



The University of Queensland's Centre for Advanced Imaging (CAI) is at the forefront of imaging science and is the only centre of its kind in Australia. The Centre is also a research platform for UQ Neurosciences – one of UQ's research strengths.

CAI is an integrated, multimodal research facility with a rich collaborative environment. The Centre brings together the skills of a large multidisciplinary team of researchers, industry experts, and state-of-the-art research facilities.

Imaging and spectroscopic techniques are key platforms for studying the structure and function of living organisms in health and disease, molecular characterisation and drug discovery. CAI's collaborations with clinical research sites, including national and international research institutes, maximises the translational impact of our research.

Providing a comprehensive 'end-to-end' biomedical imaging capability and driving research through an integrated progression from a laboratory to a clinical setting, the Centre undertakes research in a variety of areas.

### Key areas of research include

- molecular and biomedical imaging including magnetic resonance imaging (MRI) and positron emission tomography (PET) in humans and animal models (including comparative oncology)
- nuclear magnetic resonance (NMR)
- electronic paramagnetic resonance spectroscopy (EPR)
- materials science
- development and engineering of imaging technology
- data analysis and applications of novel computational methods
- structural biology and chemistry

The Centre houses the most comprehensive range of advanced magnetic resonance instrumentation in the southern hemisphere, including Australia's first 7T whole body human scanner and the only 900 MHz NMR magnet in Australia.

CAI researchers work on innovations in spectroscopic and imaging technology, imaging biomarker development and biomedical research disciplines.

CAI's vision is to be a world leader in the development and application of cutting-edge imaging science and technology, through innovation, translation, education and collaboration.

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# Human Imaging

CAI houses whole-body scanners and ultrasound. These are available for research studies ranging from neurology, cardiology, angiography, oncology and musculoskeletal, paediatrics and engineering. Research is conducted on state-of-the-art equipment, with access to world-class expertise.

## Whole-body MRI scanners

### 7T Magnetom

The first of its kind in Australia, the Siemens 7T MRI provides a high-performance gradient system with multi-receive and multi-transmit radiofrequency capabilities. These further increase the sensitivity available at the ultra-high field strength while maintaining good spatial homogeneity.

### 3T Prisma

The Siemens Magnetom Prisma provides an upgraded system with new MRI applications to deliver higher anatomical detail. The facility has a wide range of coils, software and peripheral equipment to support research studies in neurology, cardiology, angiography, oncology, orthopaedics, paediatrics and cognitive neuroscience.

### Biograph Horizon PET/CT

The Siemens Biograph Horizon human scanner provides high resolution three-dimensional CT and PET images of humans and large animals, enabling registration and fusion of physiologic and anatomic information. The PET scanner has an axial field-of-view of 164 mm and time-of-flight reconstruction capability. The CT component produces high-resolution images used for fast attenuation correction maps of the PET images and allows anatomical reference for the fused PET and CT images.

### Ultrasound

The high performance Siemens Acuson S3000 ultrasound can be used for a wide variety of studies including fetal monitoring, the assessment of musculoskeletal structures, blood flow velocity and organ perfusion.

For more information, visit  
[cai.centre.uq.edu.au/facilities/human-imaging](http://cai.centre.uq.edu.au/facilities/human-imaging)



# High-Resolution NMR Spectroscopy

The high-resolution nuclear magnetic resonance (NMR) facility at CAI caters for spectroscopic investigations in solution with applications across the chemical, biochemical and physical sciences.

### Avance 900

This Bruker instrument is the highest field system in Australia and is optimised for biomolecular studies. It provides high-resolution, three-dimensional structures of membrane proteins, complex carbohydrates, nucleic acids and protein-protein complexes and is able to map macromolecular interactions. These studies are not possible on lower field systems. The system offers unparalleled sensitivity and resolution for NMR-based metabolomics studies.

### Avance 700

The Bruker 700 MHz spectrometer is optimised for life science and chemical research in metabolomics, biochemistry, chemistry, structural biology, nutritional science and molecular diagnostics. The instrument is equipped with a cooled SampleJet high-throughput sample handling and analysis system.

### Avance 500

The Bruker Avance 500 MHz high-resolution NMR spectrometer, interfaced to a 11.7 Tesla 51 mm bore magnet, is for use in research applications in the chemical, physical and biological sciences.

### Avance 300

The Bruker Avance 300 solid state NMR is designed for material characterisation, using a combination of spectroscopy and relaxometry. It is non-destructive and requires only small quantities of material for analysis.

For more information, visit  
[cai.centre.uq.edu.au/facilities/high-resolution-nmr-spectroscopy](http://cai.centre.uq.edu.au/facilities/high-resolution-nmr-spectroscopy)



“CAI researchers have extensive experience with a wide variety of studies and are available to provide expert guidance with project planning, data analysis and optimisation.”



## Animal Imaging

The primary capabilities of CAI's animal facilities are structure, function and molecular imaging in live animal, fixed tissue or materials.

### 9.4T Pre-clinical Imaging

The Biospec 9.4T is a 400 MHz 30 cm 8 channel transmit/receive imaging system that is capable of state-of-the-art MRI of live small animals and fixed samples from 10 mm to 150 mm in diameter. The system is equipped with a cryoprobe surface coil for imaging with the highest sensitivity available and coils are available for imaging proton, fluorine, phosphorous, carbon and sodium.

### Clinscan PET-MR

The world's first Bruker ClinScan MR/PET enables translational research and molecular imaging, combining a 7T animal MRI with a PET camera to allow simultaneous acquisition of MRI or MRS and PET images. PET-MR imaging holds great promise for multimodal imaging approaches to the study of metabolic processes involved in disease such as cancer and neurodegenerative disease, and the development of targeted or smart drugs and theranostic imaging agents. The technology exploits the exquisite anatomical imaging of MRI combined with dynamic metabolic measurement by PET imaging.

For more information, visit  
[cai.centre.uq.edu.au/facilities/animal-imaging](http://cai.centre.uq.edu.au/facilities/animal-imaging)

## Molecular Imaging

Molecular imaging is rapidly growing in importance in the applied life sciences and in drug discovery and validation. Imaging techniques include PET, optical fluorescence, optical bioluminescence, MRI and ultrasound.

### Inveon PET/CT

This Siemens instrument is capable of providing three-dimensional Computed Tomography (CT) and Positron Emission Tomography (PET) images of a live mouse and rat and fixed samples. The system can deliver high-resolution CT images with a maximum field-of-view of 80 mm x 50 mm. The minimum resolution achievable with the PET scanner is approximately 1 mm (maximum field-of-view of 120 mm) with a high sensitivity in the pico-molar range. The PET scanner measures the distribution of molecular imaging probes labelled with positron-emitting radionuclides produced by a cyclotron (i.e.  $^{18}\text{F}$ ,  $^{11}\text{C}$ ,  $^{64}\text{Cu}$ ).

### Mass Spectrometry Imaging

A Bruker Autoflex MALDI-TOF/TOF MSI facility is available for both advanced MSI and protein analysis. The technology is an ideal platform for mass analysis of biomolecules and characterisation of protein folding and sequencing, including biomarker studies in cancer and drug distribution.

### IVIS Lumina X5

The IVIS<sup>®</sup> Lumina<sup>™</sup> 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. Capabilities include high throughput optical and X-ray imaging, high resolution low dose X-ray with optical overlay, Compute Pure Spectrum (CPS) spectral unmixing for deconvolution of multiple fluorophores, fluorescence detection from the visible spectrum through the NIR spectrum, and rapid data acquisition. The IVIS supports mouse or rat imaging.

### inVision 256-TF

The iThera MSOT inVision 256-TF 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 include 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 and rapid processing of temporal and spectral elements in imaging experiments.

For more information, visit  
[cai.centre.uq.edu.au/facilities/molecular-imaging](http://cai.centre.uq.edu.au/facilities/molecular-imaging)



## MR Micro-Imaging

Magnetic resonance (MR) microimaging is used to probe the microscopic properties of small biological and non-biological samples.

### Avance 16.4T

The 700 MHz wide-bore micro-imaging system is capable of providing extremely detailed images of intact biological specimens. This spectrometer allows live mouse, fixed tissue and sample imaging from 4 mm to 30 mm diameter. Probes are available for imaging proton, fluorine and carbon.

For more information, visit  
[cai.centre.uq.edu.au/facilities/microimaging-facility](http://cai.centre.uq.edu.au/facilities/microimaging-facility)

# EPR Spectroscopy

Multifrequency continuous wave (CW) and pulsed electron paramagnetic resonance (EPR) spectroscopy are powerful tools for structurally characterising molecules containing one or more paramagnetic centres. Examples include free radicals, transition metal ions and multiatom clusters found in such diverse areas as nanomaterials, materials science, structural biology and chemistry, food science, radiation dosimetry and medicine.

Non-invasive EPR imaging offers the capacity to spatially locate paramagnetic molecules in small animals and bulk materials.

Facilities at CAI include:

- a Bruker Elexsys E500 CW (Q-, X-, S-band) variable temperature (1.5-400K) EPR Spectrometer
- a Bruker Elexsys E580 Pulsed (Q-, X-band) variable temperature (1.5-300K) EPR/ENDOR/ELDOR Spectrometer
- a Bruker Elexsys E540 (X-, L-band) Imaging Scanner
- EPR software (XSophe, Molecular Sophe) for the analysis of CW and pulsed EPR/ENDOR spectra

For more information, visit  
[cai.centre.uq.edu.au/facilities/  
epr-spectroscopy](http://cai.centre.uq.edu.au/facilities/epr-spectroscopy)



# Radiochemistry

The radiochemistry facility at CAI consists of an IBA 18/18 MeV cyclotron capable of making a wide range of radioisotopes including carbon-11, fluorine-18, copper-64 and iodine-124. In addition to these isotopes, the facility is capable of using a wide range of isotopes including gallium-68, zirconium-89, technetium-99m and lutetium-177.

With access to 14 hot cells and four fume hoods, the facility provides a unique environment for performing novel drug discovery, preclinical research and translation of tracers to human imaging.

For more information, visit  
[cai.centre.uq.edu.au/facilities/  
radiochemistry-and-cyclotron](http://cai.centre.uq.edu.au/facilities/radiochemistry-and-cyclotron)

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