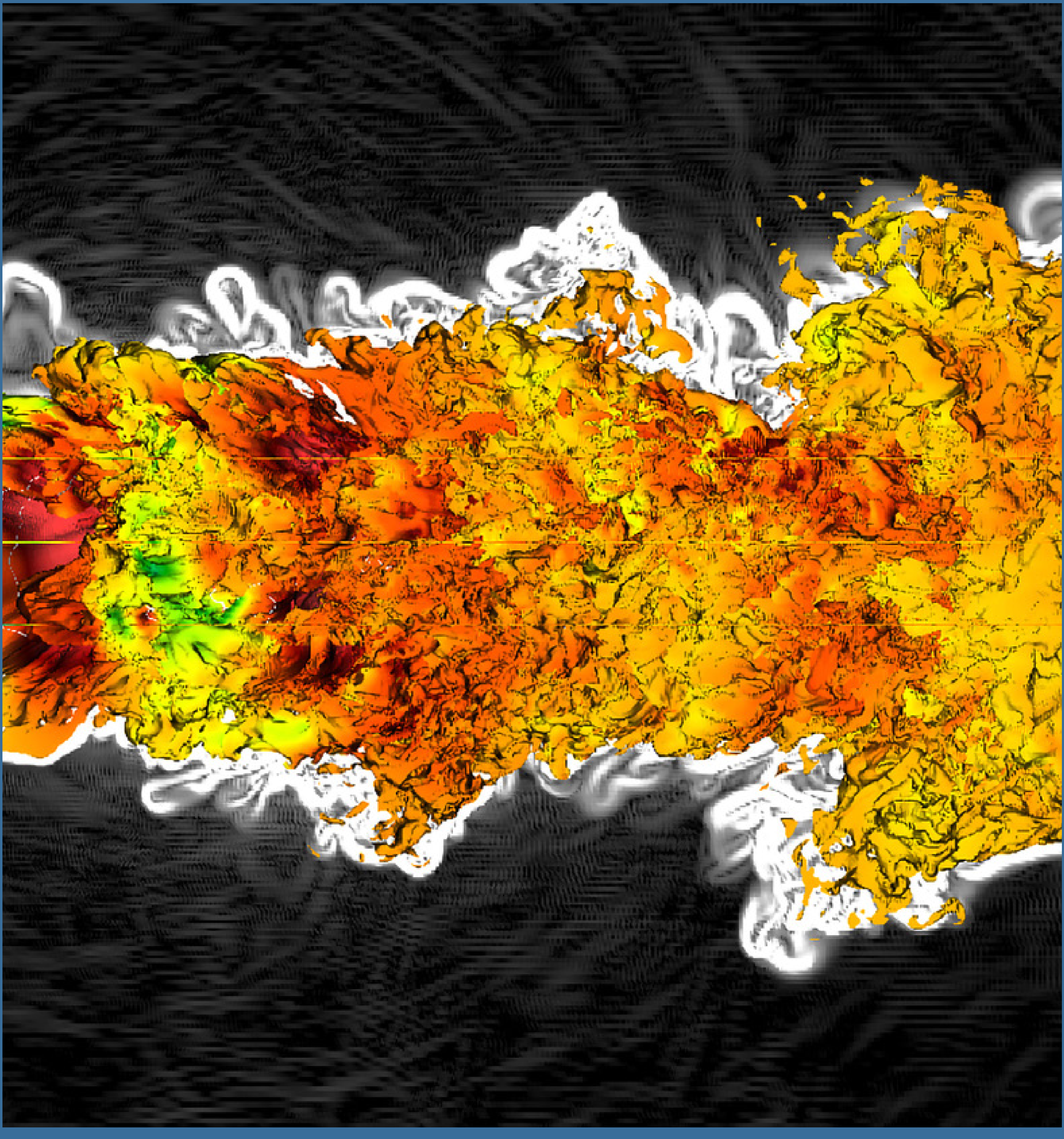
MASSIVE

Biennial Report
2019 — 2020



Cover:
The image show the density gradient field (grey-black) and iso-surfaces of temperature coloured by fluid energy of a compressible heated high Reynolds number turbulent jet.

Professor Julio Soria and Dr Shahram Karami at Laboratory for Turbulence Research in Aerospace & Combustion (LTRAC) at Monash University are developing a numerical framework to analyse and control the instabilities in jet flows.

This project is a collaboration project between Monash University (Professor Julio Soria, Dr Shahram Karami, Dr Callum Atkinson, Dr Daniel Edgington-Mitchell and Shoaib Amjad) and the University of Liverpool (Professor Vassilios Theofilis).

It is funded by the Australian Research Council.

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Partners

Affiliate Partners

Project Partners: Australian Characterisation Commons At Scale Partners

This project is supported by the Australian Research Data Commons (ARDC) and the following partners. The ARDC is enabled by NCRIS.

Project Partners: Environments to Accelerate Machine Learning Based Discovery Partners

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Contents

Dr Greg Storr

Chair, MASSIVE
Steering Committee

From the Chair

High performance computing, the analysis of large data sets and data management are the foundations for MASSIVE's operations and its growing support of Australian scientific research and development. In the 10 years since its launch in 2010 the MASSIVE team and the facility that they run has benefitted science projects in many areas of research including, molecular biology, the development of new metallic alloys, and fluid dynamics in health and medical, with these three areas, along with others featured in articles in this publication.

It is apparent that many areas of science now rely on measuring, modelling and visualising information at scales and levels of complexity that require high performance computing hardware, software and human expertise acting in an integrated way so that understanding and knowledge is unlocked. Over the past 10 years MASSIVE has taken its place in the Australian HPC environment as a significant provider of HPC facilities and expertise that provides practical support to many scientific research endeavours.

In the previous MASSIVE biennial report, I mentioned digital disruption and innovation, and in 2020 we all experienced the consequences of a huge societal disruption due to the COVID-19 pandemic. The MASSIVE team were able to keep the computational facilities operational so that important scientific work could continue across the country. MASSIVE also became directly involved in the COVID-19 response via research on 3D printed parts for ventilating machines, and understanding the societal disruption that has followed the pandemic. Please take some time to read the associated article in this report which presents a summary of this work. Articles from other fascinating and exciting research projects which may lead to transformations in our lives are also provided in this publication.

Effective partnerships are an important part of MASSIVE's strategy and its success, and it was pleasing that MASSIVE formed an important new partnership in 2020 with the ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins. This partnership which combines expertise in cryo-electron microscopy, drug behaviour on cell membranes and HPC will be used to lead the way to more effective drug treatments for a range of diseases.

I am very happy to be Chair of the MASSIVE Steering Committee and be associated with MASSIVE, Monash University and the other MASSIVE partners in fostering HPC to help solve significant problems for our society. I encourage you to read through the report, mention it to your colleagues and get in touch with the MASSIVE team to see how HPC at MASSIVE may be able to assist in solving other complex problems.

I would like to acknowledge Professor Wojtek James Goscinski for his role shaping and guiding the MASSIVE project since its inception in 2010, and wish him well in future endevours.

My thanks and best wishes to the MASSIVE leadership, the rest of the MASSIVE team and my colleagues on the MASSIVE Steering Committee.

Coordinators Message

Prof Wojtek James Goscinski

Coordinator, MASSIVE
January 2011 to June 2021

Welcome to our 2019-2020 biennial report. I'm very happy to report on a number of highlights, including our new partnership with the ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins, new national projects, and significant upgrades of our computer, M3.

It's with pleasure that I report that our M3 computer has continued to be upgraded on an annual basis. This year we have begun replacement of all the original components of the computer that were purchased in 2016 including the file system. Unfortunately this means a handful of longer outages for our users as we transition to new /project and /scratch storage. However, I am happy to report that this will position MASSIVE well to cater to growing data storage and processing requirements.

Significant work has been undertaken behind the scenes. M3 is a software-defined system, meaning that its build and configuration is defined in source code. Over 2020, this code has received significant improvement to be better tested, more consistent and to improve security. We have also collaborated with the Monash Research Cloud Team to develop and deploy a small test cluster -- this environment is now being used to test all major changes before they are rolled out to our systems.

In 2021, we plan to further automate our test and deployment pipeline. The result of this work is a higher quality environment for researchers.

We have undertaken a major programme of work with the Monash eSolutions Cyber Security Team to ensure our system is protected using best-practice cyber security controls.

In 2020, we released two new capabilities designed and configured specifically designed for genomics and machine learning communities, respectfully.

The M3 genomics partition is a 900 core partition that is dedicated to short running high-throughput genomics processing. It is governed through a community engagement process and in collaboration with the Monash Bioinformatics Platform. Our machine learning capability was delivered in two parts in 2019 and 2020 and is now fully operational. Its largest users are a spectrum of technique developers and technique adopters across IT, engineering, and medicine.

In 2019, MASSIVE was successful in leading two national research infrastructure proposals in Characterisation and machine learning. These projects, which are national-scale partnerships with support from the NCRIS ARDC, will transform the capability we offer in these areas.

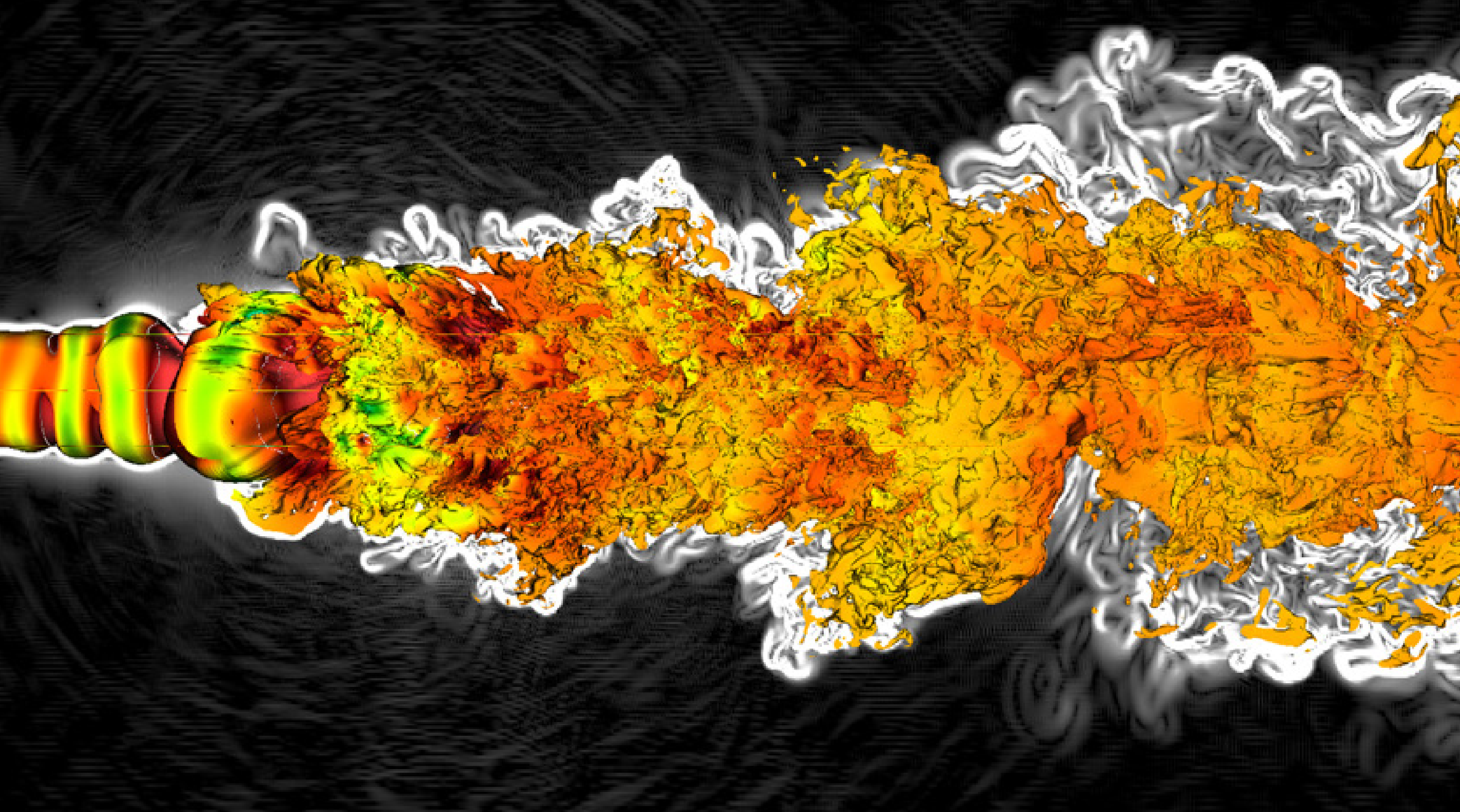
I would like to thank all the researchers who have contributed content and imagery to this report.

Most of all, I'm happy to report that MASSIVE continued uninterrupted operations during the first and second Melbourne COVID-19 shutdowns.
In March 2020, the Monash eResearch Centre, which hosts the MASSIVE facility, undertook a huge program of work to ensure smooth continued operations while all staff transitioned to working from home and data centre access was strictly limited. Under the second Victorian shutdown we managed to continue our file system replacement and hardware deployment despite the fact that many staff were affected by home-schooling and day-care restrictions. I would like to thank the staff for their commitment to the project under significant pressure.

I would also like to thank the Monash eResearch Centre, and the Monash University eSolutions team, who have all made outstanding contributions to the MASSIVE programme, and the MASSIVE Steering Committee for their governance and advice.

MASSIVE is a data processing engine for Australian science that empowers researchers to unlock impactful research discoveries within scientific data.

The MASSIVE project is: Researcher and research community focused. Accessible to a wide range of researchers, with a focus on new user communities. Dedicated to quality and best-practice.



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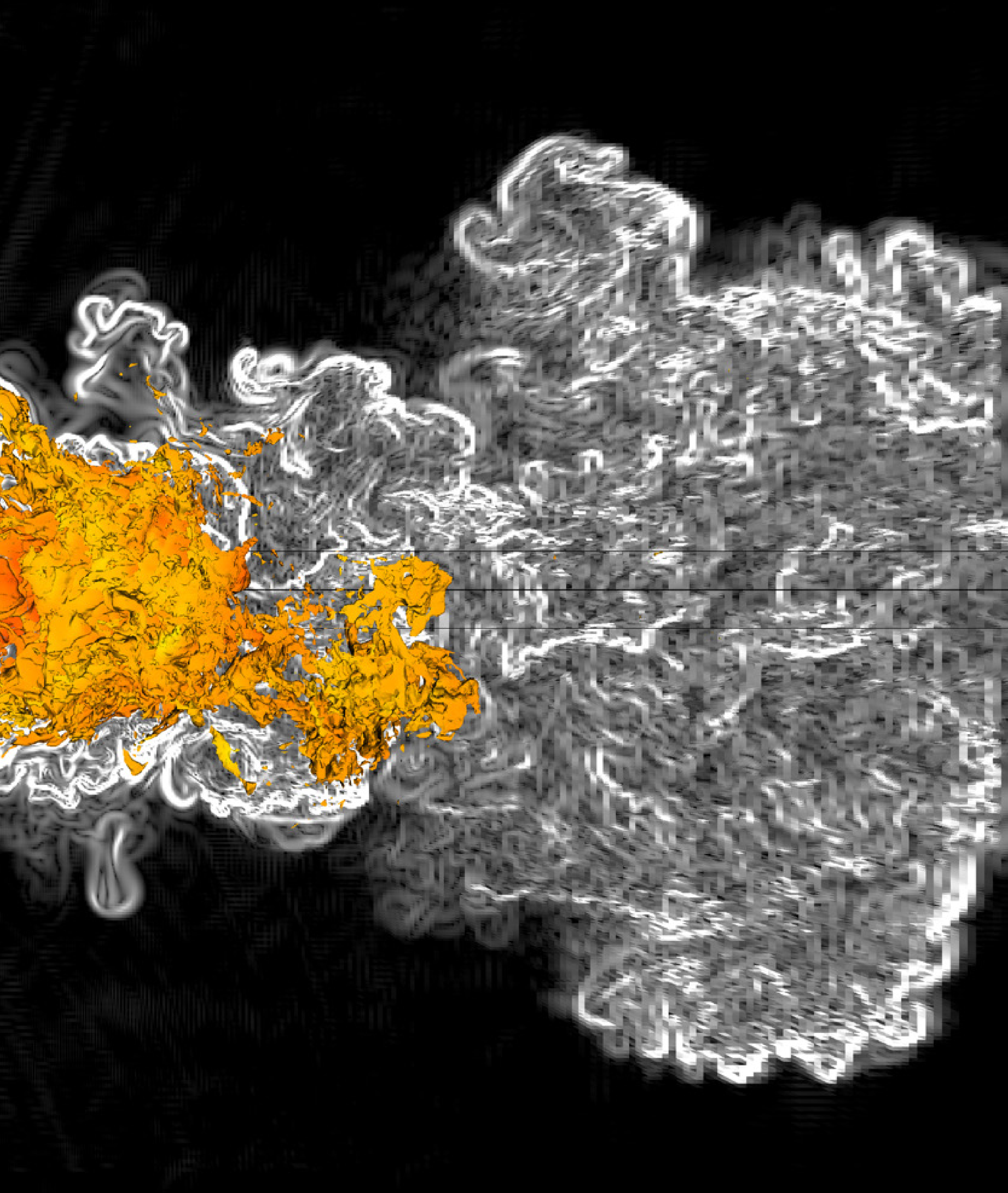
It is funded by the Australian Research Council.

The simulations are performed on the NCI facility through the National Computational Merit Allocation Scheme and visualisations are performed on MASSIVE.



MASSIVE: Celebrating 10 Years

MASSIVE was formed in 2010 as the Multi-modal Australian ScienceS Imaging and Visualisation Environment, a partnership between Monash University, Australian Synchrotron, CSIRO and the Victorian Partnership for Advanced Computing.

2010

Monash University, Australian Synchrotron, CSIRO and the Victorian Partnership for Advanced Computing enter into a partnership agreement to form the Multi-modal Australian ScienceS Imaging and Visualisation Environment (MASSIVE). The MASSIVE project secures funding from the Victorian Government and the Commonwealth under the National Computational Infrastructure Specialised Facilities Program.

2011

The M1 and M2 computers are delivered in January 2011 and become available to Australian researchers in May 2011. The facility forms an instrument integration program to help instrument facilities move data to a HPC environment and provide in-experiment data processing.

2012

Australian Synchrotron, CSIRO, and MASSIVE develop an in-experiment CT reconstruction service for the Australian Synchrotron Imaging and Medical Beamline. This service provides researchers the opportunity to process, analyse and visualise their data within minutes of data capture, and to make decisions in real-time while collecting research data.

MASSIVE commences the development of the NCRIS NeCTAR-funded Characterisation Virtual Laboratory (CVL). The CVL is a strategic project to integrate Australia's imaging equipment with specialised HPC capabilities for researchers working in neuroscience, structural biology, and energy materials.

2013

The M2 computer is upgraded and this increased capacity is delivered in February.

MASSIVE is a participant in, or supporting, two successful Australian Research Council Centres of Excellence, which join the MASSIVE partnership as affiliate partners:

- The ARC Centre of Excellence for Integrative Brain Function which is tackling the challenging problems involved in understanding how the human brain works.

- ARC Centre of Excellence in Advanced Molecular Imaging, which is developing innovative imaging technologies to explore the immune system, leading to a better understanding of how the immune system functions.

2014

Over 2,000 researchers used and benefited from the infrastructure developed by the Characterisation Virtual Laboratory project. The software technology developed provides researchers with easier tools to capture instrument data and process that data on centralised cloud and HPC infrastructure.

2015

MASSIVE integration at Australian Synchrotron is extended to the X-ray Fluorescence Microscopy (XFM) beamline.

Over 250 merit-allocated projects used instrument integration systems developed in partnership with Australian Synchrotron and CSIRO.

2016

MASSIVE welcomes a new partner, the Australian Nuclear Science and Technology Organisation (ANSTO), an important contributor to Australia's knowledge economy, and both a major operator of flagship scientific instruments and a world-class research facility.

MASSIVE launches a new computer, M3, which is made available to first users in mid-2016. This new computer is designed to sit alongside the NeCTAR research cloud services as part of the ecosystem of services for next-generation virtual laboratories.

2017

In collaboration with Monash University, ImagingCoE and other partners, M3 is integrated with Australia's first next-generation cryo electron microscope at the $30m The Clive and Vera Ramaciotti Centre for Structural Cryo at Monash University. M3 provides the capacity to process and visualise the terabytes produced by the FEI Titan Krios cryo electron microscopy per day.

MASSIVE experiences a significant growth of bioinformatics and data science projects, which now account for 14% and 11% of research projects. Neuroscience remains the largest cohort of users.

MASSIVE is ISO Quality Systems accredited.

2018

The University of Wollongong joins the MASSIVE partnership to provide research computing infrastructure to the $80m Molecular Horizons initiative. This University of Wollongong funded initiative sees Wollongong house one of Australia's most powerful biological electron microscope – the Titan Krios cryo-EM microscope – as well as high-powered optical microscopes.

After nearly 8 years and over 100 million of CPU-core hours, the M1 and M2 computers are decommissioned. Through instrument integration work and workflows at Australian Synchrotron, M1 underpinned 446 beamtime allocations, totalling over 791 investigators, across 94 Australian and International research institutions and industry.

2019

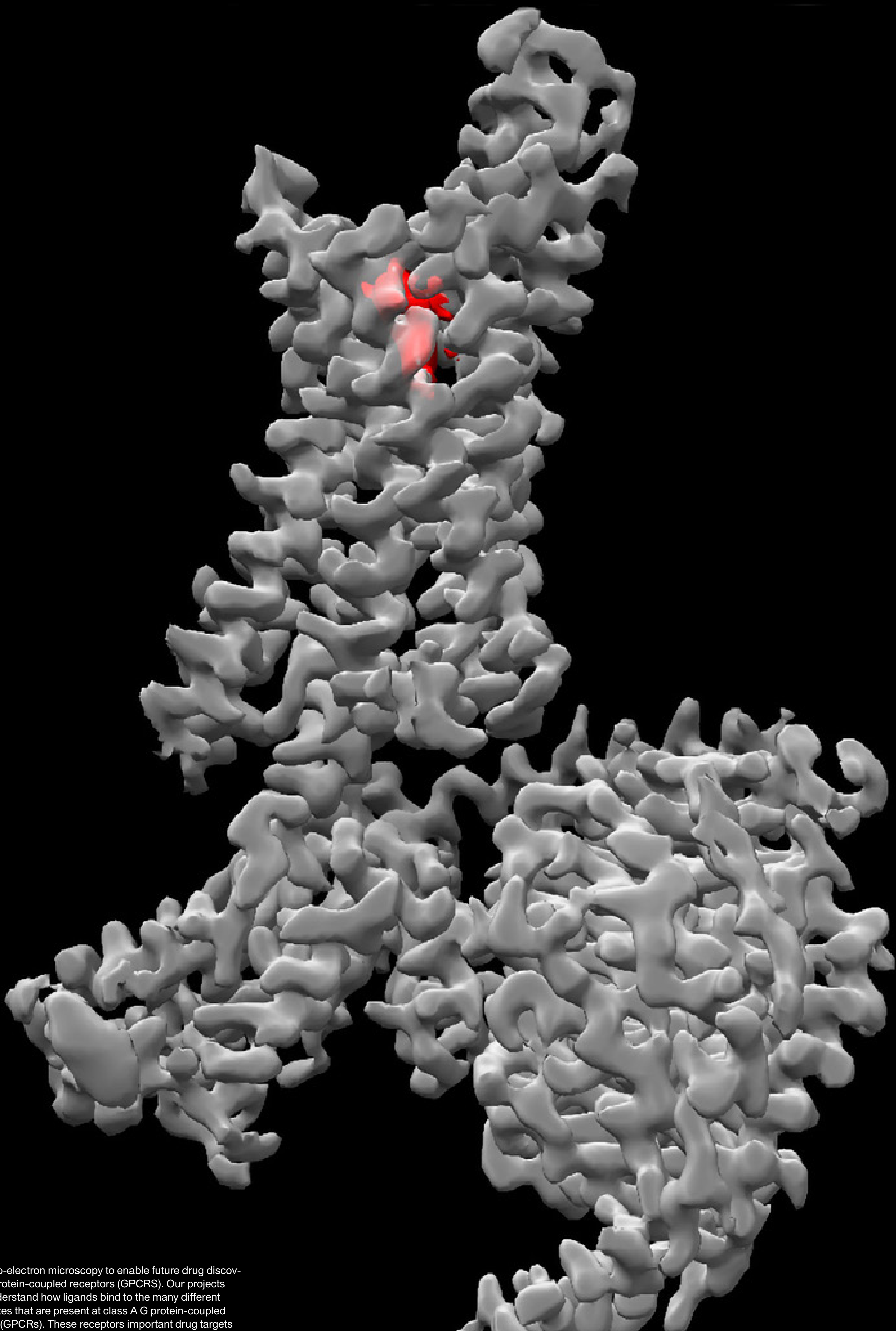
MASSIVE sees a steep increase in applied deep learning (DL) across research projects and demand on the GPU capability of M3. To address this, MASSIVE undertakes a significant upgrade in GPU computing specifically tailored for deep learning applications. Over 2019-2020, MASSIVE took possession of 11 X NVIDIA DGX 1-V servers, each with 8 NVIDIA V100 GPUs. This capability was deployed over 2019 and into 2020, and is used for large-scale deep learning projects and to underpin increased demand in other areas such as computational imaging.

2020

As the result of a bioinformatics community consultation MASSIVE deploys a dedicated partition for genomics that is suited toward short high-throughput data processing.

The M3 system is upgraded with a new 3TB parallel file system which increases overall performance and capacity for data processing in preparation for complete replacement of the original M3 file system in 2021.

MASSIVE commences activities on two national projects undertaken with national partners and the NCRIS ARDC. The Australian Characterisation Commons at Scale is a 3-year Australia-wide initiative that is deploying software for the imaging community across four states in Australia. The Environments to Accelerate Machine Learning Based Discovery is a partnership to make high performance computing facilities better suited to support machine learning through better software, tools and training.



Using cryo-electron microscopy to enable future drug discovery at G protein-coupled receptors (GPCRS). Our projects aim to understand how ligands bind to the many different binding sites that are present at class A G protein-coupled receptors (GPCRs). These receptors important drug targets for cardiovascular disease and CNS disorders such as schizophrenia, and by determining the atomic structures of these proteins we are opening the door for new avenues of drug discovery. This work is in collaboration with the teams of Alisa Glukhova, David Thal, Arthur Christopoulos, Denise Wootten, and Patrick Sexton

What is MASSIVE?

MASSIVE is a quality-accredited, high performance, data processing facility that provides access to data processing capacity as the scale required to make impactful research discoveries. By building strong partnerships with research communities MASSIVE aims to underpin scientists who are capturing ever-increasing amounts of data, including researchers new to high performance computing, such as experimental and wet-laboratory scientists.

The MASSIVE project is a collaboration between Monash University, ANSTO, and University of Wollongong, and three affiliate partners: CSIRO, the ARC Centre of Excellence in Integrative Brain Function (CIBF), and the ARC Centre of Excellence in Advanced Molecular Imaging (Imaging CoE). In 2020, MASSIVE welcomes a new Affliate Partner, the ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins.

The MASSIVE facility supports thousands of researchers from across hundreds of institutions and it has a national focus (over 40% of our users are from outside Victoria).

MASSIVE is ISO9001 accredited, ensuring quality, fairness and consistency in operations.

MASSIVE runs the M3 computer which is operated on the Monash University research cloud, and is upgraded annually.

Data Processing for Next-Generation Science

Academic and industrial research is rapidly entered into an unprecedented new era of “big data”, where routine analysis of multi-terabyte scale datasets and data collections are critical. Researchers who apply modern data-oriented techniques are no longer able to process data on desktop or laptop computers, and are moving to specialized high performance computers and research clouds in order to analyse their data.

↙ Dr. Mehrtash Harandi, Monash University, and colleagues, develop algorithms and mathematical models to equip machines with intelligence.

A particular challenge involves infering depth from two dimensional images, as shown here using a new method called Learning Effective Architecture Stereo (LEAStereo).

Services and Capabilities

Integrative High Performance Computing

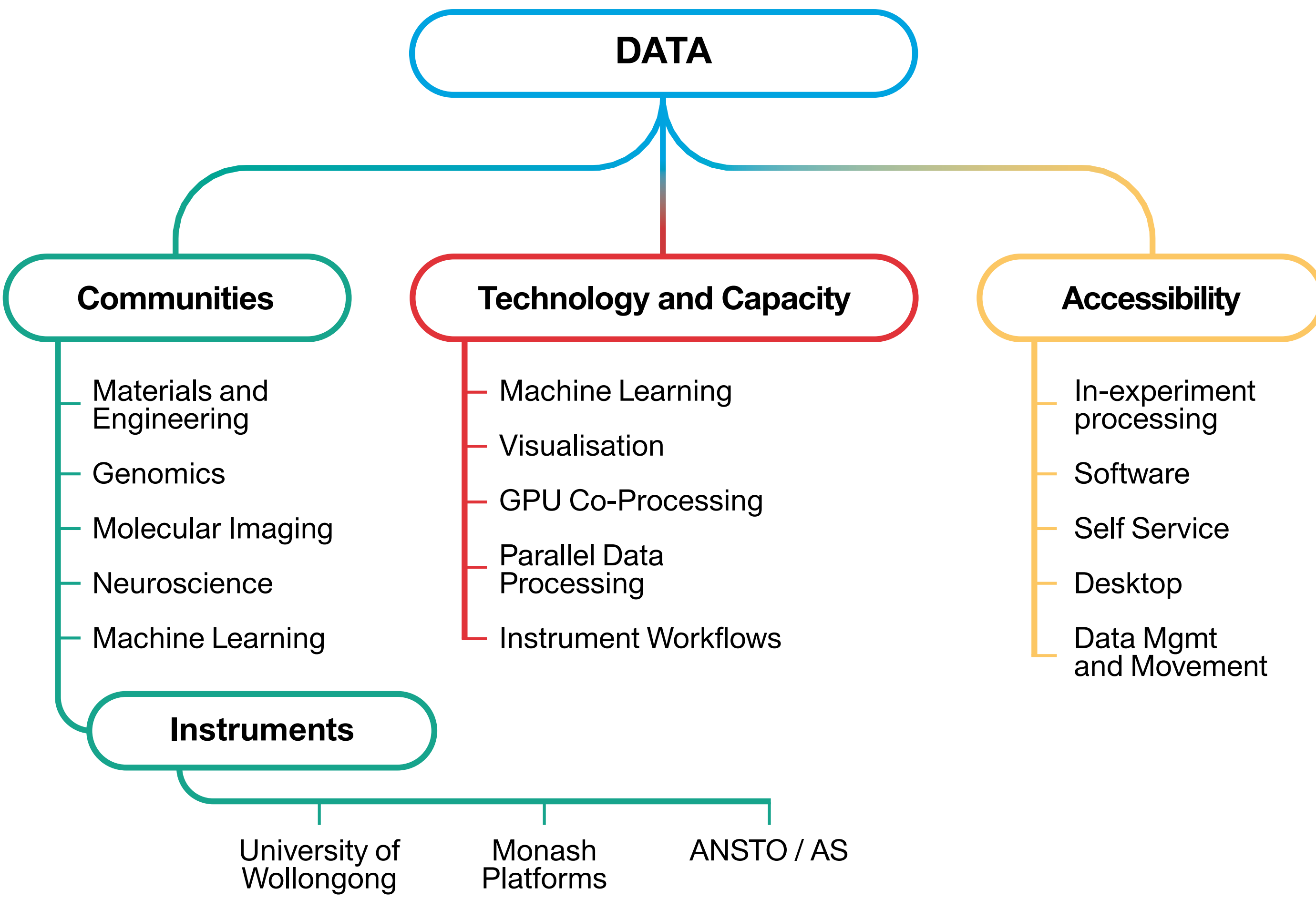
With the goal of impacting a broad range of researchers who are increasingly capturing significant volumes of data the MASSIVE facility has intentionally taken an approach that is complementary to peak HPC. This approach is integrative and this means an emphasis on:

- Usability, porosity and flexibility to allow new HPC user communities to leverage the capabilities of HPC.
- Hardware suited to data processing to cater to a broad selection of research areas, including specialised hardware for machine learning.
- Workflows that increase return on investment in instruments.
- Underpinning high performing wet, experimental and clinical laboratories, with growing data processing needs.

MASSIVE is a platform to address multiple challenges that affect research broadly across many different disciplines.

The design of the MASSIVE facility is such that it permits data capture and processing from key instruments situated around Australia. Further, specialized, instrument specific compute workflows permit scientists from around Australia to deploy common approaches to challenging scientific problems. For many of the instruments attached to MASSIVE the workflows are optimized such that data analysis can be performed “in experiment”.

Further, the confluence of big data, Machine Learning (ML) techniques and parallel computing is making AI useful across a range of research areas. The application of machine learning to extract quantitative information from large dataset collections will permit the national research community to address problems previously considered impossible. There is increasing sophistication, insight and accuracy which is driving a strong and growing appetite across research groups for access to ML capacity, services, libraries, expertise and training.



Technology and Capacity

MASSIVE provides access to high performance computing hardware that is designed for data processing, machine learning, analysis and visualisation. This capability is delivered via the M3 computer. The M3 computer is operated using a flexible research-cloud model that allows flexibility for upgrade and scalable growth, and it a goal that M3 is upgraded twice per year with both a large-scale upgrade, and a smaller specialised upgrade.

As of December 2020, M3 is composed of 6,564 CPU cores, 344 GPU co-processors across a range of products suited to parallel processing, visualisation and machine learning, and a 6PB fast parallel Lustre file system. M3 provides a combination of GPU coprocessors, including the NVIDIA K1 (for remote scientific desktops), K80, P100, V100, and the DGX1-V.

Communities

MASSIVE underpins a wide variety of research fields, including neuroscience, clinical science, molecular imaging, genomics, material, chemical and natural science, robotics and engineering, and data science. These fields share a number of characteristics:

- The increased opportunity offered by large volumes of data that require significant processing, analysis and visualisation to gain insight.
- The increased availability of new-generation scientific instruments that produce large volumes of multidimensional or large-cohort data.
- The increased opportunity offered by data and compute intensive processing techniques, including machine learning techniques, visualisation and other capabilities.

MASSIVE undertakes a number of specialised projects and capabilities in partnership with research communities *(see fig 1)*.

Accessibility

MASSIVE has a strong focus on accessibility. To underpin a broad new generation of HPC users, MASSIVE undertakes a number of initiatives, including:

- An instrument integration program, to provide data capture, processing and visualisation from the point of capture, and in specific cases 'in-experiment'.
- MASSIVE develops a curated remote desktop environment that is used by hundreds of researchers. The Strudel suite of software we developed to make interactive HPC easy is internationally and as part of the Australian Characterisation Commons at Scale.

MASSIVE is deploying resource allocation management software, developed by the Monash eResearch Centre, to allow researchers easier self management of their projects, resources and accounts.

Figure 1.

Research Community	Capability Developed or Operated
Structural Biology	Processing, data management and services for 5 cryo EMs located across Clayton, Parkville and Wollongong, and in partnership with facilities beyond
Genomics	A dedicated tailored genomic processing partition for short running genomics jobs operated in collaboration with the Monash Bioinformatics Platform
Clinical and Health Science	Staging environments from clinical sites and machine learning capabilities for radiology research problems
Materials Science	Support for new generation 4D-STEM techniques
Neuroimaging	Data management and hosting of international data collections
Data Science and Machine Learning	Dedicated hardware for deep learning and software support and a regular community meeting to help underpin this growing community

Hardware

The MASSIVE M3 Computer

- 290 nodes (6,564 cores) in 14 configurations, setup for remote visualisation desktop and compute purposes
- 2 X 3PB Lustre parallel file systems
- 100Gb/s Ethernet Mellanox Spectrum network
- Supplied by Xenon, Dell, DDN, Mellanox, NVIDIA

	Name	**Nodes**	**Total CPU cores in partition**	**Memory per node**	**Total GPUs in partition**	**GPU model**
Compute	Standard Memory	22	528	128		
	Medium Memory	13	312	256		
	Standard CPUs	52	1,872	192		
	Standard CPUs with medium memory	11	396	384		
	Standard CPUs with high Memory	1	36	1,024		
	High-Density CPUs	20	960	384		
GPU Compute	K80 with High-Density GPUs	1	24	256	8	NVIDIA Tesla K80
	P100	10	280	256	20	NVIDIA Tesla P100
	V100	24	864	384	72	NVIDIA Tesla V100
	DGX1	11	440	512	88	NVIDIA Tesla V100 32GB
	T4	1	48	384	6	Tesla T4
Remote desktops through the CVL	K1- Visualisation and Job Submission	32	96	16	32	NVIDIA Grid K1
	P4 - Light Compute	66	396	55	66	NVIDIA Tesla P4
	K80 - Heavy Compute	26	312	128	52	NVIDIA Tesla K80
		290	**6,564**		**344**	

Introducing the Australian Characterisation Commons at Scale

New imaging modalities are enabling researchers to study and characterise materials; both biological and non-biological in unprecedented detail. For example, increasingly powerful cryo-electron microscopes are revealing the cellular details even to the level of protein structures, inside whole living organisms such as roundworms, and are being used to map with unprecedented precision the structure of a critical receptor on a cell surface.

These characterisation technologies, which include microscopy, magnetic resonance imaging, nuclear and scattering techniques are all advancing so fast that their pace of development is creating a whole new problem: huge amounts of data. Managing, interpreting and manipulating that data has become a major challenge for the field of characterisation.

The Australian Characterisation Commons at Scale initiative brings together some of the biggest characterisation facilities around the country and Australia's leading universities, to develop a platform that will provide a powerful, standardised set of tools that all researchers can use to manage, analyse and visualise their characterisation data. The ACCS will offer a rich ecosystem of software, data repositories, workflow and other services, that can be applied across the entire field of characterisation science, managing the informatics challenges that are common to all scientists working in the area, from medical imaging to geological surveying.

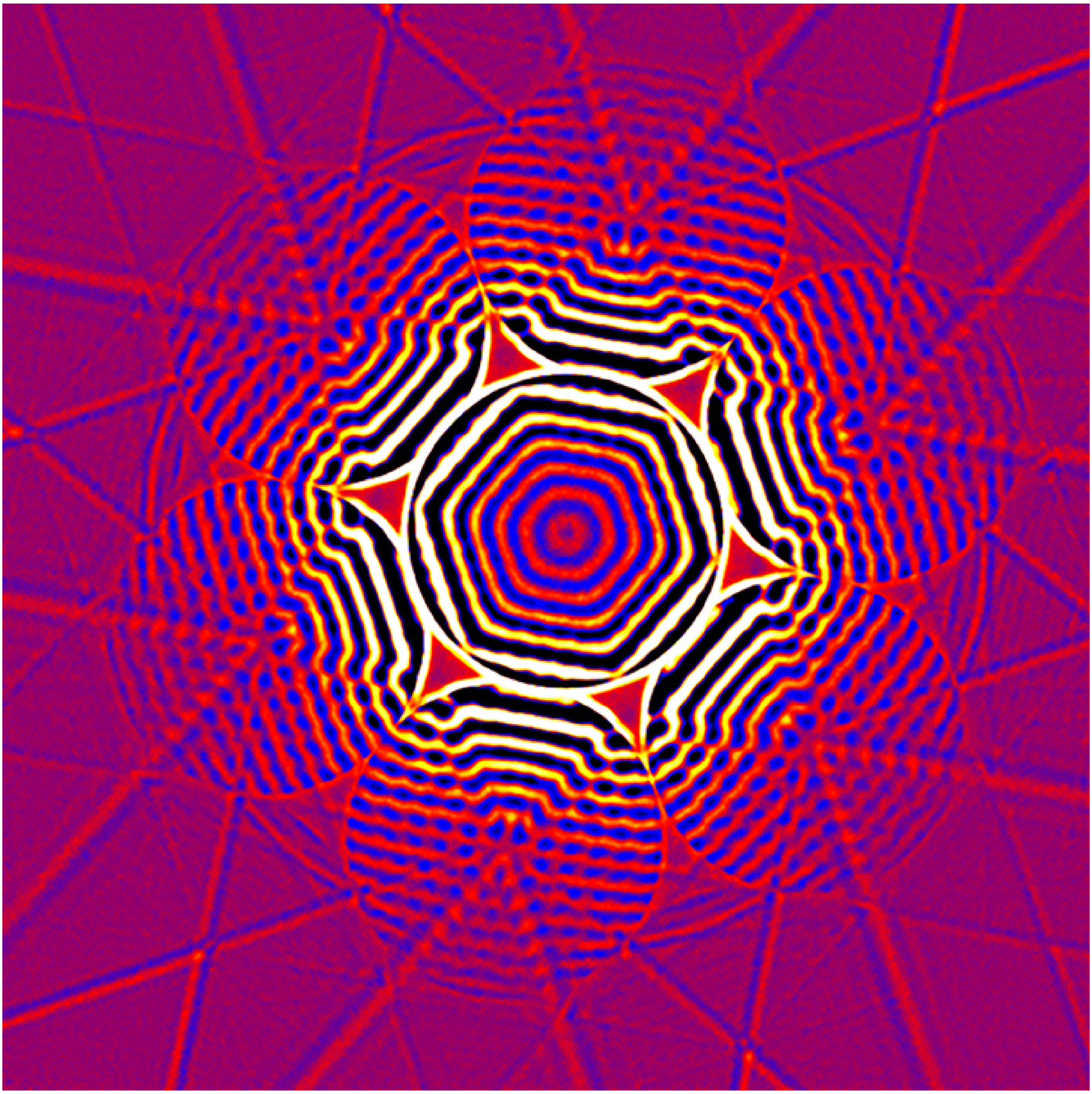
In Australia alone, there are over 5,000 scientists working on government-supported characterisation infrastructure. The software infrastructure will be hosted at four sites around Australia—the University of Sydney, University of Queensland, University of Western Australia, and Monash University — but can be accessed from anywhere through a user portal.

The initiative is also working to upskill future generations of researchers by providing a national training and outreach program that can help newer—and more established —researchers make the most of their imaging data.

The ACCS is a $5.4m project which is funded by the NCRIS Australian Research Data Commons and its partners, including 10 Australian Universities and 2 NCRIS facilities.

In recognition of the significance of the ACCS, project partners have received $1.98 million in funding from the NCRIS-funded Australian Research Data Commons, which will help fund the development of the ACCS.

↗ Pattern of electrons scattered by aluminium. Image taken in the Monash Centre for Electron Microscopy by A/Prof Philip Nakashima.



Project Outline of the Australian Characterisation Commons at Scale

Project partners:

ARDC, Monash University, MASSIVE, QCIF, AARNET, Microscopy Australia, National Imaging Facility, Pawsey Centre, University of Melbourne, Flinders University, University of New South Wales, University of Sydney, RMIT, University of Wollongong, University of South Australia, University of Western Australia, University of Queensland

Key work packages:

- Infrastructure and DevOps
- Big Data Electron and Correlative Microscopy from Instrument to Publication
- Biomedical Imaging Collections and Analysis
- National Tools for Scattering and Beyond
- Training and Outreach
- Project Management
- The project funds 15 full or part time positions across Australia

Underpinning Instruments:

The Atomic Jigsaw

“Imagine having a pinball machine with a cover hiding the pins,” says Prof Joanne Etheridge, Director of Monash Centre for Electron Microscopy. “You shoot balls into the pinball machine, they hit the pins and are scattered out the other end. How can we figure out where the hidden pins are located? We can deduce this from the direction that the balls leave the machine,” she says.

This is how a transmission electron microscope works. A stream of electrons is accelerated and focused onto the specimen using magnetic lenses. The electrons penetrate the material and are scattered as they hit the atoms. As they come out the other side of the specimen, a detector collects information about their direction from which the researchers have to work out where the atoms are. “That’s a big puzzle for us,” says Etheridge. Unlike pinballs, electrons have the added complexity that they obey the laws of quantum mechanics.

The arrangement of just a few atoms can have a profound influence on the properties of the material. Where atoms are and how they bond together controls all the material’s features, from colour to strength to conductivity. “If you want to understand the properties of a material, you need to know its structure, and you need to know it at the atomic level,” Etheridge says.

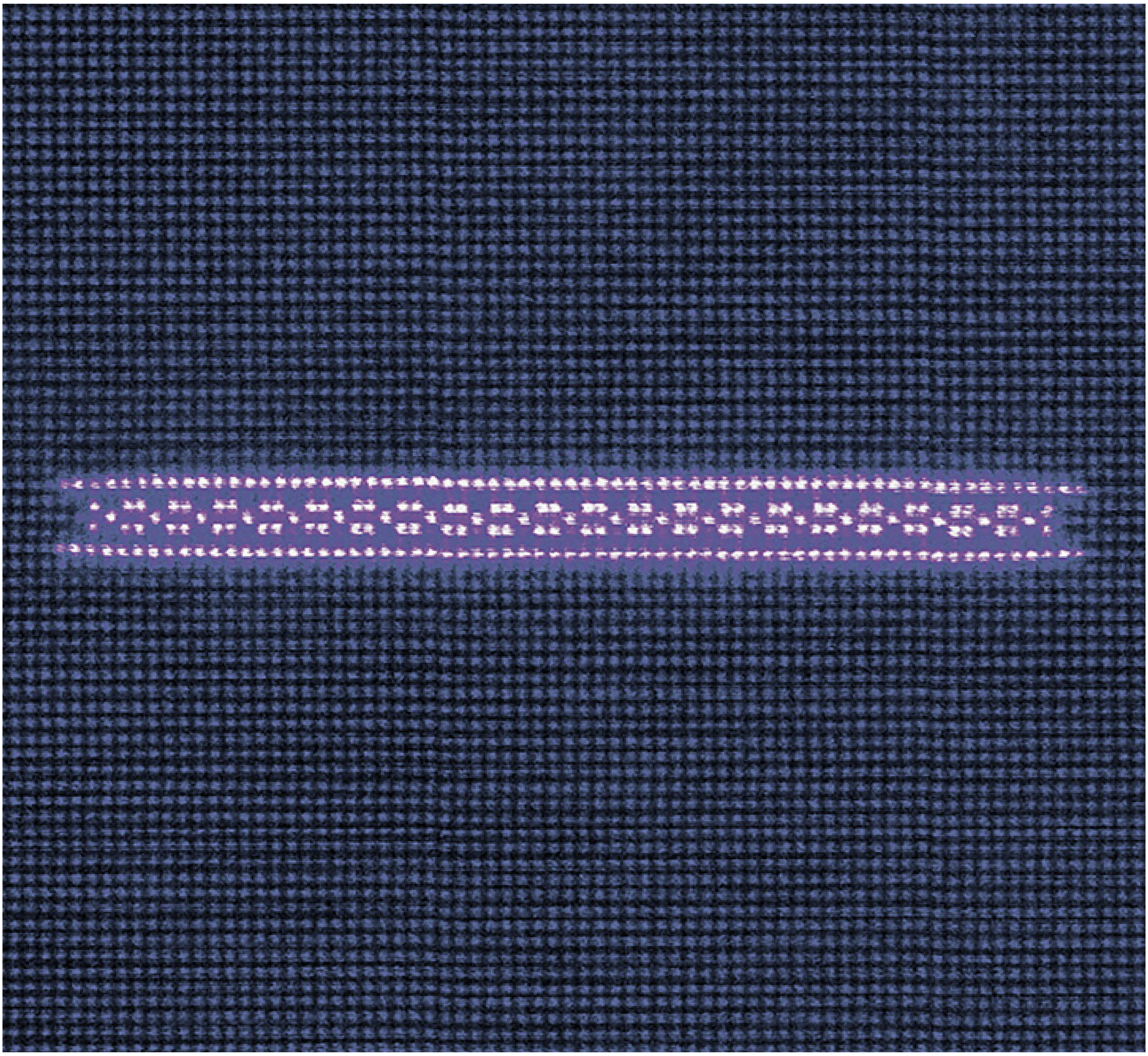
Electron Microscopy allows Prof Etheridge to do just that. But, the world-first, ultra-sensitive microscope that she is installing at the Centre can detect the direction of every single electron that has travelled through the specimen, “this allows us to learn a lot more about the specimen and solve much bigger and more complex scientific puzzles,” she says.

The microscope will be housed in the Centre’s ultra-stable building, purposely designed to protect the instruments from external influences like heat, wind, mechanical vibrations and electromagnetic radiation. “This electron microscope will take ‘photos’ of an atom on the picometre scale. That atom, and the electrons that illuminate it, must not be disturbed by any external influences.” Etheridge says.

But with the new microscope, Etheridge and colleagues face the challenge of dealing with a lot more data, “for every bit of information we used to have, we now have 1 million,” The electron beam scans the specimen, in tiny picometre steps, from atom to atom, collecting millions of bits of information at each picometre step. So the new microscope will provide terabytes of information about the specimen. “And that’s a revolution. It’s incredibly exciting. But it’s also very challenging,” says Etheridge.

“We develop algorithms for analysing the data, but we have to have the data transfer and computational architecture that can handle it,” she says. “This is a revolution for us. We have all this information about a specimen that we never had before. But it is only with the computing mega-power that MASSIVE offers, that we can give meaning to the data.”

↗ Electron microscope image of a high-strength aluminium alloy revealing the position of atoms in a new precipitate phase - the image was interpreted using the computing power of MASSIVE. Image taken by A/Prof Laure Bourgeois in the Monash Centre for Electron Microscopy. Published in Nature Comm 11 (2020) 1248.



Australian Characterisation Commons Facts

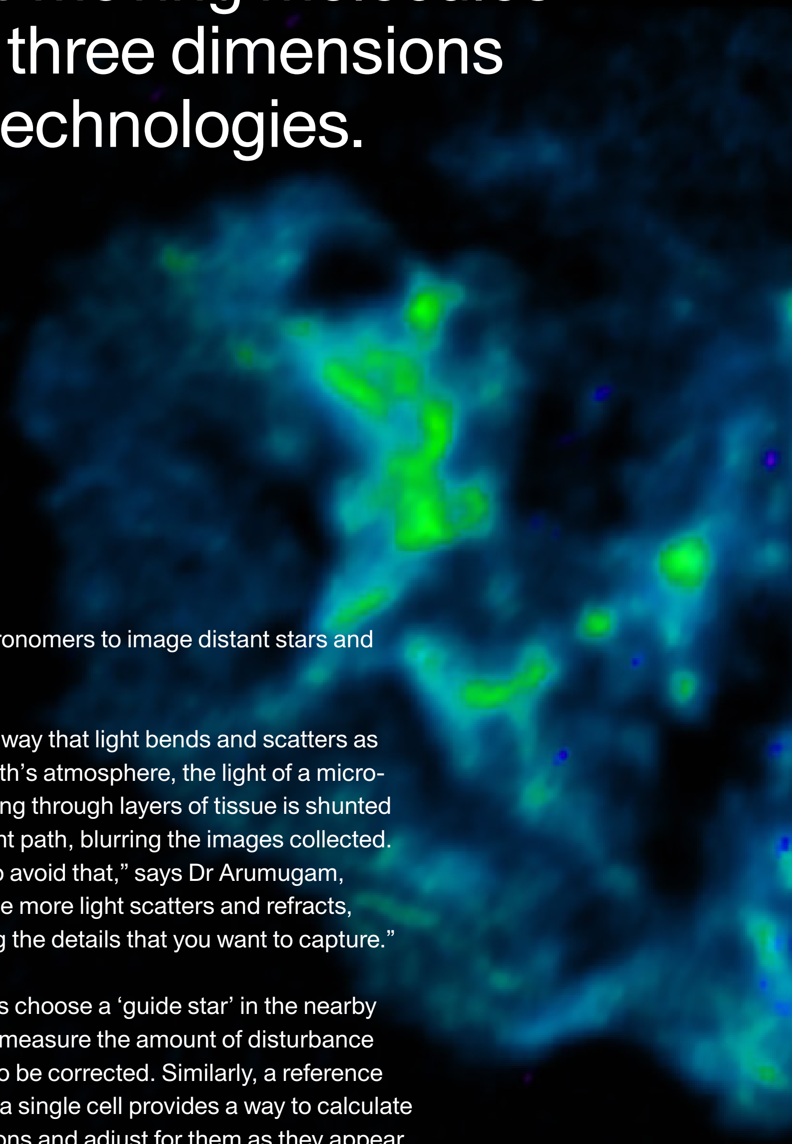
- Australian characterisation instruments are estimated to produce over a half petabyte of data per week, or 25 petabytes per year.
- The most significant data producing instruments are: transmission electron microscopy, cryo electron microscopy, lightsheet, hybrid human imaging.
- Hybrid human imaging, lightsheet, human MR, x-ray microscopy, cryo electron microscopy, and confocal microscopy have the most significant informatics requirements.

Information collected under the Developing an Australian-scale Characterisation Data Capture, Collection, and Collaboration Outline which received funding from the ARDC in 2019 and was undertaken in collaboration with the Australian Characterisation Informatics Committee.

Underpinning Instruments:

New Instruments for Understanding Biology

Inside a single cell, the smallest unit of life, there is a whole universe of fast-moving molecules which can be captured in three dimensions using currently available technologies.



But trying to image the contents of a single cell embedded deep within tissue, to get the full picture of its growth and development, takes a new breed of fluorescence microscope and the computing power to back it up.

Biophysicist Dr Senthil Arumugam is tasked with building the next-generation of microscopes at Monash University. The microscopes will be designed to handle the optical distortions that appear when light traverses tissue, and the speeds of subcellular molecular reactions.

The first instalment is a modality called lattice light sheet microscopy (LLSM) which uses very thin beams of light to image ultrathin slices of the cell, revealing their minuscule features at every step.

But Dr Arumugam, a senior research fellow in Anatomy and Developmental Biology, is seeking to understand how individual cells read signals, communicate with each other, as they divide and differentiate into specific tissues in the earliest stages of development.

Chemical signals secreted by one group of cells can be sensed by another, instructing them to turn into a bone, brain or muscle cell. The only way to truly capture that developmental process is to continually image groups of cells together as they grow at the highest resolution possible.

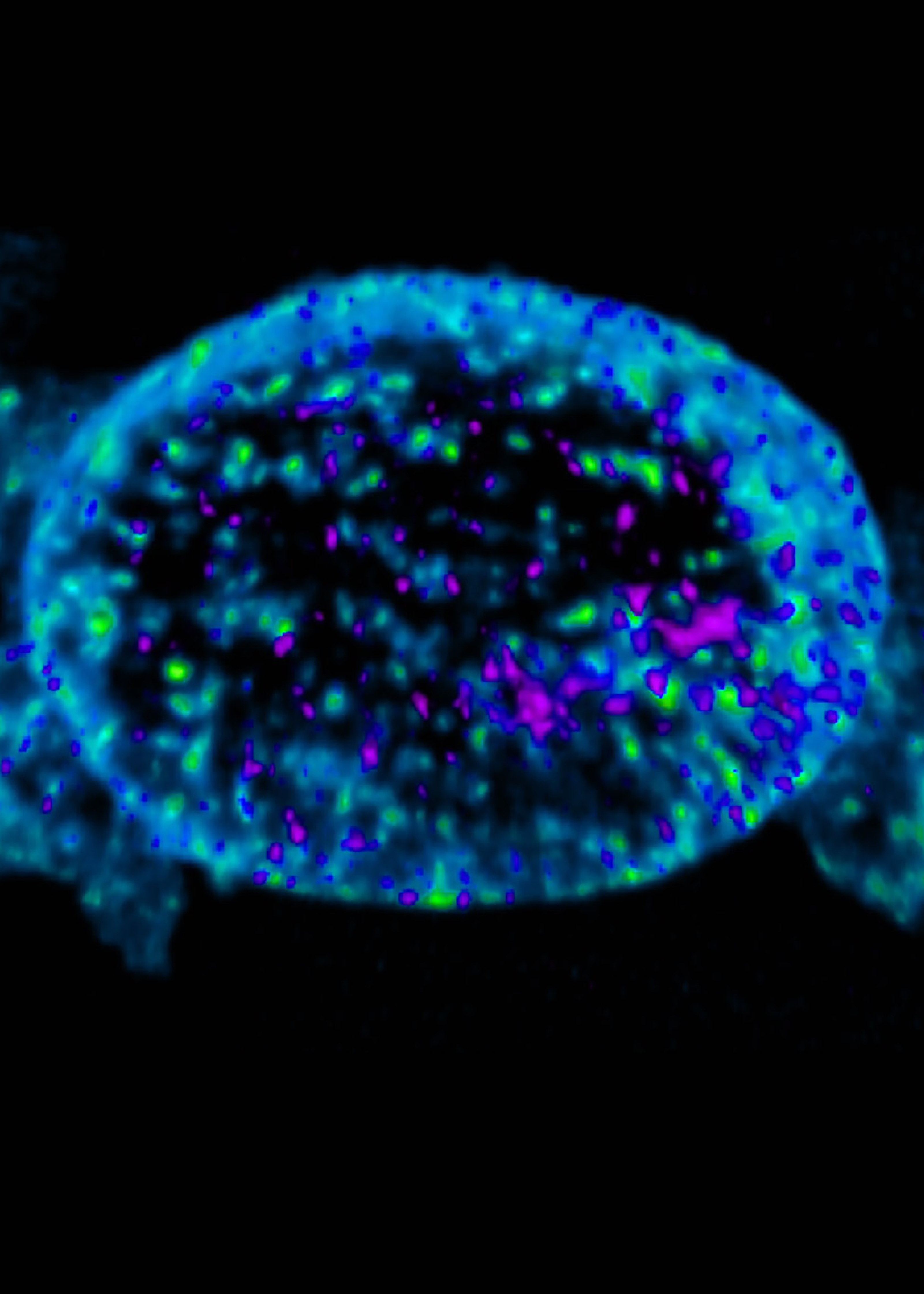
This requires a second approach called adaptive optics which has biologists adopting a technique used by astronomers to image distant stars and galaxies.

In the same way that light bends and scatters as it enters Earth's atmosphere, the light of a microscope passing through layers of tissue is shunted off its straight path, blurring the images collected. "You want to avoid that," says Dr Arumugam, "Because the more light scatters and refracts, you're losing the details that you want to capture."

Astronomers choose a 'guide star' in the nearby night sky to measure the amount of disturbance that needs to be corrected. Similarly, a reference point inside a single cell provides a way to calculate the aberrations and adjust for them as they appear.

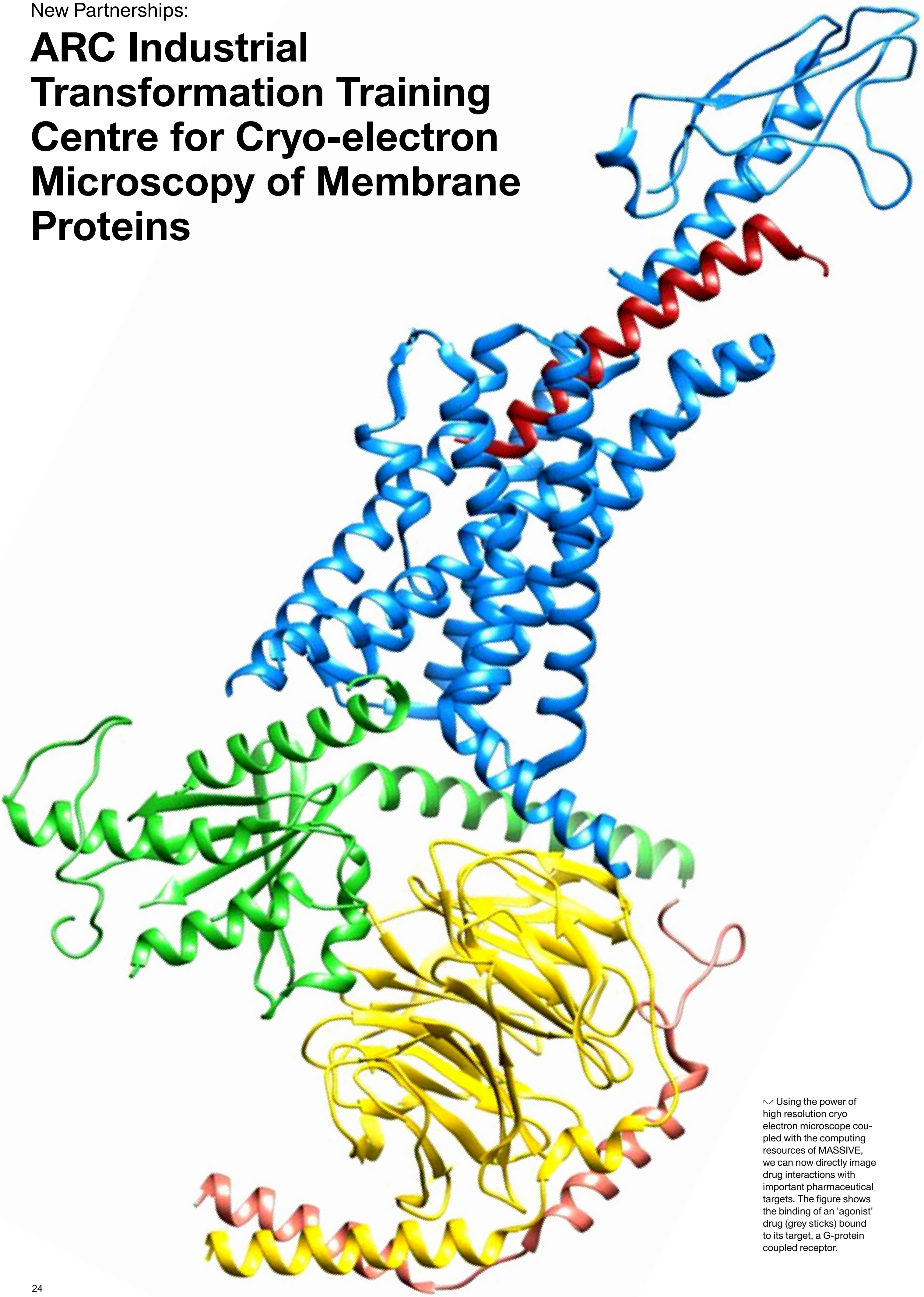
Collecting sharp images is just the first phase in this operation; visualising and analysing the data will be an ongoing challenge. This is where MASSIVE supercomputers will come in. Syncing the microscopes to MASSIVE will streamline data flow, interpretation and analysis.

"We want to be able to interact with the data," Dr Arumugam says, "To play the images forwards and back, turn them around, zoom in and out, and that requires immense computation power." Custom algorithms, run through MASSIVE, will also be developed for automated identification of cellular features and processes in imaging data. "Soon this will be the new norm," Dr Arumugam says. "We need to keep pushing the barriers so we're ready for what's coming in the future."

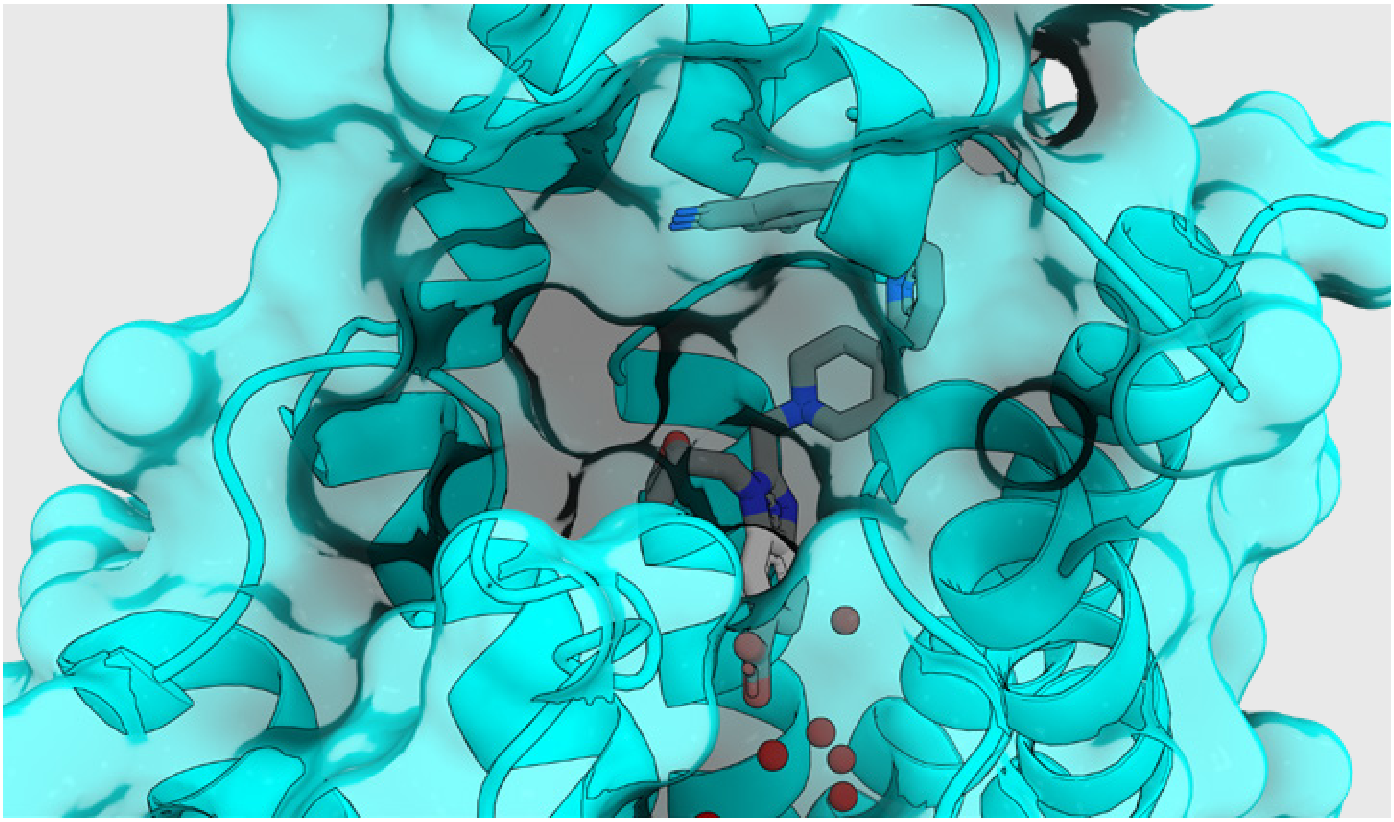


New Partnerships:

ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins



↖↗ Using the power of high resolution cryo electron microscope coupled with the computing resources of MASSIVE, we can now directly image drug interactions with important pharmaceutical targets. The figure shows the binding of an 'agonist' drug (grey sticks) bound to its target, a G-protein coupled receptor.



A group of researchers in Australia have been studying the complexities of drug interactions and behaviours, which could lead to transformational changes in pharmaceutical drug design.

High-level computing is a key to their work. "It allows us to make complex calculations from images captured by cryo-electron microscopy and to see how drugs bind," said Patrick Sexton, Professor at the Monash Institute of Pharmaceutical Science. He leads the ARC Industrial Transformation Training Centre for Cryo-Electron Microscopy of Membrane Proteins for Drug Discovery. "Arguably, we are among the world's leading Laboratories in the work we do."

According to Patrick, access to high levels of computational power lets the researchers visualise a snapshot of how drugs bind while also gaining a better understanding of the underlying dynamic processes associated with drug binding. It also allows them to get results quicker and have better control over the research process. "Having the computational power allows us to see how drugs behave," Sexton said.

The Australian Research Data Commons'-supported Characterisation Virtual Laboratory (CVL) has played an important role in running and managing the group's data-intense programs. It created the software environment to run high-powered electron microscopy, CryoEM data analysis, manage rapid large-volume data import, archiving and long term storage.

It also provided a user-friendly remote desktop, which is linked to the university's powerful MASSIVE supercomputer.

Sexton/Wootten laboratory within the Monash Node of the Centre are world leaders in the use of CryoEM and supercomputers to create detailed images of cell surface receptors, which are integral to understanding how many medications work.

For example, there are approximately 800 different types of G protein-coupled receptors, one of the target classes studied within the Centre. Around a quarter of all medications interact with these cell surface receptors, yet only a small fraction are currently used as drug targets.

Sexton and colleagues are currently studying around twenty different types of G protein-coupled receptors and the roles they play in diseases such as diabetes, obesity and cardiovascular disease.

Their work offers the potential to develop drugs that selectively target beneficial pathways and avoid those that can lead to negative side effects.

Patrick said that traditional views and knowledge about how drugs work are changing, often due to a lack of mechanistic understanding of the way the drugs work.

"Yes, we could get drugs to market but we were not necessarily predicting therapeutic effects in the way that we potentially could, and we were not directing the drugs to particular therapeutic end points as well as we could," he said.

The group's research and increased knowledge about drug interactions could enable more effective, targeted medicines with reduced negative side effects.

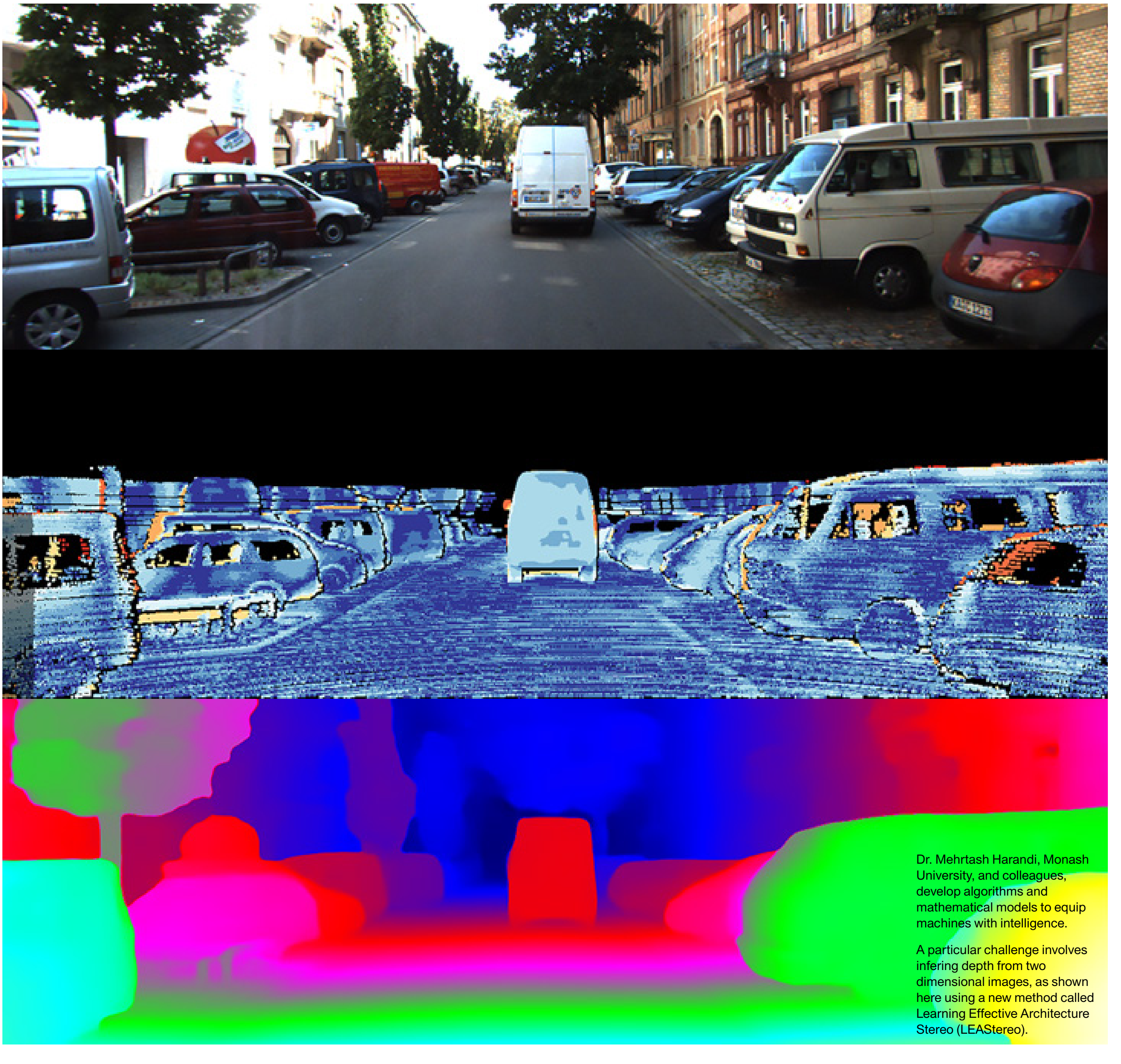
This includes better treatments for a range of diseases including schizophrenia, Alzheimer's, and type-2 diabetes.

The drug design research continues under the ARDC-supported Australian Characterisation Commons at Scale.

National Partnerships:

Introducing the Environments to Accelerate Machine-Learning Based Discovery Project

From drug discovery to image analysis and robotics to social sciences, machine learning is transforming science.



Dr. Mehrtash Harandi, Monash University, and colleagues, develop algorithms and mathematical models to equip machines with intelligence.

A particular challenge involves infering depth from two dimensional images, as shown here using a new method called Learning Effective Architecture Stereo (LEAStereo).

Alongside the growth of big data, advances in imaging, and new technologies that enable the characterisation and study of materials at a molecular level, machine learning is an essential tool that allows researchers and clinicians to analyse and learn from these huge amounts of information.

Its capacity to parse large datasets, detect patterns and associations that may be too subtle for human minds to pick up, and learn from those associations makes it an invaluable tool.

But applying or developing machine learning approaches come with some major challenges. A recent survey by Monash University found that many researchers keen to apply machine learning are limited by the enormous computing power required, while others find that applying machine-learning isn't as straightforward or user-friendly as they need it to be.

This is where the Environments to Accelerate Machine-Learning Based Discovery initiative comes in. The aim of this joint venture between the Australian Research Data Commons, Monash University and the University of Queensland is to help Australian researchers overcome the barriers that make it difficult for them to make the best use of machine learning; firstly by making it easier for them to access the high-performance supercomputing services that are needed to apply machine learning, and secondly by training those researchers to make the most of the software, tools and techniques that are integral to machine learning.

The initiative is also about building capacity in the research community around machine learning by supporting a collaborative network of researchers across a broad range of scientific fields and disciplines but who are united by their interest in the application of machine learning. The participating computing facilities include MASSIVE at the Monash eResearch Centre, and Wiener at the University of Queensland's Research Computing Centre. Training and outreach initiatives are supported by Monash's Data Science and AI platform and QCIF.

Environments to Accelerate ML Based Discovery project outline

Project partners:
Monash University, MASSIVE, University of Queensland, QCIF, NIF, The Pawsey Centre.

Key work packages:

- Accessible Tools, Libraries, Environments, and Data
- Machine Learning at Scale
- Training in Tools, Libraries, Environments, and Data
- Communities of Practice and Outreach across Australia
- The project funds 4 full or part time positions across Australia

User Survey Findings

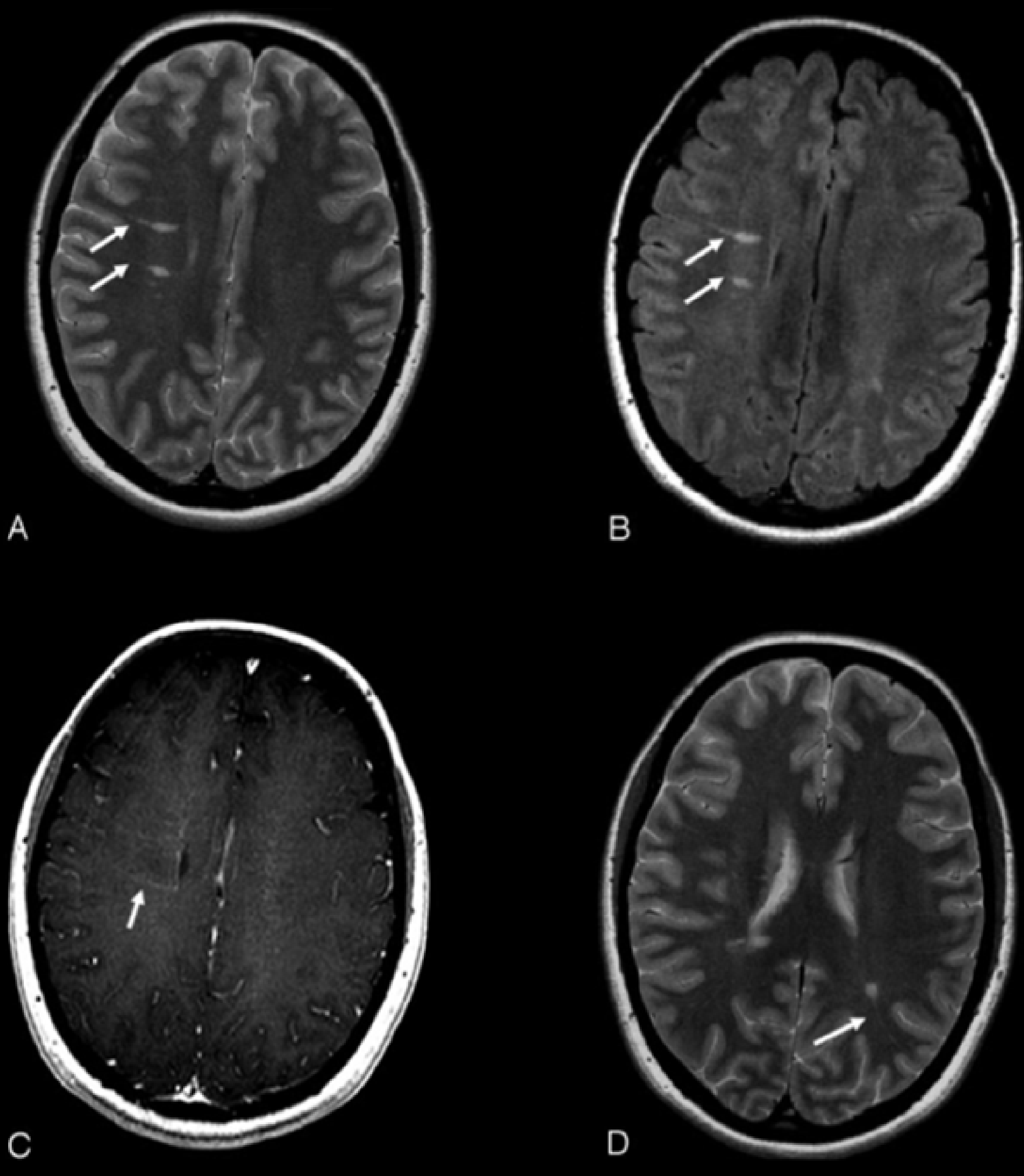
Researchers applying machine learning actively and broadly is a new phenomenon. Therefore, we have collected significant information to ensure that this our initiatives are evidence based. MASSIVE undertook an international survey of research groups across Monash University, University of Queensland and University of Auckland under the "ARDC Discovery Activity: Machine learning infrastructure deployed at scale: understanding requirements, demand, impact and international best practice" project. The recommendations and report are available (http://bit.ly/MLResearchSurvey).

Relevance and Growth	There is a strong and growing appetite across research groups for access to ML capacity, services, libraries, expertise and training.
Capacity and Hardware	Researchers use a range of capabilities to undertake ML. 63% of researchers use HPC facilities to access GPU capability. • Current computing capacity is highly inadequate with requirements growing quickly. • 68% of the researchers expect that their compute needs to grow by 100%-200% in the next year. • 15% expect that their computing needs will grow by over 200%. • 54% of the researchers indicate that compute capacity is their major challenge.
Techniques and Environments	Neural networks & Deep Learning (79%) and Linear regression (32%) are the most commonly used ML techniques. Tensorflow, Keras, Pytorch, scikit-learn, Pytorch and Caffe are the most widely used ML tools/libraries/frameworks.
Data	Availability & accessibility of quality big data is a challenge for more than 50% of the researchers surveyed. Limited availability of annotated/labelled datasets means researchers spend a lot of time and effort pre-processing data
Knowledge and Training	The lack of researchers with machine learning skills and domain expertise is seen as one of the key challenges in applying ML to research. Understandably, training needs are also found to be different for researchers with different expertise levels.
Community	The ML user community can be classified into three main cohorts: • Researchers who develop new ML algorithms and apply these new techniquest to new domains (47%) •Researchers who are primarily applying existing algorithms and libraries to their research challenge (46%), and • Researchers who are actively seeking opportunities to apply ML techniques but have not started yet(7%). 90% of ML researchers are multidisciplinary and have active collaborations to solve real and practical research questions that has social impact.

National Partnerships:

Deep Learning for Clinical Impact

Artificial intelligence applied to medical imaging is fast demonstrating its ability to categorise images and detect abnormalities, and has further potential helping radiologists interrogate more images and more complex manifestations of disease.



At Monash University and The Alfred Hospital, researchers are developing a suite of algorithms to improve the diagnosis and management of neglected and difficult-to-treat conditions.

Their computer algorithms, as with many applications of AI in medical iamaging, are trained to identify suspicious features on diagnostic images and mark them up for further inspection by a radiologist. This aids diagnosis and with enough data, AI could become more efficient and consistent in helping radiologists to review the stacks of images collected with every MRI or CT scan.

One such project, led by infectious disease physician Dr Michelle Ananda-Rajah in collaboration with radiologist Professor Meng Law and radiology trainee Dr Jarrel Seah, is developing an algorithm to help detect fungal infections of the lung that can quickly develop into pneumonia in people with impaired immune systems.

The goal is to make surveillance monitoring for fungal infections on CT chest scans feasible in this susceptible patient group. A fungal infection of the lung can be difficult to detect and can be easily missed, especially in the early stages. Training AI to detect subtle markers of fungal disease would improve patient care by detecting and treating those infections early.

The platform, called fungalAi, is a project across seven Australian hospitals and one site in Singapore. Imaging data is collected at each hospital, de-identified and then funnelled into MASSIVE supercomputers for curation, labelling and development of an algorithm.

Aside from the processing power it provides, MASSIVE hosts a high-performance clustered system which allows researchers to share data across multiple nodes of the research network. This is essential, says Dr Seah, especially when dealing with rare conditions, to amass sufficient imaging data to train AI algorithms.

"Shared data and shared resources are definitely the way forward in AI development," Dr Seah says. "A lot of these projects require collaborations between different institutions in order to get the dataset required for AI."

Having access to MASSIVE also enables the research group, led by Professor Law, Program Director of Radiology and Nuclear Medicine at The Alfred, to design algorithms for analysing multifaceted neurological conditions such as traumatic brain injury (TBI), Alzheimer's disease (AD) and multiple sclerosis (MS).

In the case of MS, their algorithms search for several indicators of MS the disease in brain scans, to test their combined predictive power and get a better understanding of the disease progression. Thinning of the protective myelin sheath around nerve cells is a definitive marker of MS, but the team are also assessing diffusion imaging and other markers of inflammation in the brain.

"We look at all these different methodologies in one 'multiplex' approach and at any one time we can do multiple different analysis on the brain," says Professor Law.

"This requires high-performance computing to put it all together, which is why we need MASSIVE."

↖ MASSIVE is being used to train models used to detect and analyse multifaceted neurological conditions such as traumatic brain injury.

The Melbourne Experiment: How COVID-19 lockdown will reshape the city.

Monash University researchers are trying to uncover how the COVID-19 pandemic is affecting Melburnians' life by looking at what people share on their social media. The large multidisciplinary experiment will allow them to answer questions across health and urbanism to prepare the city for future pandemics and climate change disasters.

The researchers, whose interest of study ranges from social sciences to psychology to urban planning, want to gauge how people are coping with the lockdown from what they post online. They then match this information with data on location, demographic and urban architecture from censuses and surveys to see how they correlate.

But while censuses and surveys data are well structured and organised, the way we create social media content takes different forms — we write, we post photos, videos and audio. "Social media data are in a format that is convenient for humans to communicate with each other, and we have to convert them into a format that computers can understand," says Dickson Lukose, professor at Monash Data Futures Institute.

Lukose and Professor Geoff Webb, Director of the Centre for Data Science at Monash University, are helping the research teams involved in the Melbourne Experiment applying artificial intelligence and natural language processing on the social media content to distil people's sentiments and emotions.

"One of the biggest challenges we have is the amount and variety of data we have to deal with," Lukose says. "This is where the MASSIVE high-performing computing infrastructure plays a crucial role in enabling us to do this work in a trackable time," he says.

What makes Lukose and Webb's job even more complicated is that every research group will look at the data with a different lens. The social scientists are interested in how the suburb where people live affects their social life, for example, while psychologists want to know how it affects their mood.

Therefore, the data need to be organised and analysed depending on what questions the researchers are trying to answer. "One set of data might be organised around locations, whereas another set may be organised around time," says Webb. "We need to unify the data into a single coherent structure, and that's a big challenge," he says.

This process requires enormous computing power that MASSIVE provides.

Giving meaning to this huge amount of data will help Monash researchers make better predictions for future pandemics and disasters. It will allow

them to rethink and reshape the city, and ultimately improve people's life.

"We aim to build a digital city model of Melbourne that allows us to visualise and plan scenarios for different outcomes on how the city might develop during and after COVID-19," says Professor Carl Grodach, Director of Urban Planning and Design at Monash University. "This will help us better forecast what the future might be like in Melbourne," he says.

Grodach is particularly interested in how the urban environment — buildings, green space, public outdoor areas, population density — influences how people cope during the lockdown.

Typically he would base his assumption on surveys of hundreds of people. Now, a Twitter analysis provides him with hundreds of thousands of people's responses on how their neighbourhood functions during this time.

"This is a unique moment where everyone focuses on their neighbourhood, and we can start to build a larger evidence base on what helps people feel better," says Grodach. "It gives us a chance to understand how people respond to the urban environment so that we can target policies and resources to help them live better in this situation and beyond. Because these resources are going to be important even after the lockdown," he says.

"COVID-19 has changed a lot of what we know about the city and how cities operate, so policymakers are dealing with a lot of unknowns and a rapidly changing environment," says Dr Alexa Gower, research fellow at Urban Planning and Design at Monash University. "We are building the knowledge base so that we can cope more effectively next time," she says.

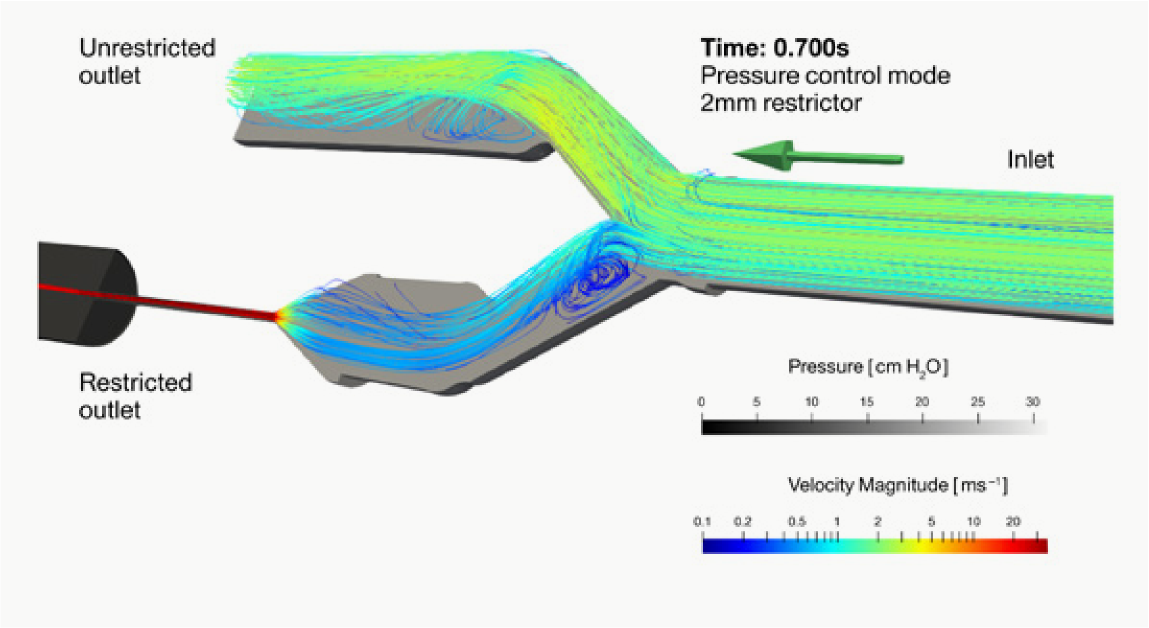
"The exciting thing is that we've gone from a small sample size of a survey to such a large sample size that enables us to answer a lot more questions," Gower says. "The challenge, though, is dealing with really complex data and teasing out the nuances."

Processing the large number of tweets Melbournians generate every day requires extraordinary computing power. But with the help of data scientists Lukose and Webb, the urban planning team can analyse the gigantic data sets in a short time using MASSIVE supercomputers.

3D Printed Ventilator Parts that can Save Lives

When the COVID –19 pandemic struck in the north of Italy at the beginning of the year, cases of severe infection spiked so rapidly that soon hospitals had not enough ventilators for every patient who needed one. Doctors found themselves having to make a tragic choice; who to ventilate and who to not.

→ Flow visualisation at the peak pressure of the inspiratory cycle in a 2-way splitter with 2 mm restrictor. The colour of the streamlines indicates the instantaneous magnitude of the local velocity, with the flow direction indicated by the arrow.



In a desperate attempt to save as many lives as possible, some Italian doctors tried to attach extra tubes to ventilators to put two patients on one machine. “This is extremely risky, and it should only be done by doctors who are suitably trained and only in an emergency,” says Dr Daniel Duke, senior lecturer at the Department of Mechanical and Aerospace Engineering, Monash University.

Ventilators are not designed to work this way. If two patients have very different lungs - for example, a child and an older man — and different oxygenation needs, the machine needs to have different settings for the two patients. The risk is to injure one patient or provide insufficient air to the other.

Splitting the airflow from the ventilator to two patients isn’t enough. So Duke and his colleagues have designed flow restrictors that can control the flow of oxygen reaching the two patients by adding additional resistance to the airflow coming from the ventilator. “3D printed ventilator restrictors allow you to ventilate two patients with very different needs,” he says.

Duke and his research team have developed a computer model that simulates how the airflow moves through the restrictor and splitter as the ventilator pushes oxygenated air into the patient's lungs. This allows new designs to be tested before they are manufactured.

But when Duke’s team printed the restrictors, they found that they performed very differently from what the simulations had predicted. “3D printers are not particularly accurate machines, they generally lay down layers of plastic that are about a quarter of a millimetre thick,” says Duke. This may seem very small to the human eye, but in fluid mechanics, that's a big difference.

“It's like airflow moving over bumpy hills instead of a smooth flat surface,” he says.

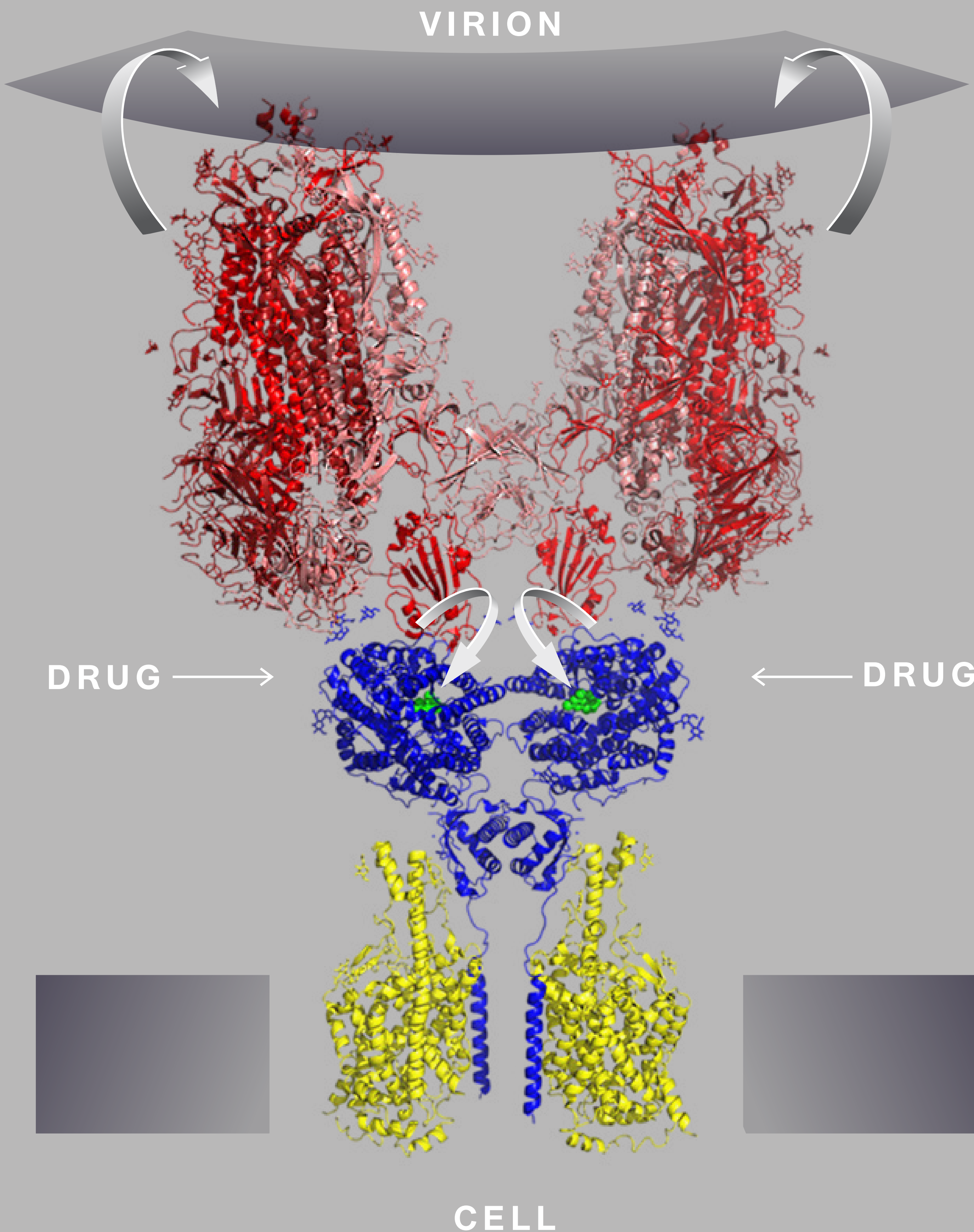
Duke’s group was able to reconcile the difference between the simulations and the printed restrictors. Yet, he warns that only high-quality printers should be used to print these parts and that any new design should be scrupulously checked because their performance may differ from simulations with life-threatening consequences. That is why Duke has made his code freely available for anyone who wants to verify a restrictor design before 3D printing.

While Italy may have flattened the curve of COVID-19 infections for now, and the shortage of ventilators is no longer an issue, other countries still struggle with ventilators availability.

“We hope that if the parts could be printed with the correct level of accuracy, they could be rapidly produced in several different standard sizes,” says Duke. “And in an emergency scenario, ICU doctors could quickly select the size they think is best for their patient.”

“There are a lot of reasons why we need to prepare for the next pandemic. Because this is probably not going to be a one-off,” he adds. “We hope that when the next pandemic comes along, the findings from this study can be used to help us make good decisions about how to have spare parts available for ventilators in hospitals.”

NOTE: The authors recommend extreme caution when utilising any type of ventilator-splitting apparatus, despite claims made by commercial manufacturers of said devices regarding safety.



Two ACE2 molecules are shown in blue, attached to the cell and another cellular protein coloured in yellow. Two SARS CoV-2 spikes are shown in red. The project investigates whether novel molecules can alter the interaction between ACE2 and the viral receptor to prevent entry as schematically represented by curved arrows.

Understanding COVID-19:

For many, the COVID-19 vaccine isn't coming soon enough

As 2020 comes to an end, the COVID-19 pandemic that has shaken the world over the year isn't going away any time soon. But the new year also brings positives. The time-record development of COVID-19 vaccines gives us hope that the pandemic is coming to its final chapter.

But although a number of COVID-19 vaccines have already been approved and rolled out in some countries, it may take years before the global population will be vaccinated and there are still many unanswered questions. Will these vaccines be effective against emerging SARS-CoV-2 virus mutations? How long does the immunity last? Will we ever be able to eliminate the virus? Or will COVID-19 come back every year like the seasonal flu? Only time will tell.

In the meantime, "antiviral agents are urgently needed," says Associate Professor Fasséli Coulibaly from the Department of Biochemistry and Molecular Biology at Monash Biomedicine Discovery Institute. The SARS CoV-2 virus causes a spectrum of diseases from asymptomatic infection to regular upper respiratory infections similar to the common cold to respiratory failure, which in some cases results in death.

On its cell surface, SARS CoV-2 has protein stalks sticking out, called spike proteins. The virus uses these spikes to attach to the ACE2 receptors in human cells. When this key-like spike unlocks the cell, the virus can then insert its genetic material into the cell to replicate, making us sick.

Most researchers worldwide are trying to hijack this process by targeting the spikes on the surface of the virus. Instead, Dr Coulibaly partnered up with a multidisciplinary team led by Dr Heidi Drummer from the Burnet Institute, Melbourne, to target the receptor, with funding from the Medical Research Future Fund.

"The receptor is a human protein, it's not going to mutate, and it's highly conserved across the whole population," says Dr Coulibaly. In contrast, the virus mutates over time and can develop strategies to escape antiviral drugs.

"We want to lock the ACE2 receptor in a state that is not compatible with the binding of the virus," says Dr Coulibaly. Together with his collaborators Dr Mark Del Borgo and Professor Rob Widdop from the Pharmacology Department at Monash University, and Professor Mibel Aguilar from the Department of Biochemistry, Coulibaly's group investigates how a series of novel peptides bind to the ACE2 receptor making it potentially unavailable to SARS CoV-2.

Dr Coulibaly uses ANSTO's Synchrotron and cryo-EM to determine the exact structure of ACE2 in complex with these peptides so that the team can design a key that fits into the ACE2 receptor excluding the virus spike. These analyses produce a vast amount of data that are stored in MASSIVE supercomputers.

"The development of COVID-19 vaccines is going much faster than any other vaccine, but not everyone can access the vaccine at the same time," says Dr Coulibaly. "A second line of defence is extremely useful to help stop transmission of the virus and for those who may not be able to be vaccinated like immunosuppressed patients or pregnant women." And while Australia has done well in controlling the pandemic so far, other countries record thousands of cases every day. No vaccine will come soon enough for the hundreds of thousands of people still fighting the disease.

Clinical Impact:

BRA-STRAP: precision prevention to beat breast cancer before it appears

Prof Southey and Dr Nguyen-Dumont advancing precision prevention or breast cancer for all women.

When the women and their families concerned about their risk of developing breast cancer attended Familial Cancer Centres around Australia in the mid 90s, they wouldn’t have expected to be recontacted almost 30 years later with updated results.

“Back in the 1990s, genetic testing was technically laborious and extraordinarily slow. It used to take 6 to 12 months to do a genetic test for BRCA1 alone,” says Melissa Southey, now Professor of Precision Medicine at Monash University, but in the 1990s she was Head of the Molecular Diagnostic Pathology Laboratory, at The Peter MacCallum Cancer Institute that provided this testing. “Genetic testing at this time was also extremely expensive, costing in the order of $5000 per gene”.

“Technological advances now mean that we can sequence a person's whole genome in one assay, and we can also sequence and analyse up to 300-500 genes of many people in just a few days,” says Dr Tu Nguyen-Dumont, cancer geneticist and bioinformatician at Monash University, “and all for a few hundred dollars”.

Southey and Nguyen-Dumont are sequencing the DNA of the women who have in the past provided blood samples for genetic testing with the advantage of modern genetic technology. They want to interpret the genetic variants in the increasing number of genes associated with (or suspected to be associated with) predisposition to breast cancer. Their mission is to identify high-risk women before they develop the disease, providing them with increased opportunities for prevention.

The two researchers are looking at genetic variants in 24 genes in over 30,000 blood samples. Each sample produces a large number of genetic variants that need to be analysed simultaneously. “You need an infrastructure that supports this type of analyses and provides enough storage,” Nguyen-Dumont says, “and MASSIVE has been crucial.”

To measure the risks associated with the genetic variants they find in women with breast cancer, Southey and Nguyen-Dumont have generated similar data involving participants from the Australian Breast Cancer Family Registry and a dataset from the ASPREE study that involves healthy elderly Australians that thus makes an excellent reference dataset.

But comparing DNA sequencing datasets that have been generated using different genetic testing technologies adds complexity to the analyses. Integrating these data requires the huge computing power that MASSIVE supercomputers provide.

BRA-STRAP is the largest, nation-wide, clinically set study on breast cancer prevention. “Data on this scale exemplifies the opportunities and challenges for realising precision medicine and precision public health for breast cancer,” says Nguyen-Dumont.

As Southey and Nguyen-Dumont understand more about which genetic variants are associated with increased risk of breast cancer, they are making this new information available to the families via the support of their local Familial Cancer Centre. “This new information will be used to support the clinical management of their breast cancer risk. But also, if they were to be diagnosed with breast cancer, it is likely to inform their treatment choices,” says Southey.

“How do families receive the news of updated clinically relevant genetic information about their breast cancer risk? They are very pleased to finally have an explanation of their breast cancer family history and absolutely delighted that they have been remembered even when their initial genetic testing had been decades ago,” she says.

Clinical Impact:

Breathing Together

1 in 10 children in Australia has asthma. It is the most common non-communicable disease of childhood and involves over 400 hospitalisations per 100,000 population among children aged 0–14. Yet there is no cure available.

"We don't understand why some children develop asthma," says Professor Benjamin Marsland from the Department of Immunology and Pathology at Monash University, Melbourne.

He hypothesises that airway epithelial cells (AEC)—cells that line the airways and first to respond to allergens and viruses—may function abnormally in infants who go on to develop asthma when they are older.

Microbes in newborns' airways seem to play a role in determining the functioning of AEC and might influence whether these infants will progress to asthma. "One of the main things that we're doing at Monash is looking at how the microbiome in the airway interacts with those cells," says Marsland.

He is collecting airway samples from 1000 newborns and older asthmatic children. He then sequences the DNA of the microbiome; bacteria, fungi and viruses present in the airways.

"We have huge amounts of data telling us which microbes are there," says Marsland, "and that's one of the most computationally intensive approaches for which we require MASSIVE."

The second step is to understand how the microbiome interacts with the cells in the airways. "We have the DNA from the microbes, we also have RNA from the children's own cells, which tells us how those cells function, and we have the metabolites present in the airways which represent one means of communication between microbes and the children's cells. Taken together, this is a seriously large panel of data," he says.

Marsland relies on MASSIVE supercomputers to integrate those data sets, "we hope that by understanding the interaction between host and microbes in these children, we might get some insight into why they're developing asthma later in life," he says

A new weapon in radiation therapy

The greatest challenge in radiotherapy is to minimise damage to healthy tissues while maximising the radiation dose delivered to the tumour.

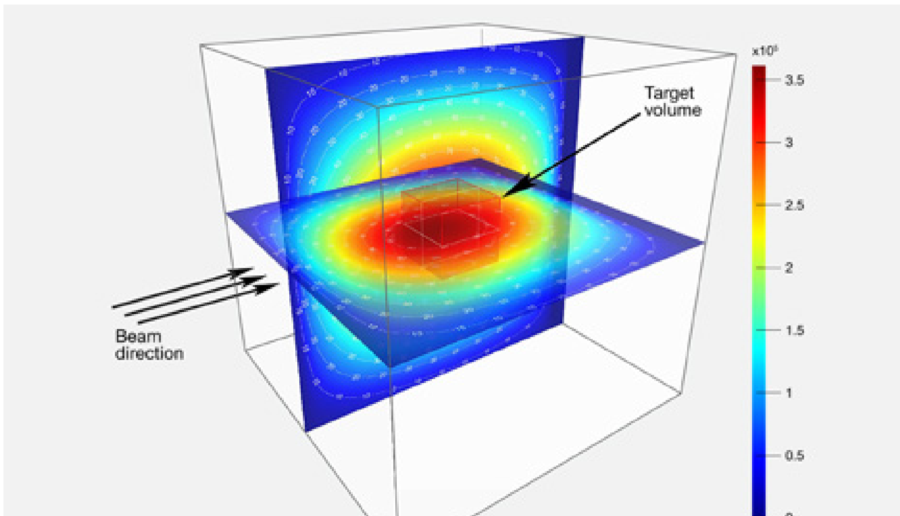
In conventional radiotherapy, photon beams deposit energy along their entire path through the body, hitting healthy organs while entering and exiting the tumour site. This can result in pain, irritation or bleeding and increases the long-term risk of developing secondary cancers.

Particle therapy is emerging as the preferred treatment option for many difficult-to-treat cancers. It uses a beam of charged particles — protons or ions such as helium or carbon — to deliver a radiation dose to the tumour. This highly targeted radiation eliminates cancerous cells while exposing healthy tissues to a lower radiation dose compared to photon therapy since most of the dose can be delivered to a precise depth in the body.

“Imagine photons like little agile people running through a crowd,” says Dr Mitra Safavi-Naeini, Senior Physicist and Research Lead, Human Health, ANSTO. “Then imagine particles like a charging team of football players; they crash through the crowd, then slow down until they completely stop,” she says.

Radiation oncologists can control how far particles penetrate the tissue by tuning the energy of the beam. Then, with a magnetic field, they can steer the beam up and down, left and right.

“Like a 3D printer, we can paint the tumour one slice at a time, starting at the maximum depth and then lowering the energy to paint each successive slice,” says Safavi-Naeini. “We continue until the whole volume of the tumour has been painted with sub-millimetre accuracy”.



Thermal neutron field surrounding the target volume

Despite this precision, it is often necessary to leave an untreated buffer zone at the edges of the tumour to avoid damage to surrounding organs, and small secondary metastases can survive treatment.

Safavi-Naeini and her team may have found a solution. As particles reach their destination, they interact with the tissues and fragment into subatomic particles, including neutrons, which disperse in the body and “thermalise”.

The team uses cancer-targeting agents containing boron-10 or gadolinium-157 that capture some of these neutrons and release very high energy short-range particles. “They stop within five to nine microns from the point of capture, so they remain within the cell and kill it,” says Safavi-Naeini.

While the particle beam treats the bulk of the tumour, these high energy short-range particles effectively treat the parts of the tumour that would have otherwise survived. “We call it Neutron Capture Enhanced Particle Therapy, or NCEPT, for short,” Safavi-Naeini says.

Safavi-Naeini's team is conducting simulation studies before taking the innovative technique to clinical trials. These simulations are critical to accurate treatment planning and optimisation. Each simulation generates an enormous amount of data and can only be performed on modern high-performance computing platforms such as Monash's MASSIVE cluster since they would take thousands of hours to complete on a single CPU.

“We probably generate between 40 and 50 terabytes per year, and it's going to grow,” says Safavi-Naeini. “We are one of the most intensive users of the MASSIVE high-performance computing facility because it’s the only way we can do real exploration in the field of particle physics applied to medicine.”

Training and Outreach

Training in Partnership with Monash Data Fluency

MASSIVE partners with the Monash University Data Fluency program, which provides regular training and workshops for researchers to become more accomplished with informatics tools and services. MASSIVE provides access to Data Fluency training for all MASSIVE users, and access is not limited to Monash affiliates.

The following is an outline of training provided through Data Fluency.

Introduction to High Performance Computing, Data Fluency

High-Performance Computing is the use of extremely powerful computers for running complex computational tasks that would take days, months or even years to complete on a standard computer. It may refer to the use of a supercomputer, a single high-powered unit with many processors, or a group of powerful computers linked together to form a 'cluster'. At the end of this course, users will have an understanding of the concepts of High Performance Computing, will know what to expect to find in a HPC cluster. They will also get experience running parallel programs on a small cluster with a Slurm scheduler.

Introduction to Unix and Command Line, Data Fluency

While the Graphical User Interface makes your computer easy to use, it does not give you full control over all its possible functions. Using the Command Line Interface (CLI) to control the Shell, in contrast, enables you to carry out a huge range of tasks, covering all of the functions of which the computer is capable. Harnessing the Shell through a CLI is particularly useful for dealing with large volumes of data or when you need to automate a process.

Introduction to TensorFlow, Data Fluency

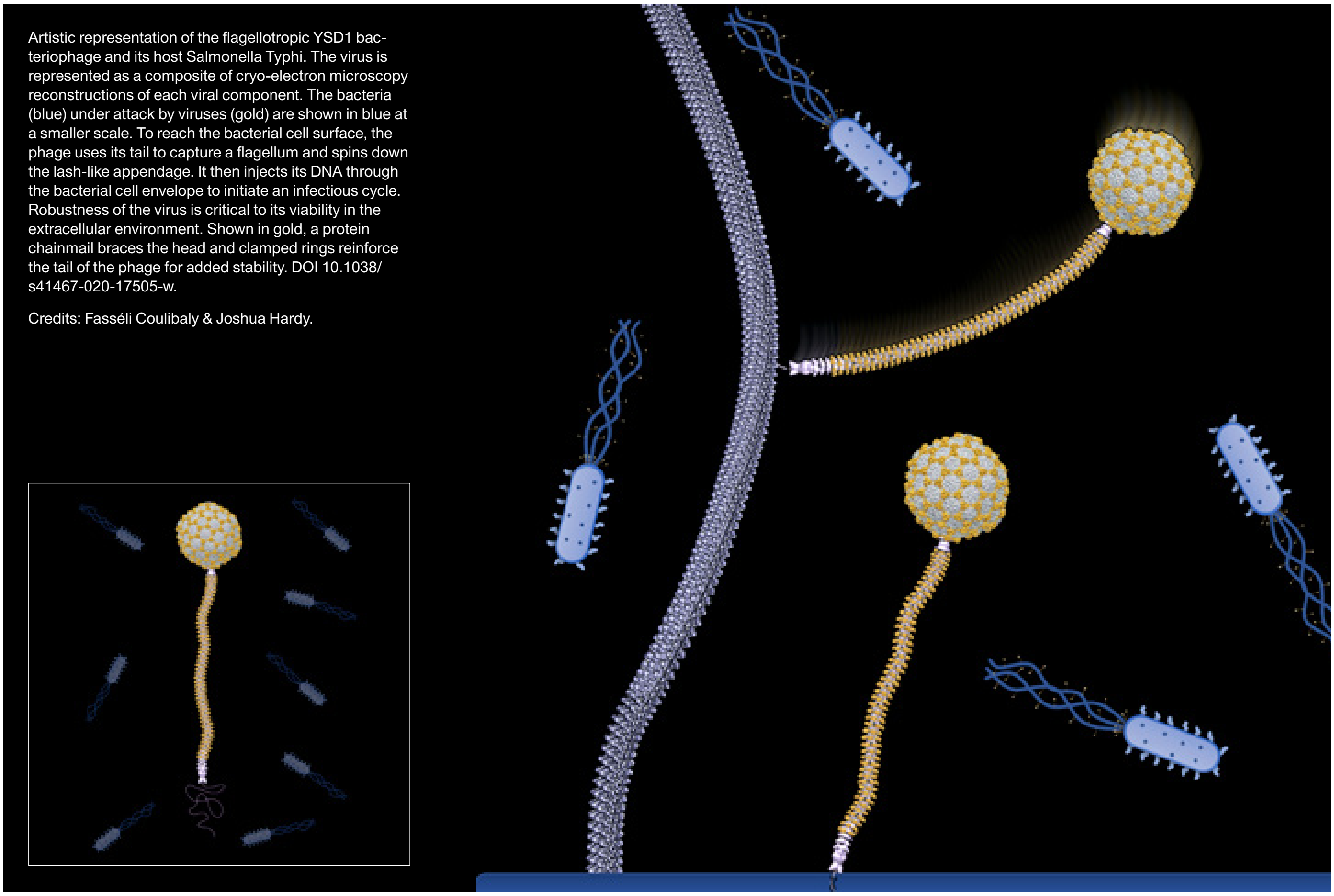
TensorFlow is used to develop machine learning applications. Instead of explicitly telling the computer what to do, machine learning uses statistical and mathematical models on large data sets to determine patterns, similarities and comparisons in the data. TensorFlow is an open source library developed by Google and is most commonly used with Python.

Python Workshops, Data Fluency

Python is a popular general-purpose programming language that is great for working with research data. As one of the most popular programming languages, Python is very versatile, has a simpler syntax than a lot of other languages, supports reproducibility, and can be used in a wide variety of research activities.

Data Fluency runs a series of different Python workshops, including:

- Introduction to Python
- Image analysis in Python with SciPy and scikit-image
- AI with Deep Learning
- Deep Learning for Natural Language Processing



Artistic representation of the flagellotropic YSD1 bacteriophage and its host Salmonella Typhi. The virus is represented as a composite of cryo-electron microscopy reconstructions of each viral component. The bacteria (blue) under attack by viruses (gold) are shown in blue at a smaller scale. To reach the bacterial cell surface, the phage uses its tail to capture a flagellum and spins down the lash-like appendage. It then injects its DNA through the bacterial cell envelope to initiate an infectious cycle. Robustness of the virus is critical to its viability in the extracellular environment. Shown in gold, a protein chainmail braces the head and clamped rings reinforce the tail of the phage for added stability. DOI 10.1038/s41467-020-17505-w.

Credits: Fasséli Coulibaly & Joshua Hardy.

Lifescience Workshops, Data Fluency

Life science is becoming increasingly computational and data-oriented. Researchers at all levels desire data analysis skills. One of the Platform's core activities is staff sharing their data analysis skills with life science researchers through training. Though the Data Fluency initiative we conduct hands-on Bioinformatics workshops to help researchers develop and improve their digital data handling skills These cover introductory to advanced computational topics such as:

- Introduction to R
- Introduction to Python
- Programming and tidy data analysis in R
- Reproducible research in R
- Linear models in R
- Working with DNA sequences and features in R with Bioconductor

For access to Data Fluency training please see the website: www.monash.edu/data-fluency/

Specialised Training in Machine Learning

For access to specialised Machine Learning Training please visit the MASSIVE
website or the ML4AU community website (www.ml4au.community/)

MASSIVE offers national training workshops through the national Environments to Accelerate Machine Learning Based Discovery project, in partnership with University of Queensland and the Monash University AI & Data Science Platform.

AI with Deep Learning and PyTorch
Monash University, Friday December 4, 2020

Introduction to Deep Learning and TensorFlow
Monash University, Thursday, December 3, 2020

Deep Learning for Natural Language Processing
National, Wednesday, December 2, 2020

Introduction to Deep Learning and TensorFlow
ABACBS 2020, Friday, November 27, 2020

Train-the-Trainer: Deep Learning for Natural Language Processing
Thursday, November 26, 2020

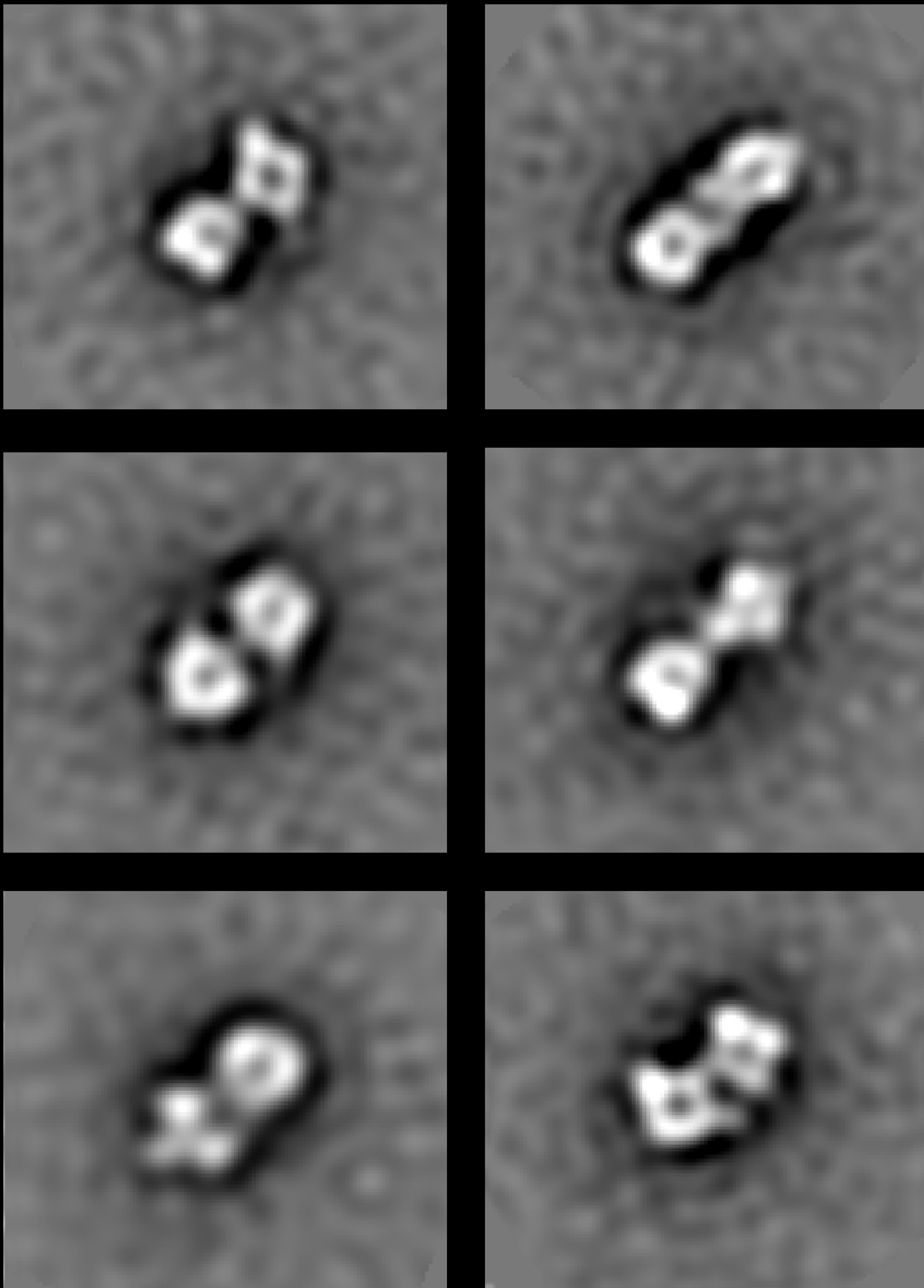
Introduction to Deep Learning and TensorFlow
Monash University, Thursday, November 26, 2020

Train-the-Trainer: Introduction to Deep Learning and TensorFlow
National, Thursday, November 26, 2020

Deep Learning for Natural Language Processing
National, Friday, October 9, 2020

Deep Learning for Natural Language Processing
Monash University, Monday, October 5, 2020

Introduction to Deep Learning and TensorFlow
Monash University, Friday, September 25, 2020



Biochemistry & Structural Biology:

Finding the Right Key

Dr Scott Cohen, senior research scientist at Children's Medical Research Institute, Westmead NSW, wants to know what telomerase's 3D molecular structure looks like.

Telomerase is an RNA-protein enzyme complex that presents several challenges to obtaining a high-resolution structure with electron microscopy (EM). EM images are achieved by averaging thousands of individual molecular projections, thus molecules that are symmetric and rigid average well.

"Telomerase is neither. It’s asymmetric and floppy," Cohen says, which means that molecules look different to one another. “When the collection of molecules exist in different conformations, they do not average well, so the result is blurring of the 3D structure and hence low resolution.”

"Conformational heterogeneity makes electron microscopy difficult, and the only way to overcome that is big datasets," he says.

For every trip to the Molecular Horizons facility at the University of Wollongong, where one of Australia's most powerful cryogenic electron microscopes lives, Cohen generates thousands of 2D raw images from which he wants to reconstruct the 3D structure of the enzyme.

"It's two or three terabytes for a small dataset," he says. Therefore, storing and processing this vast amount of data requires enormous computing power, which is provided by MASSIVE.

Drs James Bouwer & Simon Brown, managers of the Molecular Horizons facility, transfer the images from the microscope to MASSIVE supercomputers with high-speed optic fibres in a matter of hours. Once the images are transferred, Dr Cohen can access the data remotely from his laptop and process them rapidly. "Managing such volumes of data on my own would be expensive and slow, the relationship with MASSIVE greatly increases the speed of the science," he says.

Telomerase catalyses the addition of telomeric DNA repeats onto the 3'-end of telomeres, the repetitive DNA-protein complexes at the ends of linear eukaryotic chromosomes.

Telomeres shorten at every cycle of DNA replication and cell division. When they become too short, the cell stops dividing because the short telomeres are sensed as potential DNA damage. The enzyme telomerase counteracts telomere shortening, allowing the cell to maintain stable telomere length.

When telomerase is upregulated, the DNA can replicate countless times, and the cell can proliferate endlessly leading to cellular immortality. Thus, dysregulated telomerase activity is strongly associated with cancer.

"Structure dictates function," says Cohen. "So knowing telomerase's structure can tell us how it works and what its role in cancer is."

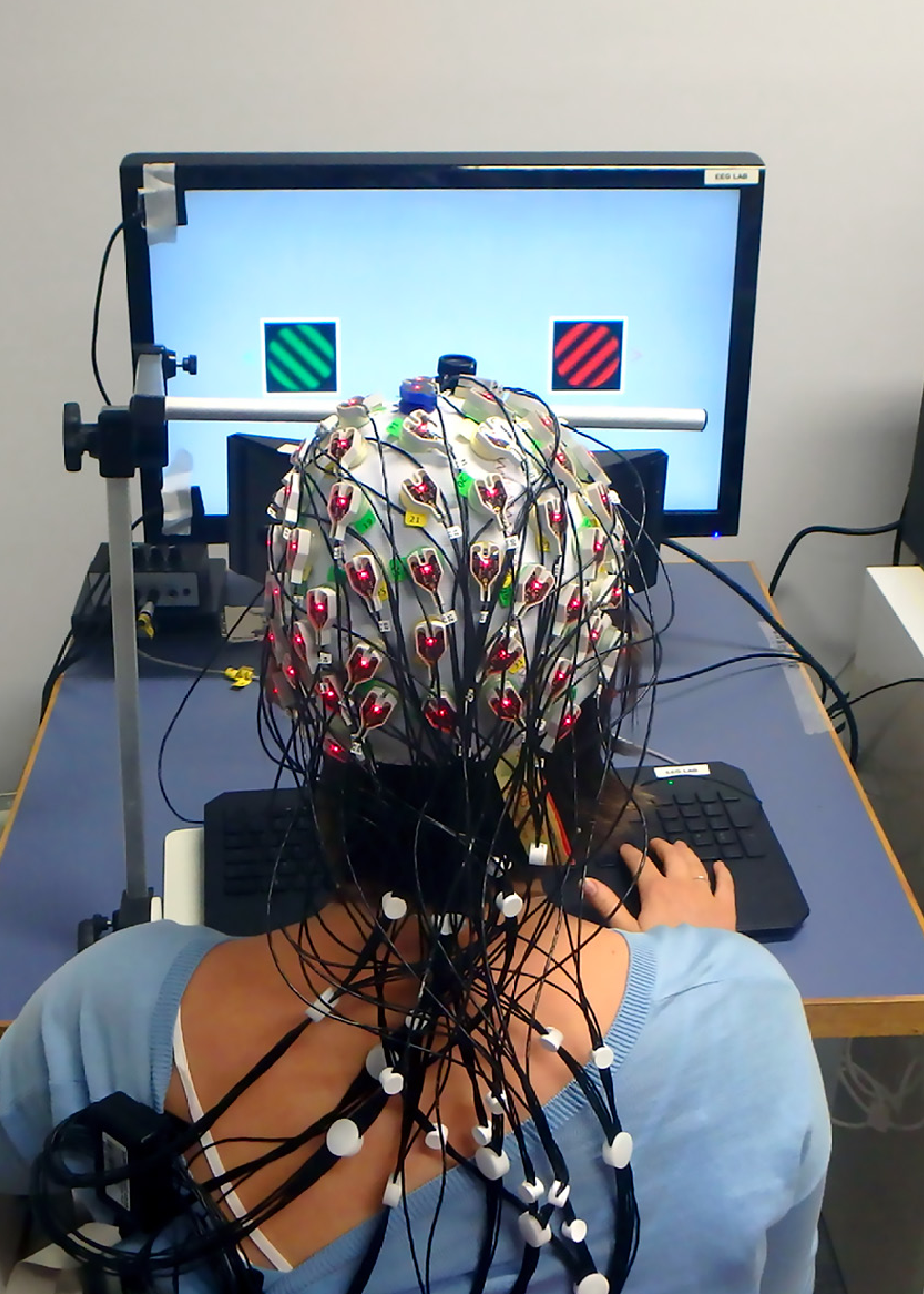
A high-resolution structure can also provide crucial knowledge for the development of cancer therapeutics, in the form of small-molecule telomerase inhibitors. Cohen wants to design small molecules that bind to telomerase, inhibiting its activity.

"Telomerase is like the lock in the door. We want to design the key that fits perfectly and uniquely into the lock, thereby providing molecular specificity and laying the foundation for a safe and specific therapeutic."

← “2D Class Averages” of human telomerase. Each image represents ~1,000 individual molecular projections of telomerase that overlay to provide a 2D class average.

These six 2D averages represent a selection of the different conformations of the telomerase enzyme. Some of these differ so significantly from each other that averaging into a 3D structure is not possible using the whole data set.

A complete understanding of telomerase will require multiple 3D structures representing different conformations and therefore, an unusually large data set.


EEG LAB

Neuroscience:

Understanding the nature of consciousness

Since early childhood, Professor Nao Tsuchiya has questioned the nature of consciousness; what it feels like to be born, or to die. Now, with the help of MASSIVE's supercomputing facilities, he is seeking the answers.

At Monash University's Turner Institute for Brain and Mental Health, Tsuchiya is exploring some fundamental neuroscientific questions about the boundary between conscious and unconscious, and what happens in the brain when we slip from one conscious state to the other.

"Surprisingly, much of the stuff that's happening in the brain is quite unrelated to our conscious experience," he says. "For example, in dreamless sleep or deep general anaesthesia, you don't experience much and if anything you don't remember much, but still your brain is extremely active."

Part of his research explores the differences between the conscious and unconscious brain in experimental models such as the fruit fly, Drosophila melanogaster. This involves recording neuronal activity in these tiny creatures, which nonetheless have more than 100,000 neurons in their brains.

Recording the activity of each of these individual nerve cell generates a colossal amount of data, which is collated into a form of virtual map of brain activity using the supercomputing facilities at MASSIVE.

Researchers are testing what's called the integrated information theory of consciousness, which attempts to tease out what systems have consciousness and if anything what kind of conscious perception they have.

"According to the theory, consciousness is something to do with integration of information, a notion which is gaining empirical support," Tsuchiya says.

To test this, they're looking at the brain activity of fruit flies under general anaesthesia, called isoflurane. When applied to humans, isoflurane induces loss of consciousness quite reliably. Using MASSIVE, Tsuchiya's team is trying to retrieve "shape" of information from the recorded brain activity. Their hypothesis is that the more complex the conscious experience becomes, the more complex and integrated the shape of information becomes. For example, when flies are awake, informational shape should become complex as it should reflect integrated processing of hearing, vision, touch and memory.

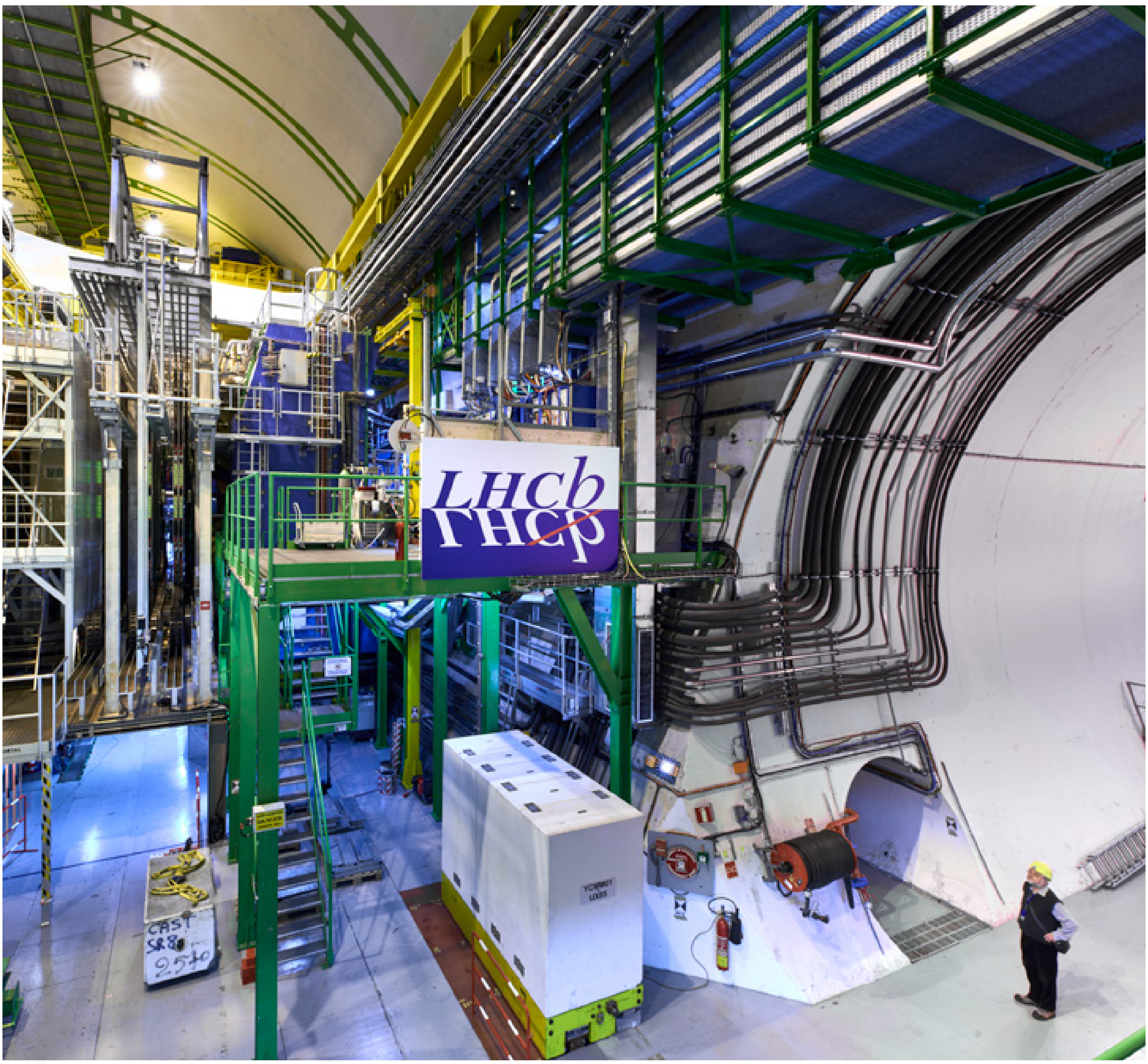
But in the unconscious anaesthetised state, that integration doesn't work the same. He likens the anesthetized brain to three people sitting together in a café, but one person is looking at their phone while the other two are talking.

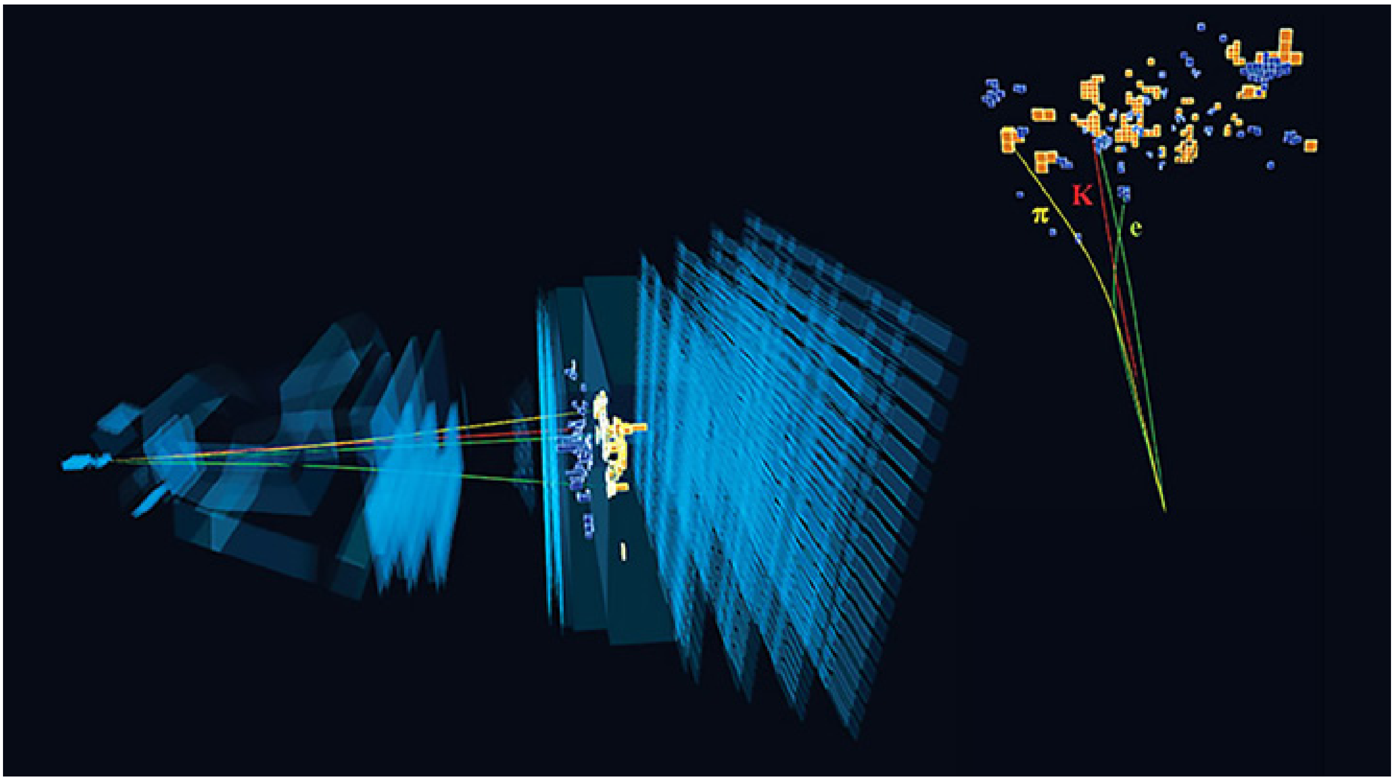
"Some parts are actually talking, but not all of them are connected and not all of them are jointly generating a unified sensory experience," he says. "That's what we are trying to test in the neurons."

High Energy Physics:

Understanding the Universe

When the Large Hadron Collider, the world's most powerful particle accelerator, gets an upgrade, every square millimetre of the new instruments, every single electrical input and data output, plus every particle possibly generated will have been simulated before construction begins.





← An image of the LHCb detector at CERN.

↑ The decay of a B0 meson into a K*0 and an electron–positron pair in the LHCb detector, which is used for a sensitive test of lepton universality in the Standard Model

The planned upgrades to the LHC, which was first switched on in 2008, will make it capable of generating more intense proton beams, boosting its experimental capabilities into the next decade. The idea is that with higher intensity beams, physicists will be able to crack open the fundamental forces of nature which hold subatomic particles together, to explain how the Universe works.

It will require new detectors, too, to capture the intensely energetic particles produced when the two amped-up proton beams collide.

One of the new detectors is for the LHC beauty (LHCb) experiment, which seeks to understand the difference between matter, which forms everything in our Universe from soil to stars and galaxies, and its twin, antimatter, which existed only for a fraction of a second after the Big Bang. Physicists think that beauty quarks, the subatomic particle after which the LHCb experiment is named, might hold some answers.

Professor Ulrik Egede, an experimental physicist based at Monash University, is part of the nucleus of physicists who are designing a new detector for the LHCb experiment which will be ready to use in 2032, at the earliest. Right now, Egede and his team at Monash University are building simulations that run on MASSIVE's supercomputers and model exactly how the detector will work.

Called a calorimeter, the detector will measure particles passing through the instrument and any traces of energy left behind.

"In real life, these detectors are huge, 10 metres long in three dimensions, but we simulate how particles are moving through them, millimetre by millimetre," Professor Egede says.

When a particle enters the future detector, their simulations model everything that could happen next: if the incoming particle hits a certain material inside the detector, does it get absorbed or split into other particles; can the materials used to build the instrument withstand the radiation produced; if the particles emit light then how that light is reflected; and what electrical signal might be generated.

Professor Egede, who started working on the LHC in 1992, says the evolution in data processing over the last three decades has been profound for particle physicists but soon, their experiments will be limited by the sheer cost of computing data which, in the new detector, will be coming in at a rate of 40 million times a second.

"We're just not seeing the same rapid evolution of computing technology as we're used to," Professor Egede says. "Using the same computer technology as we do today, we just couldn't afford to process all the data we're going to get."

So their simulations are also testing specialised computer processing technologies, including reprogrammable arrays that can be wired for one task then retrained for the next. They could be used to process data from the detector in real-time.

"The design of new detectors is this boundary between what we know is theoretically possible, what we know we can practically build and always, what we believe we can afford," he says.

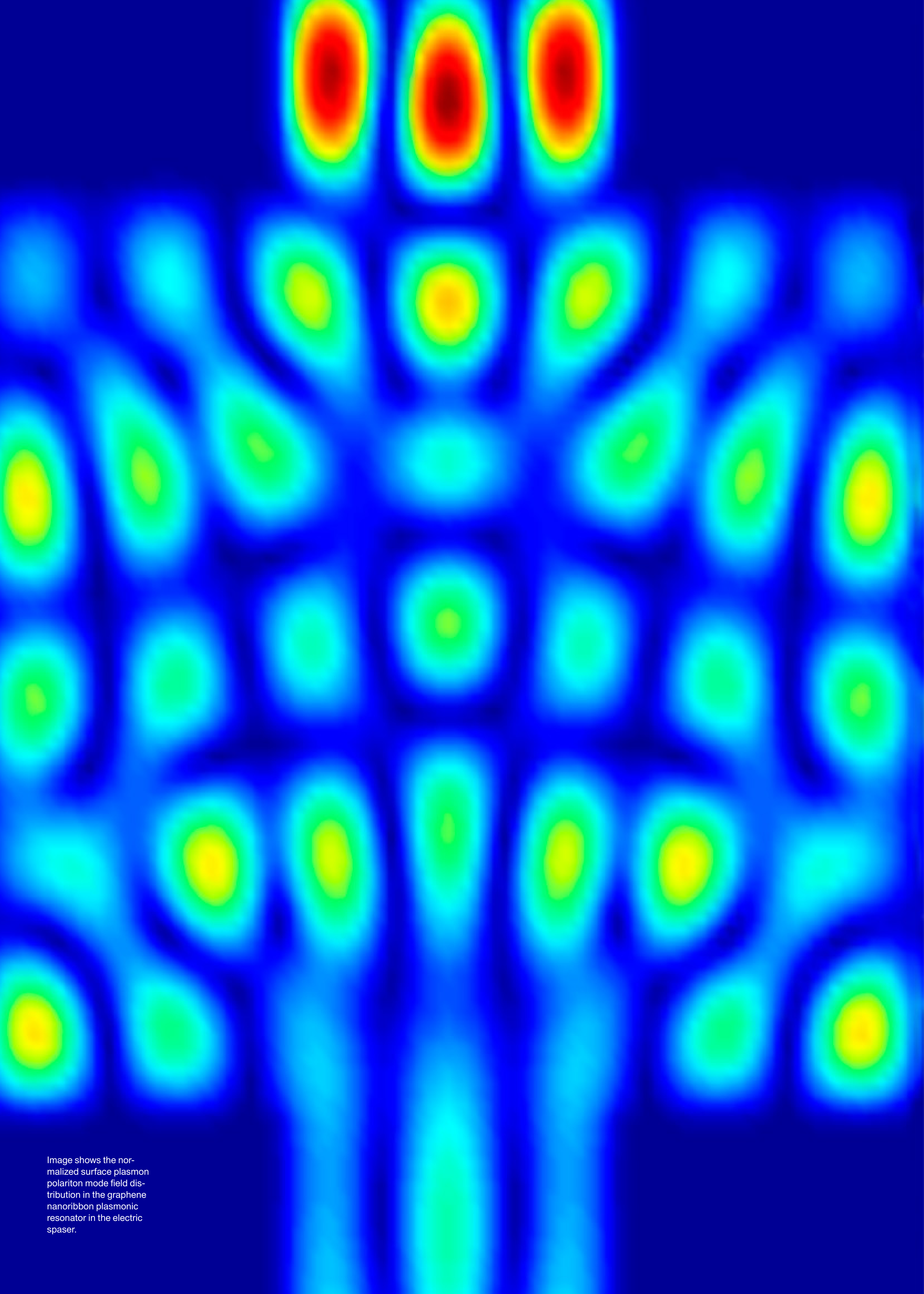


Image shows the normalized surface plasmon polariton mode field distribution in the graphene nanoribbon plasmonic resonator in the electric spaser.

Engineering:

Creating the next generation of lasers: The future is nano

When the first laser was invented in 1960, it was described as "A solution looking for a problem, but before long, scientists harnessed its distinctive qualities — coherent, structured light with the ability to form a narrow beam with almost single wavelength — for a myriad of technological and medical applications.

But lasers are limited to the mesoscopic and the macro worlds due to a fundamental physical limit known as the diffraction limit. So, Professor Malin Premaratne from the Department of Electrical and Computer Systems Engineering, Monash University, is developing a new quantum electrodynamics theory to model nanoscale light sources that can generate highly coherent, nanoscale light-like fields.

“A spaser - short for surface plasmon amplification by stimulated emission of radiation - is a nanolaser,” says Premaratne. “It provides coherent energy in the nanoscale by emitting a new particle called a plasmon, which originates from interactions of photons with electrons in materials. Unlike photons in laser light, plasmons can probe and roam the nanoworld.”

Spasers allow probing atoms and molecules or exchange information between nanodevices, “whatever you can do with lasers in the micro world, now you can do it in the nanoworld,” he says.

Making spasers isn’t easy. Premaratne and his American colleague Prof. Mark Stockman, inventor of the spaser technology, are developing the theories behind how spasers work through complex modelling. To do that, they have to write their own software and algorithms requiring extraordinary computing power. “We don’t use existing software, we develop novel algorithms and mathematically clever ways to model these systems,” says Premaratne.

“Simulating these nanodevices is a highly computationally costly exercise. So we have to have supercomputing capability to do it,” Premaratne says. His students run their tailor-made code on MASSIVE supercomputers saving time and money.

Premaratne’s group, together with Jet Propulsion Laboratory (NASA) at Caltech, and Georgia State University and the Institute of Optics at the University of Rochester, New York, has modelled and patented the world’s first spaser made completely of carbon. Compared to other heavy metal-based spasers, carbon-based spasers are biocompatible and have, therefore, a high potential for medical applications.

For example, scientists have already found ways to deliver graphene and carbon nanotubes into cancer cells. By applying highly concentrated coherent fields generated through the spasing phenomena, individual cancer cells can be destroyed without harming surrounding healthy cells.

With the help of the MASSIVE platform, the team has invented several types of spasers, with some even powered by electrical sources. “Almost all the designs except ours are optically powered. That means a laser is needed to get those spasers working,” says Premaratne. But lasers are large compared to spasers and the overall setup is huge even though spases operate in the nanoscale.

“This is a limitation if we want to use spasers in lab-on-a-chip type scenario,” he says. “Electrically powered spasers, such as ours, can be powered by the current integrated chip technology. So, they are truly nanoscale devices.”

Premaratne says the field is now matured enough for optoelectronic devices as small as a few nanometers to be a reality.

“About a decade ago, this technology was inconceivable. Now, it’s not science fiction anymore’” says Premaratne, “it can actually be done.”

Ecology:

Using genomics to control envasive weeds

Common ragweed is native to Eastern North America, but over about 100 years it has been introduce to many areas of the globe including Europe and Australia.

Ragweed is highly invasive and competes with crops resulting in substantial yield loss. It is also a primary cause of hayfever, with direct medical costs upwards of $3.5 billion per year in the US alone.

Ragweed adapts well to a wide range of climates. In North America, it can be found from Florida up into Newfoundland. "What's really cool is that you see quite a big difference between the northern and the southern populations, and these differences reflect genetic adaptation to the local climate," says Dr Kathryn Hodgins, Senior Lecturer and Head of the Plant Ecological Genomics Research Group at Monash University.

While in Newfoundland, as in Germany, ragweeds flower after just a few weeks of growth and reach a height of a few centimetres, in Florida, or in Queensland, plants can grow taller than a human and flower months later. "In Quebec and in Germany, they have a very short window in which to grow, flower and reproduce before the frost comes and kills them. In warmer areas, they have longer growing seasons. So, they have evolved genetic differences to deal with these different climates." says Hodgins.

Invasive species can adapt well to new climates, and they do it rapidly. "Are they using the same genes and the same genetic variants to adapt to new environments? Or are they developing new solutions to adapt?" asks Hodgins.

The Hodgins' lab is studying genetic variants all across the genome of this species to identify the genes involved in climate adaptation. They found that ragweed often uses the same regions of the genome to adapt to new climate conditions in Europe and Australia, as in North America. "And it happened very, very quickly," Hodgins says, "it's a really nice example of how evolution can happen very rapidly."

Hodgins and her students are sequencing the genomes of individuals from across Europe and North America and are comparing them with specimens from museum collections. "We have hundreds of samples from when ragweed was first introduced into Europe as well as an equivalent number of contemporary samples. So we're trying to track adaptation over time as well as space," she says.

Hodgins' team sequenced around 350 modern genomes, which means about 1 billion DNA base pairs and each base has to be sequenced five times. "If you multiply those numbers together, you can get an idea of the size of the raw data," says Hodgins. And that is not all because the sequence data are meaningless unless they can be analysed. "The analysis takes a very long time," she says, and the only way to do it in a feasible time is to use MASSIVE supercomputers. "None of these analyses can be done without that kind of computational power."

"What's really exciting is that we found differences between the historical and contemporary populations at the same location in flowering time genes, suggesting there has already been an adaptive response to contemporary climate change in native populations," Hodgins says.

Climate change and human disturbance of the environment are creating favourable conditions for ragweed to thrive. Understanding how ragweed is so successful may allow Hodgins to find a way to control it.

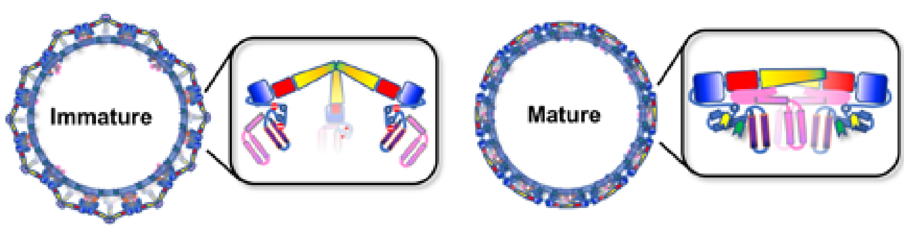
→ A botanical common ragweek specimen. Source: Meise Botanic Garden. (2019). Ambrosia artemisiifolia L. (BR0000010009994). Meise Botanic Garden Herbarium. http://doi.org/10.5281/zenodo.2696661


INPLANBEL 2003-2006
Vidit Filip Verloove
Herb. Horti Bot. Nat. Belg. (BR)
BR - S.P.
1 000 999
Ambrosia elatior L
Determinavit
Ambrosia artemisiifolia L.
JUL 1971
Willard W. Payne
443
HERBARIUM HORTI BOTANICI BRUXELLENSIS
(BELGIUM)
HERB. LOUIS MAGNEL
Ambrosia sp.
REC. L. Magnel

Record-breaking resolution microscopy shows a new possible target to fight flaviviruses

While COVID-19 has dominated headlines in 2020, the Zika virus has silently continued to put women and children at grave risk in Brazil. Since the first outbreak in 2016, Zika, which causes microcephaly in fetuses, has affected thousands of people worldwide.

Zika, Dengue, Yellow Fever belong to a family of viruses called flaviviruses. They are transmitted to humans by mosquitos and ticks and cause amongst the most prevalent viral infections worldwide.



“They've been around for a very long time and have a huge impact on human’s health,” says Dr Fasséli Coulibaly, an associate professor in the Department of Biochemistry and Molecular Biology at Monash Biomedicine Discovery Institute. But their impact on public health is less appreciated than other viral diseases, partly because they mostly affect the socially vulnerable groups in developing countries in Africa, South America and Southeast Asia.

Although flaviviruses are responsible for significant morbidity and mortality throughout tropical and subtropical regions, preventive vaccines are not yet available for most of these diseases.

“These viruses have a complex maturation process,” says Dr Coulibaly. When the virus enters a human cell to replicate, it initially produces an immature, non-infectious virus. Then, this primitive virus goes into a maturation process during which it changes shape and becomes contagious.

“It’s a process that they that they must go through to become infectious,” says Dr Coulibaly explaining that flaviviruses go from a spiky shape when immature to a round shape with a very smooth surface when infectious. “And this immature, vulnerable form of the virus is what we target,” adds Dr Coulibaly who is conducting the project with co-lead Dr Daniel Watterson from the University of Queensland.

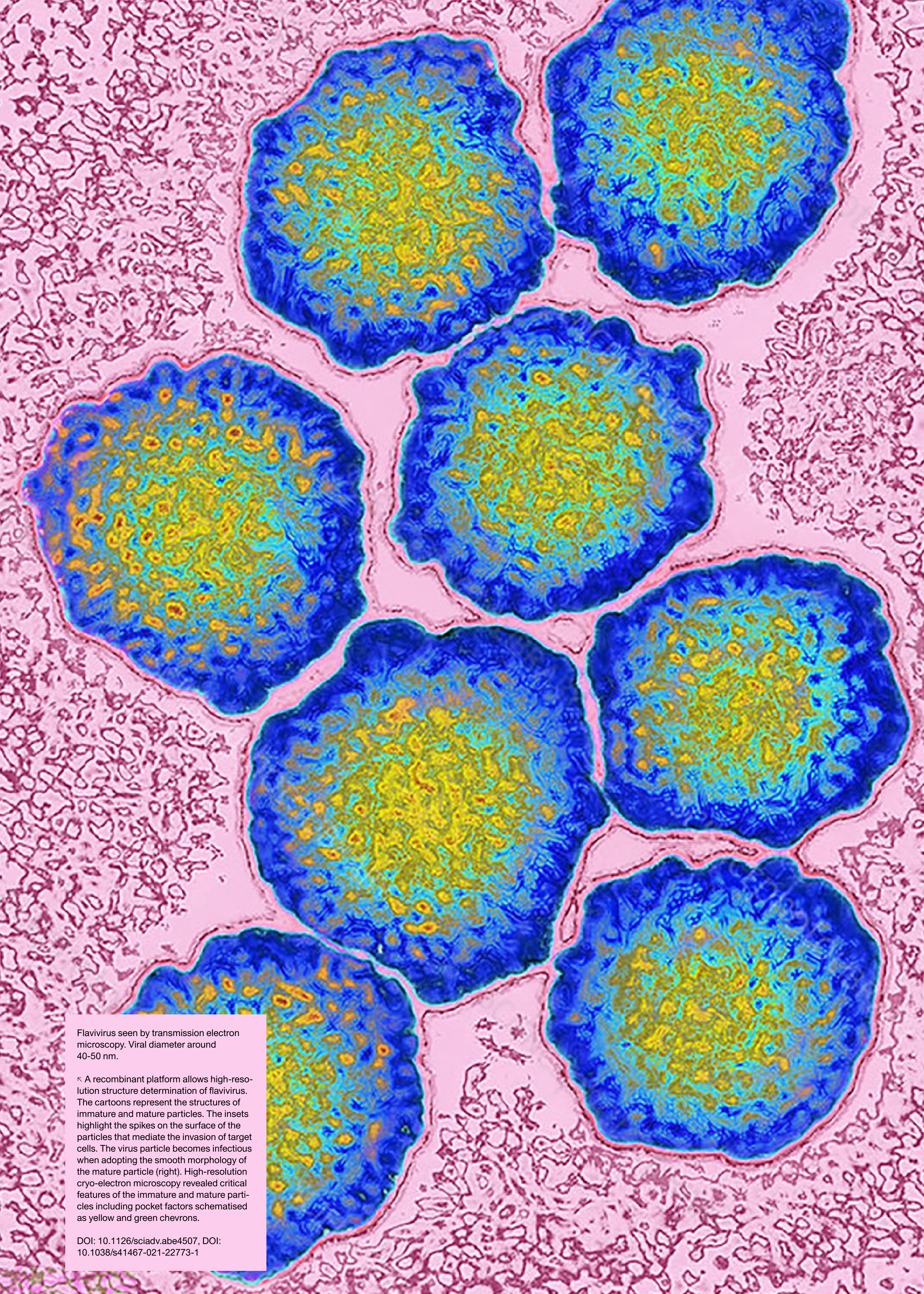
Using a cryo-electron microscope, so powerful that it can show molecule structures to the atomic level, Dr Coulibaly and his research fellow Dr Joshua Hardy have resolved the architecture of two flaviviruses that cause inflammation of the brain and a dengue virus structure at a resolution of 2.5Å, the highest ever achieved before.

“We solved them quickly and to record-breaking resolution using the Ramaciotti centre for cryo-EM at Monash University,” he says, “and we found out that there is a new feature that wasn't recognised before.” This new feature is a binding site that can be used as a target to destabilise the virus or prevent its maturation, “we call them pocket factors and that may be a completely new target.”

This incredibly high-resolution microscopy generates vast amounts of images that are stored and processed at the MASSIVE facility. The team has recently collected seven datasets with an average size of 5.2 Tb. Processing represents an extra 0.2-1 Tb per dataset. “MASSIVE is able to speed up our work,” Dr Coulibaly says.

“We've got new tools to understand flavivirus biology and ultimately develop antivirals to block the maturation process or make better vaccines,” adds Dr Coulibaly.

References: https://rdcu.be/cl3VS and https://advances.sciencemag.org/content/7/20/eabe4507



Flavivirus seen by transmission electron microscopy. Viral diameter around 40-50 nm.

↖ A recombinant platform allows high-resolution structure determination of flavivirus. The cartoons represent the structures of immature and mature particles. The insets highlight the spikes on the surface of the particles that mediate the invasion of target cells. The virus particle becomes infectious when adopting the smooth morphology of the mature particle (right). High-resolution cryo-electron microscopy revealed critical features of the immature and mature particles including pocket factors schematised as yellow and green chevrons.

DOI: 10.1126/sciadv.abe4507, DOI: 10.1038/s41467-021-22773-1

Governance

MASSIVE Steering Committee Members

The Steering Committee is composed of the MASSIVE Partners, Affiliated Partners and independent members.

It is chaired by an independent member, Dr Greg Storr.

Dr Greg Storr
Chair

Dr Miles Apperley
ANSTO

Prof Paul Bonnington
Monash University

Prof Gary Egan
ARC CoE for Integrative Brain Function

Ms Gin Tan
Architect, MASSIVE, Ex-officio

Prof Wojtek James Goscinski
Coordinator,
Jan 2011 to June 2021
MASSIVE, Ex-officio

Dr Alf Uhlherr
Independant member

Prof Antoine van Oijen
University of Wollongong

Prof James Whisstock
ARC CoE for Advanced Molecular Imaging

Dr John Zic
CSIRO member

Usage and Users

Facility Access

In 2019-2020 MASSIVE has underpinned hundreds of projects. The organisations involved cover research institutes, hospitals, universities, industry and government departments across Australia and internationally.

Access to MASSIVE is open and free of charge to all users who secure an allocation through a partner or through merit allocation scheme, or use the system through an integrated instrument.

The MASSIVE partners have made available 7% of the facility for national access based on merit and managed through the National Computational Merit Allocation Scheme (NCMAS—http://ncmas.nci.org.au) and the Characterisation Virtual Laboratory.

MASSIVE M3 Usage Data (SUs, in CPU-Hours)		**Jan-Jun 2019**	**Jul-Dec 2019**	**Jan-Jun 2020**	**Jul-Dec 2020**
Total Available		19,086,256	23,395,985	24,615,945,	29,180,562
Scheduled usage					
	Monash University	7,909,807	9,623,872	10,787,022	10,601,928
	NCMAS	1,010,794	1,255,953	577,194	945,448
	ANSTO	251,956	305,599	270,940	139,148
	CSIRO	31,708	413,101	250,359	448,042
	CIBF	95,356	102,693	95,889	93,561
	ImagingCoE	84,726	198,643	60,019	4,612
	Wollongong	260,006	337,837	545,732	574,449
	CVL	343,891	442,700	770,816	1,103,131
	Total	8,986,953	11,567,405	12,399,040	13,162,044
Reserved usage					
	System Testing and Maintenance	279,592	437,881	1,300,371	706,179
	Reserved Desktop Hours	3,492,576	3,550,464	3,492,576	3,550,464
	Reserved for Instruments and Other	1,772,352	1,678,080	1,772,352	1,678,080
Total Used		14,531,473	17,233,830	18,964,339	19,096,767
Unused		4,554,783	6,162,155	5,651,606	10,083,795
Percentage Unused		23.76%	26.30%	22.97%	34.58%

Projects

The following projects used MASSIVE M3 during the 2019-2020 reporting period.

Project Title	Partner or Scheme	Project Members	Organisation(s)
3D analysis of serial EM data — Chiton (Mollusca)	Characterisation Virtual Laboratory	Jeremy Shaw, Andrew James Mehnert, Jeremy Shaw, Luka Meyers	University of Western Australia, Southern Cross University
3D and 4D imaging of heart development in the mouse	Monash University	Gonzalo del Monte Nieto, Diptarka Saha, Eman Mohamed, Peter Kaltzis, Saiba Mahesh, Yuan Ji, Zhijian Wu	Monash University
3D fracture network evolution of geomaterials under static-dynamic coupled loading	Monash University	Qianbing Zhang, Fanchao Kong, Gonglinan Wu, Haojun Wang, Haozhe Xing, Huachuan Wang, Jing Li, Kai Liu, Marzieh Naderan Tahan, Mengqi Huang, Minghe Ju, Wanrui Hu	Monash University
3D fracture network evolution of geomaterials under static-dynamic coupled loading	Monash University	Qianbing Zhang, Huachuan Wang, Jing Li, Kai Liu	Monash University
3D imaging at the Australian Synchrotron - Large dataset analysis	Characterisation Virtual Laboratory	Chris Hall	ANSTO
3D reconstruction of electron and x-ray micrographs	Monash University	Peter Miller, Emily Chen, Nick McDougall, Yang Liu, Zhou Xu	Monash University
3D Simulations of the Interiors of Stars	Monash University	Simon Campbell	Monash University
Ab initio calculations to complement neutron scattering experiments	ANSTO	Maxim Avdeev	ANSTO
Ab initio Modelling of Nuclear Materials: Waste-forms and Accident-Tolerant Fuels	ANSTO	Eugenia Kuo	ANSTO
A brain-machine interface for control of dexterous movements	Monash University	Yan Wong, Elizabeth Arsenault, Haozhe Wang, Hersh Umesh Nevgi, Ishara Paranawithana, Jamin Wu, Joanita D'Souza, Jocelyn Halim, Kieren Brendan Pinto, Lucas Tobar, Maureen Hagan, Mojtaba Kermani, Sabrina Meikle, Timothy Allison-Walker	Monash University
A computer based approach to drug discovery: Identifying New Treatments for Osteoporosis and Asthma	Monash University	Andrew Keller, Jesse Connor Dangerfield	Monash University
ACRF Sequencing Facility	Monash University	Helen Mitchell, Graham Magor, Kevin Gillinder	Monash University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Adolescent cannabis use: mapping risk factors and neurodevelopmental trajectories using resting state and white matter connectivity	Monash University	Valentina Lorenzetti, Akhil Raja Kottaram, Chao Suo	Australian Catholic University, Monash University
Advanced Fluorescence Image Analysis for LLSM and Super-res data sets	Monash University	Abhishek Patil, Harrison York, Senthil Arumugam	Monash University
Advanced MRI analysis in epilepsy	Characterisation Virtual Laboratory	David Vaughan, Brett Larner, Cedrych Beh, Chris Tailby, David Abbott, Donna Parker, Eric Pierre, Mira Semmelroch, Remika Mito, Robert Smith	Florey Institute, University of Melbourne
Advanced neuroimaging of brain disorders	Monash University	Scott Kolbe, Ben Sinclair, Brendan Major, Carlos May, David Wright, Frederique Boonstra, Georgia Fuller Symons, Ian Harding, Jordan Wright, Joseph Walter Davies, Katherine Kenyon, Megan Ang, Myrte Strik, Negin Yaghmaie, Nurul Mohd Shukur, Sanuji Gajamange, Tracy Zhang, Warda-Taqdees Syeda, Zuitian Tao	Monash University, University of Melbourne
Adversarial Machine Learning	Monash University	Dinh Phung, Duy Dao, Ethan Zhao, Mahmoud Mohammad Ahmed Ibrahim, Van Nguyen	Monash University
Aedes structural and population genomics	Monash University	Seth Redmond, I'ah Donovan-Banfield, Mari Velasque, Peter Kyrylos	Monash University
AFT Models with frailties using Laplace Approximation	Monash University	Rory Wolfe, Daniel Flores Agreda	Monash University
A functional magnetic resonance imaging (fMRI) study addressing cognitive function in individuals with Friedreich Ataxia	Monash University	Ian Harding, Imis Dogan, Louisa Selvadurai, Louisa Selvadurai, Phil Ward, Rosa Shishegar	Monash University
Agilent AI for analysis	Monash University	Paul Bonnington, Adrian Scott, Alex (Xuelin) Zhang, Donghao Zhang, James Clemens, Louis Duverger-Noinski, Luke Visser, Zongyuan Ge	Monash University, Agilent
Agilent Thought Leader Program	Monash University	Paul Bonnington, Alex (Xuelin) Zhang, Donghao Zhang, Rui Zeng, Zongyuan Ge	Monash University, Agilent
A histologic assessment on the fidelity of OCTA images	Characterisation Virtual Laboratory	Dao-Yi Yu, Andrew James Mehnert, Paula Yu	University of Western Australia
AI, from the lab to the field	Monash University	Nick Birbilis, Renuka Sharma	Monash University
AI-directed cellular reconstruction	Monash University	Benjamin Padman	Monash University
AI-Driven Software Quality Assurance in the Age of DevOps	Monash University	Chakkrit Tantithamthavorn, Chanathip Pornprasit, Jirayus Jiarpakdee	Monash University
AIDE: Artificial Intelligence in cardiac arrest	Monash University	Burak Turhan, Dung Nguyen, Lizhen Qu, Rob Rendell, Xuanli He	Monash University
Analysis of Brain MR images for the study of Alzheimer's disease	CSIRO	Pierrick Bourgeat, Amir Fazlollahi, Dale Roach, Kerstin Pannek, Leo Lebrat, Miranda Li, Parnesh Raniga, Rodrigo Fonseca-de-Santa-Cruz-Oli, Saba Momeni	CSIRO
Analysis of complex genomes	National Merit Allocation	David Edwards, Gavin Monahan	University of Western Australia

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Analysis of genomic data produced from the Revitalising Informal Settlements and their Environments (RISE) project	Monash University	Rebekah Henry, Ellen Higginson	Monash University
Analysis of mouse skulls	Monash University	Kieran Short	Monash University
Analysis of MRI images from brains irradiated at postnatal day 16	Characterisation Virtual Laboratory	Jacqueline Whitehouse, Andrew James Mehnert, Jessica Buck	University of Western Australia
Analysis of placental and resting-state functional MRI data	Characterisation Virtual Laboratory	Alexander Clemens Joos, Adam Edwards, Bhedita Jaya Seewoo	University of Western Australia
Analysis of rodent behaviour	Characterisation Virtual Laboratory	Caitlin Wyrwoll, Ebony Quintrell	University of Western Australia
Analysis of UK Biobank MRI and genetic data	Monash University	Alex Fornito, Alexander Alan Holmes, Chao Suo, Kevin Aquino, Marc Seal, Mark Michael, Richard Beare, Russell Thomson, Stuart James Oldham, Taya Collyer	Monash University
Anatomical Image Processing and Biomechanical Modelling	Monash University	Michelle Quayle, Alexander McDonald, Emma May Handley, Hazel Richards, Justin Adams, Raf Ratinam, Sarah Fung	Monash University
An investigation of age- and sex-related neuropathophysiology of autism spectrum disorder	Characterisation Virtual Laboratory	Melissa Kirkovski, Mervyn Singh	Deakin University
A pipeline for whole mouse brain image analysis	Monash University	Tobias Merson, Abigail McGovern, Juan Nunez-Iglesias	Monash University
Apolipoprotein-D	University of Wollongong	James Bouwer, Claudia Sybille Kielkopf, Simon Brown	University of Wollongong
Application of Exact Coherent Structures to flow transition	Monash University	Hugh Blackburn, David R Lee, Ozge Ozcakir	Monash University
Applications of reinforcement learning in the healthcare industry	Monash University	Zongyuan Ge, Jiun Hong Choong	Monash University
ARC Centre of Excellence for Robotic Vision	Monash University	Tom Drummond, Ben Harwood	Monash University
ASPREE Data Science	Monash University	Jessica Lockery, Jason Rigby	Monash University
ASPREE MRI Analysis	Monash University	Robyn Woods, Ruth Trevaks, Scott Kolbe	Monash University
Assembling the Ricciocarpus natans genome	Monash University	John Bowman, Shilpi Singh	Monash University
Atomistic Simulations of Nuclear Materials	National Merit Allocation	Gregory Lumpkin, Eugenia Kuo, Meng-Jun Qin	ANSTO
Atom Probe Software Compile	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra	University of Sydney

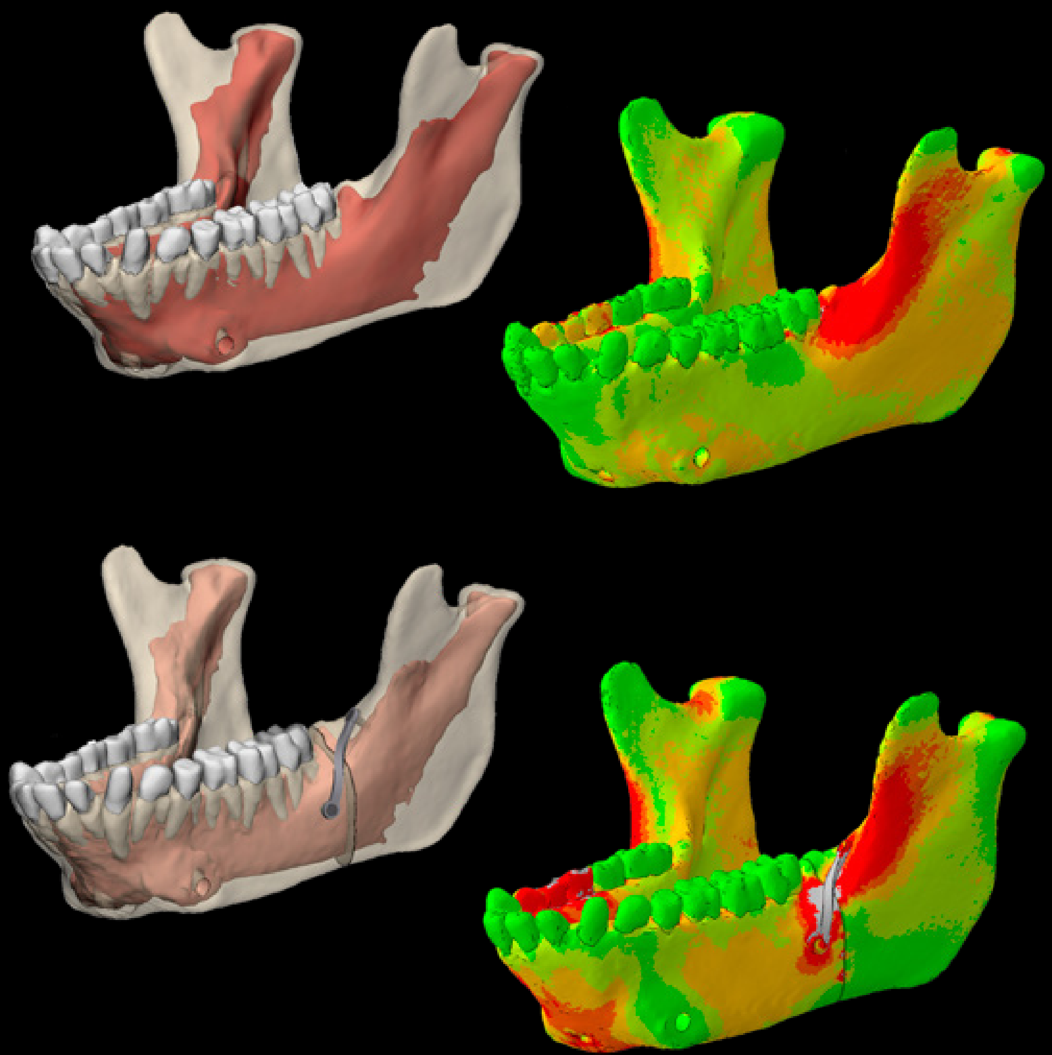
Dr Olga Panagiotopoulou, Head of the Moving Morphology & Functional Mechanics Laboratory is using 3D reconstructions and computer simulations (finite element models) of macaques and humans to model the biomechanical efficacy of fracture fixation techniques currently used in clinics.

This project is the first of its kind and is in collaboration with the University of Chicago.

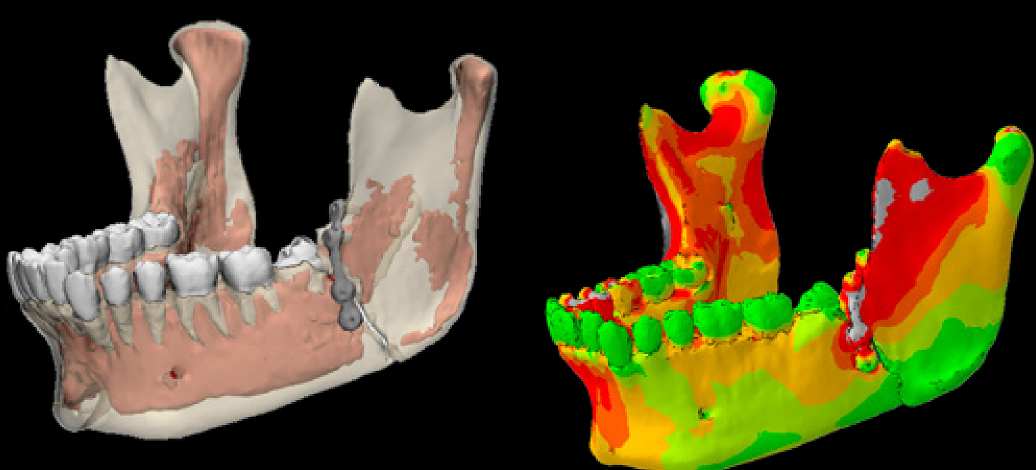
Authors:
Hyab Mehari Abraha, PhD candidate and Fulbright Future Fellow, Monash Biomedicine Discovery Institute, Department of Anatomy and Developmental Biology

Dr Olga Panagiotopoulou, Head of the Moving Morphology & Functional Mechanics Laboratory, Monash Biomedicine Discovery Institute, Department of Anatomy and Developmental Biology Monash University, Victoria, Australia

Macaque



Human



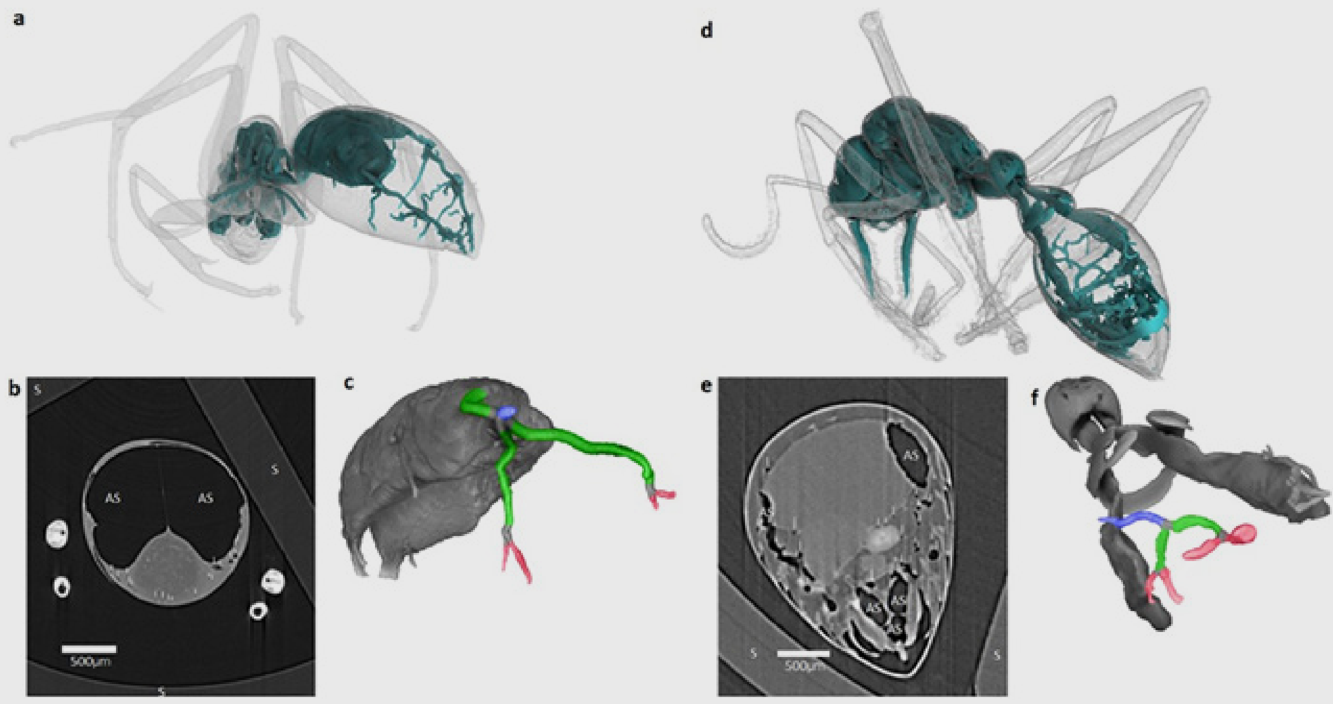
Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Atom Probe Workbench admin	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra, Alireza Samiee, Gregory Thompson, Lena-Pia Frommeyer, Li Liu, Mengwei He, Ning Mo, Thomson Chow, Tong Li	University of Sydney, University of Queensland, University of Alabama
AUS-TIMES on HPC	Monash University	Tom Yankos	Climate Works Australia, Monash University
Automated Video Tracking of Foraging Honeybees in Complex Environments for Pollination Management and Global Food Security	Monash University	Alan Dorin, Don Amarathunga, Malika Ratnayake	Monash University
Automating invertebrate counts	Monash University	Ian Aitkenhead, Kelly Greig, Rebecca Hallas	Monash University
AVG Lab	Monash University	Katharina Voigt, Alex Hugh Robinson, Amelia Elizabeth Grace Romei, Benjamin Ray Castine, Chao Suo, Christian Martinez Ruiz De Lara, Erynn Christensen, Ian Harding, Naomi Kakoschke, Tori Ellen Gaunson	Monash University
Bacterial genome sequencing data analysis and modelling	Monash University	Zongyuan Ge, Dongxu Xiang, Jiangning Song, Yanan Wang	Monash University
Bacteriophage evolution via BreSeq	Monash University	Jeremy Barr, Dinesh Subedi, Laura Avellaneda Franco, Robert Garcia, Sofia Dahlman, Wai Chin	Monash University
(Bayesian) Deep learning for language understanding	Monash University	Lan Du, Chun Lo, Dan Nguyen, Grayming Liu, Jueqing Lu, Maximillian Merrillees, Riordan Dervin Alfredo, Wei Tan, Weicong Tan	Monash University
Berry-Xray	Monash University	Richard Berry, Gabby Watson	Monash University
Biodiversity consequences of evolutionary innovation	Monash University	Matt McGee, Andrew Perry	Monash University
Bioinformatic mining of gamma delta T cell receptor (TCR) repertoires from RNAseq data	Monash University	Martin Davey, Daniel Arsovski, Kerry Mullan	Monash University
Bioinformatics and systems biology for investigating genomics to delivering personalised therapy in multiple myeloma	Monash University	Maoshan Chen	Monash University
Biomechanics of Neanderthal teeth	Monash University	Luca Fiorenza	Monash University
Blood and cancer image analysis	Characterisation Virtual Laboratory	Evan Ingley	University of Western Australia
Blood Cancer Therapeutic Centre	Monash University	Kevin Gillinder, Andrew Perkins, Charlene Lam, David Powell, Graham Magor, Helen Mitchell, Ngoc Vo, Nick Wong, Stefan Sonderegger	Monash University
Bluff Body Aerodynamics	Monash University	Mark Thompson, Shibo Wang	Monash University
Brain-inspired AI	Monash University	Duong Nhu, An Nguyen, Levin Kuhlmann, Yasmin Massoud, Yueyang Liu	Monash University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Brain and Mental Health Lab (BMH)	Monash University	Alex Fornito, Akhil Raja Kottaram, Alastair Kwok, Alexander Alan Holmes, Alexandria Wulff, Ali Ghasem-Zadeh, Anna Earl, Ari Pinar, Ashlea Segal, Ashlea Segal, Aurina Arnatkeviciute, Ben Fulcher, Benjamin Ray Castine, Camilla Beale, Camilla Druce, Carl Henning Lubba, Carsten Murawski, Chang Liu, Chao Suo, et al.	Monash University, Australian Catholic University, University of Sydney, Imperial University, University of Wollongong, University of Adelaide, Swinburne University, Policlinico
Brain network connectivity analysis for Alzheimer's disease using magnetic resonance imaging	Monash University	Adeel Razi, Aswin Paul, Devon Stoliker, Hannah Margaret Cummins, Lingbin Bian	Monash University
Brain stimulation and neural networks	ARC CoE for Integrative Brain Function	Luca Cocchi, Jinglei Lv, Luke Hearne	QIMR Berghofer
Cakile population genomics	Monash University	Kathryn Hodgins, Chris Lee, Cristobal Gallegos Sanchez, Emma Mien-Siung Barnett, Hanna Rosinger, Jonathan Wilson, Lotte Van Boheemen, Nissanka de Silva, Paul Battlay, Piyumi Wijepala	Monash University
Can machine learning algorithms improve neonatal care?	Monash University	Filippe Falcao Tebas Oliveira	Monash University
CAP-sgras	Monash University	Stephanie Gras	Monash University
Caress the Detail, a high resolution brain atlas	Characterisation Virtual Laboratory	Mark Schira, Chelle Roberts, Paul Ang, Wei-Shi Koo, Zoey Isherwood	University of Wollongong
CD39 in ischemic stroke	Monash University	Maithili Sashindranath, Richard Beare	Monash University
Cellranger and QIIME	Monash University	Scott Coutts, Agnus Monica Davis, Callum James Nott, Jacob Amy, Lynze Cheung, Piyumi Thilakarathna, Rebekah Henry	Monash University
Centre for Microscopy, Characterisation and Analysis	Characterisation Virtual Laboratory	Andrew James Mehnert, Andrew John Warnock, Bhedita Jaya Seewoo, Chris Hines, Dean Taylor, Jahmila Parthenay, James Tze Hong Wong, Janet Rose Muhling, Liisa Maija Hirvonen, Nadia Sloan, Nathanael James Yates, Nathanael Yates, Paul Joseph Rigby, Sarah Hellewell, Timothy Rosenow, Yutthapong Tongpob	University of Western Australia
Challis Group	Monash University	Hussain Bhukya, Hari Venugopal	Monash University
Characterising the oligomeric state of the M17 aminopeptidases	Monash University	Sheena McGowan, Matthew Belousoff, Nyssa Drinkwater, Tess Rosalie Malcolm	Monash University
Characterisation of the silicon nanowire-cell interface	Monash University	Crystal Chen, Stella Aslanoglou	Monash University
Characterising nanoparticle energetics in the electron microscope	Monash University	Bryan Esser, Weilun Li	Monash University
Classroom positioning analytics	Monash University	Beatriz Gallo Cordoba, Roberto Martinez Maldonado	Monash University
Climate adaptation in Ambrosia artemisiifolia	Monash University	Kathryn Hodgins, Chris Lee, Farheena Iqbal, Jacqueline Lee, Jonathan Wilson, Lotte Van Boheemen, Paul Battlay, Piyumi Wijepala, Yael Rodger	Monash University

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Clinical Genomics	Monash University	Mark Waltham, Galina Polekhina, Heidi Fettke, Jason Steen, Sarah Williams, Tu Nguyen-Dumont	Monash University
Cluster engineering in dilute aluminium alloys	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra, Alireza Samiee	University of Sydney
Cluster randomised trial simulations	Monash University	Andrew Forbes, Kelsey Grantham	Monash University
Code development - Holt lab	Monash University	Kathryn Holt, Guillaume Meric, Jane Hawkey, Kelly Wyres, Leonardos Mageiros, Margaret Lam, Roni Froumine, Ryan Wick, Ryota Gomi, Stephen Watts	Monash University
CogChip: development of a targeted genotyping chip for executive function	Monash University	Sarah Williams	Monash University
Cognitive and clinical neuroimaging of traumatic brain injury	Monash University	Gershon Spitz, Amelia Hicks, Elizabeth Bensley, Julia Rose Bak	Monash University
Collaborative Dialogue Research	Monash University	Akshay Ijantkar, Lizhen Qu, Shuo Huang, Xinming Huang, Zhuang Li	Monash University
Combes Lab scRNAseq	Monash University	Alexander N. Combes, Sarah Williams	Monash University
COMET Event Generation and Analysis	Monash University	Jordan Nash, Yuki Fujii	Monash University
Comparative genomics of Gram-negative baterial pathogens	Monash University	Adele Barugahare, Amy Wright, David Powell, Jessica Lewis, Marianne Megroz, Michael Alexander Burch, Thomas Rodney Smallman	Monash University
Comparing RNA sequencing data of B cell lymphoma from mice having or lacking T cells	Monash University	Zhoujie Ding, Feng Yan	Monash University
Complex Brain Dynamics: A Unifying Theoretical and Empirical Project	Monash University	Leonardo Gollo, Yong Xian Lee	Monash University
Comprehensive molecular profiling of pancreatic cancer	Monash University	Dan Croagh, Andrew Perry, Hugh Yang Gao, Nick Wong, Vikki Marshall	Monash University
Computational approaches towards the neuronal basis of consciousness	National Merit Allocation	Nao Tsuchiya, Ahmed Mahmoud, Akshatha Chindalur, Angus Chun-Kei Leung, Elise Rowe, Evangeline Leong, Haozhe Wang, Jamin Wu, Joanita D'souza, Joanita D'Souza, Rebecca Freeman, Wenqi Yan, Yezhen Wang, Yota Kawashima, Zhao Koh	Monash University
Computational modelling and dynamics analysis of cancer signalling pathways	Monash University	Sungyoung Shin, Karina Islas Rios, Milad Ghomlaghi	Monash University
Computer-aided design of ionic media for organic and metal batteries	Monash University	Ekaterina Pas, Abhishek Singh, Adrea Snow, Adrea Snow, Anh Nguyen, Caleb Donald Hosking, Debopriya Sadhukhan, Elisabeth Seiler, Esther Gan, Fairuz Halimah Hashim, Fiona Yu, Jack Higgins, Jacob Stiles, Jake Limb, Kaycee Low, Lewis James McArthur, Luke Adam Wylie, Michael Robinson, et al	Monash University



A fundamental assumption of models of the transport of substances through networks of tubes, such as circulatory systems in animals and vascular systems in plants, is that the total cross-sectional area of the tubes remains constant irrespective of the branching level, or that it increases slightly in the direction from the largest to the smallest tubes. One large tube should have the same or a slightly smaller area than the sum of the next two tubes after a branching. The assumption of such a pattern underpins one of biology's most influential ideas– the metabolic theory of ecology. Prof Steven Chown and colleagues used x-ray synchrotron tomography to explore this assumption. Their research shows that tracheal branching in 20 species of ants does not follow this pattern. Rather, cross-sectional area reduces in an inwards direction. Aitkenhead IJ, Duffy GA, Devendran C, Kearney MR, Neild A, Chown SL (2020) Tracheal branching in ants is area-decreasing, violating a central assumption of network transport models. PLoS Comput Biol 16(4): e1007853. https://doi.org/10.1371/journal.pcbi.1007853

Project Title	Partner or Scheme	Project Members	Organisation(s)
Computing the neural correlates of spontaneous experiences	Monash University	Thomas Andrillon, Ahmed Mahmoud, Angus Chun-Kei Leung, Elise Rowe, Haohua Li, Jonathan Dulce, Julia Paterson, Marcel Masque Salgado, Morgan Elliot Williamson, Peiyao Liu, Poe Lee, Qianchen Liang, Stuart McCowan, Zhao Koh	Monash University
Coronary Artery Plaque Growth Modelling in Humans	Monash University	Isaac Pinar, Adam Brown, Alex Michael Horner, Tomasz Strus	Monash University
Coulibaly Lab	Monash University	Fasseli Coulibaly, Josh Hardy	Monash University
Counting fur seal populations from drone imagery	Monash University	Andrew Casey, Cameron Smith, Thomas Nobes	Monash University
Creatine for Neuroprotection and Prevention of Postnatal Fatigue after Preterm Birth	Characterisation Virtual Laboratory	Andrew James Mehnert, Ellen Marie Williams	University of Western Australia
Creating a map of Victoria every 5 days	Monash University	Geoff Webb, Ahmed Shifaz, Benjamin Lucas, Chang Wei Tan, Francois Petitjean, Hassan Ismail Fawaz, Jihane Elyahyioui, Liujun Zhu, Lynn Miller, Matthieu Herrmann	Monash University
Cross-channel analysis of multi-channel electrophysiological data	ARC CoE for Integrative Brain Function	Nao Tsuchiya, Angus Chun-Kei Leung, Joanita D'souza, Oliver-Michael Cliff, Ramida Kitcharoenrot, Thomas Andrillon, William Wong, YUN Zhao, Zhao Koh	Monash University, University of Sydney
Crossword fMRI study	Characterisation Virtual Laboratory	David Abbott, David Darby, Sarah Holper	University of Melbourne, Monash University

Projects

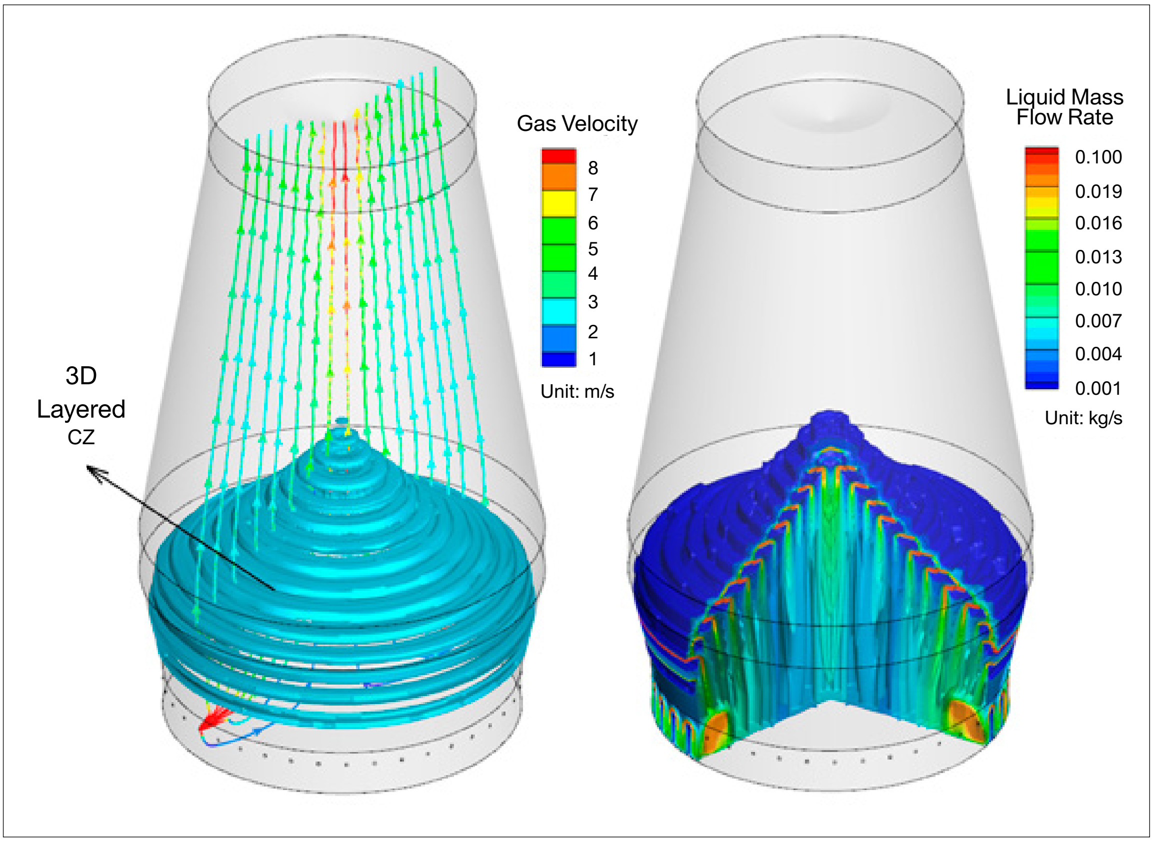
Project Title	Partner or Scheme	Project Members	Organisation(s)
Cryo-electron tomography of chromatin domains	Monash University	Chen Davidovich, Alex De Marco, Cyntia Taveneau, Michael Uckelmann	Monash University
CRYO-EM Facility	Monash University	Georg Ramm, Adam Costin, Alex De Marco, Brad Spicer, Christina Lucato, Cyril Reboul, Hans Elmlund, John Mansour, Josh Hardy, Lynn Liang, Matthew Belousoff, Richard Berry, Sarah Le, Siew Pang, Yeshwanth Yeraddu	Monash University
Cryo-EM structure of mutagenic DNA polymerase V	University of Wollongong	James Bouwer, Gokhan Tolun, Malgorzata Jaszczur, Miguel Garcia, Sarah-Sylviane Henrikus, Simon Brown	University of Wollongong, University of Southern California, University of Wisconsin
Cryo-EM structures of DNA replication complexes	University of Wollongong	James Bouwer, Andrew Worth, Bhanu Mantri, Gokhan Tolun, Jodi Brewster, Jordan-James Nicholls, Lucy-Johanna Fitschen, Sarah-Sylviane Henrikus, Simon Brown, Timothy Newing, Timothy O'Shea, Yasmin Bermudez	University of Wollongong
CryoEM determination of the structure of 186 bacteriophage	University of Wollongong	James Bouwer, Fiona Whelan, Luke Caspers, Simon Brown	University of Wollongong, University of Adelaide
Cryoemfacility 2018	Monash University	Hari Venugopal	Monash University
Cryoem Processing Optimisation	Monash University	Arun Konagurthu, George Vidalis, Gin Tan, Hari Venugopal, John Mansour, William Nash	Monash University
cryoEM studies of T cell mediated immunity	Monash University	Ben Gully	Monash University
cryoFIB on M3 - Helios	Monash University	Georg Ramm, Gediminas Gervinskas	Monash University
Crystallographic processing of UW/ PNNL collaboration APT data	Characterisation Virtual Laboratory	Peter Pauzauskie, Alex Bard	University of Washington
CT Motion Correction Development	Characterisation Virtual Laboratory	Roger-Roland Fulton	University of Sydney
CT scanning and morphological analysis of Australian lizards	Monash University	David Chapple, Alistair Evans, Jack Brand, Marco Camaiti, Siobhan Roberts, Tegan Wright	Monash University
Deciphering polymyxin resistance in Klebsiella pneumoniae with lipidomics and molecular dynamics simulation	Monash University	Yan Zhu, David Powell, Ethan Foo, Jinxin Zhao, Mengyao Li, Sherry Zhang, Xukai Jiang, Yan Zhu, Yang Hu	Monash University
Deciphering the migratory machinery of macrophages	Characterisation Virtual Laboratory	Liisa Maija Hirvonen, Mark O'Brien	University of Western Australia
Decoding stimulus features from neuronal activity	Monash University	Tristan Chaplin	Monash University
DeepCleave: a new deep transfer learning-based approach for expediting the identification of protease substrates and cleavage sites	ARC ImagingCoE	Jiangning Song, Fuyi Li, Jinxiang Chen, Xiaoyu Wang	Monash University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Deep Graph Embedding for Text Analytics	Monash University	Shirui Pan, Meiya Han, Miao Zhang, Qingyu Meng, Yuqian Liang	Monash University
Deep Learning for Classification of Sperm Cell Morphology	Monash University	Reza Nosrati, Katherine Veale, Klaus Ackermann, Lindsay Robert Spencer, Lindsay Spencer, Sahar Shahali, Sushant Powar	Monash University
Deep Learning for Cybersecurity	Monash University	Dinh Phung, Dai Nguyen, Mahmoud Mohammad Ahmed Ibrahim, Nhan Dam, Quan Hoang, Thanh Duc Van Nguyen, Trung Le, Tu Nguyen, Tuan Bui, Van Nguyen, Viet Huynh, Vu Nguyen	Monash University
Deep Learning for Environmental Monitoring	Monash University	Bernd Meyer, Chamath Abeysinghe, Md Mohaimenuzzaman, Tarun Bonu, Toby Gifford	Monash University, Baker Heart and Diabetes Institute
Deep learning for genomics	Monash University	Alison Anderson, Alex (Xuelin) Zhang, Zongyuan Ge	Monash University
Deep learning for Histology	Monash University	Zongyuan Ge, James Michael Tong	Monash University
Deep learning for time series segmentation/ subspace clustering in time series data	Monash University	Mahsa Salehi, Chang Tan, Joseph Carl Walkenhorst, Milad Chenaghlou, Sepehr Mousavi, Seyed Navid Mohammadi Foumani, Surayez Rahman, Thusitha Dayaratne	Monash University, University of Melbourne
Deep Learning in Medical Imaging — MRI and PET	Monash University	Kamlesh Pawar, Andrii Pozaruk, Han Luo, Shen Li, Viswanath Pamulakanty Sudarshan, Zhaolin Chen	
Deep learning in Radiology	Monash University	Jarrel Seah, Jennifer Tang	Monash University, The Alfred, University of Melbourne
Deep learning transport applications	Monash University	Le Hai Vu, Cuong Nguyen, Gary Au, Retham Lai	Monash University
DeepNeuron: AI interdisciplinary research	Monash University	Karina Islas Rios, Angus Trau, Ari Deutsch, Ayden Khalil, Ayesha Ali, Benjamin Peter Milanko, Calvin Zheng, Connor Vaux, Daniel Ong, Darren Tan, David Ting, Elizabeth Chai, Emily Lam, Hoang Dang, Jared Fernando, Jason Toskov, Jonathan Cameron Carter, Joon Tan, Kamron Bhavnagri, Kevin Liu, Kunj Dave, Lachlan Chumbley, et al.	Monash University
Defect prediction for testing	Monash University	Aldeida Aleti, Anjana Perera, Marcel Boehme	Monash University
Defects identification in selective laser melting process	Monash University	Andrey Molotnikov, Arden Hui Ming Phua, Marten Jurg, Zach Ryan	Monash University
Defect Structure in Materials by Additive Manufactured	Monash University	Louis Ngai Chiu, Amal Shaji Karapuzha, Daniel Schliephake, Dina Bayoumy, Greg Ingram, Haopeng Shen, Jeremy Rao, Kai Zhang, Mu Gao	Monash University
Defending against misclassification attacks in transfer learning	Monash University	Xingliang Yuan, Bang Wu, Xiaoning Liu, Xingliang Yuan	Monash University
Defining poly-C-binding protein stabilised RNA structures essential for viral genome translation and replication	Monash University	Matthew Wilce, Hari Venugopal, Matthew Belousoff, Matthew Wilce, Mehdi Youssefi Matak	Monash University
De novo fish genome assembly	Monash University	Matt McGee, Andrew Perry, Matt McGee, Michael See, Stella Loke	Monash University, Deakin University
Depth Resolution In X-ray Fluorescence Microscopy (DXFM)	Monash University	Matthew Dimmock, Carlos Pena Solorzano	Monash University

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Design House	Characterisation Virtual Laboratory	Stanley Luong, Aiswarya Pradeepkumar, Phuong Le Yen, Stanley Luong, Thuy Thi Thanh Pham	Monash University, University of South Australia
Design House Virtual Laboratory (DHVL) project 1	Characterisation Virtual Laboratory	Sean Langelier, Daniel Smith, Sara Ghavamian	Monash University
Design House Virtual Laboratory (DHVL) project 2	Characterisation Virtual Laboratory	Sean Langelier, Esma Dervisevic, Hazem Abdelmaksoud	Monash University
Design House Virtual Laboratory (DHVL) project 3	Characterisation Virtual Laboratory	Sean Langelier, Vahid Adineh	Monash University
Design of Nano-Optica and Electronic Devices	Monash University	Malin Premaratne, Ambalangoda Perera, Champi Abeywickrama, Dasuni Lelwala Gamacharige, Hetti Wijesekara, Lakshitha Kumarapperuma Arachchige, Nisal de Silva, Sachinthana Yatamalagala Pathiranage, Sudaraka Mallawa Arachchi, Viraj Kulathunge, Warnakula Warnakula	Monash University
Determination of Akt protein structure using cryo-EM with a volta phase plate	Monash University	Georg Ramm, Christina Verbruggen, Dylan Davidson, Hari Venugopal	Monash University
Determining the role of Myc in Small Cell Lung Cancer	Monash University	Daniel Gough, Jasmine Chen	Monash University
Developing more accurate object detectors	National Merit Allocation	Niko Suenderhauf, Haoyang Zhang	Queensland University of Technology
Development and Evolution of the Vertebrate Musculoskeletal System	Monash University	Peter Currie, Frank Tulenko	Monash University
Development of a Rib Fixation Device	Characterisation Virtual Laboratory	Raimund Jung	Monash University
Development of automated measures from mammograms that predict masking and risk of breast cancer	Monash University	Daniel Schmidt, Osamah Al-qershi	Monash University
Development of microfluidic devices for biosensing	CSIRO	Murat Gel	CSIRO
Development of new biomarkers for Huntington's disease via the use of machine learning, artificial intelligence and other computational approaches to predict course of disease over time	Monash University	Nellie Georgiou-Karistianis, Adeel Razi, Pierre Wibawa, Pubu Abeyasinghe	Monash University
Development of Preclinical Models of Schizophrenia at Melbourne Neuropsychiatry Centre	Monash University	Arthur Christopoulos, Bradford Moffat, Cassie Wannan, Chris Adamson, Parsa Ravanfar, Warda-Taqdees Syeda	University of Melbourne
DHVL — Design House	Characterisation Virtual Laboratory	Ash Dyer, Shan Don, Soon-Hock Ng, Yang Lim	Monash University, Swinburne University
Differences in upper airway anatomy in oronasal vs nasal CPAP masks using magnetic resonance imaging (MRI)	Monash University	Brad Edwards, Richard Beare, Shane Landry	Monash University

→ 'Three-dimensional modeling of ironmaking blast furnace with layered cohesive zone', METALL AND MATERI TRANS B, 51 (2020), 258–275. L.L. Jiao, S.B. Kuang, A.B. Yu, Y.T. Li, X.M. Mao, H. Xu,



Project Title	Partner or Scheme	Project Members	Organisation(s)
Direct numerical simulations of compressible free jets	Monash University	Shahram Karami, Hui Wu	Monash University
Discovery of new biomarkers of disease progression in Huntington's disease	Monash University	Nellie Georgiou-Karistianis, Govinda Poudel, Govinda Poudel	Monash University, Australian Catholic University
DL with EEG	Monash University	Zongyuan Ge, Duong Nhu, Levin Kuhlmann, Sheng Fung Wong, Shobi Sivathamboo, Yu Liu	Monash University
Dose Quantificationa and Enhancement in Hadron Therapy	ANSTO	Mitra Safavi-Naeini, Abdella-mohammednur Ahmed, Andrew Chacon, Harley Rutherford, Marissa Lee Kielly,	ANSTO, University of Wollongong
Dynamic Brain Connectivity	ARC CoE for Integrative Brain Function	James Henderson	University of Sydney
Dynamic PET data analysis	Characterisation Virtual Laboratory	Steven-Richard Meikle	University of Sydney
Dynamics of the N- and T-Type calcium channels	CSIRO	Kellie Tuck, Matthieu Schmit	Monash University
EEG correlates of emotion recognition in Huntington's disease	Characterisation Virtual Laboratory	Clare Kempnich	Monash University
Efficient and effective analytics for real-world time series forecasting	Monash University	Christoph Bergmeir, Aijia Yang, Arth Patel, Dilini Rajapaksha Hewa Ranasinghage, Hansika Hewamalage, Herath Bandara, Mahdi Abolghasemi, Mukul Gupta, Naveen Kaushik, Rakshitha Godahewa, Shubham Diwe, Zhenxie Dong	Monash University
Efficient and Interpretable Deep Learning	Monash University	Michael Kamp, Lasal Ranasinghe	Monash University

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Elmund Lab	Monash University	Hans Elmlund, Cyril Reboul, Marion Boudes, Monica Caggiano, Sarah Le, Simon Kiesewetter, Susan Lea	Monash University, University of Oxford
ENIGMA-Ataxia	Monash University	Ian Harding, Chiara Marzi, Hiba Bilal, Louisa Selvadurai, Louisa Selvadurai, Rebecca Kerestes, Sid Chopra, Stefano Diciotti, Thiago Rezende, Thomas Wykeham Biczok, Tiffany Maree Falcone	Monash University
Energy materials modelling	National Merit Allocation	Patrick Burr, Abhilash Sala, Conor Galvin, Dane Zielinski-Nicolson, Dillon Frost, Jodie Yuwono, Raya Tasnim, Ruoyang Zhang, Vidur Tuli, Yutong Ji	University of New South Wales
Epigenetics in Human Health and Disease Laboratory	Monash University	Antony Kaspi, Ishant Khurana, Mark Ziemann, Nick Wong, Scott Stuart Maxwell	Monash University, Deakin University
Evaluation of 3D cement paste pore structure	Monash University	Wenyi Yan, Yilin Li	Monash University
Evaluation of clonality in lentigo maligna	Monash University	Nick Wong, Peinan Zhao, Sophie Soyeon Lim	Monash University
Enabling Human-centric Security Automation Using Artificial Intelligence	Monash University	Carsten Rudolph, Tina Wu, Xingliang Yuan	Monash University
Energy Optimisation	Monash University	Ariel Liebman, Edward Lam, Peter Lusis, Semini Danusha Kumari Wijekoon, Seyedali Meghdadi	Monash University
Engineered GPCRs for cryo-EM	Characterisation Virtual Laboratory	Christopher Draper-Joyce	Florey Institute
Experimental Particle Physics	Monash University	Ulrik Egede, Jordan Nash, Renaud Amalric, Riley Dylan Leslie Henderson, Tom Hadavizadeh, Yuki Fujii	Monash University
Federated Learning for Biomedical Imaging	Monash University	Adam Morris, Kamlesh Pawar, Shenjun Zhong	Monash University
Florey fMRI projects	Characterisation Virtual Laboratory	David Abbott, Cassandra Marotta, Chris Tailby, David Vaughan, Donna Parker, Magdalena Kowalczyk	Florey Institute, University of Melbourne
Epilepsy Genomics	Monash University	Alison Anderson, Anna Harutyunyan, Kerry Mullan, Muhammad Javaid, Nick Wong, Philip Chan	Monash University
Fly RNAseq & proteomics_aa balance	Monash University	Matthew Piper, Javier Gomez Ortega	Monash University
Functional Compensation in Huntington's Disease	Monash University	Nellie Georgiou-Karistianis, Maria Soloveva, Maria Soloveva, Sharna Jamadar	Monash University
Functional imaging and modelling of the lung	Monash University	Stephen Dubsky, Maggie Lam, Melissa Helene Preissner, Mudit Agarwal	Monash University
Genome-wide association studies of Attention Deficit Hyperactivity Disorder	Monash University	Siyuan He, Janette Tong, Meadhbh Brosnan, Nicole Stefanac, Shou-Han Zhou, Ziarih Hawi	Monash University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Establishing a peptide centric proteogenomics pipeline for neoantigen discovery	Monash University	Kate Scull, Kerry Mullan	Monash University
GeoPIXE software AS users access	CSIRO	Chris Ryan, Richard Lilly	CSIRO, University of Adelaide
Evaluation and optimisation of drainage cannulae for extra corporeal membrane oxygenators	Monash University	Sam Liao, Ashkan Vatani, Azimi Azimi, Edgar Garzon Espitia	Monash University
Evans EvoMorph 3D Imaging and Analysis	Monash University	Alistair Evans, Abbie Bennetts, Cassandra Jackson, David Hocking, Fotios Gaganos, Hazel Richards, Jane Fenelon, Kathleen Garland, Marco Camaiti, Qamariya Nasrullah, Silke Cleuren, Tahlia Pollock, Vishal Subhasranjan, William Maxwell Game Parker	Monash University
Evolutionary impacts of gene interactions in a rapidly changing world	Monash University	Keyne Monro, Cristobal Gallegos Sanchez, Kathryn Hodgins	Monash University
Evolutionary study on antimicrobial resistome of Pseudomonas aeruginosa	Monash University	Jian Li, Laura Perlaza-Jimenez, Vijay Dhanasekaran, Yan Zhu	Monash University
GPU-based DEM Simulation of Particulate Systems	Monash University	Jieqing Gan, Angga Herman, Guangsi Shi, Jin Xu, Jing Li, Lin Wang, Lingling Liu, Lulu Jiao, MD Khan, Mengmeng Zhou, Patricio Jacobs Capdeville, Serene Shi Ying Tan, Siyuan He, Tengfang Zhang, Vy Tuong Phan, Xin Li, Xueshuo Li, Yinxuan Qiu, Zheng Qi	Monash University
Examination of zebrafish brain anatomy	Monash University	Robert Bryson-Richardson	Monash University
Exploring National Treasure: Automatic Photo Search for the Large Collection of National Archives of Australia	National Merit Allocation	Lei Wang, Saimunur Rahman, Zhongyan Zhang	University of Wollongong
Facts neuroimaging data analyses	Monash University	Sally Richmond	Monash University
Feature extraction from an integration of multiple biological data types	Monash University	Sonika Tyagi, Rithika Venkatesan, Shaun Dabare, Tarun Bonu, Tyrone Chen, Yashpal Ramakrishnaiah, Yuezhi Huang	
Fornito Laboratory	Monash University	Chao Suo, Alex Fornito, Aurina Arnatkeviciute, Kevin Aquino	Monash University
Fracture evolution of deep coal under coupled static-dynamic loading	Characterisation Virtual Laboratory	Ivan Zhang, Huachuan Wang, Jing Li, Kai Liu	Monash University
Global genomic epidemiology and evolution of Klebsiella pneumoniae	Monash University	Kelly Wyres, Ben Vezina, Jane Hawkey, Jiang Nansong, Kathryn Holt, Louise Cerdeira, Louise Teixeira Cerdeira, Lu Yang, Margaret Lam, Marit Hetland, Ryan Wick	Monash University
Gradient comparison for diffusion acquisition	Characterisation Virtual Laboratory	Michael Green	University of New South Wales
Functional connectivity in Bottom-of-Sulcus Dysplasia	Characterisation Virtual Laboratory	David Vaughan, Brett Larner, Fiona Permezel, Mira Semmelroch, Remika Mito, Robert Smith	Florey Institute

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Project Title	Partner or Scheme	Project Members	Organisation(s)
Gut microbiome in blood pressure regulation	Monash University	Francine Coelho Marques, Hamdi Jama, Kirill Tsyganov, Laura Avellaneda Franco, Michael Nakai, Nick Wong	Monash University
Functional Connectivity in New Onset Epilepsy	Characterisation Virtual Laboratory	Remika Mito	Florey Institute
FungalAi image and text classification	Monash University	Islam Nassar, Jarrel Seah, Lawrence Tian, Titus Tang, Walter Liao	Monash University
GWAS analysis of splicing in 1001 genomes of Arabidopsis	Monash University	Sureshkumar Balasubramanian, Craig Dent, Craig Ian Dent, David Powell, James Dylan Georges, Shilpi Singh	Monash University
HCC AI: AI in liver cancer	Monash University	Zongyuan Ge, Yanfei Zhang, Zhen Yu	Monash University, University of Melbourne
HoltLab	Monash University	Kathryn Holt, Alex Tokolyi, Ben Vezina, Carl Britto, D Paranagama, David Edwards, Fatemah Mubarak, Guillaume Meric, Hassan Al-Mana, Hugh Cottingham, Jane Hawkey, Kelly Wyres, Leo Featherstone, Leonardos Mageiros, Louise Cerdeira, Louise Judd, Margaret Lam, Nenad Macesic, Roni Froumine, Ryan Wick, et al	Monash University, University of Oxford, London School of Hygiene & Tropical Medicine
Hudson Monash Paediatric Precision Medicine Program	Monash University	Ron Firestein, Claire Sun, Paul Daniel	Hudson Institute
Human-AI for Human-AI Interaction	Characterisation Virtual Laboratory	Michael Richardson, Gaurav Patil	Macquarie University
Identifying the source of the oldest known amber of southern Gondwana	Monash University	Chris Mays	Monash University
Increasing precision in epidemiological exposure assessment by integrating genetic and epigenetic data	Monash University	Pierre-Antoine Dugue, Chenglong Yu	Monash University
Genetics of gastrointestinal diseases	Monash University	Hieu Nim, Ferdinando Bonfiglio, Leticia Camargo Tavares, Oliver Ozaydin, Tenghao Zheng	Monash University
Genital Microbiota and Mycoplasma genomics	Monash University	Catriona Bradshaw, Erica Plummer, Larissa Kathryn Ratten, Thor Haahr	Monash University
Interrogating the genomic landscape and clonal evolution of acute myeloid leukaemia	Monash University	Natasha Anstee, Chyn Chua, Nick Wong	Monash University
Investigating tissue microstructure changes in brain using ultra-high field scanner	Characterisation Virtual Laboratory	Kiran Thapaliya	Griffith University
Investigation of organelle dynamics with LLSM	Monash University	Mike Ryan, David Potter, Felix Kraus	Monash University
In vivo imaging of innate immune cell behaviour and movement	Monash University	Connie Wong, Brooke Wanrooy	Monash University

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Genomics of the Mammalian Methylome	Monash University	Kevin Gillinder, Nick Wong	Monash University
IRES	Monash University	Matthew Wilce, Matthew Wilce, Neelam Shah	Monash University
Highly-comparative time-series analysis	ARC CoE for Integrative Brain Function	Ben Fulcher	University of Sydney
HIV01	Monash University	Alex De Marco, Chris Lupton, Cyntia Taveneau, Denis Korneev, Fabian Schneider, Genevieve Buckley, Hari Venugopal, Heidi Cheng, Josh Hardy, Sergey Gorelick	Monash University
IVBD vector and pathogen genomics	Monash University	Seth Redmond, I'ah Donovan-Banfield, Kimberley Dainty, Mari Velasque, Peter Kyrylos, Ryan Wick	Monash University
HLA Class II	Monash University	Jan Petersen	Monash University
Host microbiota interactions	Monash University	Benjamin Marsland, Alana Butler, Celine Pattaroni, Giulia Iacono, Mati Moyat, Matthew Macowan, Olaf Perdijk	Monash University
Jaw biomechanics in healthy controls and post fracture fixation	Monash University	Olga Panagiotopoulou, Dedao Liu, Hyab Mehari Abraha	Monash University
Language Modelling	Monash University	Caitlin Doogan, Richard Le, Wray Buntine	Monash University
Large scale transport data analysis	Monash University	Le Hai Vu, Ali Shan, Andrew Simmons, Homayoun Hamedmoghadam Rafati, Nam Hoang	Monash University, Deakin University
Lattice dynamics in thermoelectric materials	National Merit Allocation	David Cortie	University of Wollongong
Learning Deep Semantics for Automatic Translation between Human Languages	Monash University	Gholamreza Haffari, Alexander Yuri Zenin, Chenyang Wang, Cong Hoang, Daniel Beck, Diptesh Kanojia, Dongwon Ryu, Fahimeh Saleh, Islam Nassar, Jinming Zhao, Kay Yen Wong, Lizhen Qu, Mel Mistica, Ming Liu, Minghao Wu, Narjes Askarian, Omar Al Zeidi, Paulo Antunes Ventura Filho, Philip Arthur, Poorya Zaremoodi, Quan Tran et al	Monash University, University of Melbourne
Learning in a dynamic world	Monash University	Geoff Webb, Angus Dempster, Loong Kuan Lee, Lynn Miller	Monash University
Learning Predictive SNP-SNP interaction Features from Genome-wide Association Studies	CSIRO	Cheng-Soon Ong, Qiao Wang	CSIRO
How prediction and attention affect the sensory coding of visual information	ARC CoE for Integrative Brain Function	Matthew Tang, Ehsan Arabzadeh, Morgan Kikkawa	Australian National University
HPC Cambridge	Characterisation Virtual Laboratory	Wojciech Turek	University of Cambridge
Human Studies of Motivation and Cognitive Processing	Monash University	Trevor Chong, Ariel Goh, Bridgitt Mary Shea, James Coxon, Julia Paterson, Patrick Cooper, Shou-Han Zhou	Monash University
LLSM Processing	Monash University	Abhishek Patil, Senthil Arumugam	Monash University

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Project Title	Partner or Scheme	Project Members	Organisation(s)
IRz	Monash University	John Menting	Walter and Eliza Hall Institute of Medical Research
Hyper-Heuristic Swarm Robotics	Monash University	Asad I. Khan, Phillip Smith	Monash University
Identification of (common) key factors and pathways involved in muscle and cancer stem cell clonal drifting/selection	Monash University	Peter Currie, Adrian (Abbas) Salavaty Hosein Abadi	Monash University
Identifying epitopes for SARS-CoV2 antibodies	Characterisation Virtual Laboratory	Alisa Glukhova, Julie Iskander, Katrina Black, Laszlo Kun, Phillip Pymm	University of Melbourne
Identifying Grhl3 target genes	Monash University	Marina Carpinelli, Graham Magor, Kevin Gillinder, Zihao Deng	Monash University
IMAGE_HD	Monash University	Nellie Georgiou-Karistianis, Bonnie Alexander, Brendan Tan, Christine Huynh, Pierre Wibawa, Pubu Abeyasinghe, Rosa Shishegar, Sophie Thong, Wing Yin Leung	Monash University
Imaging of Pipe soil interactions	Monash University	Jayantha Kodikara, Balachandra Ranasinghe, Kaushal Kishore, Nikhil Singh, Ravin Deo, Rukshan Azoor, Sameera Pitawala, Senarathna de Silva	Monash University
Learning Algorithms for Computer Vision	Monash University	Andrew Paplinski, Luyao Ma, Md Anit Khan, Md Sazzad Hossain, Mohammad Ali Jan Ghasab, Qinghua Wu, Varun Maithani, William Thomas Schmidt	Monash University
Lung imaging for a novel bacteriophage therapy for respiratory infections caused by superbugs	Monash University	Kaye Morgan, Melissa Helene Preissner	Monash University
Immunity & Infection - Monash-Melbourne-LaTrobe CAP	Monash University	Adam Shahine, Andrea Nguyen, Anne Chow, Bruce MacLachlan, Carine Farenc, Chris Hines, Christian Alexander Lobos, Christoper Szeto, Dimitra Chatzileontiadou, Elsa Marquez, Gabby Watson, Goodluck Onwukwe, Jan Petersen, Jerome Le Nours, Jia Jia Lim, Julian Vivian, Marcin Wegrecki, et al	Monash University
Impact of heat stress on Australian dairy cattle	Characterisation Virtual Laboratory	Andrew James Mehnert, Dominique Blache, Shilja Shaji	University of Western Australia
Machine Learning	Monash University	Mohamed Hisham Jaward, Guo Hao Th'Ng, Somayeh Ebrahimkhani	Monash University
Improved Time Series Forecasting with Deep Neural Networks	Monash University	Klaus Ackermann, Alexey Chernikov, Hansika Hewamalage, James Louis Nguyen, Jia Lin Gao, Julian Kardis, Nandini Syanavalli Anantharama	Monash University
Improving intraventricular flow with LVADs	Monash University	Sam Liao, Azimi Azimi, Kar Ying Thum	Monash University
Male Testis scRNAseq Data in CellRanger	Monash University	Benedict Nathaniel, Sarah Williams	The Hudson Institute
Mapping protoplanetary discs with ALMA	Monash University	Christophe Pinte, Brodie Norfolk, Daniel Price, Himanshi Garg, Valentin Christiaens	Monash University, Swinburne University
MBI Final Year Projects	Monash University	Zhaolin Chen, Jake William Gurnett	Monash University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Mechanisms of Neurodegeneration (Harding) Lab	Monash University	Ian Harding, Hiba Bilal, Jo Wrigglesworth, Louisa Selvadurai, Louisa Selvadurai, Muhammad Karim, Phil Ward, Rebecca Kerestes, Sid Chopra, Sina Killguss, Thomas Wykeham Biczok, Will Khan	Monash University
In-vivo characterisation of microstructural, functional and metabolic changes in a rat model of repeated mild traumatic brain injury	Characterisation Virtual Laboratory	Andrew James Mehnert, Alex Wright, Andrew Warnock, Bhedita Jaya Seewoo, Melinda Fitzgerald, Sarah Hellewell	University of Western Australia
In-vivo evaluation of brain iron accumulation in psychotic and neurodegenerative disorders using quantitative susceptibility mapping (QSM)	Characterisation Virtual Laboratory	Christos Pantelis, Bradford Moffat, Parsa Ravanfar, Warda-Taqdees Syeda	University of Melbourne
Melanoma TSO-500 Pilot	Monash University	Nick Wong, Helen Mitchell, Jen Cheung, Nick Wong, Pacman Szeto, Peinan Zhao, Tony Papenfuss, Vikki Marshall	Monash University
Information Processing in Sensory Cortex	ARC CoE for Integrative Brain Function	Ehsan Arabzadeh, Conrad Lee, Lachlan Owensby, Taylor Singh	Australian National University
Melbourne Brain Centre 7T MRI Protocol Development	Characterisation Virtual Laboratory	Bradford Moffat, Adrian Sarstedt, Alex Oman, Chengchuan Wu, Christopher Smith, David Wright, Didi Chi, Gihan-Pramuditha Ruwanpathirana, Hongfu Sun, Hongfu Sun, Jon Cleary, Leigh Johnston, Negin Yaghmaie, Scott Kolbe, Thomas Spencer, Vanessa Brait, Warda Syeda, Warda-Taqdees Syeda, et al	Florey Institute, University of Melbourne, Monash University
Infrared Tissue Imaging	Monash University	David Perez Guaita, Philip Heraud	Monash University
Melbourne Experiment	Monash University	Dickson Lukose	Monash University
Insulin receptor peptides	Monash University	James Bouwer, Nicholas Kirk, Simon Brown	University of Wollongong, Walter and Eliza Hall Institute of Medical Research
Integrating genomic and artificial intelligence approaches to combat antimicrobial resistance	Monash University	Nenad Macesic, Hugh Cottingham, Jane Hawkey	Monash University
Memory in HD	Monash University	Yifat Glikmann-Johnston, Adeel Razi, Ali Al-Rubaie, Anna Carmichael, Bonnie Alexander, Emily Mercieca, Garance Delagneau, Govinda Poudel, Ian Harding, Muireann-Irene Irish, Pierre Wibawa, Richard Beare	Monash University, Murdoch Childrens Research Institute, Australian Catholic University, University of Sydney
Metal-Semiconductor (MS) Contacts	Characterisation Virtual Laboratory	Mohammad Saleh N Alnassar	Monash University
Investigating the role of Lyn in human lupus disease	Monash University	Margaret Hibbs, Elan L'Estrange-Stranieri	Monash University
Investigation of Archaean micrometeorites	Monash University	Alastair Tait	Monash University
Mimivirus	Monash University	Daouda Traore	Monash University
MIPS Cryoem Primary Data Compute	Monash University	Matthew Belousoff	

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MIPS Cryoem Primary Data Store	Monash University	Matthew Belousoff, Alisa Glukhova, Brian Cary, Jason van Rooyen, Radostin Danev, Sarah Piper	Monash University, University of Tokyo
JAK	Monash University	Jeffrey Babon, Josh Hardy, Kaiseal Sarson-Lawrence, Nicholas Liau	University of Melbourne, Monash University
JAP89	Monash University	Yi Tian Ting, Jesse Mobbs, Jia Jia Lim	Monash University
Mitochondrial DNA in infection, autoimmunity and cancer	Monash University	Benjamin Kile, David Potter, Genevieve Buckley, Kate McArthur, Tahnee Saunders	Monash University
Kilosort	Monash University	Nicholas Price, Aaron Chan, Andrew Yip, Brian Oakley, Elizabeth Arsenault, Hersh Umesh Nevgi, Jakob Schwenk, Joanita D'Souza, Jocelyn Halim, Maureen Hagan, Mojtaba Kermani, Morgan Elliot Williamson, Morgan Williamson, Sabrina Meikle, Yan Wong	Monash University
MMI-LLSM	Monash University	David Potter, Felix Kraus, Genevieve Buckley, Juan Nunez-Iglesias, Martin Weigert, Uwe Schmidt, Volker Hilsenstein	Monash University
Modelling AML and ALL with genomics in mice and humans - ACBD	Monash University	Nick Wong, Anna Leichter, Feng Yan, Shokoufeh Abdollahi	Monash University
Modelling Nanoscale Materials for Sensing and Device Applications	National Merit Allocation	Michelle Spencer, Annelisa Rigoni, Dale Osborne, Jonathan Clarke-Hannaford, Kevin Tran, Maria Javaid, Patrick Taylor	RMIT
Large scale 3D reconstruction for electron imaging	Monash University	Jing Fu, Junke Gao, Shi Qiu, Shuo Zhang	Monash University
Marine big data: sustainable fisheries and environmental monitoring based on underwater vision	National Merit Allocation	Ivan Lee, Aaron Hodgins, Ayaz Umer, Chakkrit Termritthikun, Douglas Hudson-Walker, Elyssa Yeo, Kristy Nguyen, Namrata Nath, Natalie Watkins, Quang-Huy Tran, Raymond Stoddard	University of South Australia
Modelling of shear stress induced platelet aggregations in human blood	Monash University	Isaac Pinar, Josie Carberry, Tienan Xu	Monash University, Australian National University
Modelling the Hierarchy of Functional Connectivity in Human Brain	Characterisation Virtual Laboratory	Jinglei Lv, Qiting Huang, Saampras Ganesan, Zoe Delaney	University of Sydney, University of Melbourne
Modelling trajectories of cognitive control in adolescents and young adults	Monash University	Sharna Jamadar	Monash University
Lattice Light Sheet Data Processing - Lieschke Lab	Monash University	Graham Lieschke, David Potter, Harriet Manley	Monash University
Laxy bioinformatics pipelines	Monash University	David Powell, Andrew Perry	Monash University
Lenours Laboratory	Monash University	Jerome Le Nours, Adam Shahine, Elsa Marquez, Marcin Wegrecki, Praveena Thirunavukkarasu, Yogesh Khandokar	Monash University
Molecular Immunology	Monash University	Julian Vivian, Jesse Mobbs, Phill Pymm	Monash University

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Lithgow Lab	Monash University	Matthew Belousoff, Alexander Jackson Ivan Wright, Hamish Brown, Iain Hay, Laura Perlaza-Jimenez, Matthew Wilce, Mehdi Youssefi Matak, Natalia Rosas Bastidas, Rebecca Bamert, Tao Chen	Monash University, University of Melbourne
Molecular Mechanisms of the DNA Translocase, FtsK	University of Wollongong	James Bouwer, James Bouwer, Simon Brown	University of Wollongong
Mask design using the DHVL	Characterisation Virtual Laboratory	Soon-Hock Ng	Swinburne University
Lung imaging for severe asthma	Monash University	Melissa Helene Preissner, Alexandra Churchill	Monash University
Machine Learning for Designing New Aluminium Alloys	Monash University	Philip Nakashima, Andrews Bethala, Geoff Webb, Hanwen Zang, Hanwen Zang, Nick Birbilis, Sai Yamjala, Sophia Wang, Tianyu Liu, Xiaofei Wang	Monash University
Markov-chain Monte Carlo methods in statistical mechanics and combinatorics	Monash University	Tim Garoni, Somayeh Shiri, Zifeng Guo	Monash University
MBI Pre-Clinical Imaging Data Analysis	Monash University	Michael De Veer	Monash University
Molemap Skin Project	Monash University	Zongyuan Ge, Luis Guerra Fernandez, Toan Nguyen	Monash University
McGowan lab crystallography	Monash University	Sheena McGowan, Nyssa Drinkwater, Tess Rosalie Malcolm	Monash University
Medical Neural Language Processing for VQA and Report generation	Monash University	Zongyuan Ge, Donghao Zhang, Zhihong Lin	Monash University
Melbourne Activity-Based Model (MABM)	Monash University	Le Hai Vu, Atousa Tajaddini, Ky Nguyen, Mahsasadat Naseri, The Phan, Yifan Chen	Monash University
Monash Bioinformatics Platform	Monash University	David Powell, Adele Barugahare, Andrew Perry, Anup Shah, Kirill Tsyganov, Michael See, Nick Wong, Paul Harrison, Sarah Williams, Stuart Archer	Monash University
Monash Biomedical Imaging Small Projects	Monash University	Thomas Close, Anjan Bhattarai, Ashlea Segal, David Wright, Emma Liang, Eric Xu, Gang Zheng, Jason Rigby, Kamlesh Pawar, Katrina Anne Chapman, Linden Parkes, Mohamed Khlif, Phil Ward, Rebekah Sum-Yee Chiu, Shenjun Zhong, Tara Sepehrizadeh, Thomas Close, Zhaolin Chen	Monash University
Monash CAV	Monash University	Le Hai Vu, Aryan Faghihi, Cuong Nguyen, Dmitry Lanchtchikov, Farbod Torabi	Monash University
MeRC AI initiatives	Monash University	Zongyuan Ge, Xuelian Cheng, Zhen Yu	Monash University
MeRC Deep Learning	Monash University	Jason Rigby, Shenjun Zhong	Monash University
Meta-learning for Few-shot learning on Chest Xray	Monash University	Zongyuan Ge, Ivan Lu	Monash University

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Project Title	Partner or Scheme	Project Members	Organisation(s)
Monash Machine Intelligence and Mathematical Modeling	Monash University	Mehrtash Tafazzoli Harandi, Chengyao Qian, Edirisinghe Peiris, Ekanayake Ekanayake, Ghazaleh Mohammad Alinejad, Kaushik Roy, Leila Mahmoodi, Paul Sadauskas, Peter Chen, Phadon Phipat, Richard Yan, Ronen Schwarz, Rongkai Ma, Shayne Umesh D'Lima, Steven Khuu, Xuelian Cheng	Monash University
Movement and Exercise Neuroscience Lab (MEX Lab)	Monash University	James Coxon, Claire Cadwallader, Dylan Jon Curtin, Eleanor May Taylor, Elizabeth Bensley, Elizabeth Doery, Ellen Stavrinos, Jaeger Andre Wongtrakun, Jennifer Joanne Steiniger, Josh Hendrikse, Julia Paterson, Matthew David Wiseman, Patrick Cooper, Robin Cash, Shou-Han Zhou	Monash University
Meta-omics Survey of Trace Gas Scavenger Genes in Global Ecosystems and Pure Culture Representatives	Monash University	Chris Greening, Ashleigh Kropp, Caitlin Sarah Welsh, Jie Mao, Laura Perlaza-Jimenez, Pok Man Leung, Rachael Lappan, Rhys Grinter, Sean Bay	Monash University
Microstructural evolution of granular soils based on insitu X-Ray CT imaging	Monash University	Asadul Haque, Arun Murali, Chanaka Senanayake Mudiyanselage, Milad Bazli, Wei Bin Kee	Monash University
NCMAS Soria	National Merit Allocation	Julio Soria, Alice Martelletti, Asif Ahmed, Atsushi Sekimoto, Bihai Sun, Chong Wong, Damien Geneste, Daniel Jovic, Daniel New, Dinesh Bhatia, Ezhilsabareesh Kannadasan, Graham Bell, Hamish Self, Hongmei Cui, Hudson Ernest De Bortoli, Hui Wu, Joel Weightman, Muhammad Shehzad, Omid Amili, et al	Monash University, Università degli Studi di Firenze, University of Toledo
Modelling TB Control with the AuTuMN Platform	Monash University	James Trauer, Milinda Abayawardana, Romain Ragonnet, Sachin Wasnik	Monash University
Molecular dynamics simulation of high temperature-pressure geofluids	CSIRO	Yuan Mei, Gan Duan, Qiushi Guan, Weihua Liu	CSIRO, Monash University
NDS	Monash University	Daniel Griffiths, Benjamin John McAnulty	Monash University
Molecular Dynamics Simultions on radiation damage of accident tolerant fuels	ANSTO	Meng-Jun Qin	ANSTO
Monash CAVE2 rendering and data organisation	Monash University	David Barnes, Andreas Hamacher, Daniel Waghorn, Owen Kaluza, Toan Nguyen	Monash University
Neural mechanisms of complex decision-making	ARC CoE for Integrative Brain Function	Dragan Rangelov, Andrew McKay, Luke Hearne	University of Queensland
Multi-modal Visualisation of The Human Torso	National Merit Allocation	Caroline Grant	
Neuroimaging of human regional brain responses associated with control of physiology	Monash University	Matthew Dimmock, Abubakar Abubakar, Aung-Aung-Kywe Moe, Cylie Williams, Emma Liang, Jack Donne, Jessica Kolic, Madeline Daveney, Michael Farrell, Muath Shraim, Nabita Singh, Pascal Saker, Suhel Singh, Tara Georgina Bautista, Thusharika Dissanayaka	Monash University, University of Melbourne
Neuroscience of Addiction and Mental Health Program	Monash University	Valentina Lorenzetti, Chao Suo, Magdalena Kowalczyk	Australian Catholic University

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Monash Micro Imaging Bio-image Analytics	Monash University	David Potter, Chad Johnson, Genevieve Buckley, Ian Harper, Jeshua Brennan, Juan Nunez-Iglesias, Keith Schulze, Kirstin Elgass, Martin Weigert, Oleksandr Chernyavskiy, Owen Kaluza, Stephen Dubsky, Uwe Schmidt, Volker Hilsenstein	Monash University
Monash University, Biochemistry Department, MX Beam Time	Monash University	Ruby Law, Adam Quek, Andrew Ellisdon, Anna Roujeinikova, Brad Spicer, Daouda Traore, Guojie Wu, Hussain Bhukya, Mathias Hansen, Max Cryle, Natalie Borg, Paul Conroy, Qi Zhang, Sarah Atkinson, Siew Pang, Thierry Izore	Monash University
Motion encoding in extrastriate cortex	Monash University	Maureen Hagan, Joanita D'Souza	Monash University
New strategies for Alpha Go Zero	Monash University	Pierre Le Bodic, Mervyn Zly	Monash University
MRI Analysis of Preterm Sheep	Characterisation Virtual Laboratory	Nathanael Yates, Ellen Marie Williams, Nathanael Yates	University of Western Australia, University of Queensland
Multi-omics study of patients with nosocomial diarrhoea	Monash University	Dena Lyras, Marijana Bosnjak	Monash University
Multiple Sclerosis Genomics	Monash University	Vilija Jokubaitis, Jim Stankovich, Maria Campagna, Maria Pia Campagna	Monash University
Neural circuits for information processing in the brain	ARC CoE for Integrative Brain Function	Shaun Cloherty, Adam Morris, Jamie Mcfadyen	Monash University
Neuroimaging in Neuropsychiatric and Neurodegenerative Disorders	Monash University	Phyllis Chua, Anjan Bhattarai, Rebekah Sum-Yee Chiu, Thomas Close	Monash University
Neuroimaging of the Children's Attention Project	National Merit Allocation	Tim Silk, Ian Fuelscher, Katharina Voigt, Lillian Dipnall, Mervyn Singh, Nandi Vijayakumar, Newsha Dehestanikolagar, Phil Ward, Phoebe Thomson, Shania Mereen Soman, Yen Wong	Deakin University, Monash University
Neutron stars and their gravitational wave emission: extreme nuclear physics laboratories	National Merit Allocation	Andrew Melatos, Filippo Anzuini, Hannah Middleton, Jack Lonnborn, Liam Dunn, Patrick Clearwater, Sofia Suvorova	University of Melbourne
Next-generation imaging biomarkers for mild traumatic brain injury	Monash University	David Wright, Georgia Fuller Symons	Monash University
NIF-Fellows-CAI	Characterisation Virtual Laboratory	Paula Martinez Villegas, Aswin Narayanan, Biswa Prasanna Mishra, Elisabeth Van der Voort, Gary Cowin, Hongfu Sun, Nyoman Kurniawan, Shahrokh Abbasi-rad, Tonima Ali	University of Queensland
NIF-Fellows-Florey	Characterisation Virtual Laboratory	Paula Martinez Villegas, Bradford Moffat, David Abbott, Robert Smith	Florey Institute, University of Melbourne
NIF-Fellows-LARIF	Characterisation Virtual Laboratory	Paula Martinez Villegas, Marianne Keller	University of Adelaide
NIF-Fellows-MBI	Characterisation Virtual Laboratory	Gang Zheng, Paula Martinez Villegas, Thomas Close	University of Queensland, Monash University

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NIF-Fellows-Swinburne	Characterisation Virtual Laboratory	Iain Johnstone, David White, Matthew Hughes, Oren Civier, Wei Hong, William Woods	Swinburne University
NIF-Fellows-UniSydney	Characterisation Virtual Laboratory	Paula Martinez Villegas	University of Queensland
NIF-Fellows-UNSW	Characterisation Virtual Laboratory	Paula Martinez Villegas, Andre Bongers, Michael Green, Tzong Hung	University of New South Wales
NIF-Fellows-WA	Characterisation Virtual Laboratory	Andrew James Mehnert, Diana Patalwala	University of Western Australia
NIF-Fellows-WSU	Characterisation Virtual Laboratory	Timothy Stait-Gardner	University of Western Sydney
NK cells for anti-tumour immunity	Monash University	David Ladd, Joseph Cursons, Momeneh Foroutan	Monash University
NN for MRI image processing and radiotherapy treatment planning	Characterisation Virtual Laboratory	Mark Schira, Chelle Roberts, Michael Green, Paul Ang, Soan-Thi-Minh Duong	University of New South Wales, University of Wollongong
Noise generation in shock-containing supersonic jets	Monash University	Daniel Edgington-Mitchell, Amir Ekladious, Bhavraj Singh Thethy, Graham Bell, Hamish Self, Joel Weightman, Marcus Wong, Petronio Nogueira, Ravee Raj Pathya, Thomas Knast, Zhenhai Zhang	Monash University
Numerical Modelling of Soil Arching in GRCSEs	Monash University	Abdelmalek Bouazza, Edward Smith	Monash University
Numerical modelling of solar photospheric magnetic activity	Monash University	Sergiy Shelyag	Deakin University
Numerical simulations of Shale gas extractions Active	Monash University	Ranjith Pathegama Gamage, Aaqib Azhar, Anup Shahi, Avanthi Badulla Liyanage, Ayal Maneth Wanniarachchi, Balinee Balachandran, Bo Zhang, Dinesh Panneerselvam, Dinesha Wanigarathna Jayasekara, Guanglei Zhang, Janethri Parana Liyanage, Jun Zhou, K Mudiyanselage Adheesha Shashibhanu Bandara, et al	Monash University
Opendatafit SAXS and SANS data analysis	Characterisation Virtual Laboratory	Lance Wilson, James Wilmot, Varvara Efremova	University of New South Wales, Monash University
Optimisation of areal rainfall	Monash University	Valentijn Pauwels, Ash Wright	Monash University
Ovarian cancer project	Monash University	David Powell, Kirill Tsyganov, Maria Alexiadis, Stuart Archer	Monash University, Hudson Institute
PANDL: a deep learning-based histopathological image data analytics AI for automated image classification, prediction and annotation	ARC ImagingCoE	Jiangning Song, Litao Yang, Yanan Wang, Yun Zhao	Monash University
PATH MRI Study	Characterisation Virtual Laboratory	Katharine Huynh, Benjamin Chidiac, Kaarin Anstey, Lidan Zheng	University of New South Wales
PcrA-RNAP Complex	University of Wollongong	James Bouwer, Michael Miller, Peter Lewis, Simon Brown	University of Wollongong, University of Newcastle

Project Title	Partner or Scheme	Project Members	Organisation(s)
Pediatric Brain Imaging correlates of long-term outcome	Monash University	Amanda Wood, Adam Shephard, Amanda Wood, Edith N Botchway, Jian Chen	Monash University, Deakin University, Aston University, Murdoch Childrens Research Institute
PFIB01	Monash University	Alex De Marco, Barath Kumar S, Cyntia Taveneau, Denis Korneev, Donna Merriner, Erick Vargas Ordaz, Genevieve Buckley, Heidi Cheng, Sergey Gorelick	Monash University, National Institute of Technology Tiruchirappalli
Phase transformation of titanium alloys	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra, Tong Li	University of Sydney
Plum Cary 2018	Monash University	Michael Grace, Cami Plum, Rebekah Henry	Monash University
Polo Lab	Monash University	Jose Polo, Alexandra Grubman, Kirill Tsyganov	Monash University
Polygenic risk scores prediction on human complex diseases	Monash University	Mika Ala-Korpela, Qin Wang, Tingting Wang, Ville-Petteri Makinen	Monash University,
Predicting Surgical Outcomes In Epilepsy Using Deep Learning	Monash University	Ben Sinclair	Monash University
Predominantly antibody deficiency: Advancing genetic diagnoses in this uncharacteristically heterogeneous form of primary immunodeficiency	Monash University	Emily Edwards, Nick Wong	Monash University
Price research group - cosmology, star and planet formation	Monash University	Daniel Price, Hayley MacPherson	Monash University
Processing massive 3D images from X-ray CT to quantify microstructural heterogeneity and anisotropy of rock materials	Characterisation Virtual Laboratory	Qianbing Zhang, Saeed Aligholi	Monash University
Process simulation using TCAd	Characterisation Virtual Laboratory	Duk Yong Choi	Australian National University
Profiler analysis of live-cell imaging data	Monash University	Thomas Naderer, Seong Hoong Chow, Volker Hilsenstein	Monash University
PTSD magnetic resonance spectroscopy	Characterisation Virtual Laboratory	Scott Quadrelli	University of Newcastle
Publicly Available Melanoma Genomics Data Exploration	Monash University	Nick Wong, Pacman Szeto, Peinan Zhao	Monash University
Putative effects of exogenous dietary lipids in a murine model of Multiple Sclerosis	Characterisation Virtual Laboratoryy	Virginie Lam, Andrew James Mehnert, Liam Graneri, Timothy Rosenow	Curtin University, University of Western Australia
Quantisation for Efficient Graph Embedding	Monash University	Yuan-Fang Li, Tao He	Monash University
Quantitative susceptibility mapping processing in CVL	Characterisation Virtual Laboratory	Steffen Bollmann	University of Queensland

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Question Generation from Text using Deep Learning	Monash University	Yuan-Fang Li, Vishwajeet Kumar	Monash University
Rapid information processing in subcortical amygdala pathways	ARC CoE for Integrative Brain Function	Marta Garrido, Clare Harris, Jeremy Taylor, Jessica McFadyen, Moritz Bammel, Shivam Kalhan, Shivam Kalhan	University of Queensland, University of Melbourne
Recipeint cell biology during conjugation	Monash University	Dena Lyras, Galain Williams	Monash University
Recommending similar source code by mining big data analytics source code repositories	Monash University	Chunyang Chen, Hourieh Khalajzadeh	Monash University
Reconstructing Bioinclusions in Australian Amber and Australian Meteorites	Monash University	Andrew Langendam, Alastair Tait, Lachlan Sutherland	Monash University
Replication proteins	University of Wollongong	James Bouwer, Alok Pradhan, Gokhan Tolun, Simon Brown, Zhi-Qiang Xu	University of Wollongong
Resource of genetics and epigenetics data for elucidating the underlying mechanisms of cancer predisposition and progression	Monash University	Tu Nguyen-Dumont, David Powell, Derrick Theys, Ee Ming Wong, Jared Burke, Jason Steen, Medha Suman, Nick Wong, Sonika Tyagi	Monash University
RMMF Electron Microscopy Work	Characterisation Virtual Laboratory	Matthew Field	RMIT
RNA Polymerase	University of Wollongong	Peter Lewis, Gokhan Tolun, Simon Brown, Timothy Newing	University of Wollongong, University of New South Wales
Rodent calvaria post-TBI	Characterisation Virtual Laboratory	Bridgette Semple, Larissa Dill	
Role of epigenetic regulators in embryonic stem cells	Monash University	Partha Das, Stuart Archer, Yogesh Kumar	Monash University
Role of transcription factors in leukemia	Monash University	Matthew McCormack, Kevin Gillinder, Ngoc Vo, Nick Wong	Monash University
Room temperature deformation of Mg alloys with neutral network interatomic potentials	Monash University	Jian Nie, Bingqing Cheng, Shenlan Yang, Shiqi Liu, Sumit Maurya, Yong Zhang, Yuan Yue	Monash University
Rossjohn Lab	Monash University	Anne Chow, Ben Gully, Dene Littler, Richard Berry	Monash University
rs-fMRI, DTI and MRS study of the effects of brain stimulation in rats	Characterisation Virtual Laboratory	Jennifer Rodger, Abbey Figliomeni, Bhedita Jaya Seewoo, Samuel Bolland	University of Western Australia, Murdoch University
Seeing inside the sandbox: imaging geological analogue experiments with X-Ray CT scanning	Monash University	Sandy Cruden, Jonas Kopping, Megan Withers, Muhammad Md Ali	Monash University
Segmentation of Kangaroo lungs	Characterisation Virtual Laboratory	Peter Noble, Andrew James Mehnert, James Tze Hong Wong	University of Western Australia

Project Title	Partner or Scheme	Project Members	Organisation(s)
Sequence-Structure determinants of protein folding patterns	Monash University	Arun Konagurthu, Sandun Rajapaksa	Monash University
Sexton Industry Collaboration	Monash University	Matthew Belousoff	Monash University
Sexton Lab	Monash University	Matthew Belousoff, Alisa Glukhova, Andrew Keller, Brian Cary, David Thal, Hari Venugopal, Jesse Mobbs, Jianjun Cao, Kieran Deane-Alder, Liudi Zhang, Lynn Liang, Rachel Johnson, Radostin Danev, Sarah Piper, Xin Zhang, Ziva Vuckovic Mueller	Monash University, University of Tokyo
Shedding light on bone catch-up growth	Monash University	Alberto Rosello Diez, Brett Kagan, Elizabeth Marquez Garcia, Nandita Suresh Kumar, Santiago Andres Beltran Diaz, Santiago Beltran Diaz, Veronica Uribe Sokolov	Monash University
Short-range ordering in high-entropy alloys	Characterisation Virtual Laboratory	Bernd Gludovatz, Yokasundery Muniandy	University of New South Wales
Short range order analysis on HEAs	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra, Lena-Pia Frommeyer	University of Sydney
Short range order simulations for atom probe tomography	Characterisation Virtual Laboratory	William-John Davids	University of Sydney
Silica Gels for CO2 containment	Monash University	Stuart Walsh, Sobhan Hatami	Monash University
Simulating flow in 3D printed ventilator components for COVID-19 patients	Monash University	Daniel Duke	Monash University
Simulating short-range order in a high entropy alloy using atomic-scale simulation	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra, Jean Vereecke	University of Sydney
Simulation & Visualisation of Supernovae in 3D	Monash University	Bernhard Mueller, Lucy McNeill	Monash University
Simulation and Modelling of Particulate Systems	National Merit Allocation	Aibing Yu, Jieqing Gan, Jin Xu, Joel Samsu, Lulu Jiao, Mengmeng Zhou, Siddhartha Shrestha, Siyuan He, Wenhuan Zhang, Xin Li, Yinxuan Qiu, Zheng Qi	Monash University
Simulation of topologically interlocked structures	Monash University	Andrey Molotnikov, Georgia Alice Whitney Hunter	Monash University
Single particle data processing of F1-ATPase	University of Wollongong	James Bouwer, Alastair Stewart, James Walshe	University of New South Wales, University of Wollongong
Small Angle Neutron Scattering	ANSTO	Nick Hauser, Anna Sokolova, Manish Kumar	ANSTO
Smart Antenna for Soil Moisture Radiometer	Monash University	Nemai Karmakar, Fatemeh Babaeian, Jiewei Feng, Muhsiul Hassan, Shahriar Hasan Shehab	Monash University
Social Media Content Analysis for Understanding Risk Factors in Low Back Pain	Monash University	Pari Delir Haghighi, Robert	Monash University

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Social Neuroscience Lab	ARC CoE for Integrative Brain Function	Juan Dominguez Duque	Australian Catholic University, Deakin University
STARImaging	Monash University	Richard Beare, Jian Chen, Joseph Yuan-Mou Yang, Kantha Siddhanth Gujjari, Kay Richards, Mark Michael, Michele Callisaya, Sally Richmond, Sally-Richmond Richmond, Shanika Jayakody Arachchige Dona, Taya Collyer, Tim Siejka	Murdoch Childrens Research Institute, Monash Health, Florey Insitute, Monash University, University of Tasmania
Sticky polymers in flow: Nexus between microscopic and macroscopic dynamics	Monash University	Ravi Jagadeeshan, Aritra Santra, Isaac Pincus, Kiran Kumari, Nathan John Colvin, Nick Robe, Ramalingam Ramalingam Kailasham, Silpa Mariya	Monash University
Stochastic neural network based numerical model updating for a concrete culvert bridge	Monash University	Ye Lu, Solomon Lin	Monash University
Stroke and normative connectomes	ARC CoE for Integrative Brain Function	Jason B. Mattingley, Julia Fellrath, Luke Hearne	University of Queensland
Structural basis of drug binding to hERG potassium channels	University of Wollongong	James Bouwer, Carus Lau, Jamie Vandenberg, Mark Hunter, Simon Brown	University of Wollongong, University of New South Wales
Structural Biology	Monash University	Chen Davidovich, Dominique Livingstone, Emma Gail, Melanie Murray, Qi Zhang, Samuel Charles Agius	Monash University
Structural characterisation of Glutamate transporters	University of Wollongong	James Bouwer, Ichia Chen, Josep Font, Renae-Monique Ryan, Simon Brown	University of Sydney, University of Wollongong
Structural characterisation of the non-catalytic signaling functions of the kinase scaffold	Monash University	Josh Hardy, Onisha Patel	Monash University, Walter and Eliza Hall Institute of Medical Research
Structural determination of IGF1R	Monash University	Hari Venugopal, Yibin Xu	Walter and Eliza Hall Institute of Medical Research
Structural investigation of multidomain kinases and pseudokinases implicated in cancer	Monash University	Onisha Patel	Walter and Eliza Hall Institute of Medical Research
Structural neuroplasticity in brain injured patients	ARC CoE for Integrative Brain Function	Karen Caeyenberghs, Adam Clemente, Evelyn Deutscher, Hannah Richards, Honey Baseri, Ian Fuelscher, Juan Dominguez Duque, Juan Dominquez Duque, Phoebe Imms, Ryan Lim	Australian Catholic University, Deakin University
Structural studies of crystallin proteins	University of Wollongong	James Bouwer, Aidan Grosas, Simon Brown	Australian National University, University of Wollongong
Structural studies of G protein-coupled receptors	Monash University	David Thal, Alisa Glukhova, Michele Kattke, Ziva Vuckovic Mueller	Monash University
Structural studies of kinases and ubiquitin modifying enzymes	University of Wollongong	James Bouwer, Alice Parnell, Pavel Filipcik, Peter Mace	University of Wollongong, Otago University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Structure-property relation of Zr-Based BMG	Characterisation Virtual Laboratory	Huma Bilal	University of Sydney
Study of amyloid peptide aggregation using simulations	Monash University	Lisa Martin, Anup Prasad, Chandni Tiwari, Dr Paul O'Leary, India Wright, Torsten John, Verity Leigh Baltutis	Monash University
Sulphide analogue	Monash University	Anja Slim, Tom Lemaitre	Monash University
Super-resolution method development	Characterisation Virtual Laboratory	Liisa Maija Hirvonen, Andrew James Mehnert	University of Western Australia
Sydney Uni Brain	Characterisation Virtual Laboratory	Tom Shaw, Anup Bidesi, Arkiev-Krystof D'Souza, Arush Honnedevasthana-Arun, Cherie-Louise Strikwerda-brown, Colin-John Mahoney, Daniel-Richard Roquet, David-Gordon Foxe, Fan Zhang, Fang Lan, Hashim Emad Munir El-Omar, Isabella-Anne Breukelaar, Isabella-Hoi Leung, Jake-Robert Palmer, et al	University of Sydney
Synchrotron-based phase contrast x-ray imaging of the lungs	Monash University	Marcus Kitchen, Andrew Vincent Stainsby, Dylan William O'Connell, Florian Schaff, Gary Ruben, James Alan Pollock, Kaye Morgan, Linda Croton, Michelle Croughan, Shay Payne, Ying Ying How	Monash University
Synchrotron beam-line optimisation	Monash University	Matthew Dimmock, Amy Chew, Carlos Pena Solorzano, Matthew Oyang	Monash University
Task Allocation in Social Insects	Monash University	Bernd Meyer, Julian Garcia	Monash University
Task related motion	ARC CoE for Integrative Brain Function	Michael Breakspear, Johan van der Meer, Matthew Aburn	QIMR Berghofer
Task Specialisation for Multi-robot Foraging	Monash University	Julian Garcia, Mostafa Rizk	Monash University
TCAD at UOW	Characterisation Virtual Laboratory	Jeremy Davis, Giordano Biasi	University of Wollongong
Telomerase	University of Wollongong	James Bouwer, Scott Cohen, Simon Brown	University of Wollongong
Textural characterisation of veins and altered rocks from Namosi, Fiji	Monash University	Laurent Ailleres, Angela Afonso Rodrigues	Monash University
The Change Your Life Training Program	Monash University	Juan Dominquez Duque, Guy Anthony Prochilo, Guy Prochilo, Halina Porecki, Juan Dominguez Duque (monash), Juan Dominquez Duque, Pascal Molenberghs	Monash University, University of Melbourne, Australian Catholic University
The comparative physiology of oxygen delivery to the kidney	Monash University	Jennifer Ngo, Zohaib Khan, Zohaib Khan	Monash University, University of South Australia
The dynamics of drug behaviour in the human body	Monash University	David Chalmers, Amali Galappaththi Guruge, Billy Williams-Noonan, Dallas Warren, Estelle Suys, Herodion Adiwignyo Hartono, Karen Corbett, Teng See, William Parsons	Monash University
The effect of antidepressants on the brains response to light	Monash University	Elise McGlashan, Govinda Poudel, Govinda Poudel, Madan K-C, Sharna Jamadar	Monash University, Australian Catholic University

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
The genetic basis of fitness variation in contemporary humans	Monash University	Filip Ruzicka	Monash University
The integration of perception and thought	Monash University	Jonathan Robinson	Monash University
The Internet as Quantitative Social Science Platform	Monash University	Simon Angus, Ashani Amarasinghe, Klaus Ackermann, Nandini Syanavalli Anantharama	Monash University
The mechanism of RNA helicases	University of Wollongong	James Bouwer, Celine Kelso, Emma Andrews, Gokhan Tolun, James Bouwer, Simon Brown	University of Wollongong, University of Waikato
The neural correlates of attention and prediction	ARC CoE for Integrative Brain Function	Matthew Tang	Australian National University
The Pysical Metallurgy of High Entropy Alloys	Characterisation Virtual Laboratory	Anna Vallarta Ceguerra, Mengwei He	University of Sydney
The repeatability of the genetic mechanisms underlying behavioral evolution	Monash University	Kathryn Hodgins, Chris Lee, Hanna Rosinger, Jonathan Wilson, Nissanka de Silva, Paul Battlay, Piyumi Wijepala	Monash University
The return of memory following traumatic brain injury: follow-up	Monash University	Matthew Mundy, Abbie Taing, Gershon Spitz	
The transcriptome 3'-end dynamics that specify cell identity	Monash University	Paul Harrison, David Powell, Nitika Kandhari, Sarah Williams	Monash University
This project is for analysing data generated by the ARA 9.4T Bruker MRI.	Monash University	David Wright, Akram Zamani, Raysha Farah	Monash University
Three-dimensional rail reconstruction for virtual inspection	Monash University	Hoam Chung	Monash University
Thrombus Reconstruction	Monash University	Isaac Pinar, Freya Rudawski, Mark Zander, Raimund Jung	Monash University
To investigate interaction between polymer fibres and cementitious materials using MD simulations	Monash University	Billy Chang, Afifa Tamanna, Sherry Zhang	Monash University
Towards Automatic Recognition of Dialogue Acts for Intelligent Tutoring Systems	Monash University	Guanliang Chen, Jionghao Lin, Lele Sha, Shaocong Liu	Monash University
Towards Data-Efficient Future Action Prediction in the Wild	Monash University	Xiaojun Chang, Changlin Li, Duy Dao, Fenglei Xu, Mengyuan Ma, Mingfei Han, Mingjie Li, Qi Hao, Qian Xu, Siyi Hu, Tianxin Hang, Yuetian Weng, Zhihui Li, Zutao Jiang	Monash University
Towards Energy-efficient Inference for Deep Neural Networks	Monash University	Bohan Zhuang, Zizheng Pan	Monash University
Tracking immune cell migration	Monash University	Max Cryle, Jennifer Payne, Juan Nunez-Iglesias, Thierry Izore, Volker Hilsenstein	Monash University

Project Title	Partner or Scheme	Project Members	Organisation(s)
Training Automatic Test Oracles to Identify Semantic Bugs	Monash University	Marcel Boehme, Charaka Kapugamawasangamagedon	Monash University
Uncovering dynamic biomarkers of brain health using accelerated computational neuroimaging approaches	National Merit Allocation	Karen Caeyenberghs, Alex Burmester, Alex Burmester, Chao Suo, Evelyn Deutscher, Govinda Poudel, Govinda Poudel, Hannah Richards, Honey Baseri, Jake Burnett, Juan Dominguez Duque, Juan Dominqucz Duque, Madan K-C, Nicholas Parsons, Suzan Maleki, Valentina Lorenzetti	Australian Catholic University, Deakin University
Understanding antigen processing	Monash University	Patricia Illing, Grace Khuu, Kerry Mullan	Monash University
Understanding antimicrobial root exudates in Australian native plant as a mechanism for the removal of bacterial pathogens in passive stormwater treatment systems	Monash University	Rebekah Henry, Penny Galbraith	Monash University
Understanding defects in additively manufactured metals	Monash University	Lee Djumas, James Bott, Taylah Banham	Monash University
Understanding the molecular mechanisms by which Helicobacter pylori causes disease	Monash University	Kirill Tsyganov, Rebecca Gorrell, Stella Loke	Monash University, Deakin University
University of Auckland GPU Evaluation	Monash University	Sina Masoud-Ansari	University of Auckland
UOW Imaging Core Analysis Pipelines	Characterisation Virtual Laboratory	Luke McAlary	University of Wollongong
Using ancient sedimentary DNA to understand water quality transitions	Monash University	Anna Lintern, Rebekah Henry, Robert Sargent, Tamara Lee de Losa, Timothy Jia-Young Lim	Monash University
Using computational biology to understand the mechanisms of allostery and biased agonism at adenosine receptors	Monash University	Lauren May, Anh Nguyen, Toan Nguyen	Monash University
Using deep learning for characterisation of the cellular environment within the gastrointestinal tract	Monash University	Daniel Poole, Pradeep Rajasekhar	Monash University
Vijay Biomedicine Discovery Institute projects	Monash University	Vijay Dhanasekaran, Almaz Bailey, Celeste Donato, Don Teng, Hannah Borle, Laura Perlaza-Jimenez, Miguel Grau Lopez, Yeshwanth Yeraddu	Monash University
Viral evolution in Wolbachia infected Mosquitoes	Monash University	Cam Simmons, Johanna Fraser, Kat Edenborough	Monash University
Virulence and resistance profiles of Aspergillus fumigatus in patients with chronic lung disease	Monash University	Orla Morrissey, Nick Wong, Tanveer Ahmed	Monash University
Where, when and how do giant planets form?	Monash University	Valentin Christiaens, Christophe Pinte, Iain McDougall Hammond, James Walter Robertson, Jennifer Robyn Baird, Kris Walker, Lewis Picker	Monash University

Projects

Project Title	Partner or Scheme	Project Members	Organisation(s)
Whisstock Lab	Monash University	Ruby Law, Brad Spicer, Charles Bayly-Jones, Chris Lupton, Christina Lucato, Hari Venugopal, Siew Pang	Monash University
Whisstock Lab MX Project	Monash University	Ruby Law, Adam Quek, Andrew Ellisdon, Brad Spicer, Chris Lupton, Christina Lucato, Daouda Traore, Guojie Wu, Laura D'Andrea, Paul Conroy, Siew Pang	Monash University
Whole-brain cellular-resolution connectomic analysis of the primate cortex	Monash University	Piotr Majka, Shi Bai, Sylwia Bednarek	Monash University, Nencki Institute of Experimental Biology
Whole genome sequencing of wolbachia pipientis	Monash University	Peter Kyrylos	Monash University
Wildlife Genomics	Monash University	Alexandra Pavlova, Diana Robledo Ruiz, Gabriel Low, Gan Han Ming	Monash University
Wireless health monitoring mine equipment using RFID and machine learning	Monash University	Nemai Karmakar, Omar Salim, Shuvashis Dey	Monash University
Wolbachia genome evolution	Monash University	Heather Flores, Jane Hawkey, Kimberley Dainty, Louise Judd	Monash University
X-ray CT image analysis pertaining to fluid flow in packed beds	Monash University	Saman Ilankoon Mudiyanselage, Kai Dean Kang, Weerahennedige Ashane Madusha Fernando, Yi An Lim	Monash University
X-ray CT imaging of analogue sulphide percolation experiments	Monash University	Anja Slim	Monash University
X-ray Lung PIV	Monash University	Kaye Morgan, Andrew Costopoulos, Freda Werdiger, Matthew George King, Melissa Helene Preissner, Thomas Aaron Leatham, Ying Ying How	Monash University
Zebra rock tomography data	Monash University	Anja Slim, Andrew Coward	Monash University

Financial Statement

			2019	2020
Brought Forward			**60,447**	**116,701**
Income				
	Monash	Operational	946,513	1,364,232
		Capital	2,240,886[1]	937[2]
	CSIRO			-
	ANSTO		75,000	75,000
	University of Wollongong		157,500	180,000
	Future investors / projects			30,000
	Other		4,464	
	Total		3,424,362	1,650,169
Expenses				
	Staffing (Operational and Capitalised)		906,344	988,848
	Operations and Outreach		73,456	17,475
	Consumables		114,759	293,980
	Capital		2,225,546	16,034
	Office, Workshops and Travel		48,004	35,024
	Total		**3,368,108**	**1,351,360**
Balance			**116,701**	**415,511**

1. — Includes corrections to 2020 Brought Forward made in 2020.
2. — Capital investment deferred to 2021 due to delays under COVID-19.

Note: Co-contributions to national national projects are not included in this finance report

Contributing Researchers

Numerical Frameworks to Analyse and Control Instabilities in Jet Flows

Pg 06

Prof Julio Soria
Mechanical Engineering, Monash University

Using cryo-electron microscopy to enable future drug discovery at G protein-coupled receptors (GPCRS

Pg 10

Dr Alisa Glukhova,
Laboratory Head, Walter and Eliza Hall Institute of Medical Research

Hierarchical Neural Architecture Search for Deep Stereo Matching

Pg 12
Pg 24

Dr. Mehrtash Harandi
Senior Lecturer, Department of Electrical and Computer Systems, Monash University

Pattern of electrons scattered by aluminium

Pg 16

AProf Philip Nakashima
ARC Future Fellow, ARC Future Fellow, Monash University

The Atomic Jigsaw

Pg 18

Prof Joanne Etheridge
Director, Monash Centre for Electron Microscopy, Monash University

New Instruments for Understanding Biology

Pg 20

Dr Senthil Arumugam
EMBL Australia Group Leader, Monash Biomedicine Discovery Institute

ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins

Pg 22

Prof Patrick Sexton
Centre Director, ARC Industrial Transformation Training Centre for Cryo-electron Microscopy of Membrane Proteins, Monash University

Deep Learning for Clinical Impact

Pg 26

Prof Meng Law
Head of Diagnostic and Interventional Radiology research, Alfred Health, Professor, Monash University

Dr Jarrel Seah
Radiology Registrar, Alfred Hospital

Dr Michelle Ananda-Rajah
Infectious Diseases and General Physician, Alfred Health

The Melbourne Experiment: How COVID-19 lockdown will reshape the city

Pg 28

Prof Geoff Webb
Research Director, Monash University Data Futures Institute

Prof Dickson Lukose
Monash Data Futures Institute

Prof Carl Grodach
Foundation Professor and Director of Urban Planning & Design at Monash University

Dr Alexa Gower
Postdoctoral Research Fellow, Monash University

3D printed ventilator parts that can save lives

Pg 30

Dr Daniel Duke
Senior Lecturer, Department of Mechanical & Aerospace Engineering, Monash University

BRA-STRAP: precision prevention to beat breast cancer before it appears.

Pg 34

Prof Melissa Southey
Chair of Precision Medicine, School of Clinical Sciences at Monash Health

Dr Tu Nguyen-Dumont
National Breast Cancer Foundation (Australia) Career Development Fellow, Monash University

Breathing Together

Pg 36

Prof Benjamin Marsland
Department of Immunology and Pathology, Monash University

A new weapon in radiation therapy

Pg 37

Dr Mitra Safavi-Naeini
Senior Physicist and Research Lead in Human Health, ANSTO

Finding the right key

Pg 40

Dr Scott Cohen
Senior Research Scientist, Children's Medical Research Institute

Understanding the nature of consciousness

Pg 42

Prof Nao Tsuchiya
Department of Physiology, Monash University

High Energy Physics

Pg 44

Prof Ulrik Egede
School of Physics and Astronomy, Monash University

Creating the next generation of lasers: The future is nano.

Pg 46

Prof Malin Premaratne
Vice President of the Academic Board, Monash University

Using genomics to control envasive weeds

Pg 48

Dr Kathryn Hodgins
Lecturer, Monash University

Modelling the biomechanical efficacy of fracture fixation techniques

Pg 57

Dr Olga Panagiotopoulou
Anatomy & Developmental Biology, Monash Universtiy

Tracheal branching in ants is area-decreasing, violating a central assumption of network transport models

Pg 61

Professor Steven Chown
Director, Securing Antarctica's Environmental Future, Monash University

Three-dimensional modeling of ironmaking blast furnace with layered cohesive zone

Pg 65

Prof Aibing Yu,
Vice Chancellor's Professorial Fellow and Pro Vice-Chancellor and President — Suzhou, Monash University

Dr Shibo Kuang,
Research Fellow, Chemical Engineering, Monash University

For many, the COVID-19 vaccine isn't coming soon enough

Pg 33

cryo-electron microscopy reconstructions of of the flagellotropic YSD1 bacteriophage

Pg 39

Record-breaking resolution microscopy shows a new possible target to fight flaviviruses

Pg 32, 39, 50

AProf Fasseli Coulibaly
Biochemistry & Molecular Biology, Monash University

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