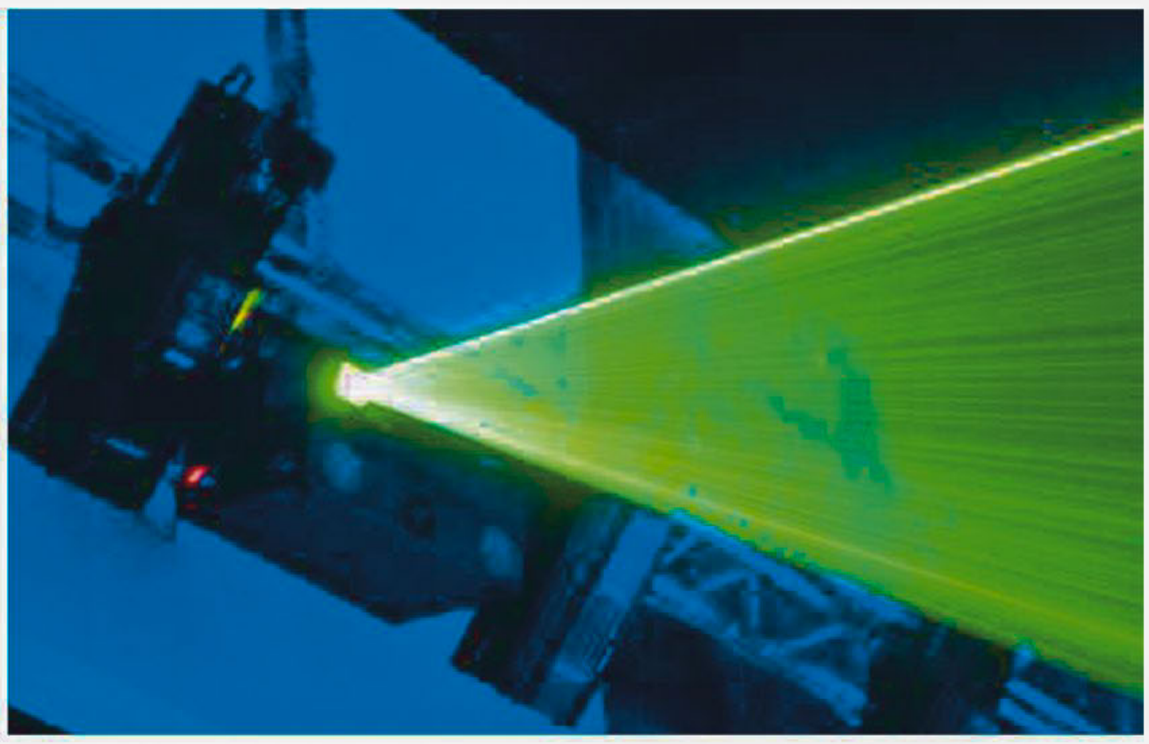
Light beam that lifts things up

'TRACTOR beams' of light that pull objects towards them are no longer science fiction. Haifeng Wang at the A*STAR Data Storage Institute and co-workers have now demonstrated how a tractor beam can in fact be realized on a small scale.

Tractor beams are a well-known concept in science fiction. These rays of light are often shown pulling objects towards an observer, seemingly violating the laws of physics, and of course, such beams have yet to be realised in the real world. Haifeng Wang at the A*STAR Data Storage Institute and co-workers have now demonstrated how a tractor beam can in fact be realized on a small scale. "Our work demonstrates a tractor beam based only on a single laser to pull or push an object of interest toward the light source," says Wang.

Based on pioneering work by Albert Einstein and Max Planck more than a hundred years ago, it is known that light carries momentum that pushes objects away. In addition, the intensity that varies across a laser beam can be used to push objects sideways, and for example can be used to move cells in biotechnology applications. Pulling an object towards an observer, however, has so far proven to be elusive. In 2011, researchers theoretically demonstrated a mechanism where light movement can be controlled using two opposing light beams -- though technically, this differs from the idea behind a tractor beam.



Laser for projection. Could lasers also be used as 'tractor beams' to pull objects towards them?

Wang and co-workers have now studied the properties of lasers with a particular type of distribution of light intensity across the beam, or so-called Bessel beams. Usually, if a laser beam hits a small particle in its path, the light is scattered backwards, which in turn pushes the particle forward. What Wang and co-workers have now shown theoretically for Bessel beams is that for particles that are sufficiently small, the light scatters off the particle in a forward direction, meaning that the particle itself is pulled backwards towards the observer. In other words, the behaviour of the particle is the direct opposite of the usual scenario. The size of the tractor beam force depends on parameters such as the electrical and magnetic properties of the particles.

Although the forces are not very large, such tractor beams do have real applications, says Wang. "These beams are not very likely to pull a human or a car, as this would require a huge laser intensity that may damage the object," says Wang. "However, they could manipulate biological cells because the force needed for these doesn't have to be large."

Such applications are the driving force for future experimental demonstrations of such pulling effects. The technology could, for example, be used to gauge the tensile strength of cells, which would be useful to investigate whether cells have been infected. "For instance, the malaria-infected blood cell is more rigid, and this technology would be an easy-to-use tool to measure this," adds Wang.

Source: Science News

PRECURSOR OF LIFE

Organic carbon from Mars

This is how Mars appeared to the Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC).

MOLECULES containing large chains of carbon and hydrogen--the building blocks of all life on Earth--have been the targets of missions to Mars from Viking to the present day. While these molecules have previously been found in meteorites from Mars, scientists have disagreed about how this organic carbon was formed and whether or not it came from Mars.

A new paper led by Carnegie's Andrew Steele provides strong evidence that this carbon did originate on Mars, although it is not biological. These findings give researchers insight into the chemical processes taking place on Mars and will help aid future quests for evidence of ancient or modern Martian life. The work is published May 24 in Science Express.

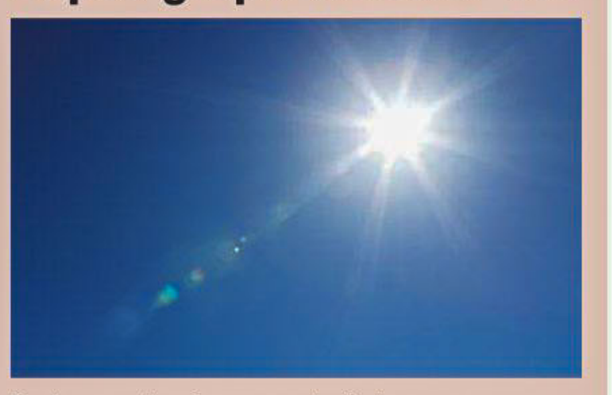
There has been little agreement among scientists about the origin of the large carbon macromolecules detected in Martian meteorites. Theories about their origin include contamination from Earth or other meteorites, the results of chemical reactions on Mars, or that they are the remnants of ancient Martian biological life.

Steele's team examined samples from 11 Martian meteorites whose ages span about 4.2 billion years of Martian history. They detected large carbon compounds in 10 of them. The molecules were found inside of grains of crystallized minerals.

Source: Science News

GOLDEN WINDOW

Doped graphene solar cell



Doping was key to unprecedented power conversion efficiency from a new graphene solar cell.

DOPING may be a no-no for athletes, but researchers in the University of Florida's physics department say it was key in getting unprecedented power conversion efficiency from a new graphene solar cell created in their lab.

Graphene solar cells are one of industry's great hopes for cheaper, durable solar power cells in the future. But previous attempts to use graphene, a single-atom-thick honeycomb lattice of carbon atoms, in solar cells have only managed power conversion efficiencies ranging up to 2.9 percent. The UF team was able to achieve a record breaking 8.6 percent efficiency with their device by chemically treating, or doping, the graphene with trifluoromethanesulfonylamide, or TFSA. Their results are published in the current online edition of Nano Letters.

"The dopant makes the graphene film more conductive and increases the electric field potential inside the cell," said Xiaochang Miao, a graduate student in the physics department. That makes it more efficient at converting sunlight into electricity. And unlike other dopants that have been tried in the past, TFSA is stable -- its effects are long lasting.

The solar cell that Miao and her co-workers created in the lab looks like a 5-mm-square window framed in gold. The window, a wafer of silicon coated with a monolayer of graphene, is where the magic happens.

Source: Science Daily

DOTTED HOPE

Nanomedicine on primate proves safe

A pioneering study to gauge the toxicity of quantum dots in primates has found the tiny crystals to be safe over a one-year period, a hopeful outcome for doctors and scientists seeking new ways to battle diseases like cancer through nanomedicine.

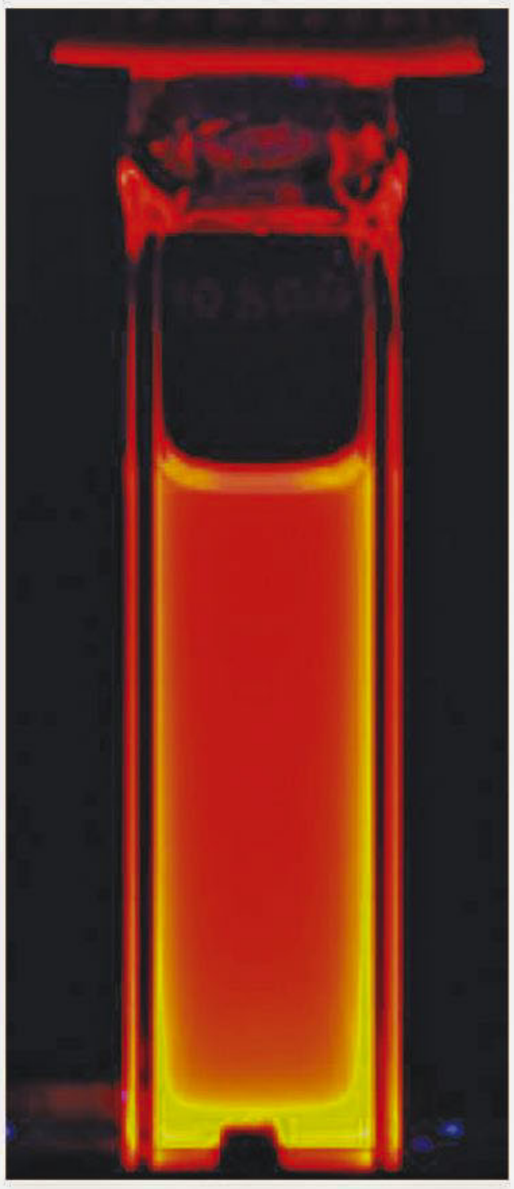
Medical uses for quantum dots -- tiny luminescent crystals -- could include image-guided surgery, light-activated therapies and sensitive diagnostic tests.

The research, which will appear on May 20 in Nature Nanotechnology online, is likely the first to test the safety of quantum dots in primates.

In the study, scientists found that four rhesus monkeys injected with cadmium-selenide quantum dots remained in normal health over 90 days. Blood and biochemical markers stayed in typical ranges, and major organs developed no abnormalities. The animals didn't lose weight.

Two monkeys observed for an additional year also showed no signs of illness.

Quantum dots are tiny luminescent crystals that glow brightly in different colors. Medical researchers are eyeing the crystals for use in image-guided surgery, light-activated therapies and sensitive diagnostic tests. Cadmium selenide quantum dots are among the most studied, with potential applications not only in medicine, but as components of solar cells, quantum computers, light-emitting diodes and more.



A solution of cadmium selenide quantum dots glows orange under ultraviolet light. This luminescence forms the basis for their use in bioimaging.

The new toxicity study -- completed by the University at Buffalo, the Chinese PLA General Hospital, China's ChangChun University of Science and Technology, and Singapore's Nanyang Technological University -- begins to address the concern of health professionals who worry that quantum dots may be dangerous to humans.

The authors caution, however, that more research is needed to determine the nanocrystals' long-term effects in primates; most of the potentially toxic cadmium from the quantum dots stayed in the liver, spleen and kidneys of the animals studied over the 90-day period.

"This is the first study that uses primates as animal models for in vivo studies with quantum dots," said paper coauthor Paras Prasad, UB professor of chemistry and medicine, and executive director of UB's Institute for Lasers, Photonics and Biophotonics (ILPB). "So far, such toxicity studies have focused only on mice and rats, but humans are very different from mice. More studies using animal models that are closer to humans are necessary."

The cadmium build-up, in particular, is a serious concern that warrants further investigation, said Ken-Tye Yong, a Nanyang Technological University assistant professor who began working with Prasad on the study as a postdoctoral researcher at UB.

Because of that concern, the best in-vivo applications for cadmium-selenide quantum dots in medicine may be the ones that use the crystals in a limited capacity, said Mark Swihart, a third coauthor and a UB professor of chemical and biological engineering. Image-guided surgery, which could involve a single dose of quantum dots to identify a tumor or other target area, falls into this category.

Source: Science Daily

MASTER OF DISGUISE

Octopus foils predators

INSTEAD of blending in with the background, octopuses hide from predators by taking on the shape and color of specific objects in their environment, new research suggests.

"Octopuses are considered to be the master of camouflage. An octopus can change its color, pattern and texture of its skin in an instant," study researcher Noam Josef, of Ben-Gurion University in Israel, told LiveScience.

"By reproducing key features of well-chosen objects, the octopus can produce an effective camouflage that may fool a wide range of potential predators," Josef and colleagues write online today (May 23) in the journal PLoS ONE.

There are a few different ways that animals use camouflage to hide. Some adopt the color or texture of their surroundings, taking in the environment as a whole like, say, a mouse that evolves to have a lighter color because it lives on the beach.

Other animals hide from predators by looking similar to nearby objects, mimicking just part of the environment, instead of the whole.

To see how octopuses do it, the researchers analyzed images of 11 octopuses of two species, O. cyanea and O. vulgaris, in their natural habitats of the Red Sea and the Mediterranean Sea, respectively. A computer program was able to detect what parts of the environment were most similar to the color and texture of the octopus' skin in each of the images. In all pictures, the octopus only matched the texture of part of the environment say a coral reef the computer analysis showed.

Not only does the octopus have to fool all different types of visual systems, it also needs to be hidden from every angle, what the researchers call the "point of view" predicament: The predator could be a fish looking down on the octopus, or, if it's an eel, it would be at eye level.

"The octopus does not imitate the object precisely (in our case, it does not look exactly like any given branching coral), but rather uses key features of the objects common in its surroundings," the authors write in the paper. "A possible advantage to such a mechanism is that it can fit a wide range of locations even if the exact level of the match is not perfect."

The octopus is well-known for its shape-shifting abilities, and can change not only its shape, but also its color and texture to blend in. Interestingly, they can do this even though octopuses are essentially colorblind.

Source: Live Science

Octopuses camouflage themselves by matching their body pattern to selected features of nearby object, like this one looking suspiciously like a conch shell.

KNOWN FOR NOSE

Sneezin' Monkey

Source: Live Science

A previously unknown type of snub-nosed monkey, discovered in northern Myanmar and dubbed Rhinopithecus strykeri, has a nose so upturned that the animals sneeze audibly when it rains. To avoid inhaling water, the monkeys supposedly sit with their heads tucked between their knees on drizzly days, according to local hunters. The species, shown here in a Photoshop reconstruction based on a Yunnan snub-nosed monkey and a carcass of the newly discovered species.

DID YOU KNOW?

How many species of eels are there?

Eels (Anguilliformes are an order of fish, which consists of four suborders, 20 families, 111 genera and approximately 800species. Most eels are predators. The term "eel" is also used for some other similarly shaped fish, such as electric eelsand spiny eels, but these are not members of the Anguilliformes order.

Eels begin life as flat and transparent larvae, or leptocephali. Eel larvae drift in the surface waters of the sea feeding on marine snow, small particles that float in the water. Eel larvae then metamorphose into glass eels and then become elvers before finally seeking out their juvenile and adult habitats. Freshwater elvers travel upstream and are forced to climb up obstructions such as weirs, dam walls and natural waterfalls.