

# Quantum brain scanner

**A new scanner based on quantum sensors can detect the magnetic fields generated when neurons fire. It will give doctors a new view of the brain at work, to aid treatment of disorders including epilepsy and dementia.**

- System at UCL will soon be scanning children with epilepsy using quantum sensors
- Sensors close to skull make the device four times as sensitive as existing technology
- The wide range of commercial applications includes assessment of head injuries in sport

Magnetoencephalography (MEG) is a non-invasive way to probe activity in the brain. This has been possible using detectors known as SQUIDs, but they must be supercooled, resulting in bulky, expensive scanners. Patients must lie still, and these devices are ill suited to smaller head sizes, especially those of children.

A group led by Matt Brookes at the University of Nottingham has developed a much more flexible and sensitive device. They use optically pumped magnetometers: quantum sensors that use the spin of atoms to measure magnetic fields. These sensors are mounted on a 3D-printed helmet, which can be tailored to each patient so it fits close to the skull. The device can reveal millisecond changes in brain activity on scales of a few millimetres.

The prototype in Nottingham has been running since 2017; the second system, at UCL, will be scanning patients in 2019. It has the potential to show neurosurgeons the location of epileptic networks in patients' brains, and could enable high fidelity monitoring of epilepsy without any need for surgery (today doctors sometimes assess this by removing part of the skull to attach electrodes directly to the brain). The new scanner could also aid diagnosis and treatment of many other conditions, including dementia, mental health, movement disorders and head injury.

Funding has come from the National Quantum Technology Programme and from the Wellcome trust. At present the sensors are imported from collaborators in the USA, but in phase 2 of the National Programme the team aim to exploit sensors being developed in Strathclyde. "We are hoping to set up a UK supply chain very quickly," says Nottingham team member Mark Fromhold.

Phase 2 funding will also enable the scanner to be improved, allowing measurement of distributed brain networks implicated in serious mental health conditions, and of the deep brain structures that become vulnerable in dementia. The system can even be reconfigured to monitor the heart, spine, muscles and digestive system.

The project has also generated a promising quantum crossover: magnetic shielding that was developed for this device is being adapted for quantum gravity sensors by the [UK National Quantum Technology Hub for Sensors and Metrology](#).

Collaborators:

- University of Nottingham
- University College London
- Magnetic Shields Limited
- QuSpin
- York Instruments
- Young Epilepsy
- Oxford University and the John Radcliffe Hospital
- Toronto Hospital for Sick Children
- Aston University
- Regonition Health
- Great Ormond Street Hospital
- National Hospital
- Queens Medical Centre
- Virginia Tech

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