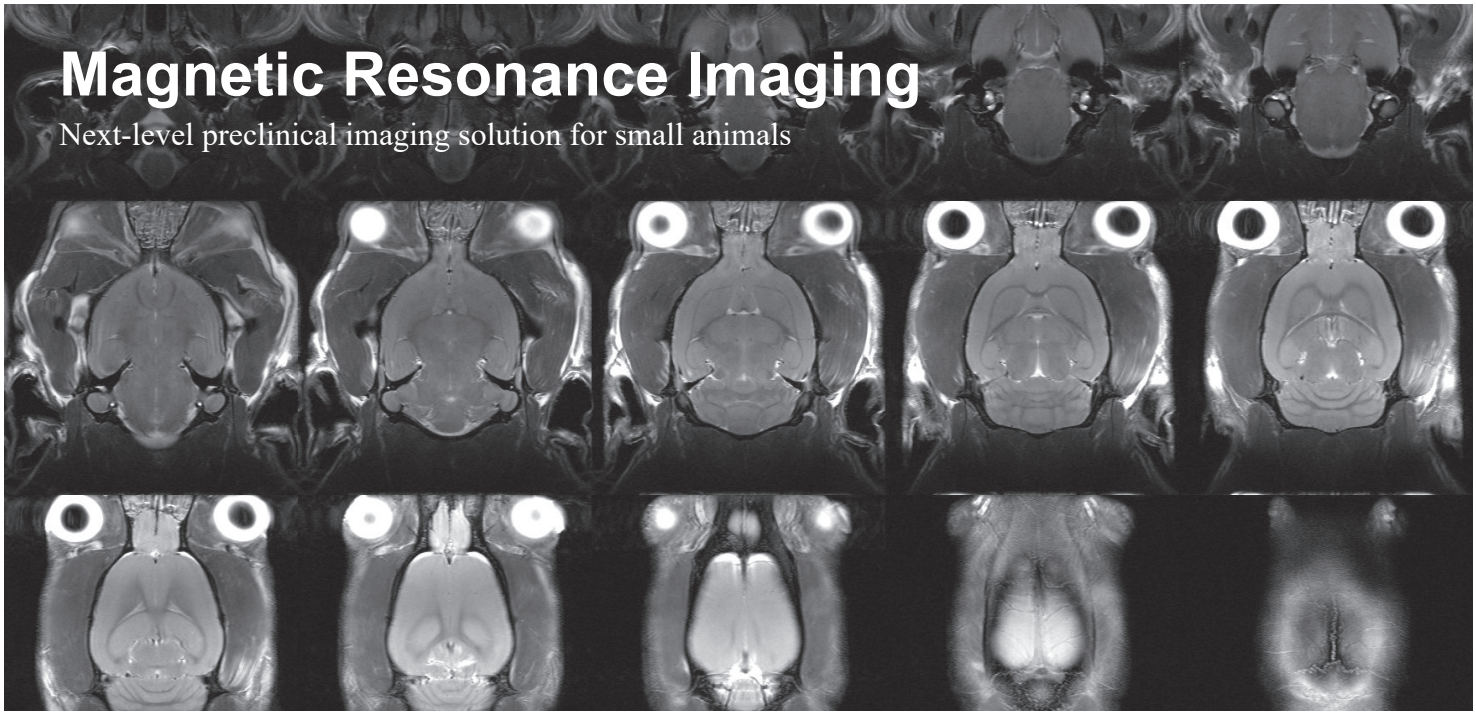
LIFE SCIENCE

NEWSLETTER OF THE UNIVERSITY RESEARCH FACILITY IN LIFE SCIENCES, THE HONG KONG POLYTECHNIC UNIVERSITY / IS13 / SPRING 2025



NEW AT THE ULS

CryoCapCell/Zeiss HPF and Live-CLEM workstation

The ULS has recently acquired a CryoCapCell HPM Live μ High Pressure Freezing (HPF) System that is coupled with a Zeiss LSM 900 Confocal Microscope with Airyscan 2. Such configuration allows users to perform live, high-resolution confocal imaging to screen and pinpoint the particular cell(s) or cellular event for which they need to "snapshot", seconds before high-pressure freezing the sample, therefore making the HPF-fixed sample biologically relevant. In addition, in combination with microscopes at our Cryo-EM Centre, the platform enables correlative light and electron microscopy (CLEM), whereby captured confocal images can be overlaid with post-HPF EM images, providing another dimension for examining the biological sample of interest.

The new HPF and Live-CLEM workstation at the ULS.

Leica STELLARIS 5 LIAchroic Cryo-confocal Microscope

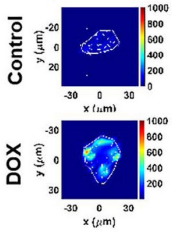
To further enhance our CLEM support, the ULS has acquired a Leica STELLARIS Cryo-confocal Microscope to allow users to image fluorescently labelled targets in their cryo-tomography (cryo-ET) samples. The samples can be safely transferred to our ThermoFisher Aquilos 2 Cryo-FIB system under cryo-condition using a dedicated shuttle after imaging, and the captured confocal images can be seamlessly imported into the Maps software to guide users to identify their target of interest with nanometre precision in 3D. Such integrated CLEM and cryo-FIB workflow would vastly reduce the amount of time required for cryo-lamella preparation.

ThermoFisher Orbitrap QE Plus LC/MS

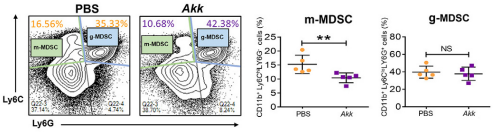
A ThermoFisher Orbitrap QE Plus Liquid Chromatography/Mass Spectrometer (LC/MS) is now available. This instrument offers accurate mass measurement of peptides and intact proteins, tandem MS function for obtaining peptide sequence information, and online connection with a hydrogen/deuterium exchange (HDX) automation system for structural analysis of proteins. Potential applications include characterisation of the conformation, modification, binding and/or dynamics of proteins and their oligomers.

POLYU RESEARCH

1. Prof. Youhua Tan's group (BME) investigated the inverse correlation between tumour cell contractility and chemosensitivity, and found that intercellular contractile force mediated nuclear export of chemotherapy drugs *via* the activation of Notch signalling and subsequently major vault protein. Our BD FACSAria III, FACSVia, PerkinElmer IVIS and Leica SPE systems were used in this study.



Above: Breast cancer cells (MDA-MB-231) selected by doxorubicin (DOX) exerts higher contractile forces than control cells. *PNAS* **122(19)**, e2417626122 (2025).
Below: *Akk* treatment was shown to suppress monocytic myeloid-derived suppressor cells (m-MDSCs) in tumours. *Cell Rep. Med.* **6**, 101900 (2025).



2. Prof. Terence Lee's group (ABCT) examined the role of *Akkermansia muciniphila* (*Akk*) in the immune resistance of metabolic dysfunction-associated fatty liver disease (MAFLD)-hepatocellular carcinoma (HCC), and found that it attenuated tumour growth, repaired intestinal lining and suppressed certain immune cells. Their findings further suggested that *Akk* may serve as a predictive biomarker for PD1 response in MAFLD-HCC. Our BD FACSAria III, Applied Biosystems QS7, PerkinElmer IVIS and Leica SPE systems were used in the study.

MAGNETIC RESONANCE IMAGING

Next-level preclinical imaging solution for small animals

Magnetic resonance imaging (MRI) is a widely used medical imaging modality for examining the body's anatomy, physiology and metabolism. It produces images of soft tissues, such as the brain, muscle, heart, and tumour with high spatial resolution and contrast. Unlike X-ray or computed tomography (CT) scans, MRI does not involve ionising radiation, making it safer for repeated use on the same subject. To strengthen our support for preclinical research, the ULS has acquired a Bruker BioSpec 70/20 USR MRI System alongside various animal imaging equipment at our Animal Imaging Centre.

MRI uses strong magnetic fields and radio waves to generate detailed images of organs and soft tissues. Hydrogen atoms, primarily found in water and fat, are abundant and randomly oriented in the body. The strong magnetic field of an MRI system causes protons to align with and create magnetic vectors oriented along the axis of the field. Radiofrequency (RF) pulses are then sent by the transmit coils to align protons at an angle to the magnetic field. Protons would then spin in phase with each other, creating "resonance". RF pulses are subsequently turned off to allow protons to "relax" back to the original alignment; dephasing of protons occurs at the same time. The relaxation of protons emits radio signals, which are detected by the receive coils to generate MRI images that are essentially maps of proton energy within the tissue. Numerous types of MRI images can be produced by varying the pulse sequence parameters of the scanner. Tissues that contain different amount of fat or water may then be differentiated **(Table 1)**. Often, healthy and pathological tissues can be identified, as the former may display a more well-organised structure and latter more cluttered areas.

Tissue type	T1WI	T2WI	PD
Fat	++++	++++	+++++
Water (*e.g.*, CSF)	+	++++	+++
Muscle	+++	+++	+++
White matter	++++	+	+
Bone (cortical)	+	+	+

Table 1. Reference signal intensities of various tissue types when imaged with T1-weighted image (T1WI), T2-weighted image (T2WI) or proton density (PD)-weighted maps.

Our Bruker MRI System is designed for preclinical imaging of small animals. It features a powerful 7-tesla superconducting magnet that delivers enhanced spatial resolution, contrast and signal-to-noise ratio (SNR) compared to systems with lower magnetic field strengths. Multiple RF coils are available for samples with different shapes and sizes, *e.g.*, the head, brain or even whole body of small rodents. Other compatible samples include zebrafish, small *ex vivo* specimens, and virtually any samples that could fit into the 20 cm bore diameter. In addition, the system is equipped with the so-called "MRI CryoProbe", which is a cryogenically-cooled RF probe that can boost the SNR, deliver higher image resolution (*i.e.*, ~20 μm), and shorten the scan time. To facilitate *in vivo* imaging, the system is equipped with a gas anaesthesia system and offers real-time physiological monitoring, including heart and breathing rates, and body temperature.

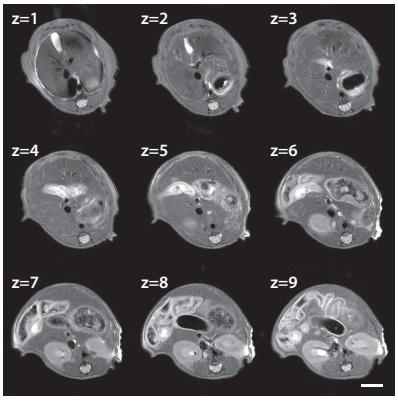


Figure 1. Serial T2-weighted images taken axially across the body of an anaesthetised mouse. Scale bar is 5 mm.

Preclinical MRI offers a fascinating window into the intricate workings of small animal models, such as mice **(Fig. 1)** and rats (see **cover image** for T2-weighted images of the head of an anaesthetised rat), before performing tests in humans. This powerful tool allows researchers to delve deep into anatomical and metabolic functions, uncover disease mechanisms, and explore potential treatments. By tracking disease progression, monitoring treatment responses over time, and assessing long-term effects, researchers can obtain invaluable information without the risks of radiation exposure or invasive surgeries.

COMING SOON

An Alvéole PRIMO 2 Micropatterning System will soon be available to help researchers precisely position cultured cells in the centres of EM grid squares, which will vastly simplify the downstream cryo-ET workflow.

GET IN TOUCH

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ULS EQUIPMENT AT A GLANCE

Mass Spectrometry
- Bruker AmaZon Speed Ion Trap-ETD MS
- Bruker UltrafleXtreme MALDI-TOF/TOF MS
- Agilent 6460 Triple Quadrupole LC/MS
- Agilent 6540 Quadrupole-TOF LC/MS
- SCIEX 6500+ QTrap LC/MS
- ThermoFisher Orbitrap IQ-X LC/MS
- ThermoFisher Orbitrap QE Plus LC/MS
- Waters UPLC with QDa Mass Detector

Cryo-Electron Microscopy
- ThermoFisher Krios G4 300 kV Cryo-TEM System
- ThermoFisher Glacios 200 kV Cryo-TEM System
- ThermoFisher Talos L120C 120 kV TEM System
- ThermoFisher Aquilos 2 Cryo-FIB System
- CryoCapCell/Zeiss HPF & Live-CLEM Workstation
- Leica STELLARIS Cryo-confocal Microscope
- NVIDIA A800/H100/RTX 4090 GPU Cluster

Fluorescence Microscopy
- Abberior STED Super-resolution Microscope
- Leica SPE Confocal Microscope
- Leica SP8 Multiphoton/Confocal Microscope
- Nikon T*i*2-E Live-cell Imaging System
- Nikon SIM/STORM/A1 SR/Confocal Microscope
- Nikon AX R MP Upright Microscope w/ NSPARC
- Zeiss Lightsheet 7 Microscope
- Zeiss Lattice Lightsheet 7 Microscope
- Zeiss V16 Zoom Microscope with Apotome 3

Preclinical Animal Research
- Bruker BioSpec 70/20 USR MRI System
- Bruker LF90II Body Composition Analyser
- Bruker SkyScan 1276 *in vivo* Micro-CT Scanner
- PerkinElmer IVIS *in vivo* Imaging Systems
- Fujifilm Vevo LARZ US/PA Imaging System
- Promethion Metabolic Cage System

Cell and Molecular Biology
- BD FACSAria III Cell Sorter
- BD FACSymphony A3 Cell Analyser
- BD Accuri C6/FACSVia Cell Analysers
- Roche LightCycler II qPCR System
- Applied Biosystems QS 5/7 Flex qPCR Systems
- Seahorse XFe24 Extracellular Flux Analyser
- Logos X-CLARITY Tissue Clearing System
- RWD DSC-810 Single-cell Suspension Dissociator

Biochemical Analysis
- Bio-Rad Bio-Plex 200 Suspension Array System
- Bruker Sierra SPR-32 Pro Analyser
- Jasco J-1500 CD/CPL-300 CPL Spectrometers
- Malvern MicroCal Automatic ITC System
- Refeyn TwoMP Mass Photometer
- Tecan Automatic Liquid Handling System

Genomic Science
- Agena MassARRAY Analyser 4 System
- Agilent 2100 Bioanalyser System
- Covaris ME220 Focused-ultrasonicator
- 10× Chromium iX Single Cell Analysis System
- Illumina NextSeq 2000/MiSeq NGS Systems
- Nanopore GridION Mk1 Sequencing System

- New in 2025