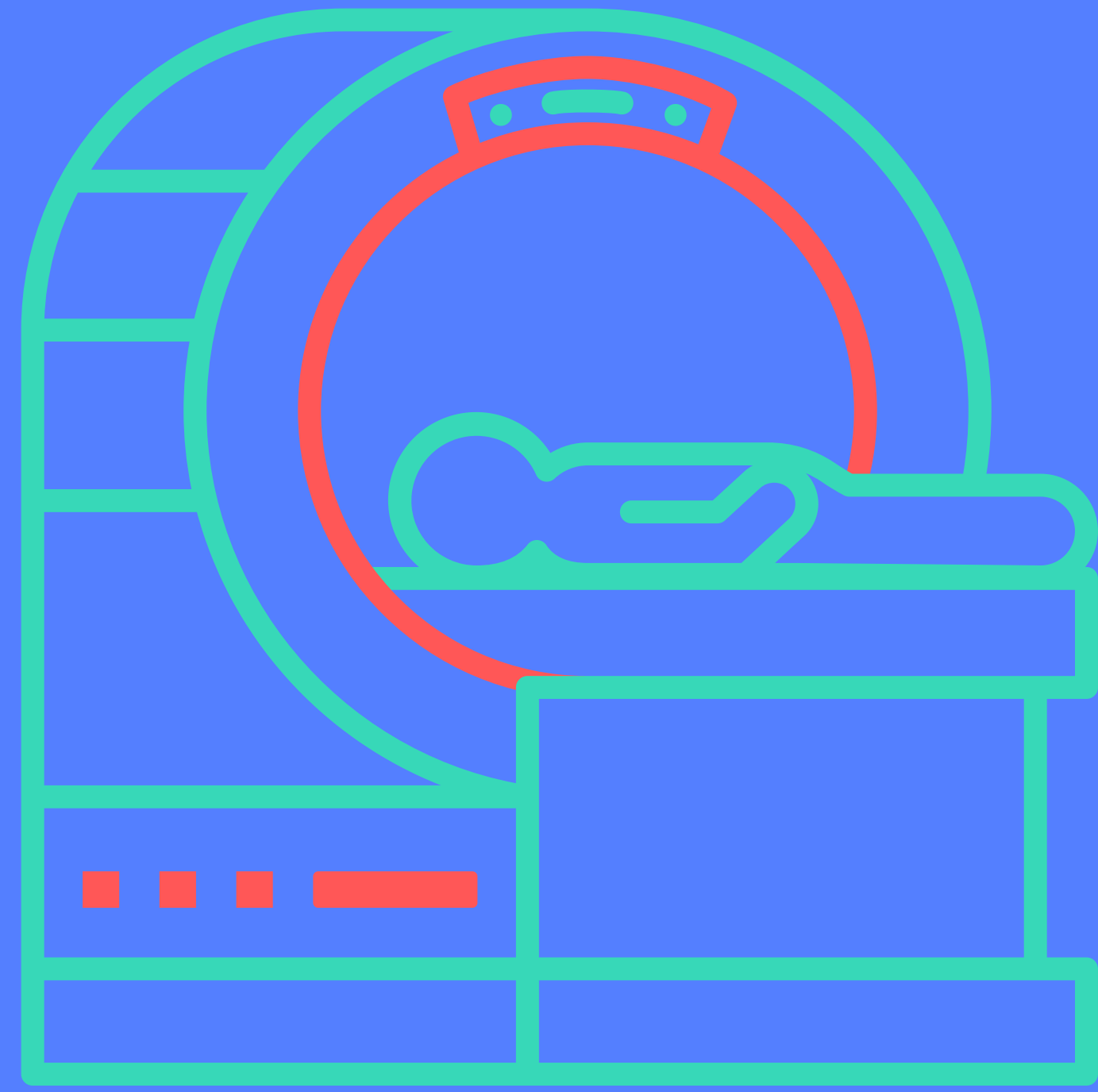


# MRI PHYSICS

Presented by Jennifer Hughes



# WHAT IS MRI

**Magnetic**

---

**Resonance**

---

**Imaging**

---

# WHAT IS MRI

## Magnetic



- Superconducting magnet
- Clinical scanners typically 1.5T or 3T field strength
- No ionising radiation

## Resonance

## Imaging

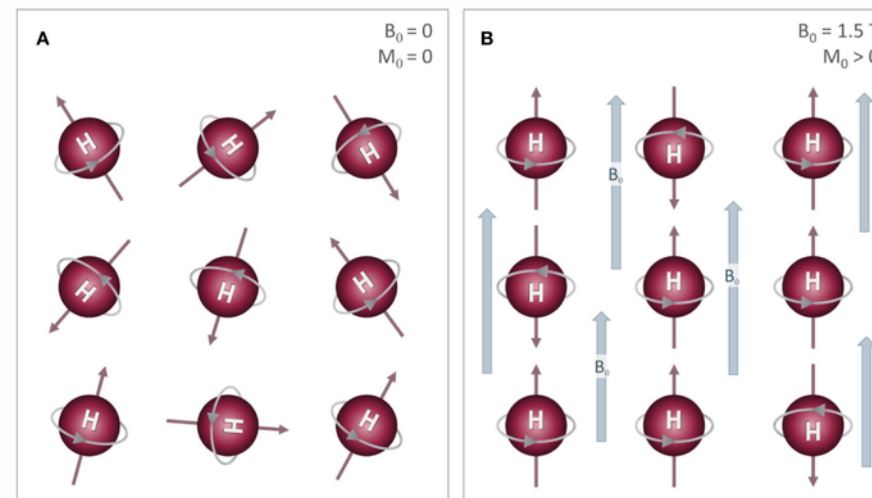
# WHAT IS MRI

## Magnetic



- Superconducting magnet
- Clinical scanners typically 1.5T or 3T field strength
- No ionising radiation

## Resonance



- Protons: spin + charge  $\rightarrow$  magnetic moment
- When placed in a strong magnetic field they align with the field
- With the combination of the static field, magnetic field gradients and radiowaves these spins are manipulated to produce a signal

## Imaging



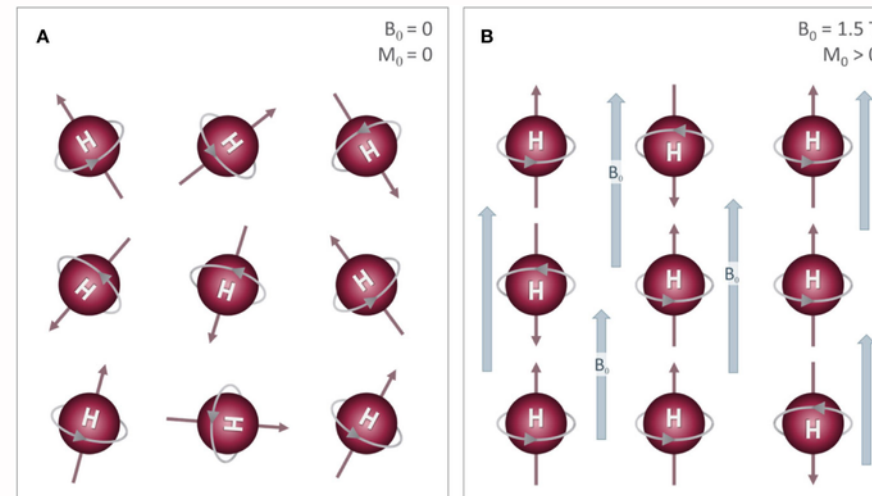
# WHAT IS MRI

## Magnetic



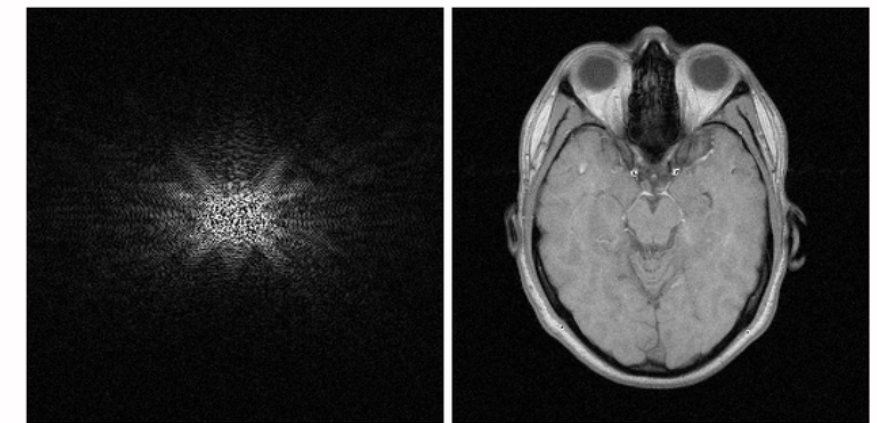
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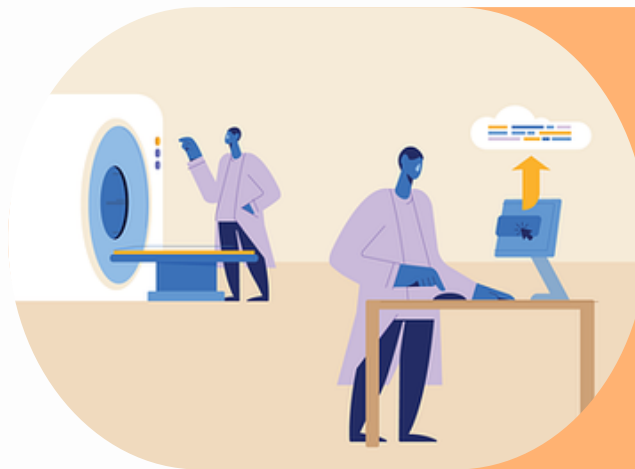


The signals detected by the computer are transformed into an image using a Fourier Transform

# MRI PHYSICS ROLE



MRI  
SAFETY



CLINICAL AND  
TECHNICAL  
SUPPORT



EQUIPMENT  
SUPPORT

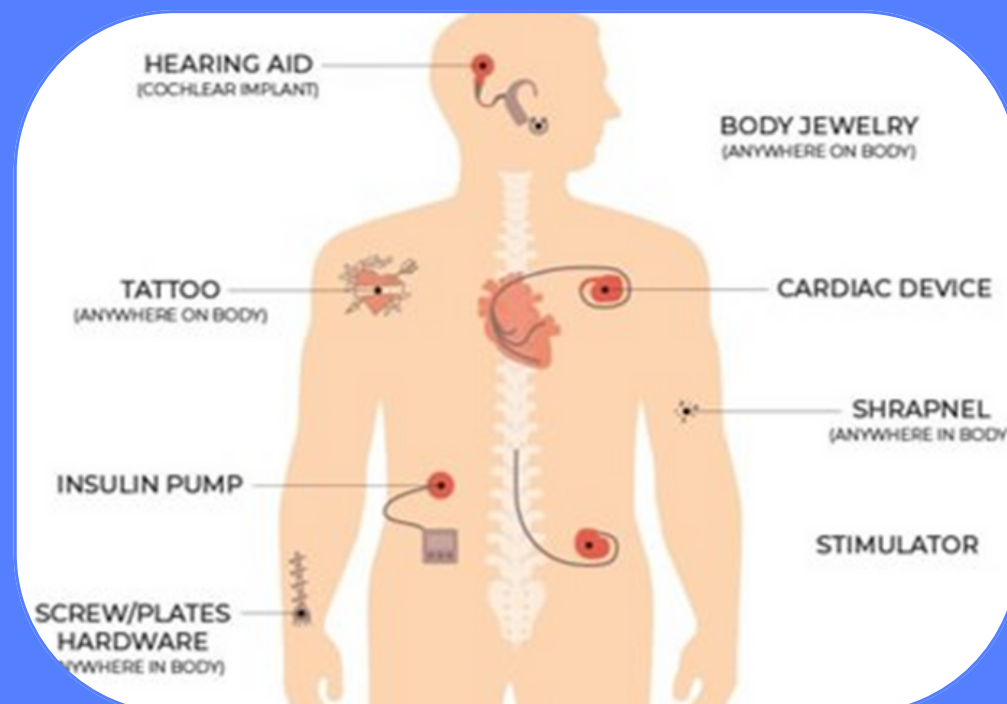


RESEARCH AND  
DEVELOPMENT



TEACHING AND  
TRAINING

# MRI SAFETY



## SAFETY RISKS

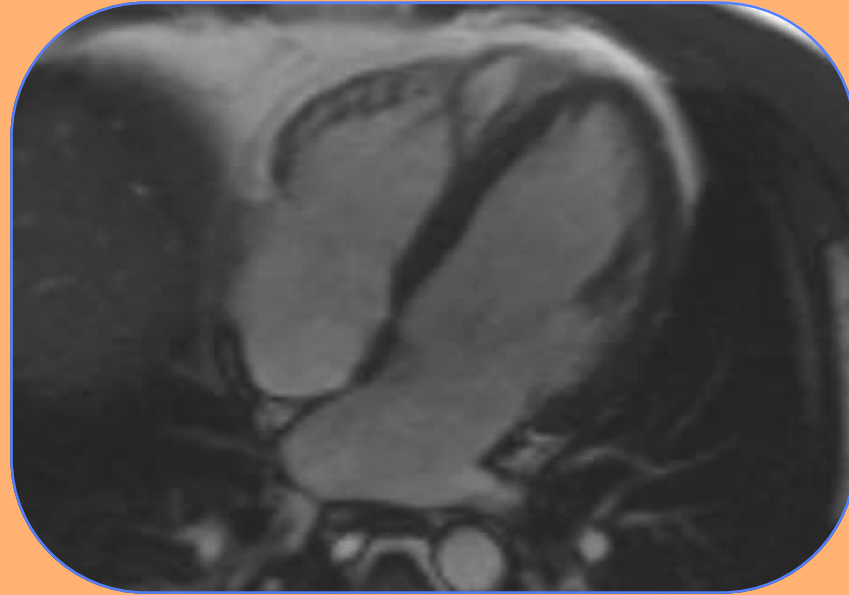
- Inherently safe as no ionising radiation
- Safety risks
  - Static magnetic field - projectile effect
  - Time-varying magnetic field - PNS, noise
  - Radiofrequency field - heating
  - All can interact with medical implants

## SAFETY WORK

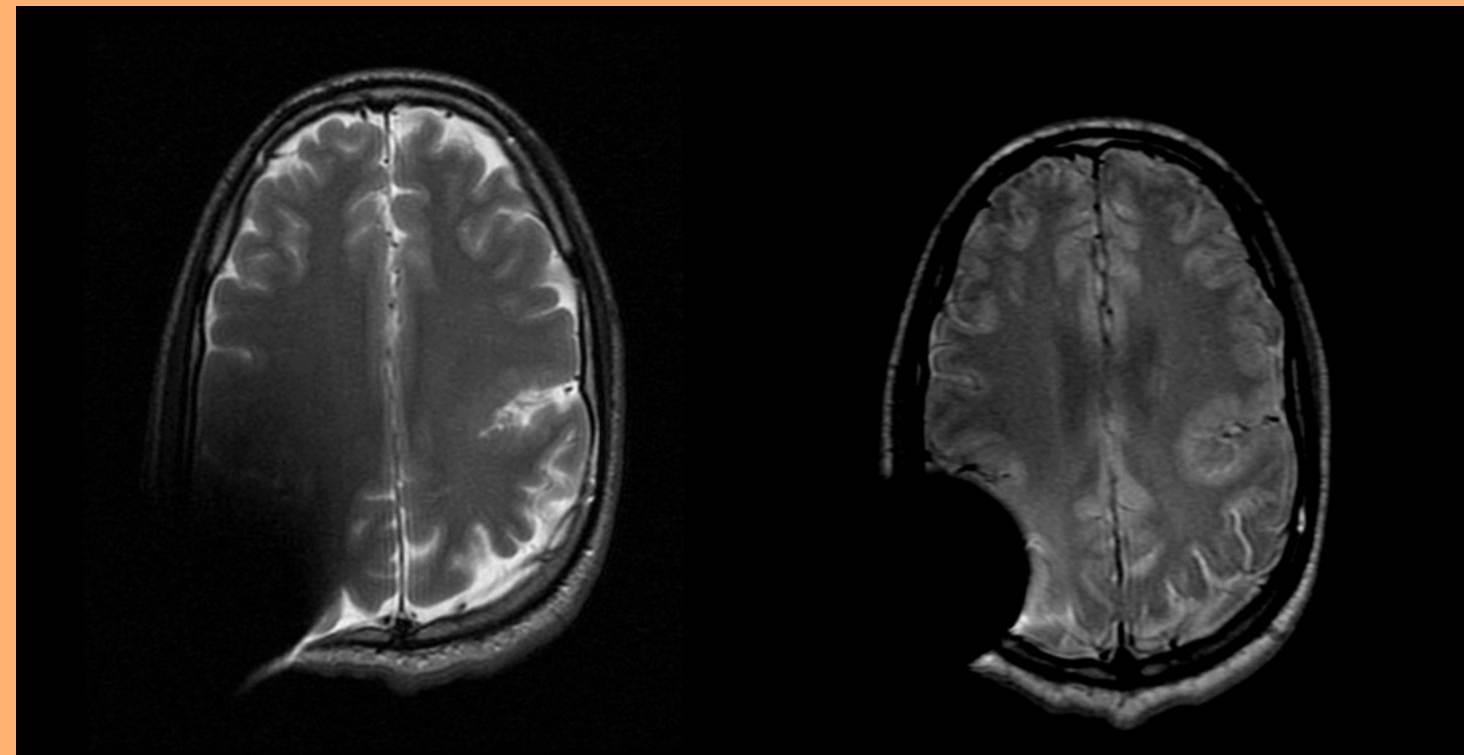
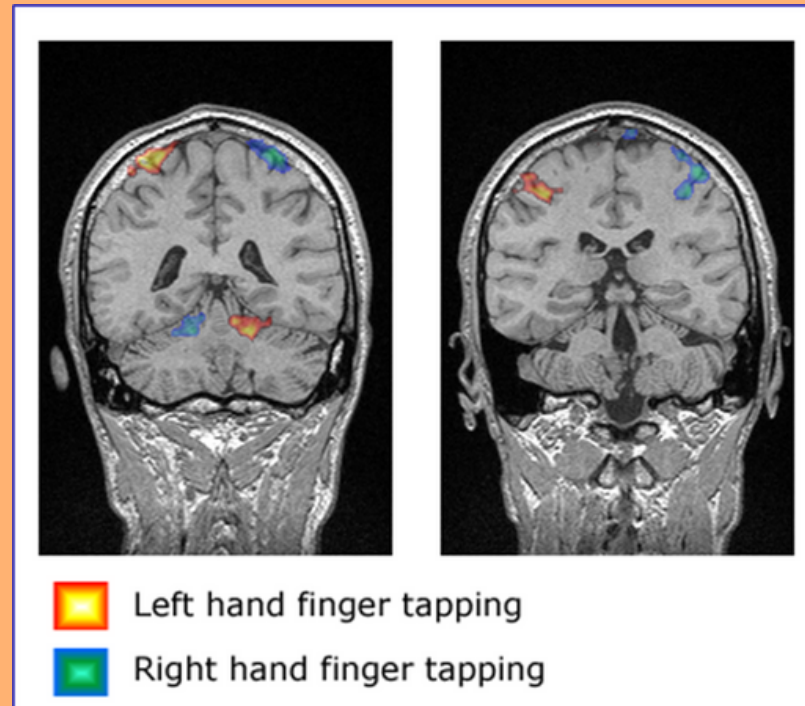
- MRI Safety queries/implant policies
- Local Rules
- Risk Assessments
- Incident Reporting
- Individual Site Support



# CLINICAL AND TECHNICAL SUPPORT



Cardiac 4CH cine



Metallic susceptibility artefact, brain scan of a cochlear implant.

## CLINICAL

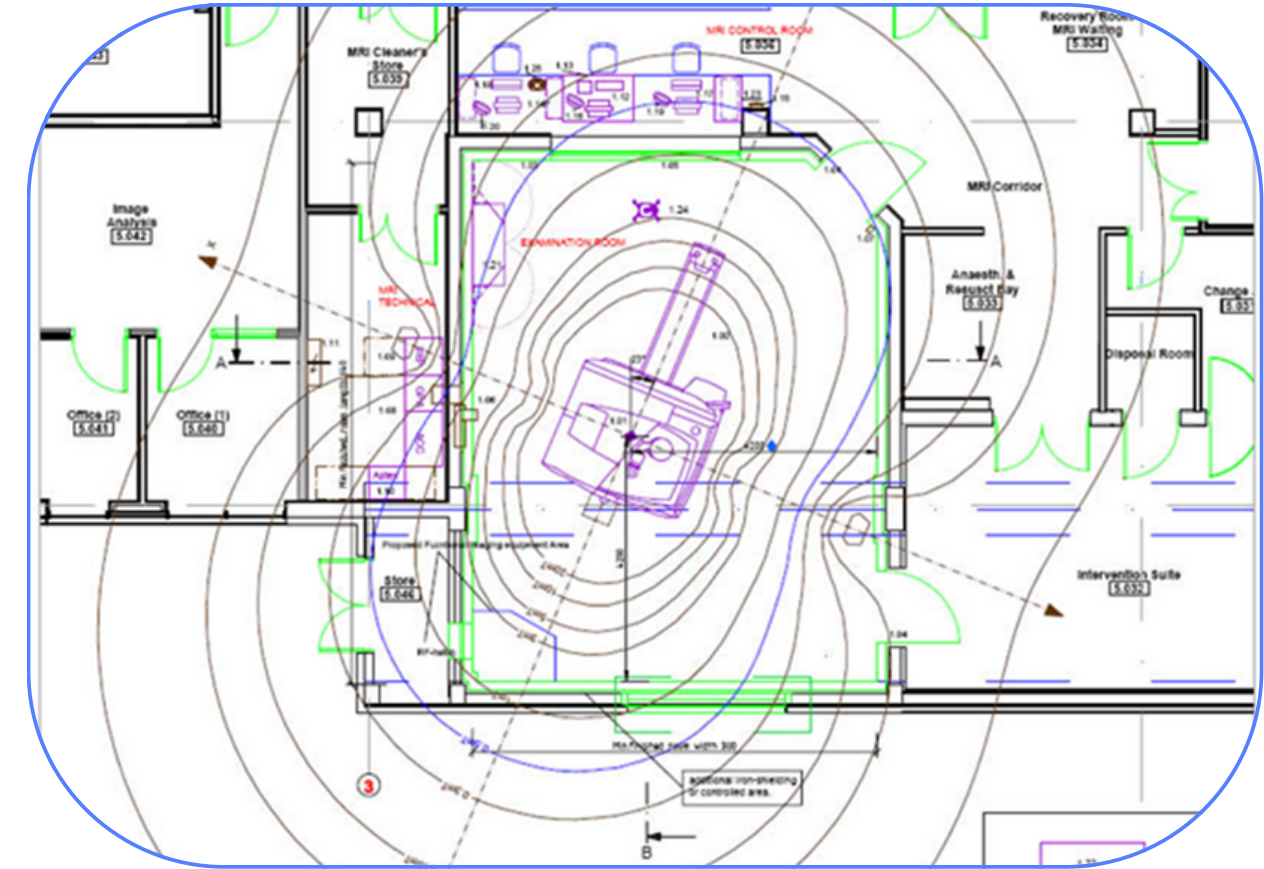
- Quantitative measurements
  - Cardiac scans
  - Breast scans
  - Liver iron quantification
- Scanner support for difficult cases

## TECHNICAL

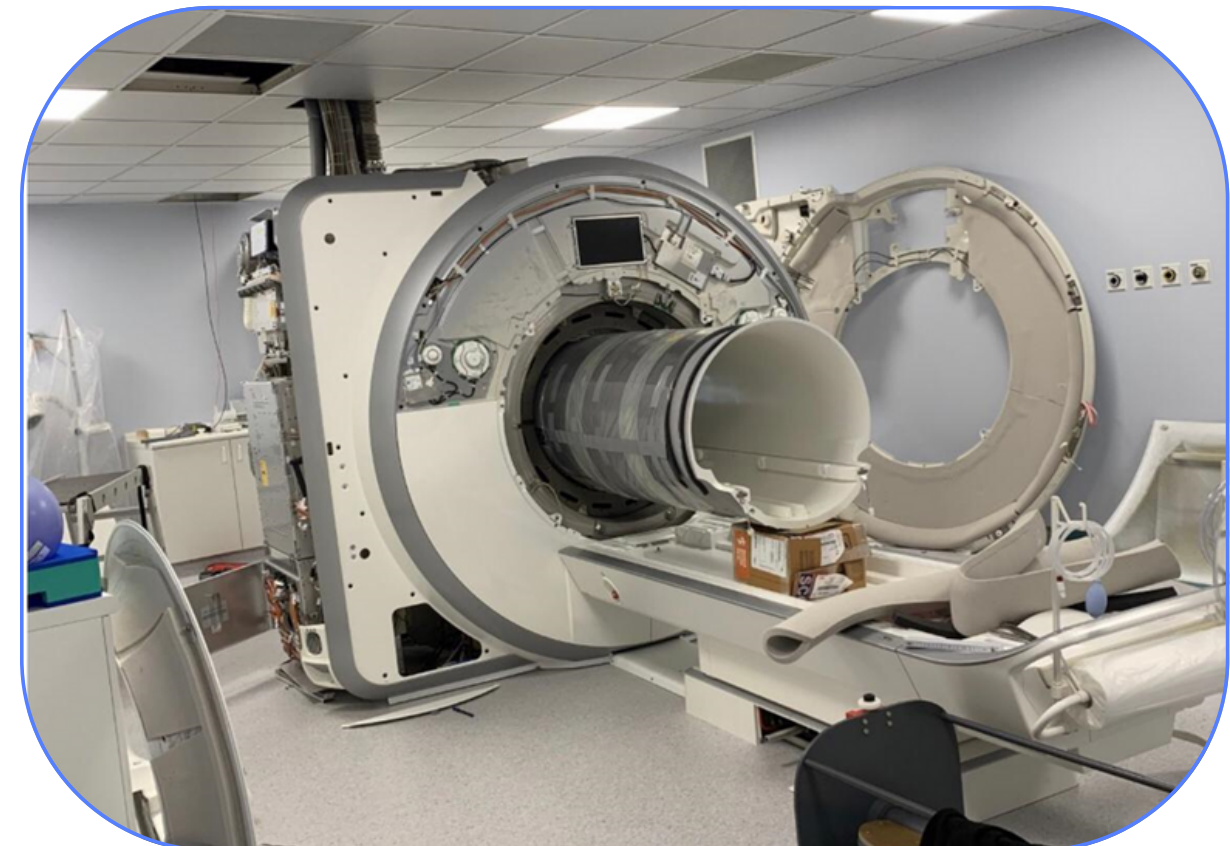
- fMRI equipment setup and paradigm running.
- Scanner support
  - Artefact reduction
  - SAR minimisation

# EQUIPMENT SUPPORT

- Procurement of new MRI scanners and ancillary equipment
- Acceptance testing
- Routine Quality Assurance



Mapping MRI field lines as part of planning scanner position

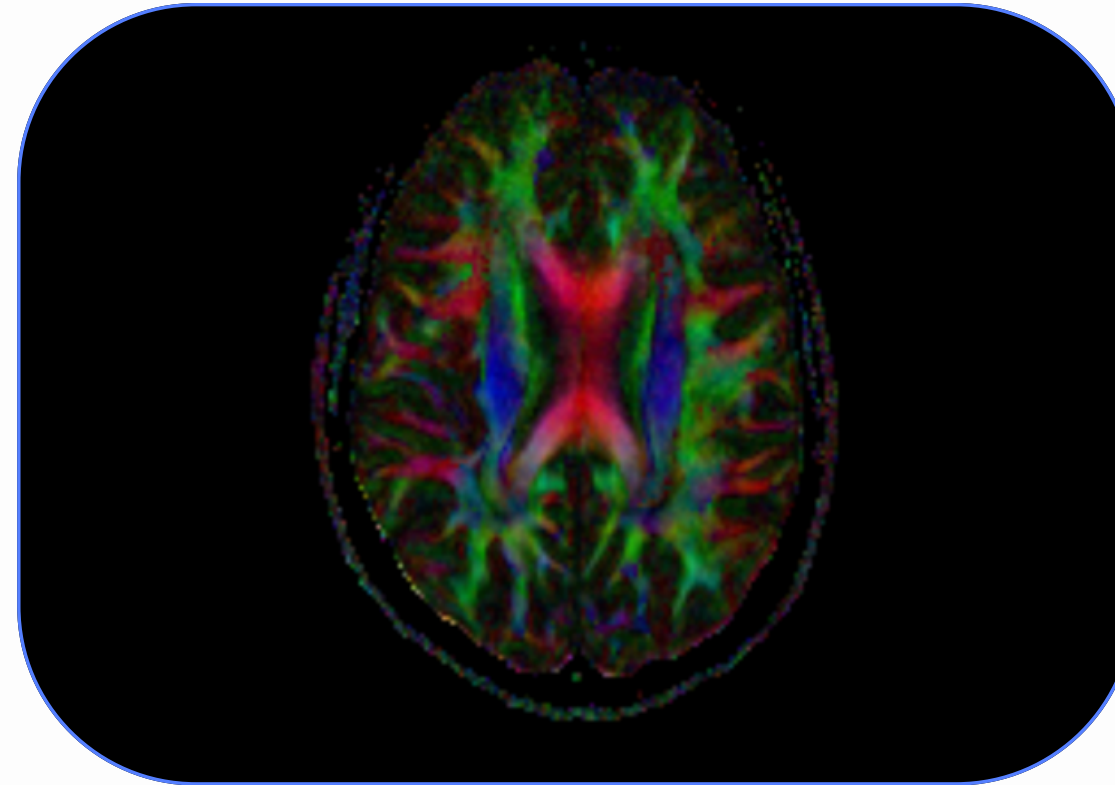


2020 installation of 1.5T scanner in Stracathro



# RESEARCH AND DEVELOPMENT

- Commercial and University research projects
  - Drug trials
  - Patient cohort studies
  - fMRI studies
- Service Development
  - Investigating new technologies, sequences etc.



Diffusion Tensor Imaging (DTI) using Simultaneous Multislice (SMS)

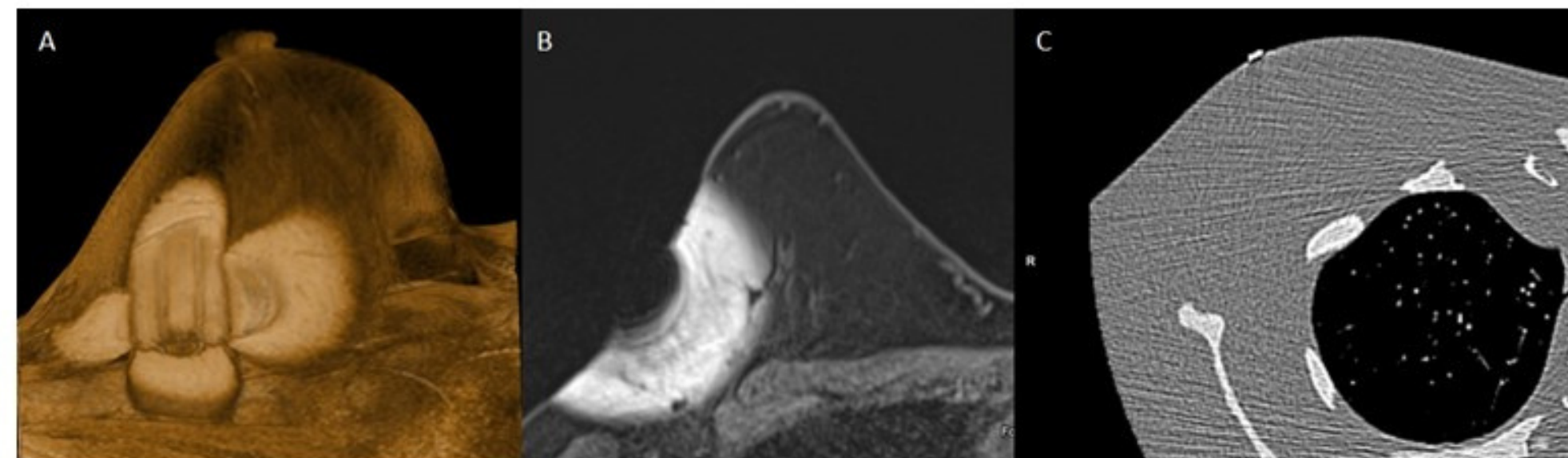
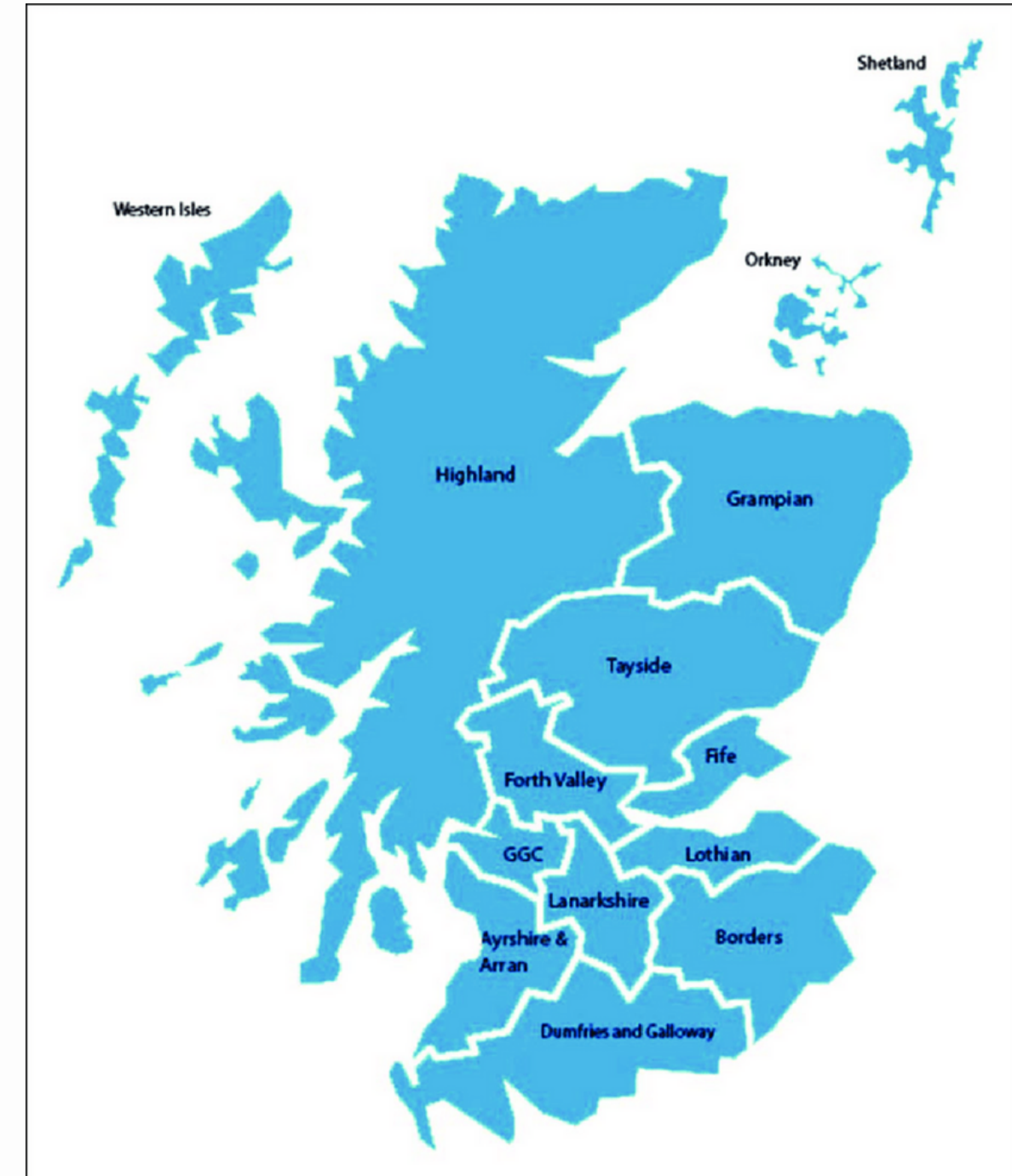


Figure 1: Three images from different scanning performed with the Magseed. A – 3D surface render of Magseed artefact on MRI imaging of a healthy volunteer on a T1 dynamic gradient echo sequence. B – Magseed artefact with area of failed fat saturation on a T1 dynamic gradient echo sequence. C – CT artefact measuring 5mm of Magseed positioned R>>L.

# TEACHING AND TRAINING



- Safety training for different MRI staff groups
- MRI physics lectures for Physicists, Engineers and Radiologists
- Trainee supervision
- MSc/PhD supervision





**Inverness MRI VR App**

**NHS Highland utilising VR headsets to aid patients preparations for MRI scans**

by Chris MacLennan January 30 2019, 9:40 am

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To Try:  
“My MRI Buddy”  
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**Aberdeen Fast field cycling**

**Significant grant for world's first Field Cycling Imaging hospital scanner**

25 January 2022

The University of Aberdeen's world-first fully operational Field Cycling Imaging scanner and suite has received a generous grant from the Wolfson Foundation.

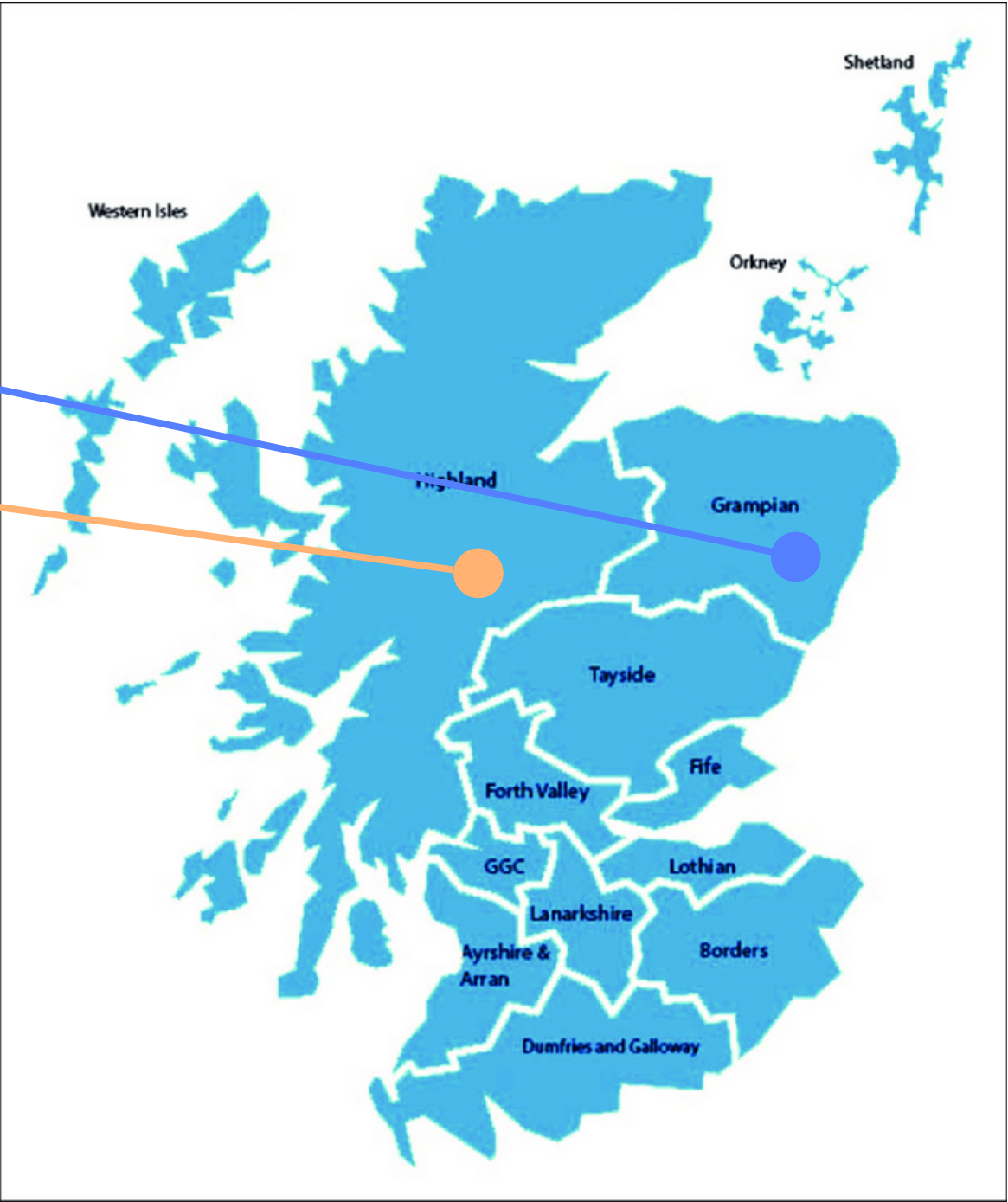
The grant of up to £723,000, generated by the University of Aberdeen Development Trust, will support the creation of a new patient-focussed version of the Field-Cycling (formerly Fast Field-Cycling MRI) scanner in a newly refurbished imaging suite within Aberdeen Royal Infirmary.

Field-Cycling Imaging (FCI) is a new technology that can produce detailed images of the inside of the body. It can be used to detect effects of diseases and other issues that are otherwise invisible to the likes of MRI and may appear earlier than what is currently detectable.

The Wolfson Foundation's generous grant brings donations for the new scanner and imaging suite to almost £1.5 million.



Dr Lionel Broche (2nd left) and Emeritus Prof David Lurie with the FCI imaging team





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**Glasgow 7T MRI, Hyperfine low-field MRI**

**Powerful 7 Tesla MRI scanner arrives in Glasgow**

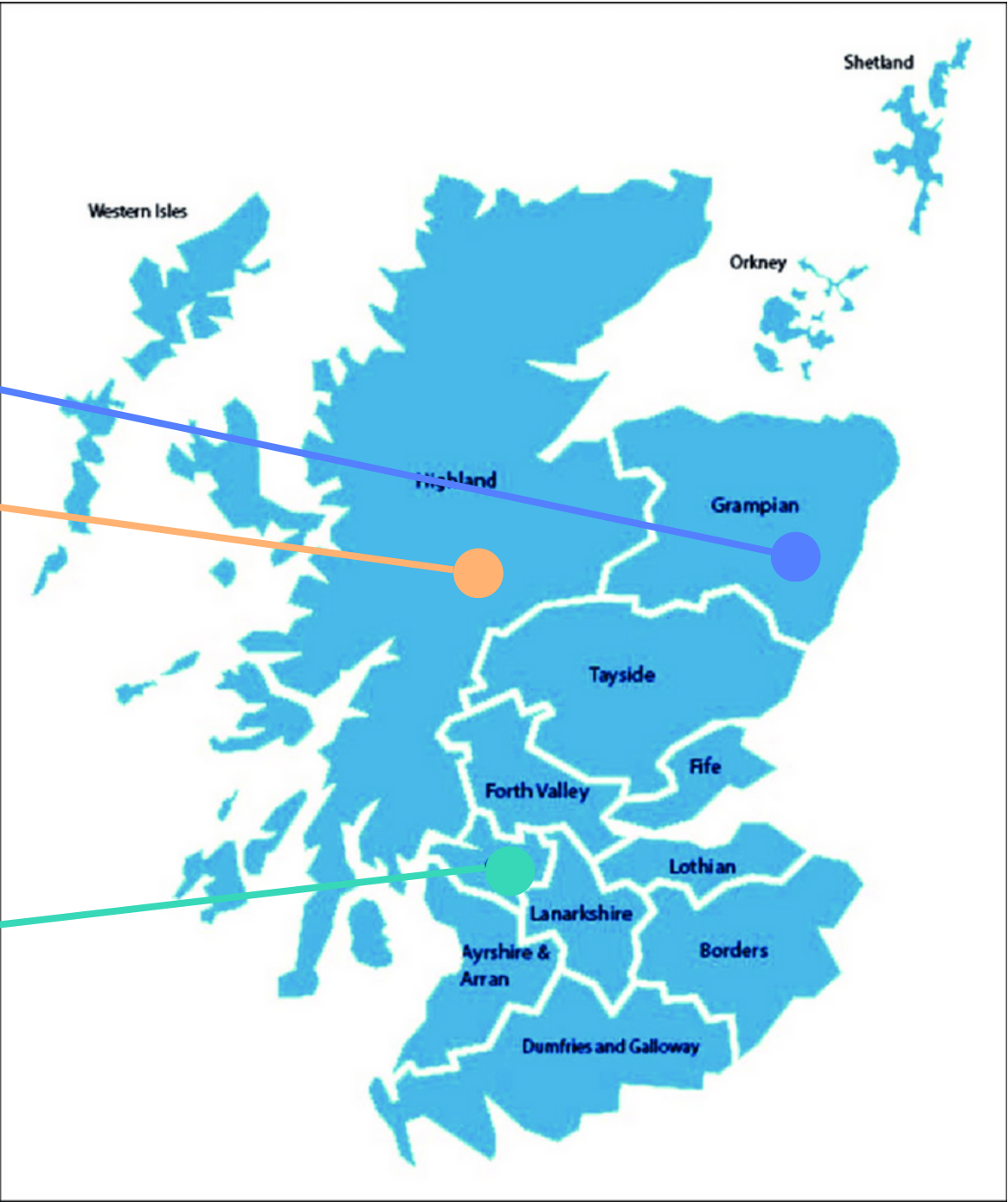
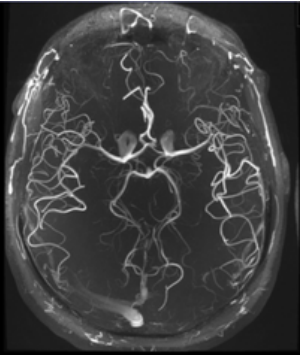
© 27 November 2018



By Kenneth Macdonald  
BBC Scotland Science Correspondent

Glasgow University has taken delivery of Scotland's most powerful magnetic resonance imaging (MRI) scanner.  
The £10m device was lifted into place at the new Imaging Centre of Excellence (ICE) at the city's Queen Elizabeth University Hospital (QEUH).  
A giant crane eased the 18-tonne scanner down an alleyway with inches to spare on each side, then through a hole in the wall of the new building.  
Once it is installed and calibrated it will be used to research - and help treat - a variety of conditions such as stroke, vascular dementia, Alzheimer's disease and epilepsy.  
In its current condition it looks like a space capsule - a huge, upended metal doughnut with a hole where the patient will go.

Image by David Porter





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January 30 2019, 9:40 am

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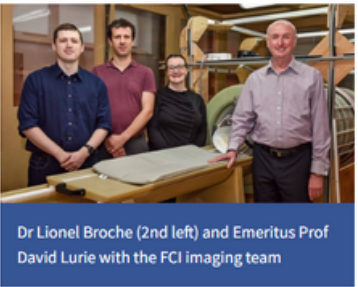
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## Edinburgh

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## MRI Guided Laser Ablation System

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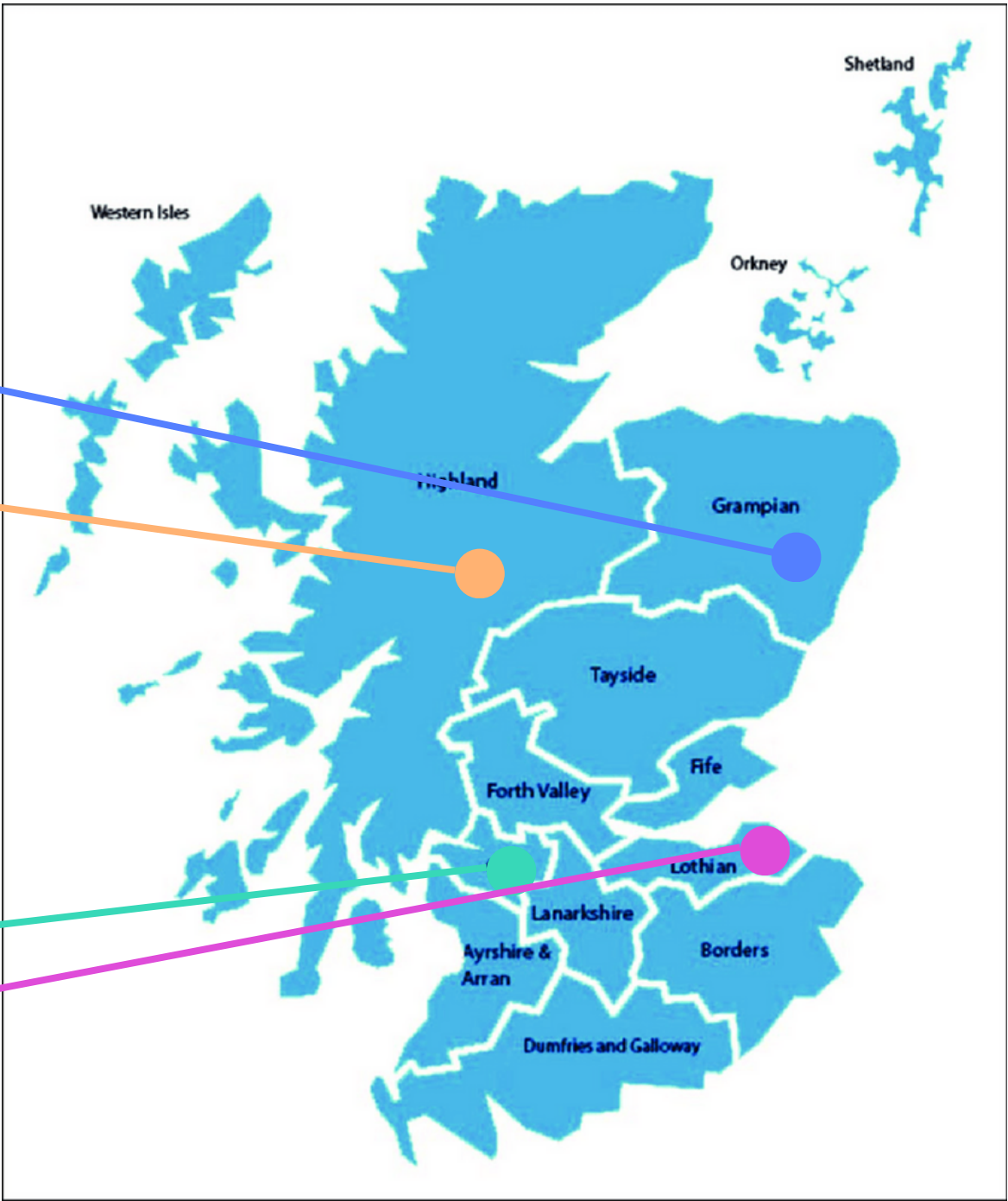
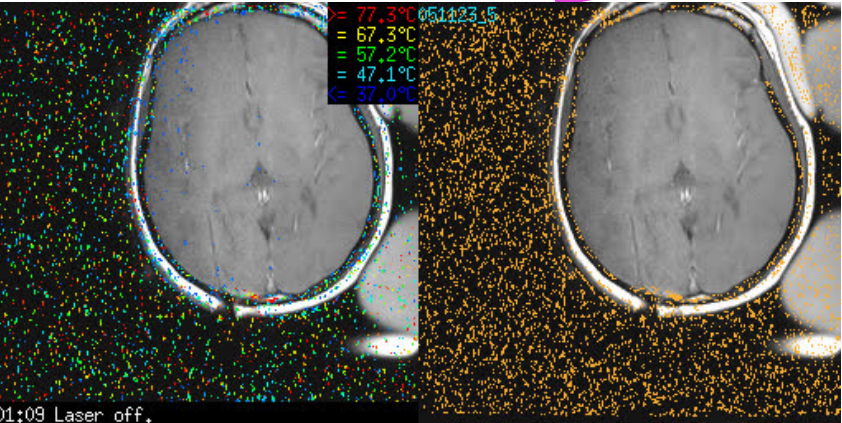
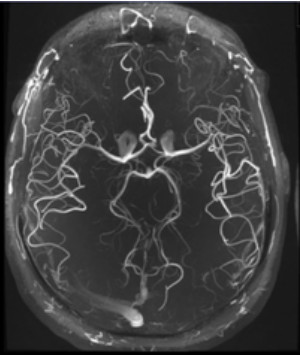
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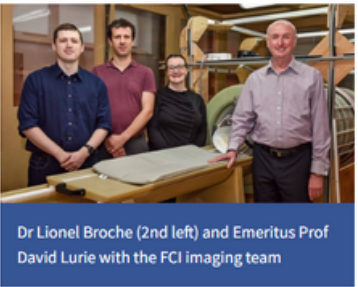
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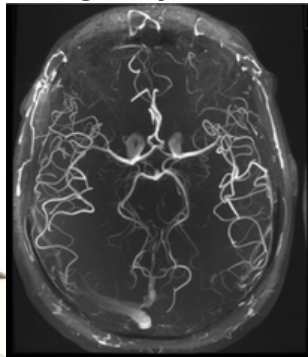
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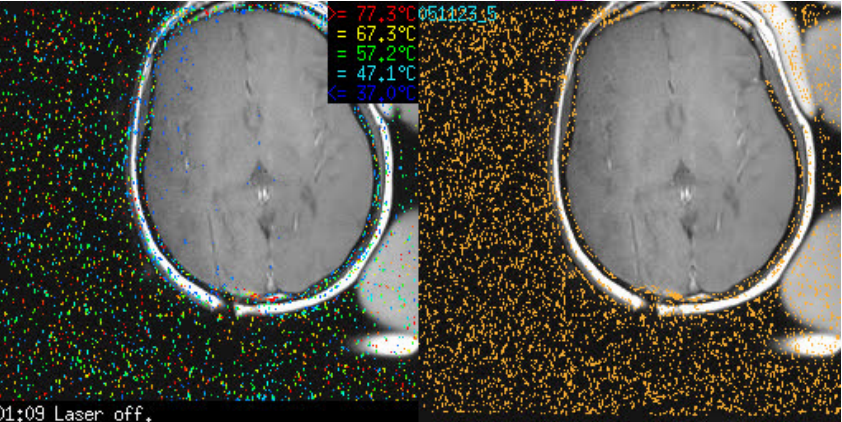
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## MRI Guided Laser Ablation System



## Dundee

## MRI Guided Focused Ultrasound

### University's incisionless brain surgery a first for Scottish tremor patients

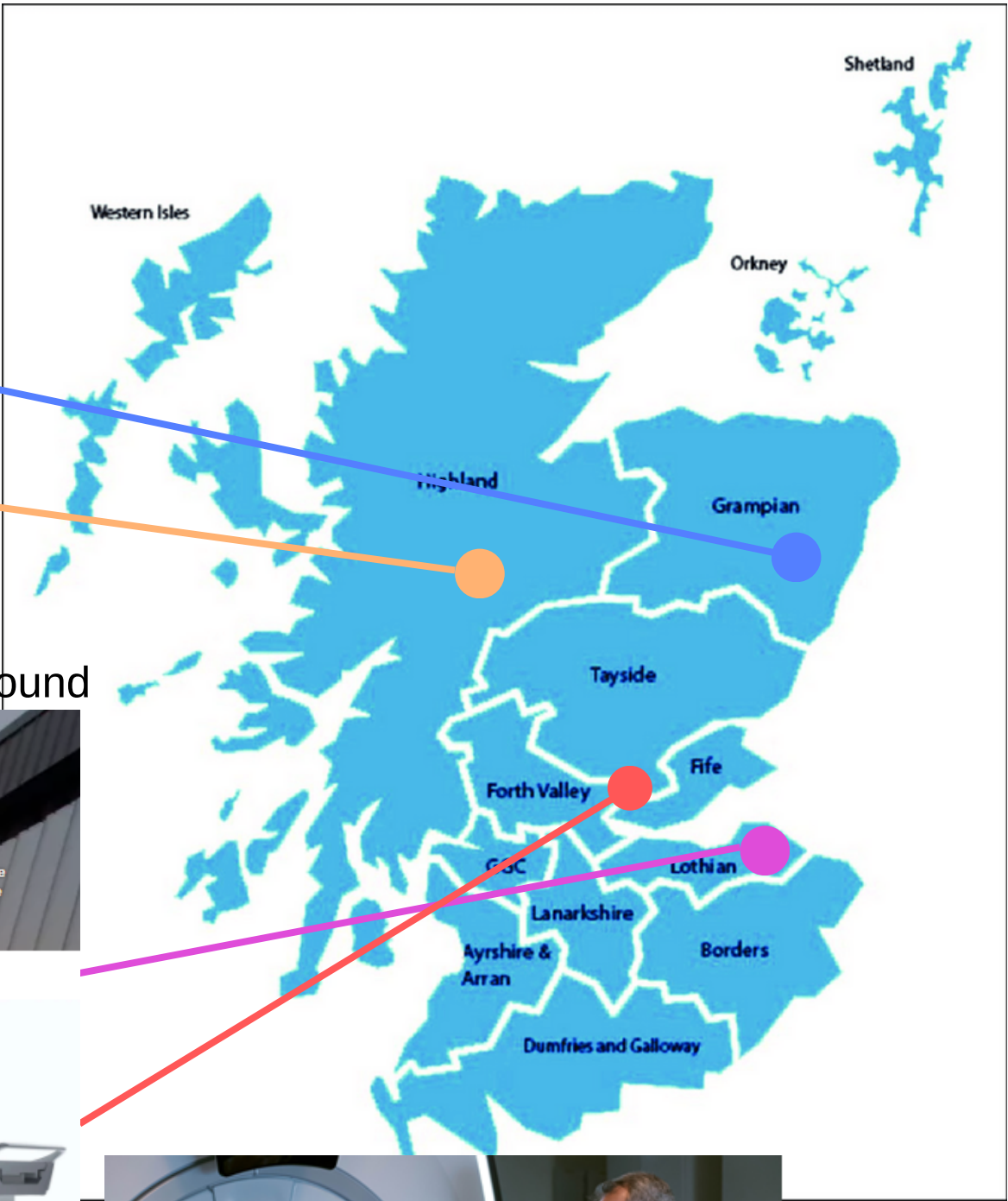
Published on 23 June 2021

A deep brain ultrasound treatment that can transform the quality of life for people with uncontrollable tremors has been made available in Scotland for the first time following a University of Dundee fundraising campaign.



Generous donors helped to provide more than £2 million to allow the purchase of Magnetic Resonance-guided focused ultrasound (MRgFUS) technology, which uses sound waves to help destroy tissue that can prompt unwanted movements in people who experience essential tremor.

The non-invasive procedure takes a matter of hours and can help restore control of movement to an individual's hands that they may not have experienced for decades. The treatment has established itself as effective in the treatment of essential tremor. Initial research suggests it may also have a role in treating the symptoms of Parkinson's disease.





**THANK YOU FOR YOUR  
ATTENTION**

