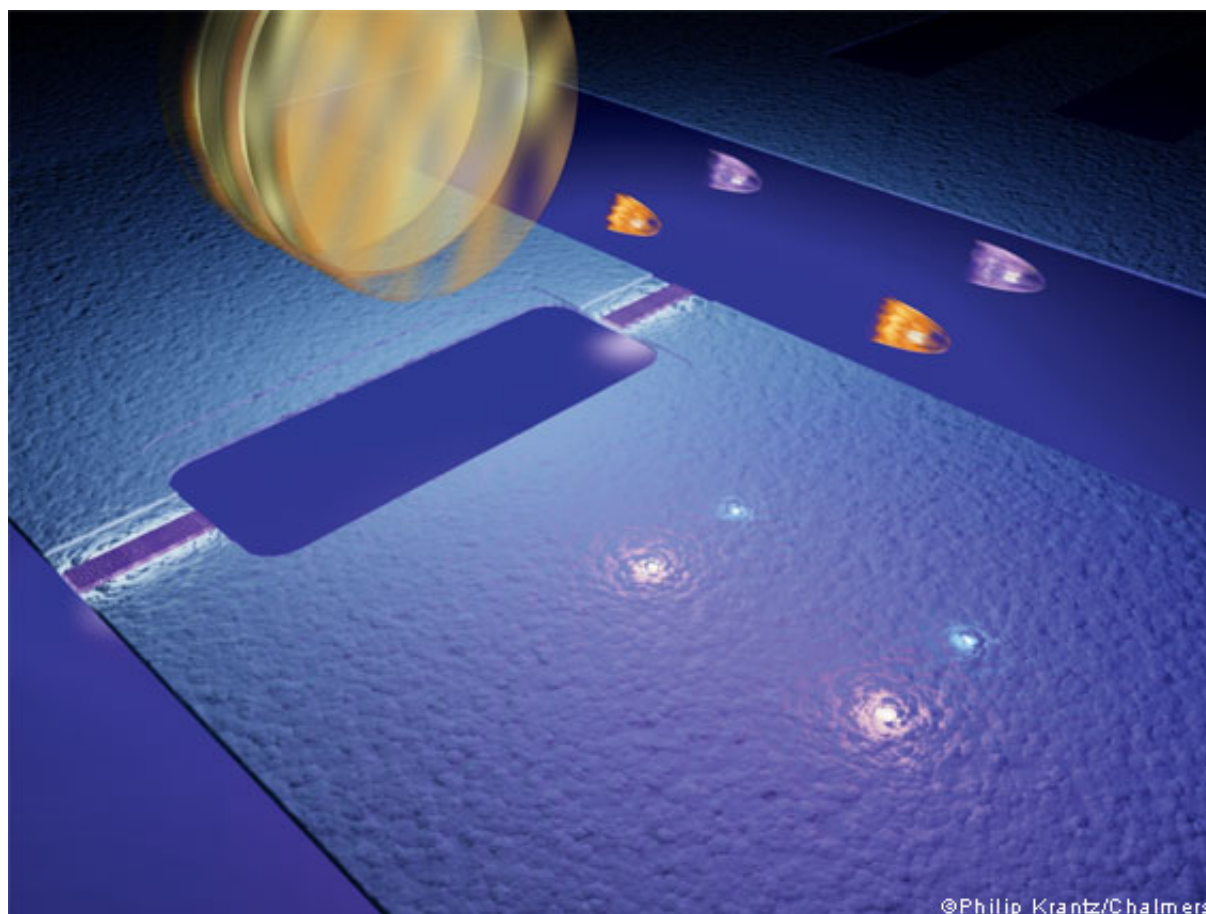


December 9, 2011 10:32 pm

# Let nothing be light

By Clive Cookson

Virtual photons that appear in pairs are captured for the first time using an electronic component



Real light particles are created by bouncing virtual protons off a vibrating 'mirror'

One of the many strange predictions of quantum theory is that there is no such thing as empty space. Even a complete vacuum teems with “virtual particles” that flit fleetingly into existence and then disappear again. Now, a remarkable experiment in Sweden has for the first time captured some of these virtual particles – creating light from nothing.

Virtual photons (light particles) appear in pairs that almost instantaneously cancel each other out and disappear. Gerald Moore, a US physicist, suggested 40 years ago that it

might be possible to separate these pairs before they could recombine – and in the process turn them into real photons – with a mirror moving at close to the speed of light.

This prediction, known as the “dynamical Casimir effect”, seemed impossible to test because the engineering challenge of making even a small mirror move so fast was too great. But scientists at Chalmers University of Technology in Gothenburg have achieved the same effect by replacing the mirror with an electronic component called a superconducting quantum interference device, or Squid.

The Squid, chilled to a temperature just above absolute zero, is extremely sensitive to the magnetic field around it. By changing the direction of the field billions of times a second, the researchers made the “mirror” vibrate at a speed equivalent to a quarter the speed of light.

“The result was that photons appeared in pairs from the vacuum, which we were able to measure in the form of microwave radiation,” says Per Delsing, physics professor at Chalmers. “We were also able to establish that the radiation had precisely the same properties that quantum theory says it should have when photons appear in pairs in this way.”

The electronic “mirror” transfers some of its kinetic energy to virtual photons, which helps them to materialise. According to quantum mechanics, there are many different types of virtual particles in a vacuum, though only photons appear in the experiment because they lack mass, says Göran Johansson of Chalmers.

“Relatively little energy is therefore required in order to excite them out of their virtual state,” Johansson says. “In principle, one could also create other particles from the vacuum, such as electrons or protons, but that would require a lot more energy.”

The production of photon pairs from the vacuum might eventually be useful in the development of quantum computing. But the experiment, published in the journal Nature, will be valuable for studying fundamental physical processes. Many scientists believe it will help to explain the mysterious “dark energy” that is pushing the universe apart.

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## **When a tan is good for your health**

A 25-year pharmaceutical quest for a safe, effective drug to promote tanning – for

medical rather than cosmetic purposes – may be approaching a positive conclusion.



The search started in the 1980s at the University of Arizona, where scientists discovered a way to stimulate the growth of melanocytes. These cells produce melanin, the tanning pigment that protects the skin against the ill-effects of exposure to ultraviolet light. Though their research was funded by the US National Institutes of Health as a skin cancer project, the scientists also explored “lifestyle” applications.

For years, attempts to exploit the discovery oscillated between medical and cosmetic applications – without success. Then, in 2006, investors formed a new company called Clinuvel out of the previous EpiTan, and focused it on treating skin disorders.

Philippe Wolgen, Clinuvel’s CEO, says: “I don’t believe in lifestyle drugs – they’re an abuse of the system.” Any suggestion of cosmetic tanning could also prejudice the regulators against the company.

Today Clinuvel’s lead product, Scenesse, is showing encouraging clinical results against three disorders. The first is erythropoietic protoporphyria (EPP), a severe light intolerance in the skin that can force sufferers to stay indoors. The second is vitiligo, the appearance of white unpigmented patches on the skin of dark-skinned people including Africans, Asians and Hispanics. The third is skin cancer in people whose immune system is suppressed following transplant surgery.

Scenesse is a chemical derivative of a natural hormone (a chain of amino acids) which stimulates melanin production in the skin. It is administered as an implant, the size of a rice grain, beneath the skin.

Wolgen says Scenesse could be available for prescription in Europe before the end of 2012. The US will follow about a year later.

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### **Power of pee: a new source of electricity?**

Urine was collected and used extensively in pre-industrial societies. Known in old

England as lant, it was particularly important as a cleaning material, because of its high ammonia content.



Ieropoulos with a urinary fuel cell

These days the 6.4 trillion litres excreted annually by the world's population are almost all wasted. But scientists at the University of the West of England, Bristol, are developing a new use for urine – as an alternative source of electricity. Ioannis Ieropoulos and colleagues have shown that urine can provide the energy and nutrients for bacteria to generate power in “microbial fuel cells” (MFCs). Their research is published in the journal *Physical Chemistry Chemical Physics*.

“While we recognise the need for a great deal more research in this area, we are very excited by the potential of this work,” says Ieropoulos. “This is the first paper to outline not just the use of urine as a potential fuel for MFCs but also the fact that urine could be an abundant source for electricity generation. The impact of this could be huge, since it enables us to think of ‘waste’ in a new way.”

Having demonstrated the potential of urine to power small individual cells, the UWE team plans next to combine them into a large generating stack, with a \$100,000 grant from the Bill & Melinda Gates Foundation. This could run on urine either from people or from farm animals.

As well as producing electricity, the process would clean the urine, making it less polluting when discharged into the environment.

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## Once upon a time, we had whiskers too

Moveable whiskers were an important feature in the early evolution of mammals, according to research at Sheffield University.

### Queen of the night

The world's first night-flowering orchid has been discovered on

Behaviour known as whisking, in which whiskers move back and forth rapidly at varying angles, helps animals to determine the position, shape and texture of objects and

the island of New Britain near Papua New Guinea. Blooms open around 10pm and last until morning.

build up environmental maps of their surroundings. This is true not only of rats and mice but also of South American opossums, which diverged from rodents 125 million years ago when mammals had themselves recently evolved from reptiles.

“This latest research suggests that alongside becoming warm-blooded, giving birth to live young and having an enlarged brain, the emergence of a new tactile sense based on moveable facial whiskers was an important step along the evolutionary path to modern mammals,” says Tony Prescott, lead author of the study published in Philosophical Transactions of the Royal Society B. “Although humans no longer have moveable whiskers, they were a critical feature of our early mammalian ancestors.”

The Sheffield team is also using its insights from biological whisking to develop animal-like robots that can use artificial whiskers to navigate without vision. These robots could have applications in search-and-rescue, particularly in environments where smoke or dust make it difficult to see.

*Editor's note: There was a wee error on our part – “daily” should have read “annually”. It was corrected on December 20.*

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