## The Scientists

**Medical physicists** provide scientific, safety and technical advice on the use of MRI. They help ensure the safety and effectiveness of the MR machine and advise on the buying and use of new equipment. They also take part in research to develop new MR techniques and clinical tests.

**Clinical computing staff,** including signal processing and software engineers, help specify, set up and maintain the specialised computing systems needed for MRI. They may also write and maintain software.

**Academic researchers** use MRI as a research tool in subjects such as cancer, neurology, psychology, psychiatry, urology, physiology, cardiology, sports medicine and biochemistry. Many different types of scientists are also involved, such as mathematicians, statisticians, chemists and molecular biologists.

IPEM Institute of Physics and Engineering in Medicine

This series of leaflets highlights the science and the scientists behind some widely used medical techniques. They are produced by the Institute of Physics and Engineering in Medicine. To find out more about Medical Physics or Biomedical Engineering, or to request free leaflets or posters in this series, contact us:


**Tel:** 01904 610821
**Email:** office@ipem.ac.uk
**www.ipem.ac.uk**

@ipemnews
Institute of Physics and Engineering in Medicine

**Institute of Physics & Engineering in Medicine**
Fairmount House, 230 Tadcaster Road, York YO24 1ES



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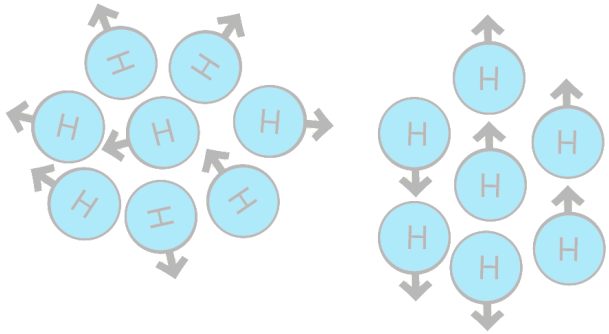



The techniques described in this leaflet are only suitable in certain cases and some are not yet widely available. If you need MRI, your doctor will advise you.

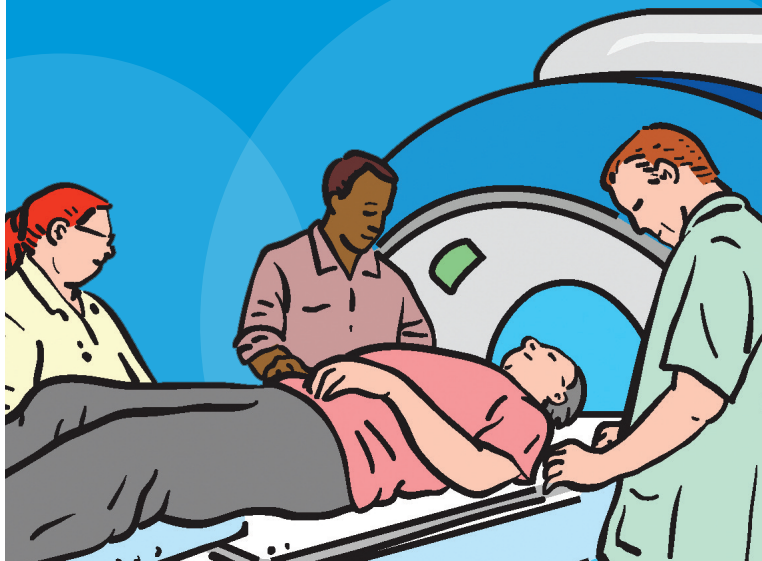

This leaflet was produced with the help of IPEM's Magnetic Resonance Special Interest Group.
October 2017


IPEM

The Science & The Scientists

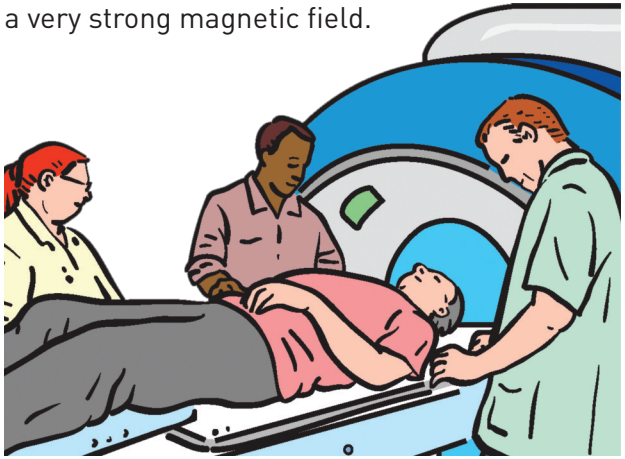
# Seeing inside the body with MRI

Magnetic resonance imaging (MRI) is one of the most powerful ways to look inside the human body. Using strong magnetic fields and radio wave pulses, it produces highly detailed images of soft tissues, which are used for medical investigations and in research.

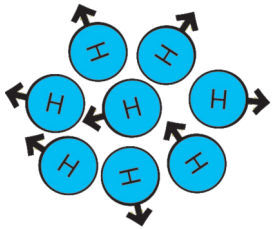


## The Science

Medical physicists, doctors and radiographers work together to produce and interpret MRI scans. They place the patient in the MRI scanner, where a powerful magnet creates a very strong magnetic field.

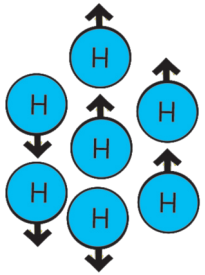


MRI works by detecting how hydrogen atoms in the patient's body respond to this electromagnetic energy. Once the patient is in the scanner, there is a small preferential magnetic alignment of their hydrogen atoms (protons) with the MRI scanner's strong magnetic field. The patient is slightly magnetised.




Unaligned protons

This magnetisation is tilted away from its equilibrium position using pulses of radio waves. Different types of tissue (such as fat, bone, muscle or disease) return to equilibrium at different rates. Adapting the timing parameters of MRI acquisition affect how different tissues appear on MR images.

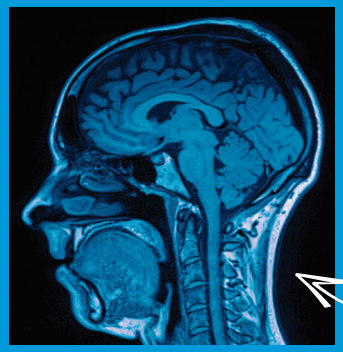



Protons aligned with magnetic field

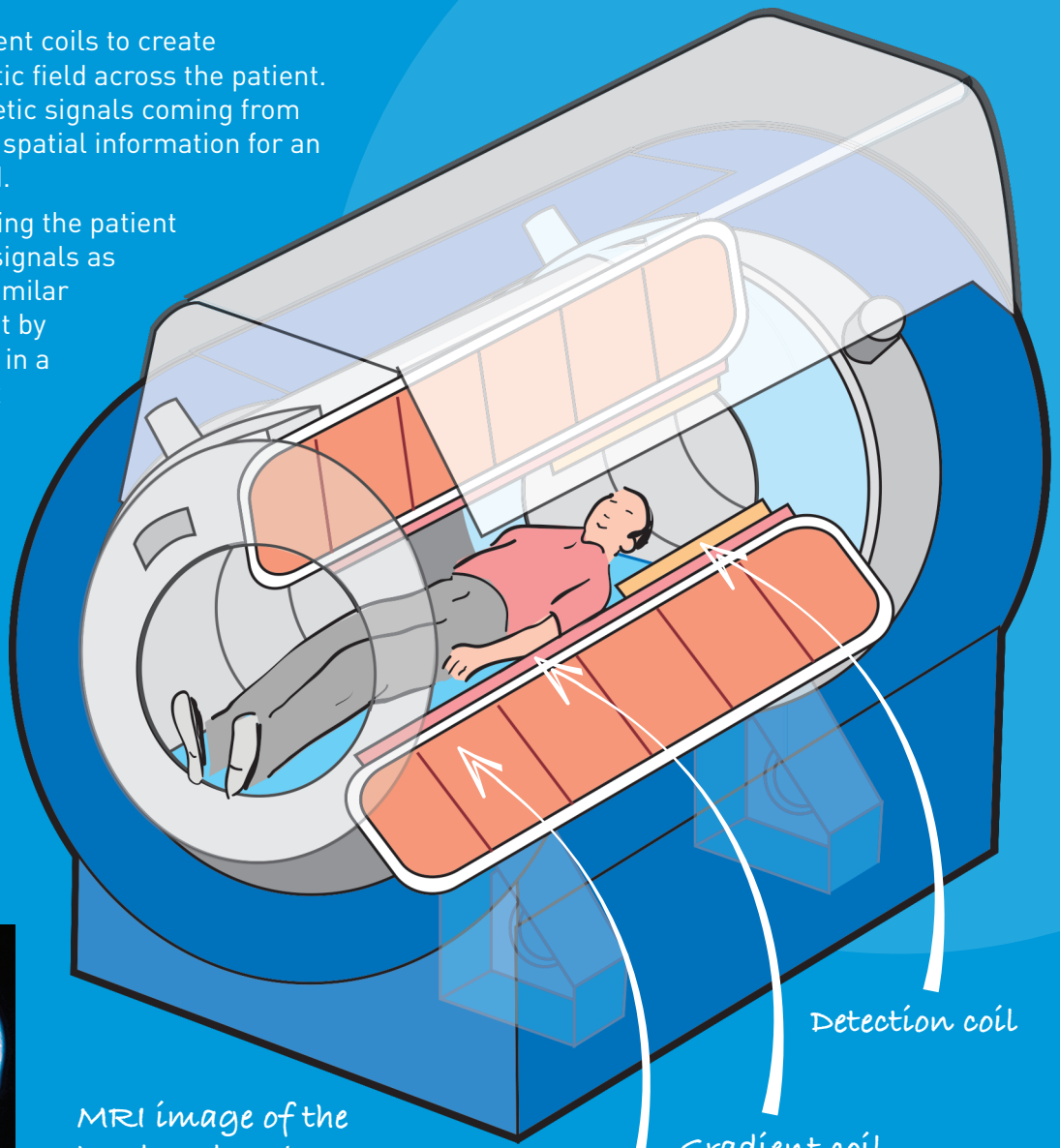
The scanner uses gradient coils to create variations in the magnetic field across the patient. This provides the magnetic signals coming from the patient with enough spatial information for an image to be constructed.

Detector coils surrounding the patient measure the magnetic signals as tiny induced currents, similar to a bicycle light being lit by the rotating bar magnet in a dynamo. These complex signals are then processed by a computer to extract all the information and produce 2D or 3D images of the human body.

MRI images are extraordinarily detailed and are used to help diagnose illness or plan and monitor medical treatments.



MRI image of the head and neck




Magnet is thousands of times more powerful than Earth's magnetic field

MRI is also an important tool for research. For example, researchers use functional MRI (fMRI) and diffusion MRI (dMRI) to investigate how the brain works or to understand more about conditions such as Alzheimer's and schizophrenia.