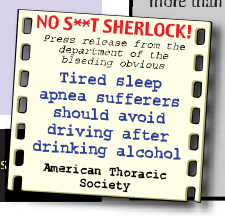
METROCOSM

Science news in brief

BARKING MAD: Want to teach your old dog some new tricks you've learned from TV trainers? Well, think twice before you do – they could come back to bite you. Control techniques taught on TV shows are 'ridiculous' and could do more harm than good, experts say. 'Dominance reduction', such as pinning down dogs or grabbing their jowls, does not subdue the animals and could make them aggressive. Tests on wild and pet dogs showed they were not 'motivated by some innate desire to control people', so would not benefit from submissive, Barbara Woodhouse-style training, experts at Bristol University said.

HAPPY HOUR: Cancer drugs could also deal with alcohol addiction. Treatments such as erlotinib play a role in changing a gene dubbed 'happy hour'. When fruit flies and mice were treated with the drug, they grew more sensitive to booze, researchers at California University found. The finding is significant because people with similarly sensitive dispositions (ie they get drunk very quickly) are less likely to become alcoholics than those who can drink everyone else under the table, experts believe.

If you have a story for MiniCosm please e-mail us at Cosm@ukmetro.co.uk



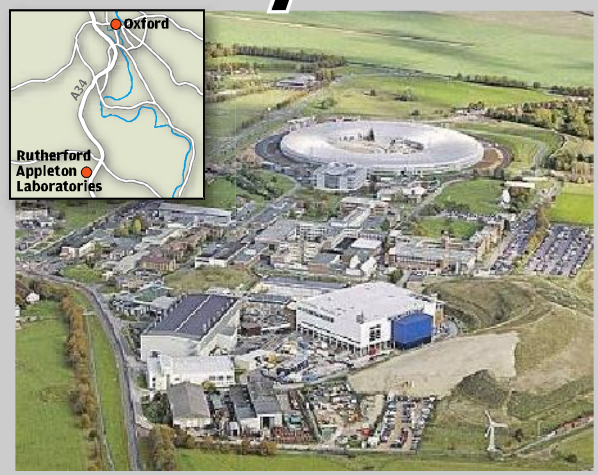
A 21st century Wonderland

In 1862, Lewis Carroll took a boat trip along the Thames near Oxford. Along the way, he entertained the three daughters of his friend with an improvised tale of a little girl called Alice who followed a white rabbit down a hole to have fantastical adventures in a nonsensical wonderland.

Nearly 150 years and a few miles down the A34 later, down a very modern rabbit hole, there exists an equally fantastical wonderland where invisible objects travelling at impossible speeds are used to perceive the imperceptible.

ISIS is a sort of super-microscope – called a pulsed-neutron source – that can look deep into objects and unlock their secrets at an atomic level. All materials are made up of atoms and these are cloaked in a force-field of electrons that prevent things like X-rays from seeing any more than surface details. ISIS uses neutrons – a subatomic particle with no electrical charge – that can sail effortlessly past these subatomic bouncers to see the beating heart of atoms: the nucleus.

ISIS's first target station (the area where neutrons are made and experiments performed) opened in 1985 and made Britain a world-leader in the field. Next week, the complex's second target station will be open for business. At a cost of £200million, this sort of technology doesn't come cheap but incredibly, in this day and age at least, it was completed, not just on schedule, but also on budget.



Run by the Science and Technology Facilities Council and located at its Rutherford Appleton Laboratories, Oxford, ISIS is the most powerful pulsed-neutron source in the world – attracting tens of thousands of scientists from all over globe, performing research in chemistry, physics, geology, engineering, biology and even archaeology.

The facility is so good that countries like the US and Japan are spending billions in an attempt to catch up.

'The second target station increases our capacity and capability,' ISIS director Dr Andrew Taylor told MetroCosm. 'It keeps us number one in the world and allows us to continue to investigate the technologies of tomorrow that affect everyday lives.'

ISIS's experiments are truly groundbreaking. The facility is helping medical researchers develop a new type of glass that will allow patients to regrow their own bones by releasing calcium into the body as it slowly dissolves. Engineers love ISIS because it allows them to peer deep within structures like aircraft wings to pinpoint areas of stress damage or weakness that can usually only be seen by cutting the object up.

The new target station will allow researchers to delve into a new world of neutron imaging by enabling them to see objects at scales of 0.1 nanometres – that's 10,000 times thinner than a human hair.

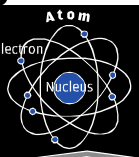
'Curiouser and curiouser', said Alice.

Through the Looking Glass: How ISIS sees to the heart of matter

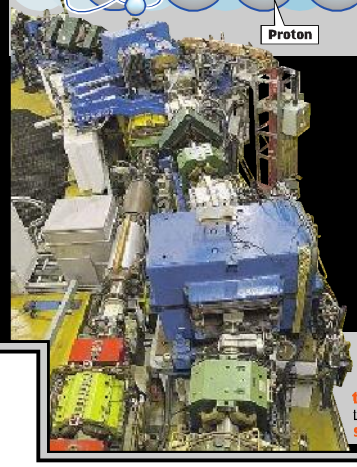
1. The process starts with the creation of negatively charged hydrogen ions – made up of two electrons and one proton

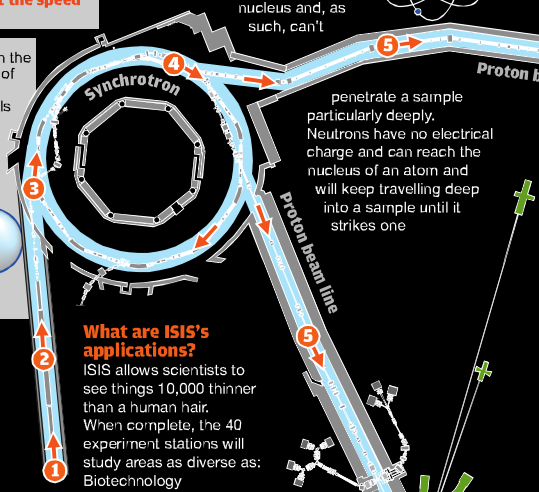
2. These are fed into the first of three accelerators where they are accelerated and focused. A second brings their speed up to **35 per cent the speed of light**

Why neutrons?
Other forms of microscopy such as X-rays carry an electric charge and are repelled by the electrons surrounding an atom and by the protons within its nucleus and, as such, can't penetrate a sample particularly deeply. Neutrons have no electrical charge and can reach the nucleus of an atom and will keep travelling deep into a sample until it strikes one



3. The final stage of acceleration takes place in the synchrotron. As the ions enter they are stripped of their electrons by a thin positively charged foil – leaving only the protons. The proton beam travels in a stainless steel vacuum tube surrounded by **35** accelerating magnets and **eight** bending magnets





What are ISIS's applications?
ISIS allows scientists to see things 10,000 thinner than a human hair. When complete, the 40 experiment stations will study areas as diverse as:
Biotechnology
Drug design
Advanced materials
Energy storage
Data storage
Quantum devices

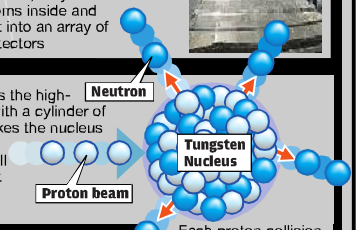
Experiment stations

Target Station One

4. The beams make **12,000** revolutions of the synchrotron until they are travelling at **84 per cent the speed of light** (at this speed they could travel around the Earth **six times** in one second)

5. The beams are split and sent down two beam lines on to the target stations

6. At the target stations the high-energy protons collide with a cylinder of tungsten. The beam strikes the nucleus of the tungsten atoms where, like a snooker ball striking a pack of reds, it scatters neutrons in all directions



The whole process takes just **ten milliseconds** during which the protons will have travelled **1,655km**. The cycle is repeated **50 times every second**

Each proton collision releases about **15 neutrons** from the target. In total about **20million million** neutrons are produced every second

Graphic: Ben Gilliland

Experiment stations

7. The neutron beams are directed into experiment areas where they are fired at the object under study. The neutrons penetrate deep inside the sample where, like one snooker ball striking another, they bounce off the atoms inside and out into an array of detectors

Target Station Two

8. By recording the angles at which the neutrons fly out, scientists can map the sample's atomic structure in a completely non-destructive way