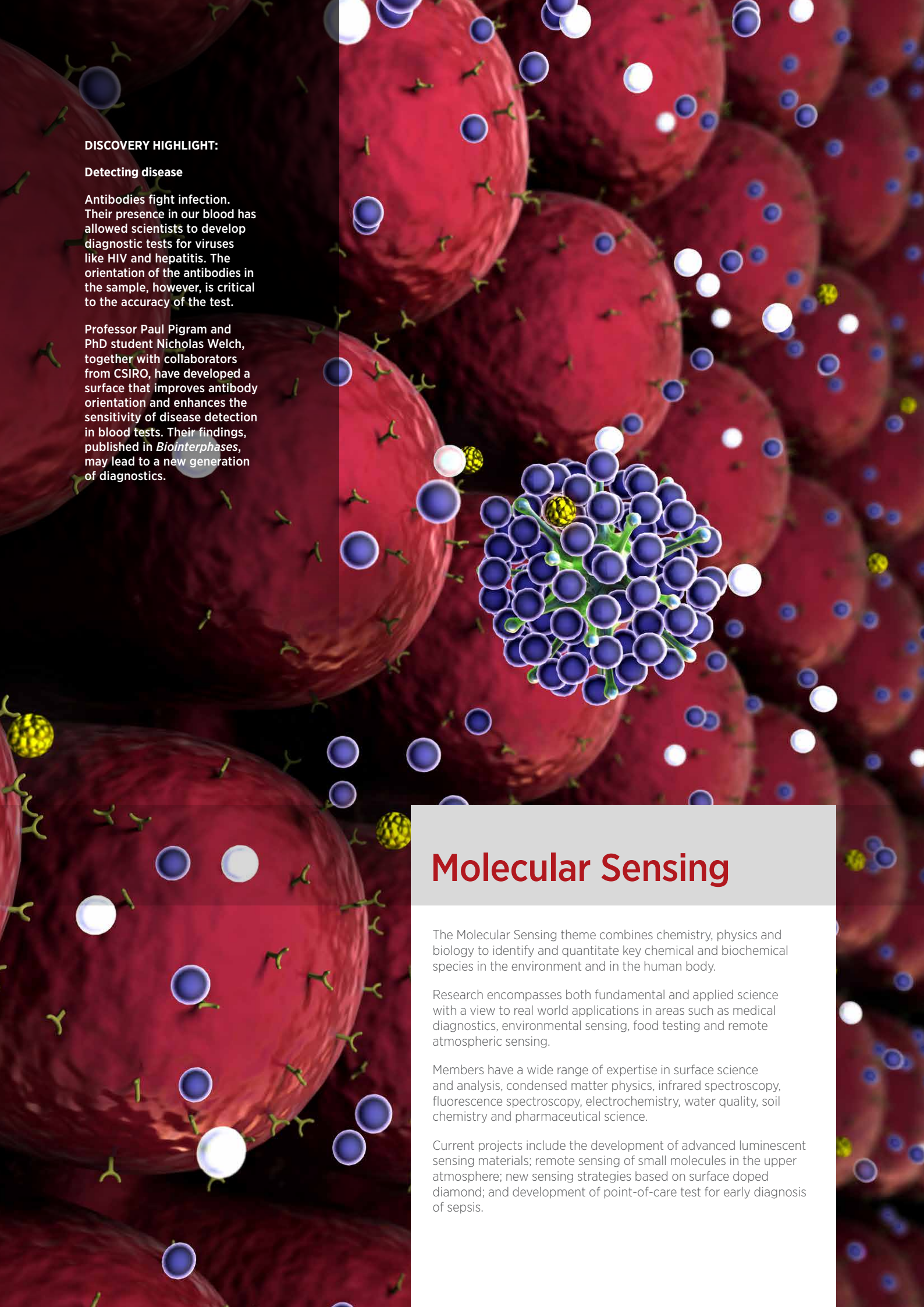
Molecular Imaging

The Molecular Imaging theme uses a broad range of methods to characterise molecular structure and function. Understanding the fundamental science that underpins disease and ageing, as well as the complex interplay between organisms and their environment, inherently relies upon molecular imaging.

The group uses the latest technologies for characterising molecules and their dynamics to understand molecular processes at the organism, cellular and macromolecular scale.

Members have expertise in a range of advanced techniques for molecular and cellular characterisation, including super-resolution and electron microscopy, nuclear magnetic resonance and X-ray crystallography. Many of our members are regular users of the Australian Synchrotron.

Current research projects include using molecular imaging and spectroscopy to investigate the inhibition of cell-death by viruses; understanding the role of metals in cells; and developing new techniques for the visualisation of molecular function within live cells.



DISCOVERY HIGHLIGHT:

Detecting disease

Antibodies fight infection. Their presence in our blood has allowed scientists to develop diagnostic tests for viruses like HIV and hepatitis. The orientation of the antibodies in the sample, however, is critical to the accuracy of the test.

Professor Paul Pigram and PhD student Nicholas Welch, together with collaborators from CSIRO, have developed a surface that improves antibody orientation and enhances the sensitivity of disease detection in blood tests. Their findings, published in *Biointerphases*, may lead to a new generation of diagnostics.

Molecular Sensing

The Molecular Sensing theme combines chemistry, physics and biology to identify and quantitate key chemical and biochemical species in the environment and in the human body.

Research encompasses both fundamental and applied science with a view to real world applications in areas such as medical diagnostics, environmental sensing, food testing and remote atmospheric sensing.

Members have a wide range of expertise in surface science and analysis, condensed matter physics, infrared spectroscopy, fluorescence spectroscopy, electrochemistry, water quality, soil chemistry and pharmaceutical science.

Current projects include the development of advanced luminescent sensing materials; remote sensing of small molecules in the upper atmosphere; new sensing strategies based on surface doped diamond; and development of point-of-care test for early diagnosis of sepsis.

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