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DNA acts like a semiconductor

Scientists at Basel have demonstrated that DNA can conduct electricity – a property that could lead to an effective way to repair a DNA helix after radiation damage.

DNA in water was dropped onto a gold-coated carbon foil punctured with an array of 2 μm holes. Blotting paper removed most of the liquid, leaving ropes of DNA molecules spanning the holes in the foil.

Inside an ultrahigh vacuum chamber

(10^{-7} mbar), the ropes were broken using a mechanical point. This was watched using a low-energy electron point source microscope (a coherent beam of 20–300 eV electrons), which produced holographic images.

The point was then used to create a potential difference between the loose end of the DNA rope and the foil, to which the other end of the rope was attached. Current flowed along the molecules and a linear variation of

the current with voltage, obeying Ohm's Law, was measured in the $\pm 20\text{mV}$ range. The DNA had a resistivity of about 1 $\text{M}\Omega/\text{cm}$ – equivalent to that of a good semiconductor.

The details of the conduction mechanism are not understood, but the fact that DNA chains of up to several tens of millimetres can easily be made means that DNA is suited for use as quantum wires in mesoscopic devices (larger than 1 nm but smaller than 1 μm).

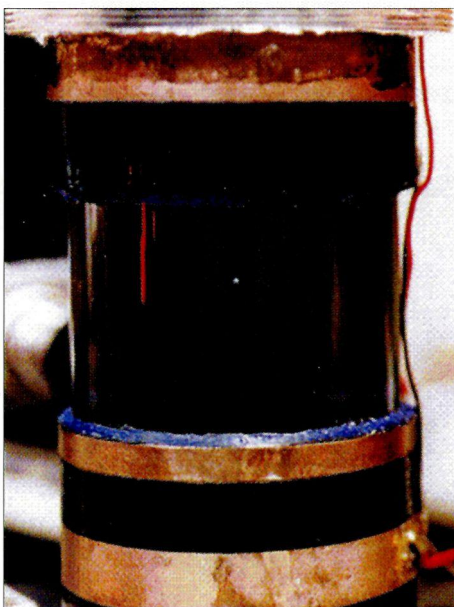
Is sonoluminescence solved?

Gas bubbles trapped in a liquid and excited by sound waves expand then collapse, emitting an intense burst of light – a process known as sonoluminescence. Typically, a bubble can expand by up to 50 μm before collapsing, usually within 50 μs , to a radius of less than 1 μm , but remain stable.

This had never been fully explained, but now a team of scientists from Harvard, Marburg in Germany and Twente in the Netherlands has proposed a model to explain the bubble's stability and the light emission.

New features include the dependence of the bubble's temperature on its radius and an allowance for the small emissivity of the weakly ionized noble gas inside the bubble (after recent experiments demonstrated that all molecules other than noble gases diffuse from the bubble).

The team has suggested that the light is emitted by radiation from the ionized gas (thermal bremsstrahlung) and by the recombination of ions within the bubble.



Lawrence Crum, University of Washington

In sonoluminescence, a gas bubble in a liquid-filled cell is excited using sound waves, causing it to expand before collapsing and emitting a visible flash.

Laser makes antimatter

Experiments with the Petawatt laser at Lawrence Livermore National Laboratory have created antimatter – something that is usually the preserve of high-energy physics.

The laser (1 petawatt in a 1 fs pulse) was focused on a thin gold disc, ripping electrons from the gold atoms and accelerating them to several mega-electronvolts. The electrons collided with other atoms, producing X-rays with enough energy to release neutrons and induce fission in a sample of uranium metal.

However, the researchers also observed positrons being created – more than 100 from a single laser shot and consistent with the expected rate of electron-positron pair production by X-rays.

AIP

Atomic laser

Several steps towards building an atomic laser have been made by groups in the US, Japan, Israel and Germany. By firing two laser beams into a Bose-Einstein condensate, a highly directional beam of sodium atoms of well defined momentum has been extracted. A pulsed laser pushing atoms out of the condensate in wave packets, which then start to overlap, produced four-wave mixing – a method familiar in nonlinear optics but demonstrated in matter waves for the first time. Meanwhile, a continuous beam of rubidium atoms has been produced for a record 0.1 s.

Science conference

A conference on science and its role in society will take place in Budapest in June. Organized by UNESCO and the International Conference on Science, the World Conference on Science will bring together representatives of government, education, research and industry, as well as the media and the general public,

to assess the achievements of science and the challenges to be faced in the 21st century.

A preparatory meeting on the future of physics has already recommended that public awareness and the training of good science teachers should be priorities, and it pushes for a declaration affirming the vital importance of basic physical science and the need to protect and support curiosity-led physics.