# Cosmic quirk in microcosm

SCIENTISTS have detected the Doppler effect a quirk of physics that makes an ambulance's siren change pitch as it drives by on the scale of a single molecule.

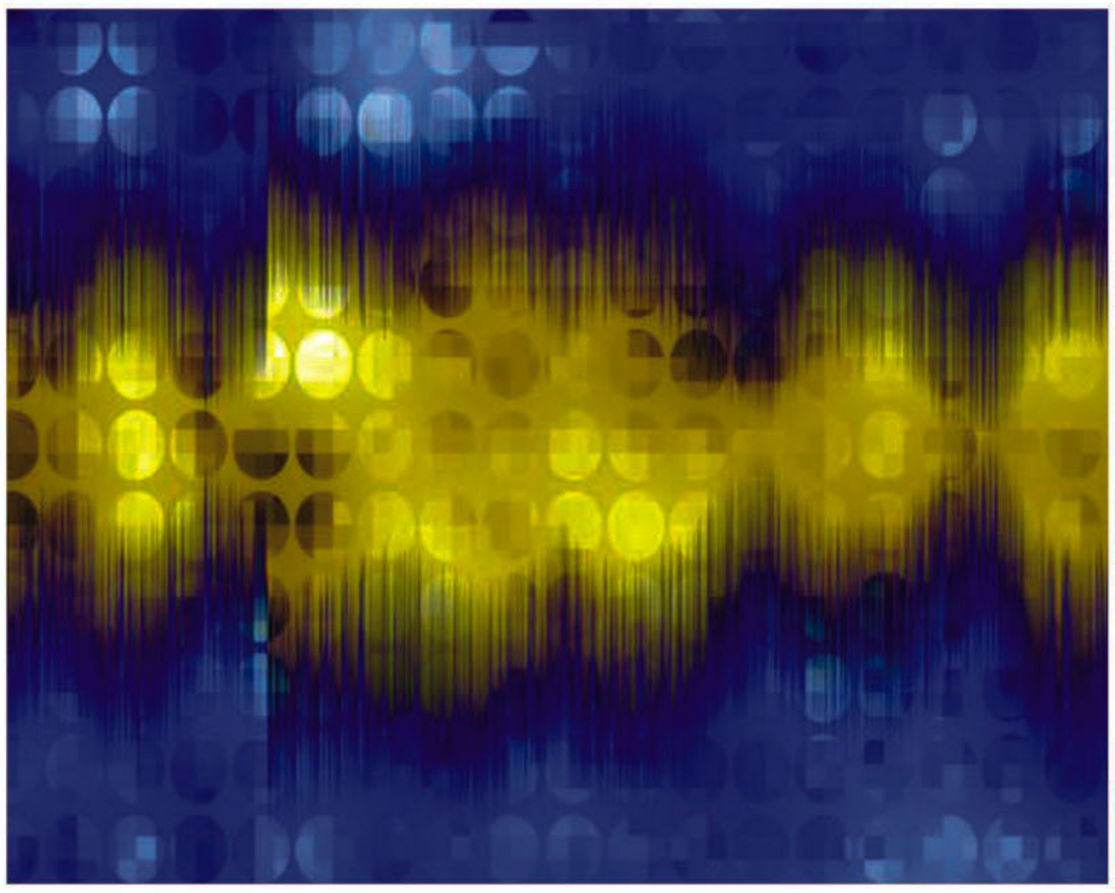
The Doppler effecthas been understood since 1842 and is used to help astronomers find faraway planets, but it never before has it been demonstrated on such a small scale.

The idea behind the Doppler effect is simple: When a moving object emits either sound orlight waves, the motion of the source causes the frequency of those waves to change. [The Coolest Little Particles in Nature]

When an object moves toward you, for example, the waves bunch together because that object's motion closes the gap between successive waves (like an accordion). This bunching means the distance between waves is shrunk and their frequency is higher than if the object were sitting still.

In sound waves, an increase in frequency (equivalent to a decrease in wavelength) corresponds to higher pitch. In light waves, the frequency determines the color: blue light has a higher frequency than red light, for example.

When an object moves away from you, the opposite occurs. As the source recedes, its waves space out as it puts more distance between the waves.



**A phenomenon called the Doppler effect causes the frequency of sound waves to shift when their source is moving. Now this effect has been seen on a smaller scale than ever before.**

"Have you ever been caught in a speed trap? You know what the Doppler shift is then," said T. Darrah Thomas, a professor emeritus of chemistry at Oregon State University. "When light or any radiation is either reflected off of, or transmitted from, a moving object, it gets its wavelength shifted. That's how the speed trap works."

Thomas led a team of researchers who observed this effect created by the rotational motion of a molecule of nitrogen.

"There is plenty of evidence of the rotational Doppler effect in large bodies, such as a spinning planet or galaxy," Thomas said. "When a planet rotates, the light coming from it shifts to a higher frequency on the side spinning toward you and a lower frequency on the side spinning away from you." The effect can also be measured when a star wobbles to and fro, revealing the presence of an otherwise unseen planet tugging the star this way and that as it orbits around. "But this same basic force is at work even on the molecular level."

The scientists blasted high-energy photons into molecules of nitrogen. When hit, the molecules were jolted with energy, which caused them to release electrons. [Twisted Physics: 7 Mind-Blowing Findings]

By carefully measuring the energies of the electrons, the researchers found that electrons released when the molecule was rotating toward the detector had a higher energy than electrons released from molecules rotating away from the detector.

Now that scientific instruments are advanced enough to detect this change, Thomas said, scientists are going to have to start accounting for it in their measurements of particles in high-energy experiments.

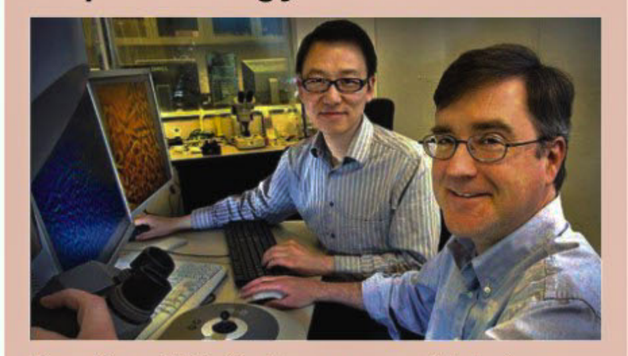
"I don't think anybody asked the question particularly" before now, Thomas told LiveScience. "It's just one of those things that nobody thought to look for."

The research was conducted at laboratories in Japan, Sweden and France, and is described in a paper published in the May 13 issue of the journal Physical Review Letters.

Source: LiveScience

ULTIMATE TRAP

## Super energy bank



**Dong Su and Eric Stach use a powerful electron microscope to analyze samples of activated graphene at Brookhaven's Center for Functional Nanomaterials**

SCIENTISTS at the U.S. Department of Energy's Brookhaven National Laboratory have helped to uncover the nanoscale structure of a novel form of carbon, contributing to an explanation of why this new material acts like a super-absorbent sponge when it comes to soaking up electric charge. The material, which was recently created at The University of Texas -- Austin, can be incorporated into "supercapacitor" energy-storage devices with remarkably high storage capacity while retaining other attractive attributes such as superfast energy release, quick recharge time, and a lifetime of at least 10,000 charge/discharge cycles.

"Those properties make this new form of carbon particularly attractive for meeting electrical energy storage needs that also require a quick release of energy -- for instance, in electric vehicles or to smooth out power availability from intermittent energy sources, such as wind and solar power," said Brookhaven materials scientist Eric Stach, a co-author on a paper describing the material published in Science on May 12, 2011.

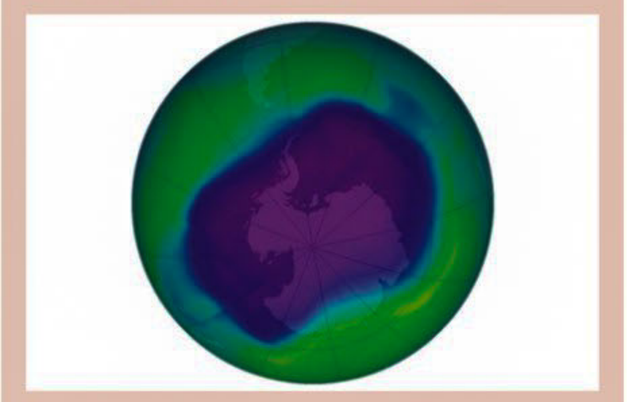
Supercapacitors are similar to batteries in that both store electric charge. Batteries do so through chemical reactions between metallic electrodes and a liquid electrolyte. Because these chemicals take time to react, energy is stored and released relatively slowly. But batteries can store a lot of energy and release it over a fairly long time.

Supercapacitors, on the other hand, store charge in the form of ions on the surface of the electrodes, similar to static electricity, rather than relying on chemical reactions.

Source: Science Daily

IN RECOVERY

## Ozone hole on the mend



**Scientists may have already spotted the annual Antarctic ozone hole, shown here in September 2006**

SCIENTISTS may have spotted Antarctica's ozone hole on the road to recovery, at least a decade sooner than they thought healing would be noticeable.

In 1989, an international agreement called the Montreal Protocol began phasing out chemicals that have gnawed away at Earth's protective ozone layer. Most researchers thought it would take until at least 2023 to detect the hole's slow recovery, but researchers in Australia now claim to have seen ozone ticking upward since the late 1990s.

"The key is to account for large year-to-year fluctuations that have obscured a gradual increase in the long-term evolution of ozone," says atmospheric scientist Murry Salby of Macquarie University in Sydney. His team published its findings online May 6 in Geophysical Research Letters.

First spotted in 1985, the Antarctic ozone hole was quickly linked to chemicals called chlorofluorocarbons, emitted mainly in the Northern Hemisphere but concentrated over the South Pole by atmospheric circulation patterns. Chlorine atoms from these CFCs react with ozone molecules, seasonally destroying the layer that shields Earth from cancer-causing and crop-damaging ultraviolet radiation.

Source: Science News

OLD IS GOLD

# Crop ancestors to feed world!

THE race is on to develop and test improved crop varieties to feed the world's growing population and help may lie in Syria's wild plants.

Many of the first crops emerged in Syria, where humans are thought to have first discovered agriculture some 11,000 years ago. Emmer wheat, barley, chickpea, pea and lentil crops all originated here.

Researchers from around the world are flocking to the Arabian desert to create crops for an increasingly bleak future, as obstacles to food production stack up, according to COSMOS Magazine.

Climate change; depletion of phosphorous supplies; the drying out of water basins; competition with biofuels for land; and the reliance on oil for nitrogen fertiliser production are all challenging the status quo, according to KennethStreet, an agriculturalist and genetic resource scientist at the International Centre for Agricultural Research in Dry Areas (ICARDA) .

As a result, many researchers have turned to breeding techniques that import useful traits from wild varieties the ancestors of domestic crops.

Although humans have only ever bred small numbers of the best-yielding varieties of crops, hundreds of thousands of species that our ancestors didn't pick contain genes that have enabled them to grow in one of the world's harshest climates, enduring droughts, high salinity and temperature variations.

If some of these genes could now be introduced to high-yielding crops they could provide them with an urgently needed boost.

To speed up this process, which normally takes up to 12 years, researchers are now looking at new technologies. For example, the Focussed Identification of Germplasm Strategy approach informs researchers where to look for certain traits by examining the environment from which the seed was collected.

"For example, if we're looking for a drought resistant crop, we're going to look in low rainfall environments in which the seasonal rainfall is highly variable this type of environment may have forced local populations to evolve towards physiological drought tolerance," says Street.

**Wheat is just one of many crops that originated in Syria**

Another initiative is to look for new molecular markers, which are common for some crops, such as wheat and barley, but largely unknown for others, such as chickpeas.

Genetic modification could also help reduce the length of time to breed new varieties, from 12 to two years, he said, but public concerns over the consequences for health and the environment may mean it never takes off.

"[GM] technology will never replace normal breeding you're only going to use [it] when you don't have any other way of getting the trait," says Muhammad Imtiaz, senior chickpea breeder at ICARDA.

Source: SciDev.net[http://www.scidev.net/]

"MUSHROOM BODIES"

## Insect brain

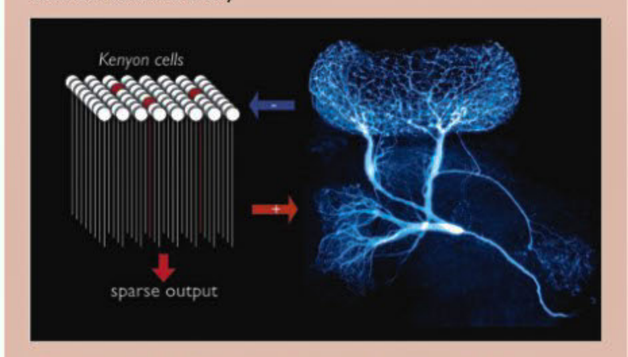
THE brain is a coding machine: it translates physical inputs from the world into visual, olfactory, auditory, tactile perceptions via the mysterious language of its nerve cells and the networks which they form. Neural codes could in principle take many forms, but in regions forming bottlenecks for information flow (e.g., the optic nerve) or in areas important for memory, sparse codes are highly desirable.

Scientists at the Max Planck Institute for Brain Research in Frankfurt have now discovered a single neuron in the brain of locusts that enables the adaptive regulation of sparseness in olfactory codes. This single giant interneuron tracks in real time the activity of several tens of thousands of neurons in an olfactory centre and feeds inhibition back onto all of them, so as to maintain their collective output within an appropriately sparse regime. In this way, representation sparseness remains steady as input intensity or complexity varies.

Signals from the world (electromagnetic waves, pressure, chemicals etc) are converted to electrical activity in sensory neurons and processed by neuronal networks in the brain. Insects sense smells via their antennae. Odours are detected by sensory neurons there, and olfactory data are then sent to and processed by the antennal lobes and a region of the brain known as the mushroom bodies. Neurons in the antennal lobes tend to be "promiscuous": odours are thus represented by specific combinations of neuronal activity. Neurons in the mushroom bodies -- they are called Kenyon cells -- , however, respond with great specificity and thus extremely rarely. In addition, they generally respond with fewer than three electrical impulses when stimulated with the right odour. This "sparse coding" strategy has the advantage that it simplifies the task of storing odour representations in memory.

Surprisingly, each Kenyon cell is connected on average to half of all possible presynaptic neurons in the antennal lobes. So how do the Kenyon cells manage to respond only extremely rarely, and with a sparseness that varies little over large ranges of stimulation conditions? Gilles Laurent of the Max Planck Institute for Brain Research and his group found that a single giant interneuron plays a key role.

Source: Science Daily




**Structure involved in olfactory memory in the insect brain**

DANCING PLANET

## Swirling clouds on Jupiter

This one will be fairly easy for some folks, impossible for others.

Hint: It's not any sort of candy.

Another hint: It's a view from above Okay, those were lousy hints. This is a close-up of swirling clouds on the gas giant planet Jupiter. It's a segment of an image, right next to the Great Red Spot. See the whole thing below.

The clouds on Jupiter change constantly, and patterns can shift in a matter of days. But major features, such as the bands of different colors that move along at up to 300 mph, persist much longer. In fact the Red Spot has been around for centuries. The clouds generate lightning, and scientists now think they may generate helium rain.

Source: Live Science

DID YOU KNOW?

## Why is countdown so important?

A countdown is loudly counting in reverse from 10 to 1, prior to an event. In a rocket launch, a countdown is a carefully devised set of procedures ending with the ignition of a rocket engine, which starts 72 to 96 hours prior to its launch time. During the countdown, step-by-step procedures like placing the vehicle at the launch site, loading the essentials needed for the launch, setting up communication with the launch centre, etc are executed. When everything is okayed, 'T minus Time', that is, 3 minutes and 40 seconds is set and the process of ignition begins.