

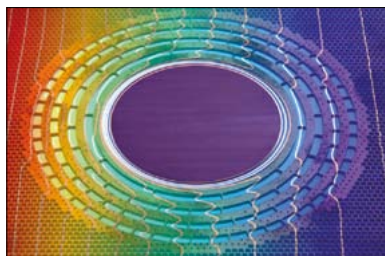
Sciencewatch

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Researchers construct invisibility cloak for heat

Many kinds of cloaking devices have been proposed – and even built – over the past decade and now there is a new one: a cloak that directs heat flow round an object.

One major approach to cloaking objects from waves uses transformation optics to engineer a material that mimics a curved space around the object to be screened. Robert Schittny of the Karlsruhe Institute for Applied Physics and colleagues have realized that the heat-conduction equation, although it describes diffusion rather than waves, is form-invariant under general curvilinear co-ordinate transformations.



This allows a similar trick to be performed. To implement this approach, the team assembled copper rings and bridges interlaid

A thermal invisibility cloak. Heat is passed around the central area from the left to the right. Temperature characteristics (white lines) remain parallel. (Image credit: R Schittny/Karlsruhe Inst. of Technology.)

with plastic, creating a heat cloak such that any object placed inside would be undetectable by a heat sensor – heat would instead appear to pass straight through it.

• Further reading

R Schittny *et al.* 2013 *Phys. Rev. Letts.* **110** 195901.

Bomb tests cast light on brain regeneration

Just how much new growth of nerve cells occurs in human adults has been difficult to estimate but now Jonas Frisén of the Karolinska Institute and colleagues have come up with an ingenious method that has allowed them to measure how many nerve cells are renewed over the course of adulthood. In other words, the researchers have worked out how to perform carbon-14 dating on brain cells.

Between 1955 and 1963, the testing of nuclear bombs above ground during the Cold War boosted the concentration of carbon-14 in the atmosphere. People who were alive then took up more of it and incorporated it into the DNA of their cells – but this radioactive isotope decays over time.

Using accelerator mass spectroscopy to count carbon-14 atoms in DNA from hippocampal nerve cells from the autopsied brains of 55 people who lived during that time, the team found that about 35% of the nerve cells in the hippocampus had been renewed over the course of adulthood – a result that would seem impossible to obtain any other way.

• Further reading

K Spalding *et al.* 2013 *Cell* **153** 1219.

Antisoundproofing

Walls are often erected to block sound but Sam H Lee of Yonsei University and colleagues have instead made one that is good at transmitting sound. As an example, they drilled 10-mm-diameter holes in a 5-mm aluminium sheet – holes that would be

A tabletop accelerator

Gianluca Sarri of Queen's University of Belfast and colleagues have made a novel accelerator that produces ultrarelativistic positron beams in short pulses (around 30 fs) with small divergences (around 3 mrad) and at high densities (10^{14} – 10^{15} cm $^{-3}$) from a fully optical set-up. The team used the HERCULES laser system at the University of Michigan to blast focused, 30 fs pulses of laser light at a wavelength of 0.8 μ m and an energy of 0.8 J onto a supersonic jet of helium doped with 2.5% nitrogen.

The result was a jet – similar to astrophysical leptonic jets – containing electrons, positrons and gamma rays, which could be separated into three distinct beams by a magnetic field. The Lorentz factors for the electrons and positrons produced are between 200 and 300, which is similar to what is observed in astrophysical situations. The system, which apart from the laser is less than 1 m long, is therefore potentially useful not only as a source of particles but also for studying astrophysical jets in the laboratory.

• Further reading

G Sarri *et al.* 2013 *Phys. Rev. Letts.* **110** 255002.



The laser set-up could help to model jets of high-speed electrons such as this one emitted by a black hole in galaxy M87. (Image credit: NASA and the Hubble Heritage Team (STScI/AURA).)

too small to allow 1220 Hz sound waves to pass through under normal circumstances. Covering the holes with tensioned plastic film 10 μ m thick, they then made air vibrate at 1200 Hz in the holes as if it were massless so that almost 80% of 1220 Hz sound passed through. Moreover, in the holes, the sound intensity rose by a factor of 950. Even higher sound concentrations are possible (they reached a factor of 5700), so apart from making walls that pass sounds of a given frequency this work also opens a way to amplify sound.

• Further reading

JJ Park *et al.* 2013 *Phys. Rev. Letts.* **110** 244302.

Hydrogen and dark energy

New measurements of cosmic hydrogen gas have determined the expansion rate of the universe in a new time window. The Baryon Oscillation Spectroscopic Survey (BOSS) used quasars to “backlight” intergalactic hydrogen and from the spectra measured cosmic expansion at a redshift of about $z=2.3$, when the universe was about a quarter of its current age of 13.8 billion years.

This fills a gap between values of z of around 1 – where nearby galaxies can be used – and z of around 1110, where radiation remaining from the Big Bang is seen. Apart from confirming cosmic acceleration, this also shows no sign that dark energy has varied over the past 10 billion years.

• Further reading

N G Busca *et al.* 2013 *Astronomy and Astrophysics* **552** A96.

A Slosar *et al.* 2013 *JCAP* **4** 026.

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