Caenorhabditis elegans is a type of roundworm, and a model organism used in a wide variety of life science disciplines. Genome scale models seek to capture the metabolic processes of an organism, to serve as a knowledgebase and modelling resource. This is a visualization of the genome scale model of C. elegans, with orange points representing the compounds that can be found in the worms, and blue points representing the reactions that convert those compounds into each other. Points cluster together into cellular compartments such as the cytosol (central), mitochondria (top left) and extracellular space (right).

*Image credit:* Jake Hattwell, WormJam Consortium and Schirra Group.

The Centre for Advanced Imaging acknowledges funding support from:
## Contents

**Message from the Director** ................................................................................................................................................................. 5

**RESEARCH & DISCOVERY** ..........................................................................................................................................................

Barth Group – Ultra high field MR ........................................................................................................................................ 8
Bhalla Group – Radiochemistry ....................................................................................................................................... 10
Blakey Group ............................................................................................................................................................................. 11
Brereton Group – MR imaging methods ........................................................................................................................................ 12
Chuang Group ............................................................................................................................................................................. 14
Harmer Group – EPR Spectroscopy ....................................................................................................................................... 15
Mobi Group - Biomolecular NMR ........................................................................................................................................... 17
Reutens Group ............................................................................................................................................................................. 18
Schirra Group – NMR-based Metabolomics ........................................................................................................................... 19
Thurecht Group – Nanomedicine .......................................................................................................................................... 21
Wright Group ............................................................................................................................................................................. 23
Higher Degree by Research .........................................................................................................................................................
2018 Student Cohort .............................................................................................................................................................. 24
Higher Degree by Research Conferrals ...................................................................................................................................... 25
Honours Research Students .................................................................................................................................................... 26
UQ Winter and Summer Research Programs .................................................................................................................................... 26

**Awards and Prizes** ................................................................................................................................................................. 27

**Grants and Contracts** ............................................................................................................................................................ 29

**Publications** ............................................................................................................................................................................. 32

**EDUCATION AT CAI** ..............................................................................................................................................................

Post Graduate Coursework Programs ........................................................................................................................................ 42
Magnetic Resonance Technology ................................................................................................................................................... 42
Molecular Imaging Technology ..................................................................................................................................................... 42
Magnetic Resonance and Positron Emission Tomography ........................................................................................................ 42
Professional Development Short Courses ....................................................................................................................................... 43
International Student Recruitment .............................................................................................................................................. 43
Non-award Programs .................................................................................................................................................................. 43
Massive Online Open Course (MOOC) ......................................................................................................................................... 43

**FACILITIES** ......................................................................................................................................................................................

Core Facilities Report ................................................................................................................................................................. 46
Human and Companion Animal Imaging ...................................................................................................................................... 46
Preclinical Molecular Imaging .................................................................................................................................................... 46
Radiochemistry ............................................................................................................................................................................. 47
High Resolution NMR Spectroscopy .......................................................................................................................................... 47
Optical Imaging ............................................................................................................................................................................. 47

Financial Reports ........................................................................................................................................................................... 48
Core Operating Activities ............................................................................................................................................................ 48
Overall Activities ........................................................................................................................................................................... 48

**STRATEGIC PARTNERSHIPS & ENGAGEMENT** .......................................................................................................................... 51

National Imaging Facility ............................................................................................................................................................. 53
CIBIT .......................................................................................................................................................................................... 56

Annual Report 2018 3
Marketing and Engagement ............................................................................................................................. 60
Events .......................................................................................................................................................... 60
CAI Seminar Series ..................................................................................................................................... 64
Centre Tours and Key Visits ........................................................................................................................ 65
Social media ................................................................................................................................................ 65
Media ........................................................................................................................................................... 65
Research engagement summary ................................................................................................................ 69
Board and committee members .................................................................................................................. 73
Community and Outreach Activities ................................................................................................................. 76

STAFF & STUDENTS ...................................................................................................................................... 79
The Centre’s Core Members ............................................................................................................................ 80
Occupational Trainees ...................................................................................................................................... 82
Student Association (STAC) ............................................................................................................................. 83
Message from the Director

In 2018, the Centre consolidated its initiatives in Research, Teaching and Learning and Engagement. Highlights included the official opening of the Australian Research Council Training Centre for Innovation in Biomedical Imaging Technology at CAI. This will allow us to train the next generation of scientists who will expand the boundaries of biomedical imaging to improve healthcare. The centre’s industry driven research will work to overcome bottlenecks in the development and application of novel diagnostics, therapeutics and theranostics – which combine diagnostic and therapeutic capability – for important diseases like cancer. The centre will involve researchers from across UQ and nine industry partners. CAI’s experienced team of Facility Fellows continues to provide a high level of research service and our Master of Magnetic Resonance Technology and Master of Molecular Imaging courses saw a steady growth in enrolment in 2018. The year also saw a number of high-level engagement visits with potential partners in the Asia Pacific Region, Europe and the United Kingdom. This included participation in UQ’s new initiative to establish a joint research academy with IITD Delhi. Efforts continued as part of the National Imaging Facility to obtain state and institutional co-investment with Federal national infrastructure funding. UQ co-investment with funding from the Australian Cancer Research Foundation has also allowed us to progress plans to establish Australia’s first research facility for Dissolution Dynamic Nuclear Polarisation. In 2018, CAI’s reporting lines changed with the establishment of the Central Research Platforms at UQ and we welcomed Professor Joe Shapter, PVC (RI) as our seventh line manager. We also reported to the Academic Board Standing Committee on progress in implementation of our responses to the 2016 septennial centre review. Significant adjustments were also required to cope with the effects of UQ’s ESS initiative. I am grateful, both to the dedicated professional staff who left us as a result of ESS – thank you for your contribution to CAI – and to the remaining team for their immense efforts in softening the impact on researchers and students.

Professor David Reutens
RESEARCH & DISCOVERY
Barth Group – Ultra high field MR

Magnetic Resonance Imaging (MRI) is a versatile technique that can provide important insights into the body non-invasively and without dangerous side effects at a high spatial resolution. Prof Barth’s main interests are in the fields of MR method development for applications in neuroimaging, with a focus on functional MRI and neurological diseases such as dementia and cancer, as well as cardiac MR.

2018 Research achievement highlights

Assessment of microstructural signal compartments across the corpus callosum using multi-echo gradient recalled echo at 7 T

Mapping of tissue parameters like myelin and axonal water fraction can potentially lead to evaluating myelin loss in the brain’s white matter in neurodegenerative diseases, such as multiple sclerosis and schizophrenia, and provide additional information about axonal damage, e.g. after traumatic brain injury. Magnetic resonance imaging (MRI) is a key technology to study human brain tissue non-invasively. Ultra-high field (UHF) MRI, performed at field strengths of 7 Tesla and above, provides increased signal and enhances image contrast and sensitivity to tissue microstructure.

Well-established biophysical models allow researchers to estimate tissue parameters at the microscale in the hope to detect pathological changes early. In this study, we successfully extracted myelin properties by modelling the MRI signal from a special multiple echo gradient echo imaging experiment. By using several tissue compartments, we were able to relate millimetre scale measurements (corresponding to the imaging resolution used in our experiments) to changes in tissue microstructure. In a first clinical application, we have now shown that this model can help to distinguish healthy from dysplastic tissue in a specific form of epilepsy.

Cardiac Magnetic Resonance Imaging (MRI) at 7 Tesla

Cardiac MRI at an ultra-high field of 7 Tesla benefits from the signal-to-noise ratio advantage inherent at higher magnetic field strengths and potentially provides improved signal contrast and spatial resolution. While promising results have been achieved, ultra-high field cardiac MRI is challenging due to energy deposition constraints and physical phenomena such as transmission field non-uniformities and magnetic field inhomogeneities.

In addition, the magneto-hydrodynamic effect renders the synchronization of the data acquisition with the cardiac motion difficult. In a large collaborative effort with national (Richard Slaughter Centre of Excellence in CVMRI, The Prince Charles Hospital; Siemens Healthcare ANZ) and international industry collaboration (MRI.Tools, Berlin), we improved cardiac triggering and developed an MR protocol that allows high fidelity functional cardiac MRI at 7 Tesla. For this, we used tailored, multi-channel radio frequency coil technology together with improved inhomogeneity correction of the magnetic field (B0 shimming). We have shared our setup and protocol as a video on the Journal of Visualized
Experiments website to support the dissemination of this expertise. If all impediments can be overcome, ultra-high field CMR may generate new opportunities for functional CMR, myocardial tissue characterization, microstructure imaging or metabolic imaging.

2018 also saw the successful thesis completion of several PhD students, namely Saskia Bollmann, Aurelien Destruel (co-supervised with Prof Crozier (ITEE)), Surabhi Sood (co-supervised with Dr Vegh), and Marge Maallo (co-supervised with Prof Goodhill (QBI)).

We continued successful collaborations within UQ, as well as nationally and internationally. Highlights include the MGH in Boston (NIH-NHMRC BRAIN initiative grant) and Siemens Healthcare (in the ARC Industrial Transformation Training Centre for Innovation in Biomedical Imaging Technology).

Bhalla Group – Radiochemistry

Molecular imaging agents play an increasingly important role in modern healthcare - Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) are remarkably sensitive non-invasive imaging techniques which provide valuable information at the cellular level. These imaging agents (also known as radiopharmaceuticals) contain a radioisotope incorporated into drug molecules and are widely used for diagnosis in neurology, oncology and cardiovascular disease.

A/Prof Bhalla’s research focuses on the development of novel tracers (neurology, oncology, cardiovascular) and new labelling strategies (and chemistry) utilising a wide range of radioisotopes (including fluorine-18, carbon-11, scandium-47, gallium-67, gallium-68, copper-64, copper-67, zirconium-89 and technetium-99m), which support the synthesis of novel PET and SPECT diagnostic agents and radio-therapeutics.

His research group is currently developing new fluorine-18 and carbon-11 ligands for the aryl hydrocarbon receptor (gliomas) and tau (Alzheimer’s disease); and exploring several peptide based tracers for oncology using fluorine-18 and copper-64 for radio-diagnostics and copper-67 for radio-therapeutic. During 2018, his team have synthesised tryptophan tracers and developed a family lipophilic gallium-fluoride complexes for potential applications in brain imaging and began development of a novel biomarker for Alzheimer’s disease. They have expanded their activities and developed several Zr-89 tracers (antibodies and particles), both for academic and industry collaborators (Figure 1). More promisingly, they have developed a novel family of chelators for radio-copper isotopes (Cu-61, Cu-62 and Cu-64 for diagnostic and Cu-67 for therapeutic applications), and are currently in the stage of finalising data prior to patent filing.

Current collaborations exist with a number of industry partners and they continue work with academic groups from the Aarhus PET Centre and The University of Sydney (tracer development), the University of Southampton (labelling methodology) and Kings College London (evaluation of novel cardiovascular PET imaging agents).

A number of neurology imaging agents are now routinely available from his group for research including C-11 PiB, F-18 PBR-11 and F-18 DPA-714, and these tracers have supported projects at The University of Queensland. The development and production of literature based tracers are driven by demands of researchers and consequently tracers, such as F-FOPA and FBCTT, are planned and will be available for 2019.
Blakey Group

A/Prof Blakey’s research focuses on understanding how the structure of materials at different length scales relates to their properties. The application of this knowledge allows for the design and construction of new materials targeting properties which will improve performance for applications that include optical sensors, computer chip manufacture and nanomedicines.

2018 Research achievement highlights

In 2018, key progress has been made into developing optical sensors that can detect and quantify chemical species in complex environments, such as in vivo sensing and in situ measurement of chemical species in industrial processes. One target area has been detection of reactive oxygen species and gasotransmitters, which are implicated in participating in a number of diseases and as cell signalling agents. We have also developed nanostructured optical sensors for detection of sulphites in wine, as well as atmospheric pollutants such as sulphur dioxide and nitrogen oxides (NOx).

A second avenue of research has been the development of methods for controlling the nano-microstructure of surfaces, which has applications in the manufacture of computer chips, microelectromechanical (MEM) devices, as well as substrates for the adhesion and growth of cells. This has involved developing novel processing methods to generate instabilities in the surface chemistry to give rise to structured surface morphologies.

Group Leader

Associate Professor Idriss Blakey

Joint Appointment with Australian Institute for Bioengineering and Nanotechnology

Group Members

Dr Yun Huang

Students

Amir Beheshti
Lewis Chambers
Ao Chen
Paul Denman
Gerald Er
Zhen Jiang
Yusuke Sasaki
Sam Richardson
Yongmei Zhao

Schematic of nanostructured optical sensors
Brereton Group – MR imaging methods

Research Theme 2: Imaging, Diagnostic and Spectroscopic Technologies

The research activities in the Brereton group are linked by a common aim of developing methods for the improved understanding of the molecular basis of biological function and disease, and informing the development of new diagnostic imaging biomarkers, technologies and approaches to therapy.

2018 Research achievement highlights

**MR imaging and spectroscopy tools for the characterisation of metabolism in cancer and neurodegenerative disease**

- Characterisation of demyelination in multiple sclerosis by MR diffusion-based methods. Methods applied to mouse brain were translated to spinal cord. Project led by Nyoman Kurniawan, PhD. Student participants: Ahmad Alghamdi, Maree Smith and Nemat Khan (CIPDD). PhD thesis under review.

- Project applying diffusion-based MRI and in vivo MRS to spinal cord in Multiple Sclerosis. A new PhD project initiated by Abdullah Althobity, in collaboration with Nyoman Kurniawan, Nemat Khan and Trent Woodruff (SMBS).

**Multimodal MR/PET imaging methods and agents in cancer and neurodegenerative disease**

- Development of universal cancer theranostics targeting the tumour endothelial marker TEM8. Protective antigen, from B.anthracis is a natural ligand of TEM8 and, therefore, a potential candidate for detection and management of tumour vasculature, metastasis and growth. Project led by Yas Tesiram, Mehdi Mobli, James Wells (UQDI) and PhD student Theo Crawford. PhD thesis under correction.

- Simultaneous Dynamic MR/PET protocol development. A comprehensive analysis of simultaneous uptake kinetics for Gadolinium MRI contrast agent and 18F-FDG PET tracer enables the combination of anatomical and delivery information with metabolic activity, laying the foundation for future targeted diagnostic and therapeutic agent development. Project led by Gary Cowin (CAI).

- The collaboration with Clarity Pharmaceuticals funded by a CRC-P grant to develop protocols for novel, copper-based radiopharmaceuticals achieved good progress with the initiation of a clinical trial in paediatric cancer conducted at the Peter McCallum Institute. Project led by Matt Harris (Clarity).
NMR metabolomics: Characterisation of metabolic processes in biological systems

- A major program initiated in the use of NMR-based metabolomics as a diagnostic tool based on profiling biofluids and tissues in diseases such as prostate cancer, epilepsy, heart disease and diabetes, as well as characterisation of environmental impact on livestock production. The NMR-based Metabolomics Facility within CAI is led by Horst Schirra.

Treasured Assets - Characterisation of new species

- 3D Structural characterisation of Australian marsupials by CT imaging. Collaboration with Queensland Museum, Vera Weisbecker (SBS) and Paul Oliver (GU). CAI research led by Karine Mardon.

MR/PET image of a rat brain.
Image credit: Dr Gary Cowin
Chuang Group

A/Prof Chuang and his group focus on mapping and understanding the functional connectome of the brain. The brain connectome describes how neurons are wired and interact. It is a critical component for linking behaviour with cellular and molecular changes. It has also been recognized that many neurodegenerative and psychiatric disorders show deficits in brain connectome, suggesting that disconnection may underlie the disease progression and implicate this mechanism.

The Chuang group pioneers functional connectivity magnetic resonance imaging (also known as resting-state functional MRI) of the rodent brain. The technique allows mapping large-scale neural synchrony, which can be used to infer functional connectivity across the whole brain. Particularly, similar functional networks and network changes can be found in both rodent and human brains, making it a translational tool to understand neural mechanisms of behaviour and disorders (Chuang, NeuroImage 2017).

The group focuses on understanding how learning and memory shape functional connectivity and how interventions (drugs and brain stimulation) improve function by altering connectivity. To improve the temporal resolution of fMRI on preclinical scanners, the group developed a novel technique that can acquire multiple slices at the same time without the need of a receiver coil array (Lee, NeuroImage 2019). This new technique allows acquisition of the whole brain with a temporal resolution as fast as 150ms. The high temporal sampling not only depicts detailed hemodynamic changes but also enhances the detection sensitivity. They also developed and optimised data processing, identifying a better way to reduce the confound of non-neural signal variations (Chuang, NeuroImage 2019). They are now applying these new techniques for mapping functional connectivity in the mouse brain. The group are also exploring the use of MRI to detect the glymphatic system, a new drainage system that has been suggested to clear toxins such as amyloid plaques in Alzheimer’s disease, and its relevance to sleep apnoea (NHMRC funded 2019-2021).

Group Leader
Associate Professor
Kai-Hsiang Chuang
Joint Appointment with the Queensland Brain Institute

Group Members
Dr Hsu-Lei Lee

Students
Zengmin Li
Harmer Group – EPR Spectroscopy

Group Leader - Electron Paramagnetic Resonance (EPR) Spectroscopy and Imaging to study substances with paramagnetic centres

The EPR Spectroscopy and EPR Imaging group led by A/Prof Jeffrey Harmer, focuses on understanding substances or materials containing paramagnetic centres (radicals). Key areas include structural biology, characterisation of the electronic structure and reactivity of metal complexes and enzymes for catalysis, and the chemistry of reactive oxygen species (ROS) - for example, in the food industry.

The group’s research in structural biology makes extensive use of Double Electron Electron Resonance (DEER) spectroscopy, a technique involving spin labelling of biomolecules with paramagnetic spin probes, and measuring distances between the probes in the range of 15-100 Å. One of these projects studied zinc (Zn) acquisition by the solute binding protein, AdcA, from Streptococcus pneumonia, which enabled a trapdoor binding mechanism for Zn acquisition at the atomic level to be established. This is just one example of such transport proteins used by the organism under investigation. The research goal is to develop a detailed understanding of this pathway to enable a rational approach to drug development. S. pneumoniae (the pneumococcus) is the leading cause of bacterial pneumonia, which accounts for 15% of all childhood disease mortalities, and has a global economic health burden for treatment of more than A$5.5 billion (US$4 billion) annually. This work formed part of Alina Motygullina’s PhD thesis, which was accepted at the start of 2019 and for which our group extends our congratulations.

The EPR group also makes extensive use of Hyperfine Spectroscopy to determine the local structure around paramagnetic centres. Mostly recently we have been investigating cytochrome P450s, a family of enzymes that catalyse mono-oxygenation reactions. These enzymes are a target for fine chemical synthesis in biotechnology applications. Joshua Harbort’s PhD project aims to understand substrate binding to wild-type and engineered P450 (CYP199A4) at an atomic level, to aid in protein engineering. The figures (see overleaf) show a HYSCORE experiment exhibiting magnetic couplings between the active site Fe3+ paramagnetic centre with pyrrole nitrogens and a coordinated substrate.

EPR is the only technique that is able to directly measure radicals and thus, reactive oxygen species. The processes which create ROS and the subsequent chemical reactions play an important role in the food industry. The EPR facility recently teamed up with Associate Professor Sultanbawa (ARC Training Centre for Uniquely Australian Foods, Queensland Alliance for Agriculture and Food Innovation, UQ) to measure free radical concentrations and anti-oxidant capacity of a number of food industry products. We anticipate to exciting results to report in 2019 from this collaboration.

Group Leader
EPR Spectroscopy
Associate Professor
Jeffrey Harmer

Students
Joshua Harbort
Alina Motygullina
Shermiyah Reinecker
Figure (above) X-band HYSCORE spectra (top) showing that substrate coordinates to the active site paramagnetic Fe3+ ion of a cytochrome P450 enzyme (bottom), inhibiting the enzyme.
Mobli Group - Biomolecular NMR

Research in the Mobli group involves understanding the molecular basis of biology. The group uses a number biochemical and biophysical methods to study the structure and function of biomolecules. The research is focused on different types of peptides and proteins, which are the molecules responsible for the majority of cellular function and signalling. Our aim is to shed light on complex biological processes to both better understand dysfunction that leads to disease, and to explore how molecular interactions can be manipulated for the development of drugs, diagnostics or agricultural products.

2018 Research achievement highlights

In 2018, the group expanded with the addition of two new PhD students, Ms Sarah Kuschert and Mr Biswa Prasanna Mishra. The two candidates will strengthen the work in the group in understanding ion channel function and modulation by ligands with applications in development of novel analgesics (Mr Mishra's field of study), and in the development of novel methods for discovery of new ion channel ligands (Ms Kuschert's field of study). The addition of these bright young students demonstrates the direction of the group in ligand discovery and ion-channel research.

The group attended a number of meetings, with A/Prof Mobli awarded the reputable MERCK Research Medal Award from the Australian Society for Biochemistry and Molecular Biology at the 2018 ComBio (“combined biosciences”) conference held in Sydney. The Merck Research Medal is awarded to an outstanding Australian biochemist or molecular biologist. Research from the group was also presented at two major international conferences: The Experimental NMR Conference (ENC) in Florida, United States; and the International Council on Magnetic Resonance in Biological Systems (ICMRBS) conference held in Dublin, Ireland.

Publication highlights included a major review paper on the pharmacology of venom peptides that target voltage gated ion-channels, and a study that defines a new class of multidomain disulphide rich peptides – one that shows great promise as a novel molecular scaffold.

Additionally, the group received three major research grants – two from the National Health and Medical Research Council, and one from the Australian Research Council, due to commence in 2019. This will ensure our research projects remain on track for the next three years, and we are very excited to commence these new projects in 2019.
Research in the Reutens laboratory focuses on neurological disorders, particularly epilepsy, and the development of novel imaging methods to better understand, diagnose and manage them. In 2018, we progressed our work in ultra-low field MRI and PET imaging using quantum entanglement. Work on therapies to retard the development of epilepsy in an experimental model of epileptogenesis, and on predictive PET and MRI biomarkers, which received funding from the US Department of Defense, continues with promising early results.

Research areas in human epilepsy include ways of better imaging the epileptogenic zone and tissue affected by focal cortical dysplasia. These include studies utilising EEG-fMRI and novel ways of using MRI phase signal phase to understand tissue microstructure. We have also been able to repurpose the Laminar Cortex Model, originally developed to understand neural current MRI imaging, to model the generation of seizures and to predict novel therapeutic approaches.

**Localising the epileptic region using EEG-fMRI**

Simultaneous Electroencephalography (EEG) and functional MRI (fMRI) are used as a non-invasive technique for the localisation of the epileptic focus. Image shows a volumetric reconstruction of patient with a left parietal low-grade tumour (red cross) causing recurrent parietal lobe seizures. Voltage map EEG-fMRI of epileptic spikes with and without high-frequency oscillations (red and green volumes) are showed in red and green volumes adjacent to the tumour. Traditional spike-triggered EEG-fMRI is depicted in blue. Both voltage map and spike-triggered EEG-fMRI localised the epileptic regions in the lateral aspect of the left parietal lobe tumour. (Note the bumps on the scalp (brown) are the site of the electrodes used during the simultaneous EEG and fMRI study). Image credit: Javier Urriola Jaksic
Schirra Group – NMR-based Metabolomics

Dr Schirra’s group uses NMR-based metabolomics and systems biology methods to investigate the basic principles of metabolic regulation and the role they play in fundamental biological processes, environmental change, and in the development of disease. NMR-based metabolomics characterises how metabolites in an organism change in response to external and internal stimuli. Thus, it is an ideal platform technology for investigating the biological ramifications of environmental change, disease, and other fundamental physiological processes. Dr Schirra manages the UQ facility for NMR-based metabolomics at CAI (cai.centre.uq.edu.au/nmr-based-metabolomics), and leads a research program in metabolomics and megavariate science at the Centre.

2018 Research achievement highlights

In 2018, the Schirra group took over leadership responsibilities for WormJam, a global research consortium, which aims to construct and curate a high-quality consensus genome-scale metabolic model of the nematode, Caenorhabditis elegans, which can then be used in a variety of biomedical applications (Front. Mol. Biosci. 5:96). C. elegans is an important model organism in metabolomics, biomedical research, developmental biology, genetics, and other life science disciplines. With the increasing recognition of metabolism as being of pivotal importance in the study of topics such as ageing, development, and disease mechanisms; the ability to model the metabolism of C. elegans for a computer platform has become increasingly important for the characterisation of this key biomedical model organism and its physiological processes.

The Schirra group also has a large focus on environmental metabolomics. A collaboration highlight of 2018 was with CSIRO and an industrial partner from Europe. During this, Dr Schirra characterised methods that ameliorate greenhouse methane gas emission from cattle, which led to two provisional patent applications with the European patent office and a ground-breaking publication in the area (PMID 30131771). Additionally, the groups worked to characterise the metabolism of Aedes aegypti mosquitoes, which are the primary transmission vector for Dengue fever and other tropical diseases. The groups intend to use the results to develop ways to reduce transmission of these diseases.

A new area for Dr Schirra’s group is food metabolomics. A collaboration with the Australian Wine Research Institute saw the metabolomic analysis of several wine varieties. In addition, Dr Schirra is working in cooperation with researchers from the Cooperative Research Centre (CRC) for Honeybee Products and industry stakeholders in formulating a national response to the recent issue of adulterated honey entering Australia’s food supply chain. This project involves developing a national database of authentic honey products.
Top: WormJam Genome Scale Model of C. elegans - a schematic representation of the metabolic network of C. elegans.

Caenorhabditis elegans is a type of roundworm, and a model organism used in a wide variety of life science disciplines. Genome scale models seek to capture the metabolic processes of an organism, to serve as a knowledgebase and modelling resource. This is a visualization of the genome scale model of C. elegans, with orange points representing the compounds that can be found in the worms, and blue points representing the reactions that convert those compounds into each other. Points cluster together into cellular compartments such as the cytosol (central), mitochondria (top left) and extracellular space (top left).

Left: NMR samples prepared for the analysis of wine.
Thurecht Group – Nanomedicine

Associate Professor Thurecht’s research group focuses on the development of polymer and nanoparticle-based devices for nanomedicine. The group works across the boundaries of chemistry and materials science, biology and imaging science to probe how nanomaterial properties affect their function in living animals.

Probing the interface between nanomaterials and biological systems offers unique insight into how two disparate environments interact and respond to exogenous stimuli. Our group has been particularly interested in developing new systems and techniques to better understand the fundamental mechanisms that drive nanomedicine efficacy. This ultimately guides our approach to translatable therapies. Over the last year, we have been particularly interested in a number of important challenges in the field:

• We continue to explore what properties of nanomedicines affect their biodistribution, distribution across tumour tissue, as well as their trafficking within cells.

• We are interested in developing ideas around how to better design, develop and characterise nanomaterials for use in biological systems.

• Our approach has shifted to translation of nanomedicines into companion animals, with the intent to inform future human trials of targeted therapeutics.

One of the key factors that drives enhanced accumulation of polymeric nanoparticles in tumour tissue is their prolonged circulation time in blood. While it is well-recognised that longer circulating particles provide greater opportunity for the therapeutic cargo to extravasate into tumour tissue, it also has the effect of prolonging contact and exposure to blood components leading to immunological effects. It is well established that within seconds of entering the blood stream, nanomaterials are bombarded with an array of compounds endogenous to plasma. Many of these plasma constituents then non-covalently bind to the surface of the polymers to form the protein corona. This subsequently affects the way they behave on a macro and micro level in animals. Associate Professor Thurecht and collaborators from Melbourne University (Professor Stephen Kent) have investigated how the surface chemistry of polymeric nanomedicines affects their biological identity upon injection in mice (ACS Applied Bio Materials 1(3), 756). In collaboration with colleagues at Murdoch University (Associate Professor Rakesh Veedu), this was further evaluated in terms of developing new approaches to increase accumulate nanomedicines in tumours using oligonucleotide aptamers as targeting ligands and measured by PET-CT (Chemical Communications, 54(82), 11538).

The establishment of the comparative oncology program at CAI has offered a unique testbed for the nanomedicines developed in the Thurecht group. Building on successful treatment of breast cancer in mice using targeted nanomedicines (Nanotheranostics, 2(4), 360), the team has undertaken a world first study to first image prostate cancer in a canine patient using nanomedicines, and then treat the disease using targeted therapeutics. This study is ongoing, but through strong
collaboration with Dr Rod Straw (Brisbane Veterinarian Specialist Centre), we aim to use this veterinary trial to expedite clinical translation of the nanomedicines.

The group also worked closely with collaborators within the Australian Research Council (ARC) Centre of Excellence in Convergent BioNano Science and Technology to encourage rigorous reporting in bionano science. This was underpinned by a publication in Nature Nanotechnology (Nature Nanotech. 13(9), 777) which discussed framework and policy for reporting standards for researchers in the field developed by the group.

3D-rendering of a migrating glioblastoma cell labelled with calcein after nanocarrier-induced endosomal escape. Image credit: Joshua Simpson
Wright Group

The research of Associate Professor Margie Wright and her group encompasses the neurobiological causes and modifiers of brain function. Brain imaging, neuropsychological, behavioural, and molecular genetic approaches are used; and a vast dataset of imaging, clinical, and genetic information has been collected from people at different ages. The group investigates genetic and environmental factors that lead to differences between individuals in brain structure, brain wiring and connectivity. Key aims are to understand normal variation in the healthy brain to provide insights into deviations from normal development and ageing, and to increase understanding of biological processes core to illness risk for psychiatric and age-related brain disorders.

Highlights in 2018 include the first evidence that, even in healthy people, variation in brain structure is associated with taste perception. The most robust association, found in two independent samples, showed that individuals with larger entorhinal volumes rated quinine bitterness as less intense. The year also saw the fruition of a number of collaborative projects with large consortia, which allow important questions to be addressed in large samples. Work with the Enhancing NeuroImaging Genetics through Meta-Analysis (ENIGMA) Consortium identified cortical brain asymmetries in 17,141 healthy individuals, while a study of substance dependence in 3,240 individuals showed that a common neural substrate underlies dependence on a range of different substances (see figure). Work undertaken with the Cohorts for Heart and Aging Research in Genomic Epidemiology (CHARGE) Consortium in 23,533 individuals identified novel genetic variants influencing ventricular volume, for which abnormal enlargement is a key feature of several neurological and psychiatric diseases.

During 2018, the Wright group continued to collect data for a longitudinal neurodevelopmental study tracking normative brain changes during adolescence. Twins aged nine to 13 years visit CAI for a brain scan and assessment of cognitive and emotional well-being. Currently, over 170 families have participated.
Higher Degree by Research

2018 Student Cohort

The following HDR students were principally or co-supervised by CAI Staff in 2018 (by enrolling unit)

**Australian Institute for Bioengineering and Nanotechnology**
- Hissein Adelnia
- Salma Ahmed
- Dewan Akhter
- Arupandian Balaji
- Lewis Chambers
- Elizabeth De Lisle
- Paul Denman
- Arukattu Ediriweera
- Anna Gemmell
- Arghavan Golbaz Hagh
- Amal J Sivaram
- Joshua Markus
- Mark Mathew
- Samuel Richardson
- Joshua Simpson
- Vanessa Soh
- Nicholas Westra van Holthe
- Yongmei Zhao

**Faculty of Medicine**
- Daniel Bobo
- Sharon Del Vecchio
- Dominique Scott
- Shi Yi Goo
- Hayley McDonald
- Kowsalya Murugappan
- Brenda Tai

**Queensland Brain Institute**
- Shahrokh Abbasi-rad
- Shaezez Abdulla
- Shahrokh Akbari
- Mufarreah Alazmi
- Abdullah Althobity
- Hamzeh Al Masri
- Abdullah Asiri
- Saskia Bollmann
- Gregory Brown
- Pietro Caradonna
- Theo Crawford
- Jai Croucher
- Samuel Fynes-Clinton
- Joshua Harbort
- Jake Hattwell
- Philip Janowicz
- Zahid Kausar
- Sarah Kuschert
- Sue Lawrence
- Zengmin Li
- Anne Maallo
- Michael Maxwell
- Tomas Miljenovic
- Biswa Mishra
- Shahrzad Moeiniyan Bagheri
- Alina Motygullina
- Victoria O’Callaghan
- Ruben Pellicer Guridi
- Zheng Qiao
- Vanessa Schendel
- Gagan Sharma
- Thomas Shaw
- Li Sheng
- Surabhi Sood
- Ashley Stewart
- Jiasheng Su
- Sultan Taha
- Kiran Thapaliya
- Xuan Vin To
- Javier Urriola Yaksic
- Alan Zhang

**School of Biological Sciences**
- Saad Alzahrani

**School of Chemical Engineering**
- Amir Beheshti

**School of Chemistry and Molecular Bioscience**
- Md Habibur Rahaman

**School of Health & Rehabilitation Sciences**
- Bhavya Adlja
- Akma Viviana Silva Guerrero
- Alan Wan
- Marie-Pier Mc Sween
- Georgia Thomas

**School of Information Tech & Electrical Engineering**
- Aurelien Andre Vincent
- Destruel

**School of Psychology**
- Liza van Eijk
<table>
<thead>
<tr>
<th>Name</th>
<th>Thesis Topic</th>
<th>Program</th>
<th>Principle Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdullah Ali M. ASIRI</td>
<td>Anatomical study of the human cervical spinal cord and pathology assessment of spinal cord injury in animal models using Magnetic Resonance Imaging</td>
<td>PhD</td>
<td>Dr Nyoman Kurniawan</td>
</tr>
<tr>
<td>Dewan Taslima AKHTER</td>
<td>Development of novel polymeric theranostic for the treatment of colorectal cancer</td>
<td>PhD</td>
<td>Associate Professor Kristofer Thurecht</td>
</tr>
<tr>
<td>Saskia BOLLMANN</td>
<td>Evaluating acquisition techniques for functional Magnetic Resonance Imaging at ultra-high field</td>
<td>PhD</td>
<td>Professor Markus Barth</td>
</tr>
<tr>
<td>Daniel HWANG</td>
<td>Individual differences in taste and their association with genes, dietary behaviour, and brain structure</td>
<td>PhD</td>
<td>Associate Professor Margaret Wright</td>
</tr>
<tr>
<td>Shrinath KADAMANGUDI</td>
<td>Exploring the utility of GRE-MRI signal compartments for temporal susceptibility mapping and investigation of neural microstructure</td>
<td>MPhil</td>
<td>Dr Viktor Vegh</td>
</tr>
<tr>
<td>Anne MAALLO</td>
<td>Neural correlates of visual function in agenesis of the corpus callosum</td>
<td>PhD</td>
<td>Professor Markus Barth</td>
</tr>
<tr>
<td>Thu Van NGUYEN</td>
<td>Neurological study of a mouse model of Fetal Alcohol Spectrum Disorders using advanced imaging techniques</td>
<td>PhD</td>
<td>Dr Nyoman Kurniawan</td>
</tr>
<tr>
<td>Ruben PELLICER GURIDI</td>
<td>Towards a low-cost and portable ultralow field magnetic resonance system based on permanent magnets and room temperature detectors</td>
<td>PhD</td>
<td>Dr Viktor Vegh</td>
</tr>
<tr>
<td>Venkatraman RAMANUJAM</td>
<td>In vivo protein splicing of secreted cysteine-rich repeat proteins and their structural characterization by NMR spectroscopy</td>
<td>PhD</td>
<td>Associate Professor Mehdi Mobli</td>
</tr>
<tr>
<td>Lachlan STRIKE</td>
<td>Examining the impact of genetic variation on the structure and function of the human brain</td>
<td>PhD</td>
<td>Associate Professor Margaret Wright</td>
</tr>
<tr>
<td>Yongmei ZHAO</td>
<td>Investigation of polymeric drug delivery systems to improve therapeutic efficiency for breast cancer</td>
<td>PhD</td>
<td>Associate Professor Kristofer Thurecht</td>
</tr>
</tbody>
</table>
Honours Research Students

<table>
<thead>
<tr>
<th>Name</th>
<th>Thesis Topic</th>
<th>Principle Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandra GLORIA</td>
<td>Characterisation of acute heat stress in cattle using metabolomics and systems biology</td>
<td>Dr Horst Schirra</td>
</tr>
<tr>
<td>Shauna HERBST</td>
<td>An approach to a NIR activated imaging probe for enhanced spatial and temporal resolution</td>
<td>Associate Professor Kristofer Thurecht and Dr Craig Bell</td>
</tr>
<tr>
<td>James HUMPHRIES</td>
<td>Synthesis of oxazoline derived polymers and evaluation of their bioactivity</td>
<td>Associate Professor Kristofer Thurecht, Dr Nick Fletcher, Dr Craig Bell, and Dr Kristian Kempe (external)</td>
</tr>
<tr>
<td>Luke HUSDELL</td>
<td>Development and improvement of analysis methods in NMR-based metabolomics and their application to the characterisation of the blood-feeding cycle of <em>Aedes aegypti</em></td>
<td>Dr Horst Schirra</td>
</tr>
<tr>
<td>Catherine JOE</td>
<td>Mapping of focal cortical dysplasia in focal epilepsy</td>
<td>Dr Viktor Vegh</td>
</tr>
<tr>
<td>Sarah KUSCHERT</td>
<td>NMR studies of the protein hydration shell</td>
<td>Associate Professor Mehdi Mobli</td>
</tr>
<tr>
<td>Zheyi WEN</td>
<td>MRI for early diagnosis of invasive glioma</td>
<td>Dr Viktor Vegh</td>
</tr>
</tbody>
</table>

UQ Winter and Summer Research Programs

UQ’s Summer and Winter research scholarship program, coordinated through the UQ Student Employability Centre, continued to be popular with students in 2018. The research projects offered through the program highlighted the range of cutting edge research performed at the Centre, which included designing cancer therapeutics using nanoparticles, investigating enzymes with spectrometry imaging and imaging chemical exchange processes using magnetic resonance.

2018 Summer Research Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Supervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-vivo trafficking APEX with bispecific antibody-nanomaterial construct</td>
<td>Dr Nick Fletcher and Associate Professor Kristofer Thurecht</td>
</tr>
<tr>
<td>Mapping enzyme activity on tissue by functional mass spectrometry imaging</td>
<td>Dr Eivind Undheim</td>
</tr>
<tr>
<td>Polymers in nanomedicine: Development of polymeric theranostics</td>
<td>Associate Professor Kristofer Thurecht</td>
</tr>
</tbody>
</table>
### 2018 Winter Research Projects

<table>
<thead>
<tr>
<th>Title</th>
<th>Supervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cytochrome P450 – understanding drug, substrate and inhibitor</td>
<td>Associate Professor Jeffrey Harmer</td>
</tr>
<tr>
<td>interactions using Electron Paramagnetic Resonance</td>
<td></td>
</tr>
<tr>
<td>Developing mathematical techniques for structural biology using DEER</td>
<td>Associate Professor Jeffrey Harmer</td>
</tr>
<tr>
<td>spectroscopy</td>
<td></td>
</tr>
<tr>
<td>Develop simultaneous fMRI and calcium recording system for the rodent</td>
<td>Associate Professor Kai-Hsiang Chuang</td>
</tr>
<tr>
<td>brain</td>
<td></td>
</tr>
<tr>
<td>Imaging chemical exchange processes by magnetic resonance techniques</td>
<td>Dr Yas Tesiram</td>
</tr>
</tbody>
</table>

### Awards and Prizes

<table>
<thead>
<tr>
<th>Name of Recipient</th>
<th>Name of Award</th>
<th>Awarding entity/organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aiman AL-NAJJAR</td>
<td>Star Service Award</td>
<td>Inaugural Research and Innovation Expertise Portfolio Awards, The University of Queensland</td>
</tr>
<tr>
<td>Markus BARTH</td>
<td>2018 ISMRM Outstanding Teacher Award</td>
<td>International Society for Magnetic Resonance in Medicine (ISMRM)</td>
</tr>
<tr>
<td>Saskia BOLLMANN</td>
<td>ISMRM 2018 Educational Stipend</td>
<td>International Society for Magnetic Resonance in Medicine (ISMRM)</td>
</tr>
<tr>
<td>Dr Nick FLETCHER</td>
<td>2018 Centre for Advanced Imaging Travel Award to attend 20th International Conference on Nanotechnology and Nanomedicine, Prague.</td>
<td>Centre for Advanced Imaging, The University of Queensland</td>
</tr>
<tr>
<td>Dr Nick FLETCHER</td>
<td>2018 Contributing to Australian Scholarship and Science Travel Award to attend 20th International Conference on Nanotechnology and Nanomedicine, Prague</td>
<td>The CASS Foundation</td>
</tr>
<tr>
<td>Dr Nick FLETCHER</td>
<td>2018 Award for best presentation for “Noncovalent antibody-nanomaterial conjugates: a simple approach to produce targeted nanomedicines”</td>
<td>20th International Conference on Nanotechnology and Nanomedicine 2018</td>
</tr>
<tr>
<td>Lesley GREEN</td>
<td>Key Contributor Award</td>
<td>Inaugural Research and Innovation Expertise Portfolio Awards, The University of Queensland</td>
</tr>
<tr>
<td>Name</td>
<td>Achievement</td>
<td>Location/Event</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Jake HATTWELL</td>
<td>Best student presentation for &quot;WormJam – an international open research community for C elegans systems biology and metabolic modelling&quot;</td>
<td>11th Annual MetaboMeeting, Nottingham, United Kingdom</td>
</tr>
</tbody>
</table>
| Associate Professor Mehdi MOBLI | 2018 Merck Research Medal  
The Merck Research Medal is awarded to an outstanding ASBMB member with no more than 15 years since the award of the PhD degree (or equivalent taking any career disruption into account) at the nominated deadline | Australian Society for Biochemistry and Molecular Biology (ASBMB)                  |
| Amal J SIVARAM         | UQ Centre for Advanced Imaging  
3-minute Thesis (3MT)                                                              | Centre for Advanced Imaging, The University of Queensland                          |
| Kiran THAPALIYA       | ISMRM 2018 Educational Stipend                                                | International Society for Magnetic Resonance in Medicine (ISMRM)                  |
Grants and Contracts

Patents

<table>
<thead>
<tr>
<th>Year</th>
<th>Application Details</th>
<th>Organisations</th>
<th>Names of recipients and organisations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>The use of a methane reducing agent such as propanediol mononitrate for the treatment of stress, the reduction of oxidative stress, the improvement of the immune system, the provision of healthy cartilage, as well as the alleviation of pain in ruminants. European Patent Office provisional patent application.</td>
<td>CSIRO, DSM Nutritional Products and The University of Queensland</td>
<td>Gonzalo Martinez-Fernandez (Commonwealth Science and Industry Research Organisation (CSIRO)), Stephane Duval (DSM Nutritional Products, France, Switzerland (DSM)), Maik Kindermann (DSM), Horst Joachim Schirra (The University of Queensland), Stuart E. Denman (CSIRO), Christopher S. McSweeney (CSIRO).</td>
</tr>
</tbody>
</table>

Research Grants

<table>
<thead>
<tr>
<th>First Year</th>
<th>Funding Years</th>
<th>Start – End Dates</th>
<th>UQ Admin Unit</th>
<th>Grant Title</th>
<th>Grant Scheme</th>
<th>RM Number</th>
<th>Total Amount Approved</th>
<th>Names of Recipients or Chief Investigators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>2018 – 2021</td>
<td>01/01/2019 – 20/12/2022</td>
<td>PVC (Research Infrastructure)</td>
<td>Next generation imaging to bridge the knowledge gap in nanomedicine delivery</td>
<td>NHMRC Career Development Fellowship</td>
<td>2017000743</td>
<td>$476,728</td>
<td>*THURECHT, Kristofer J</td>
</tr>
</tbody>
</table>

Annual Report 2018 29
<table>
<thead>
<tr>
<th>Year</th>
<th>Start - End</th>
<th>PVC (Research Infrastructure)</th>
<th>Project Description</th>
<th>Grantor</th>
<th>Grant Number</th>
<th>Amount</th>
<th>Principal Investigators</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>01/01/2018 - 31/12/2020</td>
<td>PVC (Research Infrastructure)</td>
<td>Novel insights into the molecular mechanisms of manganese recognition and acquisition by pathogenic bacteria (NHMRC Project Grant led by The University of Adelaide)</td>
<td>University of Adelaide</td>
<td>2018000077</td>
<td>$60,634</td>
<td>*HARMER, Jeffrey R, CORDES, Thorben, IWATA, So, MAHER, Megan, MCDEVITT, Christopher, O'MARA, Megan</td>
</tr>
<tr>
<td>2018</td>
<td>01/01/2018 - 02/02/2020</td>
<td>PVC (Research Infrastructure)</td>
<td>Social cognition in patients with epilepsy</td>
<td>UQ Development Fellowships</td>
<td>2016003454</td>
<td>$60,012</td>
<td>*REUTENS, David C, *ZIAEI, Maryam</td>
</tr>
<tr>
<td>2018</td>
<td>01/04/2018 - 21/03/2019</td>
<td>PVC (Research Infrastructure)</td>
<td>IterdAptamer targeted therapies for triple-negative breast cancer (Cancer Australia administered project funded by Cure Cancer Australia)</td>
<td>Cure Cancer Australia Foundation</td>
<td>2017001881</td>
<td>$97,766</td>
<td>*FLETCHER, Nicholas L</td>
</tr>
<tr>
<td>Year</td>
<td>1/01/2018 – 31/12/2018</td>
<td>PVC (Research Infrastructure)</td>
<td>Project Description</td>
<td>Recipient</td>
<td>Grant Number</td>
<td>Amount</td>
<td>Principal Investigators</td>
</tr>
<tr>
<td>------</td>
<td>------------------------</td>
<td>--------------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>--------------</td>
<td>--------</td>
<td>------------------------</td>
</tr>
<tr>
<td>2018</td>
<td>01/01/2018 – 31/12/2018</td>
<td>From bench to bedside: shortening the pipeline of new treatments for glioma by building a robust treatment monitoring protocol from mice to dogs</td>
<td>UQ Early Career Researcher</td>
<td>2017003106</td>
<td>$17,000</td>
<td>*HOUSTON, Zachary</td>
<td></td>
</tr>
</tbody>
</table>
Publications

Book Chapter


Journal Article


2D Nyquist ghost correction. Magnetic Resonance in Medicine, 81(3): 1924-1934.


AMP restores osmoreistance in a high cyclic-di-AMP Lactococcus lactis mutant. PLOS Genetics, 14 (8).


Critical Review


Conference Paper


Abstract

Oral Presentation and/or Poster


**S. Bollmann**, D. Staeb, M. Barth. BOLD fMRI with 0.5 mm isotropic voxel size and minimal in-plane distortion using 3D planes-on-a-paddlewheel (POP) EPI at 7 Tesla. Proc. Joint Annual Meeting ISMRM-ESMRMB, Paris, 16-21 June 2018.


Other


**Data collection**: Eivind Undheim (2018) Supplementary Data to "A centipede toxin family defines an ancient class of CSαβ defensins"


See also: Research engagement summary
EDUCATION AT CAI
CAI continues to offer a range of educational opportunities with both formal degrees and professional development courses. These courses benefit from the use of the state of the art facilities at CAI and the expertise of the Centre’s researchers teaching into the programs.

**Post Graduate Coursework Programs**

**Magnetic Resonance Technology**

Now in its 18th year, the Graduate Certificate, Graduate Diploma and Master of MRT continues to attract interest from students with a range of backgrounds. While radiographers and medical imaging professionals contribute to the bulk of enrolments, the program is also of interest in fields such as biomedical engineering, pharmacy, psychology and medical physics.

The Magnetic Resonance Technology Program has seen a few changes this year, with flagship courses MRES7001 and MRES7004 being replaced by updated courses MRES7100 and MRES7400. Following the departure of Associate Professor Katie McMahon, Associate Professor Markus Barth was appointed as the new course coordinator for MRES7005. In 2018, PhD Candidate, Shahrokh Abassi-Rad contributed to teaching in these courses, and Dr Ruben Pellicer was the lead tutor of MRES7002 during semester 2, 2018.

The cohort continues to consist of mainly external students. This is likely due to the flexibility of our programs, with a fully external online study mode available. The internal student cohort is largely comprised of international students. In 2018, we welcomed students from new countries including Malawi, Ghana and Papua New Guinea, further diversifying our multicultural CAI community.

**Molecular Imaging Technology**

The Master of Molecular Imaging (MMI) was historically offered in partnership with University of Sydney. In 2017, the decision was taken to discontinue the degree, and 2018 saw the introduction of the Master of Molecular Imaging Technology, offered solely by The University of Queensland.

In 2018, the Master of Molecular Imaging Technology (MMIT) program celebrated its first year run exclusively by The University of Queensland. Dr Karine Mardon, has extended her contributions within CAI as a Molecular Imaging Facility Manager and NIF Facility Fellow, to include Program Coordination for this offering. With support from Joshua Simpson, Dr Nick Fletcher, Dr Jennifer Lu, Darren Korbie and Chira Palmeri, Dr Mardon redesigned the course, MOLI7110 Pathological Correlates of Molecular Imaging. The course has received very positive feedback from students after the implementation of these changes. Dr Zachary H. Houston and Associate Professor Rajiv Bhalla, in collaboration with Associate Professor Kris Thurecht also made important contributions to MOLI7101 Targets and Imaging Probes and MOLI7104 Cell Labelling and Tracking.

MOLI7109 Radiotracer Based Imaging was re-structured with new and updated content developed by Dr Viktor Vegh, in his role as course coordinator.

Other teaching contributions in the MMIT program include Associate Professor Kris Thurecht (MOLI7101 & MOLI7104) and Dr Viktor Vegh (MOLI7103 & MOLI7109), Dr. Gary Cowin (MOLI7107 and MRES7009) and Mr Matt Meredith (MOLI7108).

**Magnetic Resonance and Positron Emission Tomography**

Semester 2, 2018 saw the graduation our first class of the new Graduate Certificate in Magnetic Resonance and Positron Emission Tomography (GCMRPET) program, established in 2017. The program was developed at the suggestion of industry stakeholders, reflecting the diverse range of skills required with the emergence of hybrid imaging technology. The program is designed for professionals who require an in-depth knowledge of the theoretical fundamentals and operational considerations of hybrid MR-PET scanners. Enrolment in the Grad Cert in MR-PET continues to attract students who are seeking to learn more about innovative imaging technologies.

An exciting feature of this program is a one week on-campus component where students have the opportunity to experience ‘hands-on’ scanning at CAI and visit a number of clinical sites where imaging technology is used in day-to-day practice. During the program, students are exposed to a wide variety of imaging technologies including MRI, MR-PET and PET-CT and experience first-hand how these technologies are used in a clinical setting.
Professional Development Short Courses

During 2018, CAI professional development short courses were held at the centre, including Introduction to MR Physics and Functional MRI (fMRI). The two-day MR Physics course was proved popular, having an attendance of 21 people.

The fMRI short course was organised by Dr Maryam Ziaei and Mrs Saskia Bollmann with the support and participation of Associate Professor Markus Barth and Dr Steffen Bollmann. The course was delivered over a three-day period and saw good attendance with 17 professionals from diverse backgrounds. The majority of attendees were professionals from the medical imaging sector.

The short courses currently offered by the centre include:

- Introduction to MRI
- Introduction to Diffusion
- Cardiac MRI
- Introduction to MR Physics
- Functional MRI (fMRI)
- Introduction to Spectroscopy

International Student Recruitment

International student enrolment remains strong, with the Master of Magnetic Resonance Technology (MMRT) and Master of Molecular Imaging Technology (MMIT) being the most in demand programs. International student admittance shows a steady increase within these programs, with MMIT in particular attracting students from Saudi Arabia.

The Centre is well known for its multicultural educational and research environment, which continues to grow each year. 2018 saw international students join us from China, Ghana, India, Jordan, Myanmar, Papua New Guinea, Oman, Saudi Arabia and Singapore.

<table>
<thead>
<tr>
<th>Percentage of International student admittance by course</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Semester 1, 2018</strong></td>
<td></td>
</tr>
<tr>
<td>Grad Dip - Magnetic Resonance Technology</td>
<td>5.26</td>
</tr>
<tr>
<td>Master's - Magnetic Resonance Technology</td>
<td>25.00</td>
</tr>
<tr>
<td>Master's - Molecular Imaging Technology</td>
<td>50.00</td>
</tr>
<tr>
<td><strong>Semester 2, 2018</strong></td>
<td></td>
</tr>
<tr>
<td>Master's - Magnetic Resonance Technology</td>
<td>30.77</td>
</tr>
</tbody>
</table>

Non-award Programs

Massive Online Open Course (MOOC)

The sixth offering of the free, online Biomedical Imaging MOOC offered through UQx was delivered in 2018. This is a self-paced course, aimed at high school graduates and above, and covers the fundamentals and clinical applications of x-ray, computed tomography (CT), ultrasound (US), magnetic resonance imaging (MRI) and nuclear medicine.
FACILITIES
Core Facilities Report
CAI manages a comprehensive array of world-class imaging and spectroscopy instruments that are utilised by the UQ scientific community as well as external and commercial partners. The centre’s facility managers all possess significant expertise and experience in their respective field, enabling users to push the boundaries of science. This year the centre continued to further develop collaborations with industry, including new and repeat clients in the Australian Biotechnology sector.

Our Facilities include:

- Animal Imaging
- Cyclotron and Radiochemistry
- Engineering development laboratory
- EPR Spectroscopy and Imaging
- High Resolution NMR Spectroscopy
- Human Imaging
- Molecular Imaging
- MR Micro Imaging
- NMR based Metabolomics
- Solid State NMR

Human and Companion Animal Imaging

7T MRI
Over the last 12 months, usage of the 7T MRI scanner has continued to increase, including a significant increase of external usage (particularly by Australian Universities i.e. UNSW and University of Wollongong).

Collaborative relationships continue to expand and strengthen both internally and externally. In 2018, significant development headway was made on Parallel Transmit technology throughout sequence and coil development, supported by collaborations with Siemens and UQ research units.

Large bore PET CT
The facility is actively used for specimen, sample and animal imaging. A number of key research projects (molecular and structural) commenced in 2018, including the world’s first targeted therapy nanomedicine research project. The centre also performed Australia’s first 18F-FDOPA PET-CT scan of a companion animal, as part of CAI’s Comparative Oncology program.

A few research projects (investigating Alzheimer and Down syndrome), have been approved and anticipated to commence in 2019. Our team looks forward to further exciting advancements working with both UQ researchers and external partners who are seeking the use of PET-CT for research.

3T Prisma MRI
In comparison to 2017, the commercial use of the 3T MRI has doubled in 2018. In 2018, our collaboration with veterinary hospitals has expanded to include Gold Coast and Logan-based animal hospitals. 2018 marked one of highest 3T usage years since the commissioning of the 3T service.

Preclinical Molecular Imaging
The preclinical molecular imaging facility allows an internationally unique combination of MR-PET, PET/CT, autoradiography and Beta-counter capabilities. This has attracted new collaborations in 2018; using the full suite of equipment to investigate novel drugs for treatment of disease and first in animal testing of new PET tracers adding to a growing array of internal, external and international collaborations with academic and commercial groups.

Preclinical PET/CT Imaging
The system has an expanded base of CT projects including live animals, fixed specimens and materials research. Scanning of museum samples has been increasing with new collaborations. The number of research projects using the PET/CT scanner for PET imaging have also increased, particularly with the ability to scan 4 mice in one session. A higher throughput of PET/CT scanning can be achieved maximizing the use of each radiopharmaceutical being tested.
MR-PET Imaging
The number of projects using simultaneous MR-PET acquisitions have increased during 2018 with new large studies commencing. This relies on increased deliveries of PET tracer from the radiochemistry facility which is moving to more routine productions. There has been an increase in focused ultrasound studies, specifically to investigate the effect of blood brain integrity on Gadolinium MRI contrast uptake and PET tracer uptake into the brain.

Radiochemistry
The Radiochemistry facility works with research teams within both Australia and globally (academic and commercial) on the development of novel agents (for oncology, neurology, cardiovascular applications) using a variety of radioisotopes including C-11, F-18, Cu-64, Cu-67, Zr-89 and I-124 for both diagnostic and therapeutic applications.

This includes collaboration with research groups to utilise radiolabelling of “therapeutic drug candidates” (small molecules and macromolecules including antibodies and antibody fragments) to understand their in vivo characteristics as part of therapeutic drug development. Our team make a number of benchmark (literature) agents on request for researchers which include, but is not limited to, [18F]DPA714, a Translocator Protein (a biomarker of inflammation) and [11C]PiB, an amyloid imaging agent. The production of literature based tracers is driven by researcher demand and subsequently, tracers such as F-DOPA and FBCTT are planned and will be available during 2019.

High Resolution NMR Spectroscopy
The Centre for Advanced Imaging has a range of NMR spectrometers at different field strengths including a 900 MHz NMR spectrometer (Australia’s highest field NMR). All NMR spectrometers are maintained at a high level to ensure the best data quality for users. The facility services many different research areas including chemistry, structural biology, biochemistry, engineering, NMR based metabolomics, polymer chemistry and food science.

In the past year, key facility clients have included other Australian universities, CSIRO and Rio Tinto. A chief objective of the High Resolution NMR Spectroscopy Facility is education. Our facility users have the opportunity to undertake training to operate the NMR spectrometers independently to obtain high quality data.

NMR-based Metabolomics
After its foundation in 2016 and rapid expansion in 2017, the UQ Facility for NMR-based metabolomics (UQFNMRM) consolidated its activities in 2018. The facility was used by researchers from within UQ, the Translational Research Institute, QIMR Berghofer, CSIRO, and an international industry partner, DSM. Projects extended from clinical sciences to microbiology, environmental science and nutrition. The facility expanded its research activities in 2018 by adding food metabolomics to its portfolio, particularly analysis of wine and honey. Excitingly, results from research conducted by the facility led to two provisional patent applications in 2018. To promote its capabilities to potential collaborators nationally and internationally, the facility team undertook outreach activities both through targeted facility seminars and delivering presentations at scientific conferences.

Optical Imaging
The Centre has purchased a state-of-the-art IVIS Lumina X5 optical imaging system from Perkin Elmer.

Installed in November 2018, the system is in operation and running well and is actively booked by CAI, UQ researchers and collaborators. This instrument expands the scope of optical imaging capabilities at UQ, able to detect bioluminescence and fluorescence in living animals to investigate a variety of important questions in biomedicine.
### Financial Reports

#### Core Operating Activities

<table>
<thead>
<tr>
<th>Revenue</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>UQ - Strategic Funding Allocation (1)</td>
<td>3,243,027</td>
</tr>
<tr>
<td>Tuition Fees from Teaching</td>
<td>677,571</td>
</tr>
<tr>
<td>Commonwealth Grant Subsidy (RBG) (2)</td>
<td>1,360,215</td>
</tr>
<tr>
<td>Commercial Services Fees and charges (3)</td>
<td>1,019,589</td>
</tr>
<tr>
<td>Tuition Fees from HDR</td>
<td>128,064</td>
</tr>
<tr>
<td>Other Income</td>
<td>10,396</td>
</tr>
<tr>
<td>UQ Tax on Commonwealth Grant Subsidy</td>
<td>-708,456</td>
</tr>
<tr>
<td><strong>Total Revenue</strong></td>
<td><strong>5,730,406</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Academic Salaries</td>
<td>2,541,653</td>
</tr>
<tr>
<td>Professional Support Salaries</td>
<td>1,830,612</td>
</tr>
<tr>
<td>Staff Appointment &amp; Development Cost</td>
<td>22,517</td>
</tr>
<tr>
<td>General Operating Expenditure</td>
<td>377,375</td>
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<tr>
<td>Consultants Professional</td>
<td>68,031</td>
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<tr>
<td>Equipment - Capitalised and Non-capitalised (4)</td>
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<tr>
<td>Travel</td>
<td>65,685</td>
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<tr>
<td>Scholarships</td>
<td>37,153</td>
</tr>
<tr>
<td>Other Operating expenditure</td>
<td>36,118</td>
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<tr>
<td><strong>Total Expenditure</strong></td>
<td><strong>5,969,362</strong></td>
</tr>
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**Net Surplus/(Deficit)**                     **(238,956)**

#### Overall Activities

<table>
<thead>
<tr>
<th>Revenue</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>UQ - Strategic Funding Allocation (1)</td>
<td>3,994,277</td>
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<tr>
<td>Tuition Fees from Teaching</td>
<td>677,571</td>
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<td>Commonwealth Grant Subsidy (RBG) (2)</td>
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<tr>
<td>Research Income (5)</td>
<td>43,340,939</td>
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<tr>
<td>Investment Scholarships &amp; Donations</td>
<td>429,321</td>
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<tr>
<td>Commercial Services Fees and charges (3)</td>
<td>1,138,859</td>
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<tr>
<td>Tuition Fees from HDR</td>
<td>128,064</td>
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<td>Other Income</td>
<td>-34,557</td>
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<td>UQ Tax on Commonwealth Grant Subsidy</td>
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</tr>
<tr>
<td><strong>Total Revenue</strong></td>
<td><strong>50,326,233</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>$</th>
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</thead>
<tbody>
<tr>
<td>Research Academic Salaries</td>
<td>4,688,662</td>
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<tr>
<td>Professional Support Salaries</td>
<td>2,771,297</td>
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<td>Other Employment Costs</td>
<td>-111,860</td>
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<tr>
<td>General Operating expenditure</td>
<td>632,817</td>
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<tr>
<td>Consultants Professional</td>
<td>261,700</td>
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<tr>
<td>Equipment - Capitalised and Non-capitalised (4)</td>
<td>1,588,710</td>
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<tr>
<td>Travel</td>
<td>231,460</td>
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<tr>
<td>Scholarships</td>
<td>216,534</td>
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<td>Collaborative Projects</td>
<td>1,665,872</td>
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<tr>
<td>Other Operating expenditure</td>
<td>69,197</td>
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<tr>
<td><strong>Total Expenditure</strong></td>
<td><strong>12,014,389</strong></td>
</tr>
</tbody>
</table>

**Net Surplus/(Deficit)**                     **38,311,844**
Notes

1) UQ Strategic Funding Allocation is net-off CAI’s Contribution to the Research Infrastructure Pool, Service Recovery Cost for Finance/HR & all other strategic funding support paid from CAI Operating

2) Allocation Commonwealth Grant Subsidy is shown gross (i.e. before deduction of 54% tax on Core Operating)

3) Includes consultancy fees, instrument usage income, sales and services fees, sponsorships and reimbursements

4) Includes Service Level agreements on Instruments

5) Includes NIF funding of $36 M
STRATEGIC PARTNERSHIPS & ENGAGEMENT
Picture (left-to-right): Professor Peter Høj, Vice-Chancellor and President, The University of Queensland; the Honourable Jane Prentice MP, Federal Member for Ryan, representing the Honourable Dan Tehan MP, Minister for Education; Professor David Reutens, CIBIT and CAI Director; Professor Sue Thomas, ARC CEO; and Professor Aidan Byrne, Provost and Senior Vice-President, The University of Queensland; at the official launch of CIBIT on 5 September, 2018.
National Imaging Facility

The National Imaging Facility (NIF) is a National Collaborative Research Infrastructure Strategy (NCRIS) project that provides state-of-the-art imaging capability of humans, animals, plants, and materials. Access to world-class research infrastructure is critical to support high quality research and development activities and to improve Australia’s overall innovation output. NCRIS was established to facilitate such infrastructure, providing cutting-edge instruments, facilities and expertise and enabling public and private research activities.

NIF is directed by Professor Graham Galloway and has 11 participants comprising University of Queensland, University of New South Wales, University of Sydney, Western Sydney University, The Florey Institute of Neuroscience and Mental Health, South Australian Health and Medical Research Institute for Large Animal Research & Imaging Facility, University of Melbourne, Monash University, Swinburne University of Technology, University of Western Australia, and ANTSO as a national partner in radiochemistry and radiopharmaceuticals. NIF has made advanced imaging technologies more widely available than ever before and, importantly, the sharing of expertise has resulted in a far more effective use of the available resources. With its range of leading-edge imaging instrumentation and expertise, NIF presents the optimal use of imaging technology to the Australian research community & industry partners. For more information regarding NIF and associated nodes, please visit: www.anif.org.au

In 2018, NIF secured a $53.5 million investment over five years through the National Collaborative Research Infrastructure Strategy. Thanks to this investment, NIF plans to grow its network by including 21 more NIF/NCRIS funded or contributed instruments and 15 new Fellows, with 1 Fellow welcomed in 2018.

The Global Bioimaging Project, funded through Horizon 2020, ended in late 2018. However, through the support of NIF, Microscopy Australia, and the project partners, the networks will continue to facilitate access to a global network of imaging infrastructure, exchange experience, and standardise data protocols.

Australia’s research community is increasingly reporting the impact they have on the economy, society, and environment. The following section highlights some of the example projects highlighting the collaborative efforts of NIF scientists at the Centre for Advanced Imaging, The University of Queensland node.

Investigating the effects of a novel anti-B-cell antibody in a mouse model of Multiple Sclerosis

Multiple Sclerosis (MS) is a neurological disorder characterised by lesions in the central nervous system, inflammation, and the degeneration of neuronal sheaths. Affecting more than 25,000 Australian, there is currently no cure for MS. A collaborative team consisting of researchers at the University of Queensland, La Trobe University, and Novartis Pharma, are investigating a safer, more effective therapy to treat relapsing MS.

To date, results have focused on the absorption and distribution of an 89Zr-anti-CD20 antibody in mice. Anti-CD20 therapies act on lymph node resident B-cells, facilitating autoimmune activation. The topography of lesions in a novel rhMOG-induced experimental autoimmune encephalomyelitis (EAE) mouse variant were mapped using standard histological approaches and parameters of neuroinflammation (B- and T-cell infiltration, demyelination and microglial reactivity) were evaluated by immunohistochemistry. The biodistribution of 89Zr-anti-CD20 antibody in sham-injected control mice and EAE mice following subcutaneous right lower flank injection was assessed using positron emission tomography-computed tomography (PET/CT) and gamma counting of excised organs at early (24 h) and later (72h and 7 days) time points.

The clinical severity of EAE was mild and spatio-temporal mapping identified reproducible lesion topography along the whole of the neuraxis. Data from PET/CT imaging demonstrated that the proportion of 89Zr-anti-CD20 antibody remaining in the whole body at 7 days following subcutaneous injection was comparable between normal (55±4%) and EAE (58±9%) mice. Per gamma counting data at early time points, 89Zr-anti-CD20 antibody levels were highest in the local draining lymph nodes, spleen, circulating blood, and in highly
perfused organs in normal and EAE mice. In local draining lymph nodes, the peak uptake of tracer was faster in EAE mice (24h) versus normal mice (72h). These results highlight that the route of administration affects the distribution of 89Zr-anti-CD20 antibody, with subcutaneous administration resulting in effective absorption and biodistribution.

The results from this project will contribute to the development of a more effective and safer therapy to treat relapsing MS, revealing the best administration route, site and pattern. Insights gained in this study will allow optimisation of future applications in MS patients in terms of injection route and frequency, ideally minimising adverse effects while maximising selective B-cell reduction. Preliminary studies in animal models and patients have shown that this will be a powerful tool to stop the development of new lesions and disease progression in MS patients.

NIF contributed facilities and scientific & technical assistance provided by NIF Fellow, Dr Karine Mardon (k.mardon@uq.edu.au) to this research. For more information on this work, contact Prof David Reutens (d.reutens@uq.edu.au).

The First Australian Multi-Centre Study of Dementia using Ultra-High Field MRI

Australia is at the forefront of dementia research with world-leading studies such as the Australian Imaging and Lifestyle study of Ageing (AIBL) led by a consortium of Australia’s leading Dementia centres, and the recently started Prospective Study of Ageing (PISA) led by the QIMR Berghofer.

The 2014 installation of the first human ultra-high field MRI scanner in the southern hemisphere within the Centre for Advance Imaging, the Queensland node of the National Imaging Facility, opened up a new era of imaging research. The Siemens 7T whole-body MRI scanner brought Australia to the forefront of ultra-high field research enabling examination of the human brain with an unprecedented level of detail.

Subsequently, a second 7T scanner was installed at the Melbourne Brain Centre providing a unique opportunity for a national multi-centre collaboration in ultra-high field MRI and the capability to explore new imaging biomarkers for diagnosis of neurodegenerative disease. A major project is underway, led by the Brisbane-based CSIRO eHealth Research Centre, co-funded by the CRC for Mental Health and in collaboration with the QIMR Berghofer, University of Melbourne and Florey Institute for Neuroscience. The
broad aim of this study is the characterisation of new imaging biomarkers of neurodegeneration in the aging population. A suite of MRI methods is being applied at both sites on large cohorts of healthy aging subjects and patients diagnosed with fronto-temporal dementia. The scanning part of the project has been successfully completed with superb image quality obtained using state of the art sequences. A significant effort is now underway to analyse this valuable data which may contain a wealth of diagnostic information not otherwise available.

NIF contributed to this research by the facilities and scientific and technical assistance provided by NIF Fellow, Dr Steffen Bollmann (steffen.bollmann@cai.uq.edu.au). For more information on the MRI data set research, contact Prof Markus Barth (m.barth@uq.edu.au).
CIBIT

Events

Official CIBIT Launch
5th September 2018

The $8.5 million ARC Training Centre for Innovation in Biomedical Imaging Technology (CIBIT) was launched by Member for Ryan, Jane Prentice, at CAI in September. The training centre will train more than 20 industry ready scientists and deliver innovations in biomedical imaging techniques and probes. The training centre has been established with the Australian Government, with ARC funding of $4.7 million and $3.8 million in industry partner contributions.

Industry partners include Siemens Healthcare Pty Ltd, Clarity Pharmaceuticals Pty Ltd, Minomic International Ltd, Inter-K Peptide Therapeutics Ltd, Theranostics Australia Pty Ltd, Beijing Genomics Institute, Brisbane Veterinary Specialists Centre, Uniting Care Medical Imaging, and Red Radiology Pty Ltd.

The event welcomed executive guests including government delegates and industry partners such as ARC CEO, Professor Sue Thomas, UQ Provost and Senior Vice-President, Professor Aidan Byrne, and UQ Vice-Chancellor and President, Professor Peter Høj.

ARC Joint Symposium on Advanced Bioengineered Systems
19th November 2019

The ARC Joint Symposium – Advanced Bioengineered Systems was held on the 19th and 20th November. The Symposium was a joint initiative of the ARC Industrial Transformation Training Centre for Innovation in Biomedical Imaging Technology, the ARC Industrial Transformation Training Centre for Biopharmaceutical Innovation, the ARC Centre of Excellence in Convergent Bio-Nano Science & Technology and the ARC Industrial Transformation Training Centre in Additive Biomanufacturing.

We were delighted to welcome Dr Robert Mun, Executive Director, Engineering and Information Sciences at the Australian Research Council (ARC), to open the event. As part of the event, Dr Mun toured our facilities with CAI and CIBIT Director, Professor David Reutens and CIBIT Centre Manager, Irene Dullaway. The symposium featured presentations from each of the Centres and from industry partners, and provided a great opportunity to come together and foster collaboration.
Conference proceedings

<table>
<thead>
<tr>
<th>Conference Title</th>
<th>Authors</th>
<th>Journal/Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>improving FLAIR SAR efficiency by predicting B1-maps at 7T from a standard</td>
<td>Tesiram, Yas, <strong>Barth, Markus</strong> and O'Brien, Kieran (2018).</td>
<td></td>
</tr>
<tr>
<td>Improving FLAIR SAR efficiency by predicting B1-maps at 7T from a standard</td>
<td>Bollmann, S, Kelly, S, <strong>Vegh, V</strong>, Rodell, A, Tesiram, Y, <strong>Barth, M</strong>,</td>
<td><em>Proceedings of the International Society for Magnetic Resonance in Medicine</em>.</td>
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<tr>
<td>7-Tesla cardiac magnetic resonance imaging with electrocardiogram gating despite</td>
<td>Hamilton-Craig, C, Stäb, D, O'Brien, K, Galloway, G, Barth, M (2018)</td>
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### Engagement presentations

<table>
<thead>
<tr>
<th>Name</th>
<th>Event</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>Geoffrey McLachlan (School of Maths and Physics)</td>
<td>2nd International Conference on Econometrics and Statistics (EcoSta 2018), Hong Kong (June, 2018). 2018 Winter School in Mathematical &amp; Computational Biology, St. Lucia, Brisbane (July, 2018). Advances in Finite Mixture and Other Non-Regular Models. Opening Plenary. Guangxi Normal University, Guilin, China (August, 2018). The 11th International Conference of the ERCIM WG (European Research Consortium for Informatics and Mathematics Working Group) on Computational and Methodological Statistics (CMStatistics 2018), Pisa, Italy (December, 2018).</td>
<td></td>
</tr>
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</table>
Chris Howard  
*Bioprocessing Network (BPN) Australia annual conference*. Melbourne, Australia (October 30-November 1, 2018).

<table>
<thead>
<tr>
<th>Media features and outreach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professor Markus Barth</strong></td>
</tr>
<tr>
<td>ABC Network: ABC Catalyst – Memory Matters, 18 September 2018, featuring Professor Markus Barth.</td>
</tr>
<tr>
<td>Nature International Journal of Science, Vol 563, November 2018 (feature image of The Strongest Scanners and The world’s strongest MRI machines are pushing human imaging to new limits). Image credit: Professor Markus Barth and Barth Group.</td>
</tr>
<tr>
<td><strong>Associate Professor Kris Thurecht</strong></td>
</tr>
<tr>
<td>Network Ten (Scope TV), <em>UQ News – Hoover gives hope for novel nanomedicine cancer treatment</em> (21 September, 2018), South Burnett Times: Exclusive excursion for our budding scientists (20 June 2018), Ten eyewitness news, 7 news Brisbane (September 2018 – refer to ‘Novel nanomedicine and comparative oncology’ of Media section for details).</td>
</tr>
<tr>
<td><strong>Outreach:</strong></td>
</tr>
<tr>
<td>Annual Kingaroy State High School polymer chemistry program (June 2018)</td>
</tr>
<tr>
<td>Springwood Rd State School Science Challenge Day (September 2018)</td>
</tr>
</tbody>
</table>
Marketing and Engagement

A Marketing and Engagement role was introduced in 2018 to continue growing marketing and engagement initiatives as the centre expands. Marketing goals for 2018 included strengthening the communication of CAI’s vision and developing key areas such as brand awareness and student recruitment through outreach activities and increased media engagement, as well as, developing strategic collaborations by fostering stakeholder relationships with local and international stakeholders.

A chief focus was to raise the awareness of the centre broadly, the scope of our research areas, particularly recent research developments in comparative oncology, pain therapy and metabolomics. This included developing programs to share the centre’s location at the UQ St Lucia campus and the undergraduate and postgraduate programs (Summer/Winter research, Honours, Short Courses, Postgraduate Coursework and HDR programs) education opportunities available.

Increasing the centre’s digital reach through social media marketing (Facebook and Twitter platforms) and media presence supported these activities, with a focus on targeting student and research markets and national audiences. A benefit of raising CAI’s digital exposure was to expand our reach to international audiences across online platforms, which are accessible globally. These initiatives are successfully meeting engagement targets, with feedback from international and interstate stakeholders showing audiences accessing the centre’s news and events through social media platforms and digital promotions.

The centre also increased outreach and student recruitment focused event engagement, participating in key UQ and research community events.

We would like to acknowledge the efforts of all CAI staff and students who assisted the centre to achieve massive growth in awareness and engagement across all platforms during 2018. These achievements would not be possible without student volunteers and research representatives at events.

Media highlights of the year were features across Australian news channels for CAI’s novel research in nanomedicine cancer theranostics, and pain therapy developments, as well as, coverage in international science magazines, and features on ABC Catalyst, National Geographic and various children’s science television programs.

The Centre welcomed a number of key visits throughout the year, including the Honourable Jane Prentice MP, Federal Member for Ryan, representing the Honourable Dan Tehan MP, Minister for Education, ARC CEO, Professor Sue Thomas and ARC Executive Director for Engineering and Information Services, Dr Robert Mun. We also had the pleasure of hosting international guests such as Professor Seong-Gi Kim (Center for Neuroscience Imaging Research), the Saudi Arabia Cultural Mission (SACM) group and Dr Elizabeth James (Technical Services Business Partner for the College of Engineering, Mathematics and Physical Science (CEMPS)), from the University of Exeter.

Towards the end of 2018, CAI commenced rebranding activities as part of the university’s One-UQ branding, introduced in October. CAI will continue to update our marketing materials as part of this project into 2019.

Events

The professional, academic and student teams represented the CAI at national and international conferences, research exhibitions, student events, school outreach visits, as well as, UQ and community STEM events. Highlights included the 2018 BLiSS symposium, SCMB Honours Day, UQ Association of Biomedical Students (ABS) Honours evening, Women in Imaging workshop, Inaugural UQ Research Capabilities Expo, and CAI’s first Honours and Research Information event.
Student recruitment translation

The CAI Honours and Research Information event was particularly successful with 17 registered attendees from undergraduate, postgraduate and research backgrounds, and received excellent feedback from students. Attendance included UQ students from biomedical science, biotechnology, chemistry and physics backgrounds. The event led to a direct translation of student recruitment, welcoming three new honours students in PET, image analysis and methodology development, and radiochemistry. Our team looks forward to continuing student recruitment events throughout 2019.

Queensland Health Supervised Practice Program (SPP) Training Day
16th November 2018

For the first time, the Queensland Health SPP Training Day was held at CAI on 16 November. Hosted by Sarah Daniel, Statewide Educator - Advanced Nuclear Medicine Scientist, Department of Nuclear Medicine & Specialised PET Services Queensland; and CAI Research Nuclear Medicine Technologist. We had the pleasure of hosting Queensland Health Graduates (Medical Radiation Science - Nuclear Medicine) at the Centre for a day to learn more about future journeys in Nuclear Medicine.

The program included a seminar delivered by the graduate group in preparation for the annual RADPHARM award and upcoming ANZSNM QLD meeting, and a tour of our facilities including the 3T and 7T MRI, PET/CT Large Bore facilities, and pre-clinical imaging suite. The day also involved a Clinical Skills Workshop, presentations from our senior researchers (covering topics on High Field MRI and Safety, Preclinical imaging, Pathways to PhD and beyond, and Comparative Oncology).

Pictured: Sarah Daniel (centre) with Aiman Al Najjar (left), showing Queensland Health Nuclear Medicine graduates the 7T facility, featuring the National Imaging Facility Human 7T MRI Flagship Instrument.
CAI actively encourages an awareness of equity issues and is committed to providing an inclusive and productive work environment for all. The Women in Imaging group provides support, guidance and networking opportunities for women within the Centre and the wider Brisbane imaging community.

The group hosted their second event in March with guests enjoying special presentations by Dr Shyuan Ngo (UQ AIBN and QBI), Dr Dee Gibbon (UQ Workplace Diversity & Inclusion), Dr Mellissa Naidoo (Gold Coast Health) and Professor Greig de Zubicaray (QUT Institute of Health and Biomedical Innovation).

The lunchtime workshop included group discussions on topics including: “How can we encourage, support or promote women in science?”, “Forging your way as a woman in science/business (trials, tribulations, and successes)”, and Skills and mentorship.

The event brought together women and men from a variety of science backgrounds at UQ, QUT, Queensland Health, the Royal Brisbane and Women’s Hospital (RBWH), and CSIRO.

Left to right: Dr Shyuan Ngo, Scott Sullivan MND Research Fellow, UQ AIBN and QBI, Dr Dee Gibbon - Associate Director, UQ Workplace Diversity & Inclusion, Dr Mellissa Naidoo – Senior Director Clinical Governance Service and Deputy Executive Director Clinical Governance, Education and Research at Gold Coast Health, and Professor Greig de Zubicaray - Assistant Dean (Research), Faculty of Health and Deputy Director, Institute of Health and Biomedical Innovation, QUT.
UQ 3MT Institutes Final, hosted by CAI  
27th July 2018

The University of Queensland’s 3MT competition, established in 2008, cultivates students’ academic, presentation, and research communication skills. Presenting in a 3MT competition increases their capacity to effectively explain their research in three minutes, in a language appropriate to a non-specialist audience. For the first time, CAI hosted and coordinated the UQ 3MT research institutes and centres final, consisting of the Australian Institute for Bioengineering and Nanotechnology (AIBN), CAI, Institute for Molecular Biosciences (IMB), Queensland Alliance for Agriculture and Food Innovation (QAAF), Queensland Brain Institute (QBI) and the Sustainable Minerals Institute (SMI).

The successful event brought together an estimated 100 (internal and external) guests who enjoyed networking across the research institutes over afternoon tea. The judging panel included members from UniQuest, UQ Office of Marketing and Communications and the UQ Graduate School. The event strengthened our student-staff, research and cross-organisational relationships.

Inaugural CAI Honours and Research Information Event  
5th October 2018

CAI held its first Honours and Research Information event in October, welcoming internal and external undergraduate and postgraduate students and researchers, to find out more about the centre’s research opportunities. The half-day event involved an information session and Q&A with our education and research teams, a tour of the centre’s facilities, afternoon tea and networking with CAI research group leaders, current honours students, PhD candidates and post-doctoral fellows.

The aim of the event was to increase awareness of the centre amongst the student and research community, targeting students of science, engineering, mathematics and technology backgrounds interested in honours and research projects. The event successfully attracted domestic and international UQ students and researchers. Feedback received from attendees was positive, with students strongly recommending to continue the event.

2018 Imaging@Brisbane Conference  
24th August 2018

As a co-host of the 2018 Imaging@Brisbane conference, CAI hosted a visit from conference members in August. The visit included research discussions with our team and a tour of the centre’s facilities led by senior researchers. Visitors included professional members from CSIRO, Western Australia Government (Health), RBWH and Queensland Health (Wide Bay hospital and health service).

Asia-Pacific EPR Society and International EPR (ESR) Society Joint Conference  
September 2018

The third joint conference of the Asia-Pacific EPR/ESR Society and The International EPR (ESR) Society (IES) was hosted by Associate Professor Jeffrey Harmer, Co-Chair APES-IES2018 at The University of Queensland on 23 – 27 September 2018.

The conference covered a vast range of applications of EPR in fields including imaging in vivo, biological, soft matter, chemistry, physics, quantum computing, molecular magnetism, spintronics, sensing, organics semiconductors, methods and instrumentation. Thank you to the major sponsors of this event: The University of Queensland, Bruker, Clin EPR and Avanti.
Deep Learning Workshop and Weekend Hackathon

The three-day Deep Learning workshop and hackathon at the end of 2018 was a resounding success. The workshop, supported by the CAI and led by Dr Steffen Bollmann, consisted of lectures and projects proposed by participants to be worked on over the weekend. The workshop brought together groups of people from different backgrounds and skills, which allowed research projects to make significant headway.

The lectures included: Deep Learning for Medical Imaging, Deep Learning Toolkit Overview, Python Basics necessary for Deep Learning, and Beyond Neural Nets in Tensorflow: Compute Graphs, Regression, TensorFlow Probability. The projects put forward and developed in groups, included:

- Deep Learning for time series analysis and spectroscopy
- Deep Learning for fMRI
- Deep Learning for Image Segmentation

Dr Bollman has recently relocated to Boston to undertake an internship with Siemens at the Athinoula A. Martinos Centre for Biomedical Imaging, where he will continue to work as an Affiliated Fellow and part of the Magnetic Resonance Collaborations team. In this role, he will continue to work with researchers to integrate deep learning models into applications that run directly on the Siemens Software Platform.

CAI Seminar Series

The seminar series remains consistent, with a total of 43 seminars held in 2018. While the number of seminars remains the same as 2017, there was a significant increase in seminar attendance and growth in the number of external speakers (an increase of nine speakers in comparison to 2017). The centre has identified social media marketing and online promotions of the series has increased seminar audience numbers. The series received highly positive feedback from attendees in 2018, including a number of requests to record seminars in the future. The series had a total of 22 external speakers, including international speakers. External speakers represented 51 per cent of the seminars, seeing an increase of 30 per cent from 2017.
Centre Tours and Key Visits

Centre tours increased by 35 per cent compared to 2017, with a total of 14 tours hosted. 10 tours were held for major events and groups including the official CIBIT Launch, conference groups, international agent visits, research recruitment events, UQ Tea and Tours (alumni), ASPins high achievers and the Queensland Health Supervised Practice Program – Nuclear Medicine. Centre tours involve experiencing the CAI facilities, led by senior academics and facility managers.

The centre would like to thank members of staff who are actively involved in these engagement activities and assist with facility tours in addition to their research duties: Aiman Al Najjar, Nicole Atcheson, A/Prof Rajiv Bhalla, Dr Gary Cowin, Sarah Daniel, Gail Dulbridge, Dr Nyoman Kurniawan, Dr Karine Mardon, Dr Greg Pierens, Dr Horst Schirra and Damion Stimson.

Key visits, as highlighted above, included executive guests from the ARC and help to strengthen relationships with UQ Alumni, Industry partners, and UQ global partners.

<table>
<thead>
<tr>
<th>Date</th>
<th>2018 Centre Tours</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/04/2018</td>
<td>National Youth Science Forum group</td>
</tr>
<tr>
<td>8/05/2018</td>
<td>Redlands College Year 12 Physics group</td>
</tr>
<tr>
<td>19/07/2018</td>
<td>UQ Alumni: Tea and Tours</td>
</tr>
<tr>
<td>30/07/2018</td>
<td>Cavendish Rd State High Year 11 group</td>
</tr>
<tr>
<td>7/08/2018</td>
<td>SACM visit</td>
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<tr>
<td>14/08/2018</td>
<td>Ambrose Treacy College group</td>
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<tr>
<td>24/08/2018</td>
<td>Imaging@Brisbane conference</td>
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<tr>
<td>5/09/2018</td>
<td>Official CIBIT Launch</td>
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<tr>
<td>14/09/2018</td>
<td>UQ Research Capabilities Expo</td>
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<tr>
<td>27/09/2018</td>
<td>EPR Conference group</td>
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<tr>
<td>3/10/2018</td>
<td>Brisbane Home Education Unit group</td>
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<tr>
<td>5/10/2018</td>
<td>CAI Honours and Research Information event</td>
</tr>
<tr>
<td>12/10/2018</td>
<td>ASPins group</td>
</tr>
<tr>
<td>16/11/2018</td>
<td>Queensland Health Supervised Practice Program (SPP) Training Day</td>
</tr>
</tbody>
</table>

Social media

Though currently in the early stages, there was a significant increase in CAI’s social media following in 2018 (from 1 January to 31 December), indicating a strong promise of growth to follow. With support from the centre’s research community becoming more active on social media, the CAI Facebook page following increased by 45 per cent (from 469 to 678 followers); and the Twitter following increased by 229 per cent (from 100 to 329 followers). At the end of 2018, the Twitter account reflected an organic average of 27 new followers per month. This significant increase reflects the growing following and public interest in the centre, particularly with research audiences across Twitter.

Media

Media engagement for the year was productive in raising the awareness of the centre’s capabilities and our research with features across 7 News, Ten Eyewitness News, South Burnett Times, Brisbane Times, News Talk 4BC 1116, Network Ten (Scope TV), Seven Network (Get Clever), ABC Catalyst, National Geographic, international magazines and UQ News.
These included coverage of our outreach activities (Kingaroy SHS chemistry outreach program), youth engagement with children’s science television shows (Scope TV and Get Clever) and key research developments.

**Outreach**

*South Burnett Times: Exclusive excursion for our budding scientists* (published 20 June 2018)

**Youth Engagement**

*Network Ten, TenPlay: Scope TV* (aired 29 April 2018)

About the show: Scope is a fast, funny and informative children’s science show produced in association with the CSIRO.

*Seven Network* Get Clever (filmed November 2018, to air in 2019)

About the show: An outrageous series where adventure, fun and the wonders of science are burst wide open.

**Research**

*fMRI and memory (Barth and Reutens Groups):*  
*ABC Catalyst: Series 19 season final – Memory Matters*  
See: 3.29 - 20.15 (aired September 2018).

The centre featured in the ABC science documentary series, ABC Catalyst, as part of the 2018 season final, 'Memory Matters'.

*Description: In the episode, Dr Caroline West meets with CAI scientists working at the forefront of memory research, introducing remarkable individuals whose exceptional memories and unique abilities are helping unlock the secrets of memory (sic). Professor Markus Barth and Dr Maryam Ziaei designed a unique functional magnetic resonance imaging (fMRI) activity for the episode, which saw inside Dr West's brain and how it responded to memory. The functional task measured how a brain reacts to visual stimuli which would evoke a memory response.*

This activity was filmed in one of our core facilities, (7T MRI facility), a facility supported by the National Collaborative Research Infrastructure Strategy (NCRIS) and featuring the 7 Tesla whole-body MRI scanner, a NIF flagship instrument. The episode demonstrated the centre's research capabilities and research infrastructure.
Bull ant venom and pain treatment developments

Advancements in bull ant venom and pain research by Dr Sam Robinson and Dr Eivind Undheim were featured across local news, as well as an exciting article feature by National Geographic on the exclusive National Geographic app: Are Bull Ants the Key to Understanding Pain? (published 21 September, 2018 by Lulu Morris).

The research was also selected to be included in the 2019 ARC annual publication: Making a Difference: Outcomes of ARC supported research.

Other features:

UQ News
News Talk 4BC 1116
Brisbane Times

Novel nanomedicine and comparative oncology

September was an exciting month with substantial developments in nanomedicine. Associate Professor Kris Thurecht, Dr Rod Straw and the Thurecht Group completed an exciting world-first in nanomedicine research, as part of our comparative oncology program and ACRF Facility for Molecular Imaging Agents in Cancer at the Centre. Hoover, a ten-year-old beagle with prostate cancer, became the first patient in the world to receive a novel nanomedicine engineered by the Thurecht team to specifically target a protein found in prostate cancer. The team hopes it will help track and treat his cancer and lead to better treatment for people with the same disease.

This represents an exciting step forward in our research, encompassing our vision to be a world leader in the development and application of cutting-edge imaging science and technology through innovation, translation, education and collaboration.

The story was featured across Australian news channels, including 7 News, Ten Eyewitness News and UQ News:

UQ News – Hoover gives hope for novel nanomedicine cancer treatment (published 21 September 2018)
Ten eyewitness News
7 News Brisbane

The Centre thanks Hoover and his family, Brenda and Neil Douglas, and congratulates the Thurecht Group, our PET-CT facility team and Brisbane Veterinary Specialist Centre.
Australian first canine PET-CT $^{18}$F-FDOPA scan (comparative oncology)

In April, we performed the first canine PET-CT $^{18}$F-FDOPA scan in the centre’s ACRF Facility for Molecular Imaging Agents in Cancer, highlighting our developments in cancer research. The story was featured exclusively by UQ News: PET for pets: an Australian first to advance cancer treatment (published 27 November 2018).

Nature: International Journal of Science

Our image featured as a main news feature in Nature: International Journal of Science (volume 563), published in November. Our image and caption, crediting CAI and The University of Queensland, headed the online and print publications as the feature image: The world’s strongest MRI machines are pushing human imaging to new limits and The Strongest Scanners: Researchers are pushing non-invasive brain imaging to new limits.

The image, captured by the centre’s 7 Tesla MRI scanner, is time-of-flight angiography of the human brain showing cerebral blood vessels; imaged by the Barth Group. This was featured in the journal’s print magazine, online news and on social media. Nature’s social media accounts on Facebook and Twitter, have a mass following of over 928,000 (Facebook) and 1.5 million (Twitter). The featured ‘tweet’ received over 900 likes and 470 retweets. As a leading science journal, this brought significant exposure to the centre’s imaging technology and capabilities across science networks and international audiences.

About the journal: “Nature is a weekly international journal publishing the finest peer-reviewed research in all fields of science and technology on the basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions. Nature also provides rapid, authoritative, insightful and arresting news and interpretation of topical and coming trends affecting science, scientists and the wider public.”
Research engagement summary

We had a very successful year in research engagement with active involvement in many national and international conferences, including invited talks, research presentations, editorial participations and other events highlighting the centre's successful relationship developments and collaborations in research.

Major national and international meetings

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
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<tbody>
<tr>
<td>Dr Gary Cowin</td>
<td>Attended the Congress of the World Federation of Nuclear Medicine and Biology, (April), Melbourne.</td>
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<tr>
<td></td>
<td>National Imaging Facility annual meeting, (May), Melbourne.</td>
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<tr>
<td>Mary-anne Migotto</td>
<td>70th Annual American Academy of Neurology (AAN) Conference 2018, (April), Los Angeles, USA.</td>
</tr>
<tr>
<td></td>
<td>4th Congress of the European Academy of Neurology (EAN) Conference 2018, (June), Lisbon, Portugal.</td>
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<tr>
<td></td>
<td>34th Congress of the European Committee for Treatment and Research in Multiple Sclerosis (ECTRIMS) Conference 2018, (October), Berlin, Germany.</td>
</tr>
<tr>
<td>Dr Horst Joachim Schirra</td>
<td>WormJam - an international open research community for C. elegans systems biology andmetabolic modelling. The 11th MetaboMeeting, Nottingham, United Kingdom.</td>
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<tr>
<td></td>
<td>The 2nd Australia and New Zealand Metabolomics Conference, Auckland, New Zealand.</td>
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<tr>
<td></td>
<td>3rd Joint Symposium, Centre for Advanced Imaging – Singapore Bioimaging Consortium, Singapore.</td>
</tr>
<tr>
<td>Damion Stimson</td>
<td>12th Congress of the World Federation of Nuclear Medicine and Biology (April), Melbourne.</td>
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Invited talks – International

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Professor Markus Barth</td>
<td>M. Barth. Magnetic resonance imaging of structure and function at ultra-high field. Symposium Magnetresonanzphysik. Vienna, Austria, 27 February, 2018.</td>
</tr>
</tbody>
</table>
K. Thapaliya, V. Vegh, S. Bollmann, D. Reutens, M. Barth. 7T GRE-MRI frequency shifts obtained from signal compartments can differentiate normal from dysplastic tissue in focal epilepsy.

D. Stäb, T. Wech, M. Barth. A Data Driven Nyquist Ghost and Gradient Delay Correction for Navigator-Free 3D Planes on a Paddlewheel (POP) EPI.


S. Bollmann, D. Staeb, M. Barth. BOLD fMRI with 0.5 mm isotropic voxel size and minimal in-plane distortion using 3D planes-on-a-paddlewheel (POP) EPI at 7 Tesla.

S. Bollmann, L. Kasper, K. Pruessmann, M. Barth, K.E. Stephan. Interactive and flexible quality control in fMRI sequence evaluation: the uniQC toolbox.

A. Destruel, M. Fuentes, E. Weber, K. O’Brien, M. Barth, F. Liu, S. Crozier. Comparison between experimental and simulated electric field near a hip implant at 7T.

A. Destruel, K. O’Brien, M. Barth, J. Jin, F. Liu, S. Crozier. Adaptive SAR mass-averaging to predict RF heating for B1 shimming in the presence of a hip implant for parallel transmit at 3T.

Dr Steffen Bollmann

ISMRM (International Society for Magnetic Resonance in Medicine) 2018 in Paris, France:

BOLD fMRI with 0.5 mm isotropic voxel size and minimal in-plane distortion using 3D planes-on-a-paddlewheel (POP) EPI at 7 Tesla

Author: Bollmann, Saskia; Staeb, Daniel; Barth, Markus.

Improving FLAIR SAR efficiency by predicting B1-maps at 7T from a standard localizer scan using deep convolutional neural networks

Author: Bollmann, Steffen; Kelly, Samuel; Vegh, Viktor; Rodell, Anders; Tesiram, Yas; Barth, Markus; O’Brien, Kieran.
<table>
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<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Associate Professor Idriss Blakey</td>
<td>Invited Keynote for: The First International Conference of Polymeric and Organic Materials in Yamagata University, <strong>Japan</strong> (<em>to be held in January 2019).</em></td>
</tr>
<tr>
<td>Dr Gary Cowin</td>
<td>Invited speaker at the Preclinical Imaging Symposium, Brain Health Research Centre, University of <strong>Otago</strong>, November.</td>
</tr>
<tr>
<td>Dr Nick Fletcher</td>
<td>Noncovalent Antibody-Nanomaterial Conjugates: a simple approach to produce targeted nanomedicines, 20th International Conference on Nanotechnology and Nanomedicine, Prague, <strong>Czech Republic</strong> (<em>received Presentation Award for best presentation).</em></td>
</tr>
<tr>
<td>Dr Nyoman Kurniawan</td>
<td>Invited speaker for 2018 SBIC-CAI symposium, <strong>Singapore</strong>, Brain structural Connectome at 16.4T, August.</td>
</tr>
<tr>
<td>Associate Professor Mehdi Mobli</td>
<td>Invited speaker for Experimental NMR Conference (ENC – April, Florida, <strong>USA</strong>), presenting: Non-uniform sampling methods in structural studies of peptides and proteins.</td>
</tr>
<tr>
<td></td>
<td>International Conference on Magnetic Resonance in Biological Systems (ICMRBS – August, Dublin, <strong>Ireland</strong>), presenting: Structural characterisation of bioactive disulphide-rich peptides and their interactions with lipid membranes and ion channels in solution.</td>
</tr>
<tr>
<td>Dr Horst Joachim Schirra</td>
<td>2018 Invited Keynote, ANZMET 2018, 2nd Australian and New Zealand Metabolomics Conference, Auckland, <strong>New Zealand</strong>.</td>
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<tr>
<td></td>
<td>2018 Invited Talk, 3rd Joint Symposium, Singapore Bioimaging Consortium – Centre for Advanced Imaging, <strong>Singapore</strong>.</td>
</tr>
<tr>
<td>Associate Professor Kris Thurecht</td>
<td>American Chemical Society National Meeting and Exposition. March, 2018. New Orleans, USA. Probing the behaviour of nanomaterials in biology</td>
</tr>
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**Invited talks – Local**

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
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<tr>
<td></td>
<td>M. Barth. Innovation in cancer imaging with high and ultra-high field MRI. Princess Alexandra Hospital Health Symposium. Brisbane, 31 July - August 3.</td>
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<tr>
<td>Name</td>
<td>Event Description</td>
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<tr>
<td>M. Barth</td>
<td>Magnetic resonance imaging of structure and function at ultra-high field. MR Seminar Series, QUT, Brisbane, 14 May, 2018.</td>
</tr>
<tr>
<td>Associate Professor Idriss Blakey</td>
<td>Invited speaker for the World Polymer Congress: MACRO18, Cairns, July.</td>
</tr>
<tr>
<td>Dr Gary Cowin</td>
<td>Invited speaker at the seminar series at Griffith Institute for Drug Discovery, Griffith University, Brisbane, 26 July.</td>
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<tr>
<td>Dr Nick Fletcher</td>
<td>Invited presenter for:</td>
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<td></td>
<td>ARC Centre of Excellence in Convergent Bio-nano Science &amp; Technology (CBNS) Queensland Node Meeting Research Update, October.</td>
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<td></td>
<td>2018 International Conference of Young Researchers on Advanced Materials (ICYRAM) November, Adelaide: Targeted polymeric nanomedicines as cancer therapeutics.</td>
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<tr>
<td></td>
<td>UQ Australian Institute Bioengineering and Nanotechnology (AIBN) Seminar Series: Targeted polymeric nanomedicines as cancer therapeutics, Brisbane.</td>
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<td></td>
<td>Invited presentation for Targeted polymeric nanomedicines as cancer therapeutics, Australasian Association of Clinical Biochemists and Australian Institute of Medical Scientists Joint Annual Meeting, Sydney.</td>
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<tr>
<td></td>
<td>Noncovalent Antibody-Nanomaterial Conjugates: a simple approach to produce targeted nanomedicines, World Polymer Congress: MACRO18, Cairns.</td>
</tr>
<tr>
<td></td>
<td>Polymeric nanomedicines for targeted cancer diagnostics and therapeutics, QIMR Berghofer Medical Research Institute (Queensland Institute for Medical Research) Cancer Biology Seminar Series, Brisbane.</td>
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<tr>
<td></td>
<td>An Aptamer-targeted hyperbranched polymer for detection of triple negative breast cancer, Cure Cancer Australia Research Symposium, Sydney.</td>
</tr>
<tr>
<td>Associate Professor Mehdi Mobli</td>
<td>COMBIO (organised by ASBMB, Sydney), September, presenting: Probing the structural details of ion-channel function using venom peptides.</td>
</tr>
<tr>
<td>Associate Professor Kris Thurecht</td>
<td>MACRO2018 (July), Cairns, presenting: Relating polymer material properties to their behaviour in vivo.</td>
</tr>
<tr>
<td></td>
<td>Australian Society for Biomaterials and Tissue Engineering (April), Perth, presenting: Development of Polymer Theranostics.</td>
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</tbody>
</table>
### Board and committee members

#### Editorial board roles

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Professor Markus Barth</td>
<td>Editorial board of Tomography</td>
</tr>
<tr>
<td></td>
<td>Editorial board of Frontiers in Biomedical Physics.</td>
</tr>
<tr>
<td>Dr Horst Joachim Schirra</td>
<td>Regional Editor, Current Metabolomics.</td>
</tr>
<tr>
<td></td>
<td>Editorial Board Member, Metabolites.</td>
</tr>
<tr>
<td></td>
<td>Editorial Board Member, Current Metabolomics.</td>
</tr>
<tr>
<td>Associate Professor Kris Thurecht</td>
<td>Guest Editor, Polymers.</td>
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</tbody>
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#### Conference session chairs

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Dr Nick Fletcher</td>
<td>2018 World Polymer Congress - MACRO conference, presented by the Royal Australian Chemical Institute (July, Cairns).</td>
</tr>
<tr>
<td></td>
<td>20th International Conference on Nanotechnology and Nanomedicine, Prague, Czech Republic, 2018.</td>
</tr>
<tr>
<td></td>
<td>2018 International Conference of Young Researchers on Advanced Materials (ICYRAM - November, Adelaide).</td>
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#### Group memberships

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Associate Professor Rajiv Bhalla</td>
<td>Chairperson of the Radiopharmaceutical Sciences Special Interest Group (Australian and New Zealand Society of Nuclear Medicine).</td>
</tr>
<tr>
<td>Dr Horst Schirra</td>
<td>Director, The Australian and New Zealand Society for Magnetic Resonance.</td>
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<tr>
<td></td>
<td>Director, Metabolomics Society.</td>
</tr>
<tr>
<td></td>
<td>Committee Member, Australian and New Zealand Metabolomics Network.</td>
</tr>
<tr>
<td>Name</td>
<td>Details</td>
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<td>--------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Dr Steffen Bollmann     | ISMRM (International Society for Magnetic Resonance in Medicine), June 2018 in Paris, France:  
Myelin water fraction across the corpus callosum using multi-echo gradient echo at 7T - influence of model settings and flip angle.  
Author: Thapaliya, Kiran; Vegh, Viktor; Bollmann, Steffen; Barth, Markus.  
Interactive and flexible quality control in fMRI sequence evaluation: the uniQC toolbox.  
Author: Bollmann, Saskia; Kasper, Lars; Pruessmann, Klaas; Barth, Markus; Stephan, Klaas.  
7T GRE-MRI frequency shifts obtained from signal compartments can differentiate normal from dysplastic tissue in focal epilepsy.  
Author: Thapaliya, Kiran; Barth, Markus; Bollmann, Steffen; Reutens, David; Vegh, Viktor.  
A data driven nyquist ghost and gradient delay correction for navigator-free 3D Planes on a Paddlewheel (POP) EPI.  
Author: Stäb, Daniel; Wech, Tobias; Barth, Markus.  
DeepQSM - Solving the quantitative susceptibility mapping inverse problem using deep learning  
Author: Kristensen, Mads; Bøtker Rasmussen, Kasper; Blendal, Rasmus; Østergaard, Lasse; Plocharski, Maciej; Janke, Andrew; Langkammer, Christian; O’Brien, Kieran; Barth, Markus; Bollmann, Steffen. |
| Dr Nyoman Kurniawan     | ISMRM (International Society for Magnetic Resonance in Medicine), June 2018 in Paris, France, E-posters:  
Comparison between 2D and 3D MEDIC in human cervical spinal cord at 3T.  
MR spectroscopy of mouse spinal cord injury at 9.4 Tesla.  
Spinal cord axonal diameter variations in the relapsing remitting EAE mouse model of multiple sclerosis. |
| Mary-anne Migotto       | Comparison of biodistribution following subcutaneous and intravenous administration of a novel zirconium-89 labelled anti-CD20 antibody using imaging. 70th Annual American Academy of Neurology (AAN) Conference 2018 (April), Los Angeles, USA.  
Authors: Mary-anne Migotto, Rajiv Bhalla, Karine Mardon, Jacqueline Orain, Gisbert Weckbecker, Rainer Kneuer, David Reutens.  
Imaging and biodistribution of a novel anti-CD20 antibody following subcutaneous administration in control and experimental autoimmune encephalomyelitis-variant mice. 34th Congress of the European Committee for Treatment and Research in Multiple Sclerosis (ECTRIMS) Conference 2018 (October), Berlin, Germany. Authors: Mary-anne Migotto, Rajiv Bhalla, Karine Mardon, Jacqueline Orain, Gisbert Weckbecker, Rainer Kneuer, David Reutens. |
Towards the development of novel fluorine-18 agents as alternatives to Ceretec for neuroimaging: 12th Congress of the World Federation of Nuclear Medicine and Biology (April), Melbourne.

**Other**

<table>
<thead>
<tr>
<th>Name</th>
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<th>Details</th>
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</thead>
<tbody>
<tr>
<td><strong>Professor Markus Barth</strong></td>
<td>Community and industry services</td>
<td>Science mentoring program: Mentored two high achieving students from Brisbane Boys College for their Science project for one semester. Industry services: Provided reference site for Siemens Healthcare customers and 7T reference site attracting visits from national and international academic and industry delegations.</td>
</tr>
<tr>
<td><strong>Sarah Daniel</strong></td>
<td>Special election</td>
<td>Elected President of the QLD Australian and New Zealand Society of Nuclear Medicine (ANSNM) Branch for a 2 year term, November 2018.</td>
</tr>
<tr>
<td><strong>Dr Nick Fletcher</strong></td>
<td>Community Service public speaker</td>
<td>Discussion with fundraisers of the Can Too Foundation about research funded by their contributions, June 2018.</td>
</tr>
<tr>
<td><strong>Mary-anne Migotto</strong></td>
<td>ePresentation</td>
<td>International Meeting: 4th Congress of the European Academy of Neurology (EAN) Conference 2018: June, Lisbon, Portugal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Title of Presentation: Comparison of biodistribution following subcutaneous and intravenous administration of a novel Zirconium-89 labelled anti-CD20 antibody using imaging.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Authors: Mary-anne Migotto, Rajiv Bhalla, Karine Mardon, Jacqueline Orain, Gisbert Weckbecker, Rainer Kneuer, David Reutens.</td>
</tr>
<tr>
<td><strong>Dr Horst Joachim Schirra</strong></td>
<td>News and Conference Reports</td>
<td>2018 MetaboNews interview, April 2018 (<a href="http://www.metabonews.ca">http://www.metabonews.ca</a>). MetaboNews is the leading monthly newsletter for metabolomics, produced in collaboration between The Metabolomics Innovation Centre and the international Metabolomics Society.</td>
</tr>
</tbody>
</table>
Dr Eivind Undheim  

**Paper publication highlights**

Publications in PNAS (Proceedings of the National Academy of Sciences of the United States of America), Science Advances, and Nature Communications (*selected from a total of ten publications in 2018)*.

**Supervision report:** PhD student, Vanessa Schendel, received an international PhD student scholarship and commenced in January (Project details: Centipede venom secretion: Modulation, functional neuro-anatomy and evolutionary origin of the venom gland).

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**Community and Outreach Activities**

CAI is passionate about education and sharing knowledge inspiration with the scientists of tomorrow. In 2018, CAI had a key focus on increasing outreach engagement, particularly in forming new collaborations and relationships with youth education groups.

**School tours**

The Centre held a total of 14 tours in 2018, including four school tours and one youth science group tour. CAI recently teamed up with the UQ School Liaison team to be included in UQ Campus Tours for activities and workshops for students. This saw an increase of school tour requests from new school partners such as Ambrose Treacy College and a Brisbane home education unit. In comparison to 2017, the school tours saw a steady increase. Additional tours were organised with Noosa Pengari Steiner School and the Queensland Academies of Science, Mathematics and Technology (QASMT) – due to availability, these tours were rescheduled at the group’s request to 2019.

The School tours include an overview of the centre, the science covered in our research and visiting the suite of our facilities including: human and animal imaging facilities (3T MRI, 7T MRI, 9.4T MRI, 16.4T MRI, large bore PET/CT), molecular imaging facilities (pre-clinical PET/CT and PET/MR), NMR and radiochemistry (cyclotron).

**National Youth Science Forum (NYSF)**

In 2018, the centre hosted the National Youth Science Forum (NYSF) for the first time. The NYSF visit in April was coordinated with assistance from the Faculty of Science. The exciting relationship with NYSF has developed, with the group organising tours in advance and a request to include CAI as part of the NYSF professional development program for science professionals (National Science Teachers Summer School - NSTSS), anticipated in 2019.

**Cavendish Road State High School:** An annual visit led by Dr Andrew Janke, physics and chemistry students of the school returned in 2018. A group of over 30 students joined an information session given by Dr Janke and toured the ultrasound, radiochemistry, 7T MRI and the PET/CT facilities. During these tours the students see first-hand how what they are learning as part of coursework on the use of radioactive isotopes in everyday practice and research.

**Redlands College:** For the fifth year running, the annual Redlands College visit was held at CAI as part of the Year 12 Physics program and assessment. The annual program includes an information session and presentation with Professor Ian Brereton, followed by a tour of the CT, MRI, PET and radiochemistry facilities. The tour included an ultrasound demonstration, and learning more about the 7T MRI, large bore PET/CT and cyclotron of the radiochemistry facility. The group incorporate what experience at the centre with in-class learning about physics used in medical imaging as part of their mid-year assessment.

**Brisbane Homeschool Group Outreach:** In October, the Centre hosted a home school group visit for the first time with the Brisbane Home Education Unit. The group, who were learning about the human brain, health,
disease and magnet strengths, were excited to see CAI’s cutting-edge technology in use for research in these areas, particularly the 7T MRI facility.

**Kingaroy State High School polymer chemistry program**

In a program led by Associate Professor Kris Thurecht and Dr Craig Bell, the Centre once again hosted STEM students from Kingaroy State High School (KSHS) for a three-day research camp in June. The annual visit aims to inspire young scientists. Involving the entire Thurecht Group, the group work with KSHS to develop a unique program that gives science students an opportunity to learn and apply practical skills in polymer chemistry. During the program, Thurecht Group members travel to the school and teach students advanced chemistry and assist in preparing polymer projects for a three-day excursion at CAI. Students learned how to synthesise their own polymers in the classroom and then travelled to UQ, where they were able to use the centre’s advanced facilities to characterise the polymers developed, exploring a number of techniques.

As part of the excursion, KSHS Students also had first-hand experience with VR nanomedicine technology and NMR spectroscopy. The 2018 KSHS STEM visit was featured in the South Burnett Times: *Exclusive excursion for our budding scientists*. The outreach program continues to receive excellent feedback from KSHS teaching staff and participating students.

**Springwood Rd State School Science Challenge Day**

In September, the Thurecht Group hosted a school science competition at Springwood Rd State School. PhD candidates and Postdoctoral Research Fellows spent the day with students, taking an innovative teaching approach outside of the classroom environment and organising a competition involving entertaining science activities. Students enjoyed a day of creative hands-on experiments, suitable to engage with children of all ages. Learning activities included learning about nanomaterials and ionic bonds, microorganisms, the surface of water, and acidity and pH levels. These activities (respectfully) involved making jelly beads, yeast balloons, building boats and creating red cabbage indicator. The aim of the school science challenge day was to show school students that science can be fun, as well as challenging.
Advance Science Program of Aspley State High School

In August, the expert NMR team, Dr Nyoman Kurniawan, Dr Greg Pierens and Dr Horst Schirra, supported the Aspley State High School Advance Science Program assisting the science students’ fermentation project. Using the Bio700NMR, the team completed NMR measurements of alcohol content of fruit juice fermentation (wine) made by the students as part of the Chemistry program. The student’s dedicated Chemistry teacher attended the centre to assist Dr Schirra prepare and run the student samples which were later analysed by the students in class.

Fundraisers

Our team are proud supporters of fundraiser events which contribute to research for disease prevention and helping those living with disease. In collaboration with MS Queensland and The Movember Foundation, CAI hosted fundraising events for MS Brissie to the Bay (led by Dr Yas Tesiram) and Movember (led by Dr Nick Fletcher and Nicole Atcheson), to support Australians living with multiple sclerosis and men’s health issues. Fundraising activities included barbecues, selling baked goods, and games such as decorating the beards of the research team. All funds raised were donated to MS Brissie to the Bay and The Movember Foundation.
STAFF & STUDENTS
The Centre’s Core Members

**Director**
Prof David Reutens

**Director Research and Technology**
Prof Ian Brereton

**Deputy Director, Operations**
Dr Celia Webby (until March)

**Centre Manager**
Dr Lorine Wilkinson (Acting from April)

**Executive Assistant**
Mrs Lesley Green

ARC Centre for Innovation in Biomedical Imaging Technology (CIBIT)

**Centre Managers**
Ms Irene Dullaway
Dr Shona Osborne

**Administrative Officers**
Mr Rohan Osborne
Ms Erika Reardon (from May)
Mrs Alani Winter

**Infrastructure and Operations Manager**
Mr Alan Pringle

**Engineers**
Mr Carl Dixon (until March)
Mr Donald Maillet

**Research and Projects Manager**
Dr Lorine Wilkinson (until April)

**Occupational Health and Safety Manager**
Dr Simon Nevin

**Radiation Protection Advisor**
Mr Ping Liu

**Finance Staff**
Ms Jennifer Cook
Mr Wayne Bahr (until April)
Ms Siobhan Power (from May)

**Information Technology Manager**
Mr Alan Hockings

**Senior IT Officer**
Mr David Butler

**Head of Teaching and Learning**
Mrs Gail Durbridge

**Lecturer**
Mr Matt Meredith

**Marketing and Engagement Officer**
Nina Moore (until April)
Maria Moran (from April)

**Student Administration**
Dr Talia Sellers (until March)
Ms Nathacha Subero Castillo (from May)

**Facility Managers**
Mr Aiman Al Najjar
A/Prof Rajiv Bhalla
Dr Gary Cowin
A/Prof Jeff Harmer
Dr Nyoman Kurniawan
Dr Karine Mardon
Dr Greg Pierens
Mr Damion Stimson
Dr Ekaterina Strounina

**Senior Research Radiographer**
Mrs Nicole Atcheson

**Senior Research Nuclear Medicine Scientist**
Ms Sarah Daniel

**Facility Staff**
Ms Xin Song

**National Imaging Facility**
Dr Saba Salehi
Ms Veah Tapat
Ms Candace Purdon

**Associate Professor**
A/Prof Rajiv Bhalla
A/Prof Idriss Blakey (joint appointment)
A/Prof Jeffrey Harmer
A/Prof Kai-Hsiang Chiang (joint appointment)
A/Prof Katie McMahon (until May)
A/Prof Kris Thurecht
A/Prof Margaret Wright (joint appointment)
A/Prof Mohammadmehdi Mobli

**ARC Future Fellows**
Prof Markus Barth
Senior Research Fellows
Dr Gary Cowin
Dr Andrew Janke
Dr Quang Tieng

Research Fellows
Dr Christopher Howard
Dr Yasvir Tesiram
Dr Viktor Vegh

Postdoctoral Research Fellows
Dr Reza Bonyadi
Dr Craig Bell
Dr Steffen Bollmann
Dr Min Chen
Dr Jiaxin Du
Dr Nick Fletcher
Dr Zach Houston
Dr Place Huda
Dr Xinying (Sid) Jia
Dr Daniel Stäb
Dr Eivind Undheim
Dr Michael Vogel
Dr Maryam Ziaei

Research Officers
Ms Charmaine Jeffrey (until July)
Mr Aung Aung Kwyee Moe

Research Support
Mr Aswin Narayanan

Clinical Trials Coordinator
Mrs Kimberley Irwin

Clinical Trials Officer
Ms Yvonne Guatam
Ms Leanne Rigby

Research Assistants
Mr Dhiraj Maskey (until Aug)
Ms Megan Campbell
Ms Ashley York
Ms Kathryn Richardson
Ms Dewan Akhter (from Sept)
Ms Mary-anne Migotto
Mr Ruben Pellicer Guridi (from Oct)

Adjunct Appointments
A/Prof David Wong
Dr Hanna Gauvin
Dr Kieran O’Brien
Dr Jeremy Ullmann
Dr Rod Straw
Dr Lars Marstaller
Dr Simone Bosshard
Dr Hana Burianova
Mr Dominic Kennedy (from Mar)

Affiliate Professorial Fellow
Prof Stuart Crozier
Prof Andrew Whittaker

Affiliate Research Fellow
Dr Marta Garrido
Dr Lena Oestreich

Honorary Professor
Prof Michael Kassiou
Prof Carolyn Mountford (until Sept)
Prof Michelle Sterling (until June)

Honorary Senior Research Fellow
Dr Andrew Janke (from Aug)

Honorary Research Fellow
Dr Christine Guo
Dr Chris Noble
Dr Sonia Brownsett (until Nov)
Occupational Trainees

Dominique Eden  
Supervisor: Dr Steffen Bollmann  
Project: Develop and assess strategies for registration of high-resolution structural and functional MR images  
(QUT, Australia)

Pia Hoy  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Matilde Kristensen  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Morten Larsen  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Sofie Mathiasen  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Mathias Olsen  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Mads Pedersen  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Kristine Soerensen  
Supervisor: Dr Andrew Janke & Dr Steffen Bollmann  
Project: Solving inverse problems in imaging using Deep Learning  
(Denmark)

Henar Rituerto Prieto  
Supervisor: Dr Steffen Bollmann  
Project: Creating multimodal minimum deformation atlases of the human brain  
(Spain)

Aline Martins dos Santos  
Supervisor: A/Prof Kris Thurecht  
Project: Development and evaluation of nanoparticle-loaded microparticles for oral delivery to colorectal cancer  
(Brazil)

Sarah Moen  
Supervisor: Dr Eivind Undheim and Sam Robinson  
Project: Green Ant Venomics  
(USA)
Student Association (STAC)

The CAI Student Association (STAC) aims to promote and foster the growth of our students through social and professional development activities throughout their studies. STAC promotes student engagement in social and professional activities to supplement high-quality research. With the support of the CAI executive team, STAC provides social and networking events, group outings, inter-institute competitions, skills workshops and educational seminars.

Each year, a small student team work together to facilitate a balanced lifestyle for all staff, prospective and current students including PhD, masters, honours and undergraduates through networking in a positive atmosphere. STAC aims to encourage our community to relax in a stress-free environment and have fun!

The group has continued to involve post-graduate coursework students as well as HDR students. This has provided a greater diversity of experiences and perspectives within the group.

In 2018, students took part in the following activities:

- **Information session for CAI student on life after PhD**: An information session was organised for new students about what can be expected post-PhD regarding various career opportunities like academia (Post-doctoral fellowships, industry jobs, or IP).
- **EKKA Day Hike and Barbecue**: Students enjoyed a group Mt Coot-tha hike on Royal Brisbane Show Day Public Holiday.
- **Bowling-n-Lasertag night**: Annual CAI extravaganza at STRIKE Wintergarden in Brisbane CBD, encouraging the student body to interact in an off-campus, informal setting.
- **Social mixers and barbecues**: A get-together for CAI students (as well as inter-institute students), to get to know each other outside the workspace and encourage networking with students in related disciplines amongst friendly drinks and barbecue together.
- **Inter-institute competitions, including the 2018 inter-institute soccer tournament**: This year, STAC teamed up with AIBN and came runners-up in the tournament!
- **Inter-institute Frisbee Afternoon**: STAC organised a friendly frisbee afternoon with AIBN.