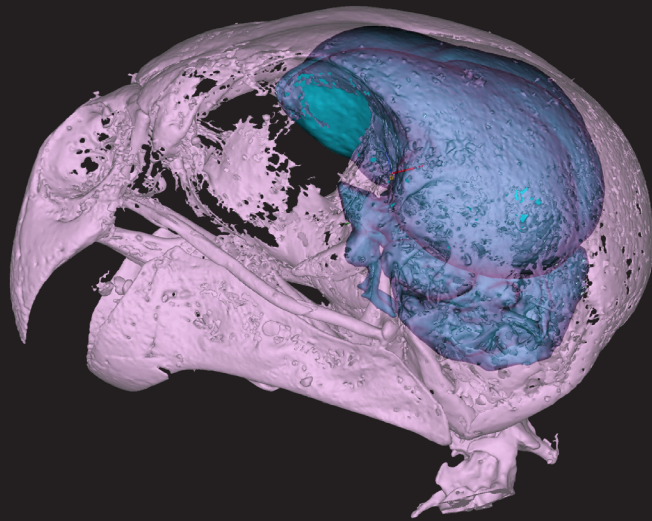


# Animal Imaging



The University of Queensland's Centre for Advanced Imaging (CAI) contains a comprehensive range of imaging technologies and expertise to enable novel small and large animal research.

**Access to the CAI animal imaging facilities is available on a fee basis. The following services are available:**

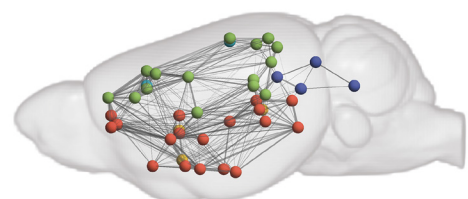
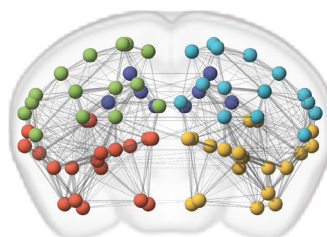
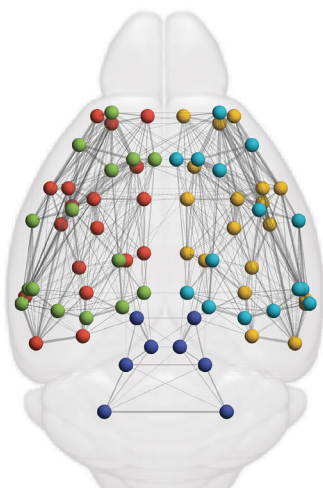
- Planning for *in vivo* projects
- Animal anaesthesia, surgery and holding rooms
- Development of novel hardware and sequence development
- MR coils for imaging of mouse and rat head and body
- Reconstruction and analysis of static or dynamic image data
- Kinetic modelling of dynamic image data

## 9.4T Biospec pre-clinical MRI

The Bruker Biospec MRI scanner consists of a 9.4 Tesla, ultrashield refrigerated 30 cm magnet interfaced to a Bruker Avance III spectrometer that allows unparalleled flexibility for MRI scanning of small and medium-sized research animals, fixed tissue and plant samples and MR technology development.

### Capabilities:

- Mouse and rat head and body coils for live animal and sample imaging
- <sup>1</sup>H mouse head cryoprobe, which enables maximum signal and image quality to be achieved for mouse brain imaging
- carbon-13 coils to investigate metabolism
- sodium-23 coils to investigate cell viability
- phosphorus-31 coils to investigate tissue energetics
- fluorine-19 coils for labelling of targeted tracers
- 8 parallel RF transmit and receive channels for multi-coil phased array



Rodent brain networks.

Top page image: CT image of a night parrot (*Pezoporus occidentalis*) skull.  
Imaged at CAI in collaboration with the Queensland Museum.



CT scan of a seahorse using the Inveon PET/CT scanner, for the purposes of studying anatomical structures and evolution.

## Inveon PET/CT

The Inveon multimodality PET/CT imaging scanner is capable of providing three dimensional CT and PET images of live mouse and rat as well as fixed biological samples and materials.

### Capabilities:

- Anatomical CT and functional PET images are automatically co-registered for easy analysis
- An integrated isoflurane anaesthetic gas system and physiologic monitoring system allow for image gating and animal monitoring during scanning
- The Inveon PET component delivers 1.4 mm full width at half maximum (FWHM) spatial resolution at the centre of field of view (FOV) with an axial FOV of 12.7 cm
- The PET scanner uses molecular imaging probes labelled with positron-emitting radionuclides (i.e.  $^{18}\text{F}$ ,  $^{11}\text{C}$ ,  $^{64}\text{Cu}$ )
- The CT component has a large area 125 mm X-ray camera and incorporates a high resolution, low noise X-ray imaging detector with 3072 x 2048 pixels and can be configured for a FOV as large as 8.4 cm x 5.5 cm
- Delivers high spatial resolution *ex vivo* CT images down to 8  $\mu\text{m}$  for a 20 mm FOV, allowing separate analysis of cortical and trabecular compartments of bone
- Multiple Inveon Research Workplace workstations for multimodality image review, fusion, and analysis
- Workstations support CT, PET and MR data in DICOM and Siemens CT and PET formats
- Quantitative analysis can be performed on static, gated and dynamic data

Higher resolution *ex vivo* and *in vitro* technologies are available at CAI for validation of pre-clinical *in vivo* PET imaging data:

- Biodistribution studies (Perkin Elmer Wizard Gamma well counter)
- Autoradiography studies (Amersham Typhoon Biomolecular Imager)

This is a flagship instrument of the National Imaging Facility.

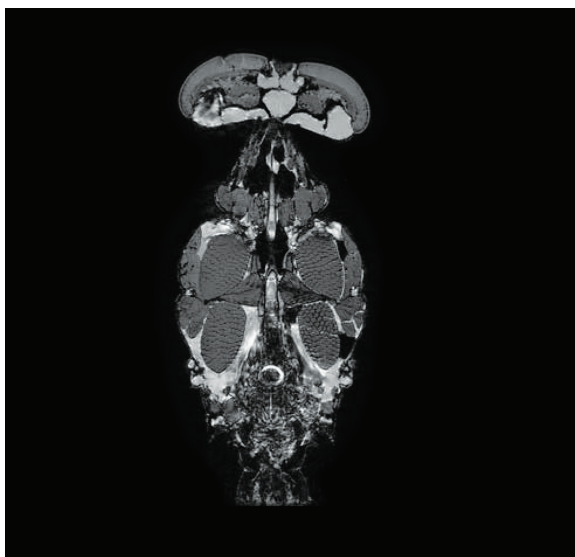
## 16.4T MR Microimaging

The 16.4T has the highest sensitivity for small sample imaging including fixed tissue, plant and materials imaging. This system is ideal for 3D imaging of fixed tissue, such as rodent brains, for atlas generation, or comparison of treatment animals with previously generated normative atlases. Specific applications include high-resolution 3D anatomical, high-resolution diffusion imaging and susceptibility-weighted imaging.

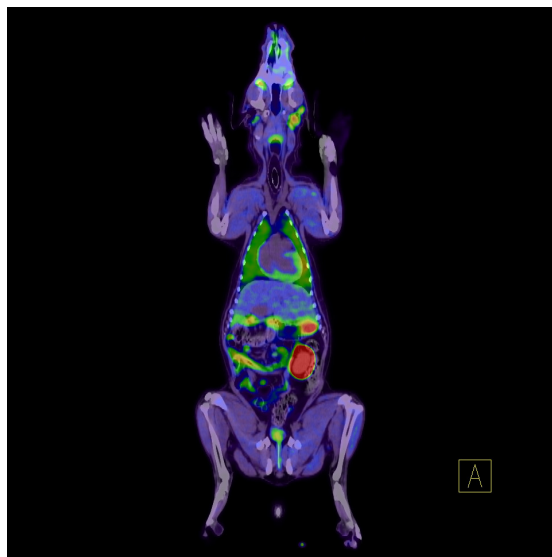
### Capabilities:

- Vertical 89 mm bore magnet providing sample space up to 34 mm diameter
- Three types of gradient inserts: micro5, micro2.5 and mini0.5 which provide gradient strengths of 4.8, 2.5 and 0.5 mT/m/A
- Range of microimaging coils (5, 10, 15, 20, 25, 28 and 35 mm diameters) to optimise image quality for various sample sizes
- The 20–35 mm coils are available for live mouse imaging
- High Resolution Magic Angle Spectroscopy (HR-MAS), which can be used to obtain  $^1\text{H}$ ,  $^{13}\text{C}$  and  $^{31}\text{P}$  spectroscopy information from biopsy samples
- Capable of imaging at sub-10 micron resolution enabling imaging of microscopic properties of biological samples and materials eg polymers and plastics

This instrument is part of the Queensland NMR Network (QNN), a consortium of linked NMR facilities at UQ, QUT and Griffith University.



MRI scan of a fly



PET-CT scan of a dog using radiotracer  $^{68}\text{Ga}$ -PSMA (prostate-specific membrane antigen).



Brain fibre tracts of a zebrafish

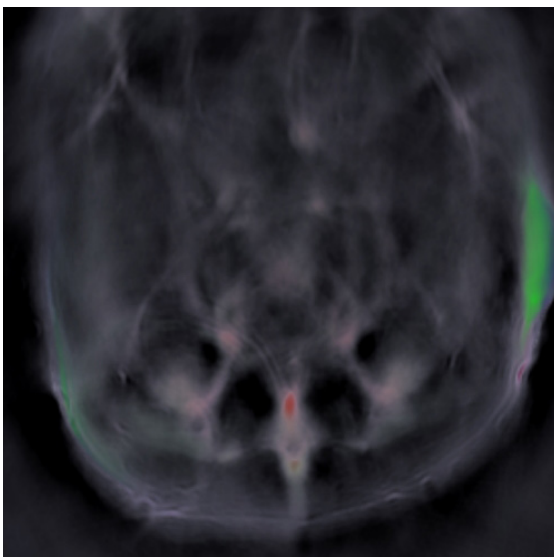
## Optoacoustic Imaging

### Multispectral Optoacoustic Imaging – iThera MSOT inVision 256-TF system

The inVision 256-TF MSOT system offers unique imaging capabilities, combining tomographic acoustic imaging with optical sensitivity. The exquisite spectral resolution offered by this instrument provides a powerful methodology for elucidating the presence of both endogenous and exogenous probes.

#### Capabilities:

- Single wavelength optoacoustic imaging at 10 Hz
- Real-time spectral component visualisation
- Penetration depth of up to 2-4 cm facilitating enhanced whole animal imaging
- Cross-sectional in-plane resolution of 150  $\mu\text{m}$
- Tomographic ultrasound detector array with 256 elements
- Rapid processing of temporal and spectral elements in imaging experiments



Optoacoustic image of gold nanoparticles surface coated with a polymer (highlighted green). Imaged by Nick Westra van Holthe, CAI Thurecht Group.

## Optical Imaging

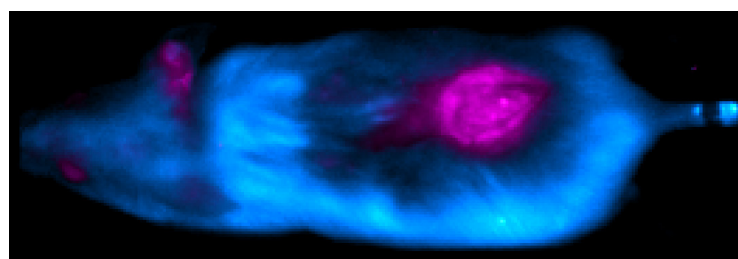
### IVIS Lumina X5 Imaging system

The IVIS® Lumina™ X5 high-throughput 2D optical imaging system combines high-sensitivity bioluminescence and fluorescence with high-resolution x-ray. This instrument is the workhorse for those undertaking preclinical assessment of novel therapeutics or imaging agents, with very high throughput enabled by the rapid screening of up to 5 mice simultaneously.

#### Capabilities:

- High-throughput optical and x-ray
- High resolution, low dose X-ray with optical overlay
- Supports mouse or rat imaging (20 x 20cm FOV)
- Compute Pure Spectrum (CPS) spectral unmixing
- Full fluorescence tenability through the NIR spectrum (up to 900 nm)
- Rapid data acquisition, analysis with streamlined workflows

“Optical imaging is a rapidly emerging technology which offers powerful imaging capabilities to measure the biodistribution and localisation of fluorescent and bioluminescent probes.”



Optical image of *Cyanine5* labelled protein targeting skin cancer (highlighted magenta). Imaged by Theo Crawford.



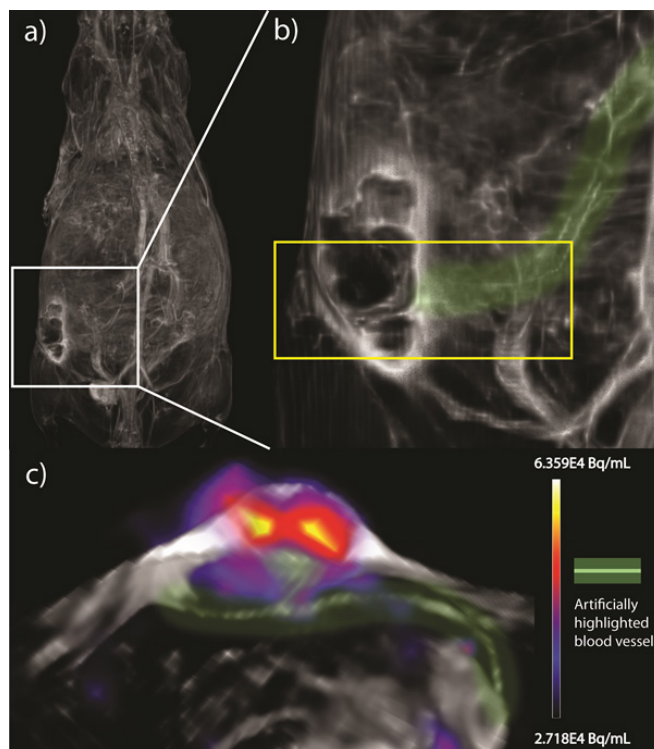
## Clinscan PET/MR

The Clinscan PET/MR allows simultaneous MRI and PET image acquisition and enables direct translation of research outcomes from animals to humans. This system is the first of its kind worldwide combining a high field MRI scanner, for high definition anatomical and functional MRI, with a PET insert that provides dynamic metabolic information. This is a powerful emerging multimodal imaging technology for studies of cancer and neurodegenerative disease.

### Capabilities:

- Provides simultaneous acquisition of MRI and PET images of an animal or sample
- 7 Tesla, 30 cm bore superconducting magnet, with operating software identical to the Siemens clinical MRI platform (Syngo)
- Mouse and rat head and body coils for live animal and sample imaging
- 150 mm large sample rf coil
- PET insert has a FOV with a diameter of 9 cm and length of 7 cm
- PET image acquisition is performed with the Siemens Inveon Acquisition Workplace (IAW) software

This is a flagship instrument of the National Imaging Facility.



PET/MR image showing distribution of a polymeric nanomedicine (rainbow colour) in a melanoma tumour (blood vessels artificially highlighted in green).

## Large animal imaging

Large animal imaging research is available at CAI with the Centre's 3T and 7T Whole Body MRI and Biograph Horizon PET/CT Large Bore Scanners.

The scanners are used for CAI's comparative oncology research program, assisting with the diagnosis of companion animals whilst contributing to cancer research.

To find out more about large animal imaging, visit [cai.centre.uq.edu.au/facilities](http://cai.centre.uq.edu.au/facilities) or contact [humanMRI@cai.uq.edu.au](mailto:humanMRI@cai.uq.edu.au)



A canine patient undergoes a PET/CT scan as part of the comparative oncology research program



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109638 June 2019

**Enquiries** W: [cai.centre.uq.edu.au](http://cai.centre.uq.edu.au)  
T: +61 7 3365 4100  
E: [molecular\\_imag@cai.uq.edu.au](mailto:molecular_imag@cai.uq.edu.au)  
[preclinical\\_imag@cai.uq.edu.au](mailto:preclinical_imag@cai.uq.edu.au)

Centre for Advanced Imaging  
The University of Queensland  
Brisbane Qld 4072 Australia



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