

# SCIENCE & LIFE

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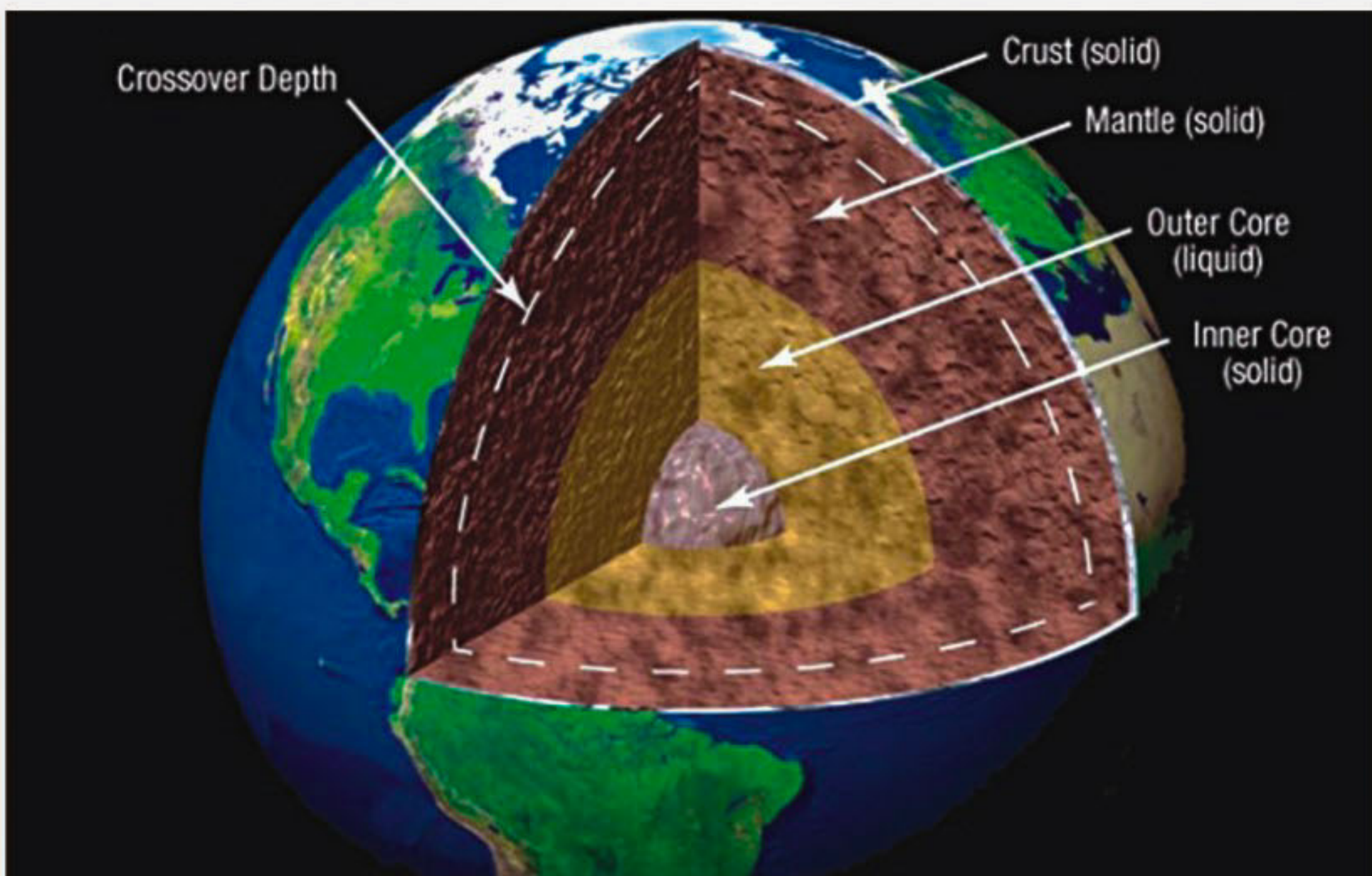
## EARTH'S CORE

# How fast does it rotate?

OBAIDUR RAHMAN

SCIENTISTS from the University of Cambridge (UoC), for the very first time, have come up with the first accurate estimation of how fast the Earth's inner core is rotating compared to the rest of the planets in our solar system. Although previous researches have shown that Earth's core is rotating but, this recent study, of which details have been published in the 20th February edition of the journal Nature Geoscience, depicts a more exact picture. It has been discovered by the researchers from UoC that the previous estimates of the rotation of Earth's core by 1 degree every year were in fact inaccurate and the core of our home planet is actually moving much slower than that. To be precise, the rate is approximately 1 degree, every million years.

The inner core is 5200 km beneath our feet and the effects of its presence is one of great importance on Earth's surface. Because, as the inner core grows, the heat released during solidification drives convection in the fluid in the outer core and this convection generates Earth's geomagnetic field. And without this magnetic field, the surface of Earth would not be protected from solar radiation and hence life on this 3rd planet from the Sun would not be



Artist's impression of Earth's core and inner layers

able to exist. It is also key to mention here that the inner core grows very slowly over time as material from the fluid outer core solidifies onto its surface and during this very process, an east-west hemispherical difference in velocity is frozen into the structure of the inner core. And according to Lauren Waszek, lead author of the paper and PhD student from the UoC's Dept. of Earth Sciences, "The faster rotation rates are

incompatible with the observed hemispheres in the inner core because it would not allow enough time for the differences to freeze into the structure". The researcher further explains that, this very thing of nature has been a major problem since the two properties cannot coexist. And this prompted the researchers to derive the rotation rates from the evolution of the hemispherical structure which exclusively made this study the

very first one in which the hemispheres and rotation are inherently compatible.

For the purpose of the research (which was a rigorous one), the scientists used seismic body waves which pass through the inner core that is 5200 km beneath the surface of Earth and compared their travel time to waves which reflect from the inner core surface. And the difference between the travel times of these

waves provided the team with the velocity structure of the uppermost 90 km of the inner core. And this particular information was reconciled with the differences in velocity for the east and west hemisphere of the inner core. At first, the scientists observed the east and west hemispherical differences in velocity and this was followed by constraining of the two boundaries which separate the hemispheres. And this process of examination discovered that they both shifted consistently eastward with depth. And since the inner core grows over time, therefore the deeper structure is older and the shift in the boundaries between the two hemispheres results in the inner core rotating with time. And the rotation rate is consequently calculated by the research team from the shift of the boundaries and the growth rate of the inner core which eventually lead to the research finding.

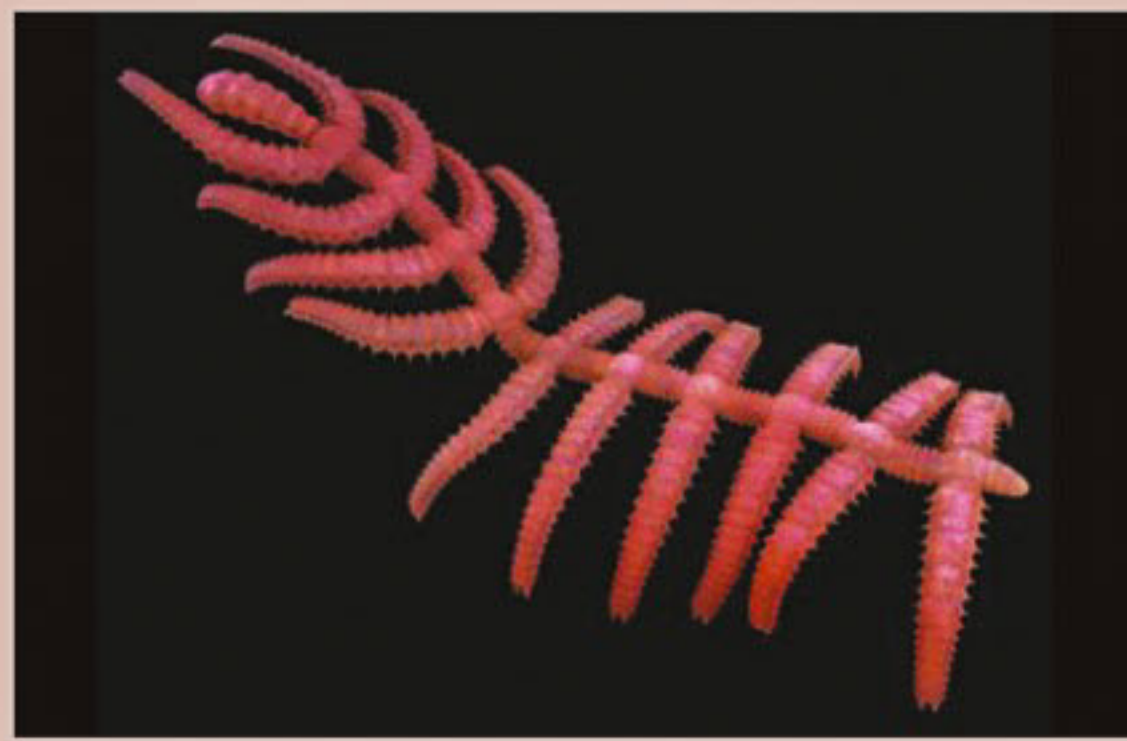
In conclusion, Lauren Waszek thinks "This result is the first observation of such a slow inner core rotation rate. It therefore provides a confirmed value which can now be used in simulations to model the convection of the Earth's fluid outer core, giving us additional insight into the evolution of our magnetic field".

The contributor is a freelance science writer



## WALKING CACTUS

### Evolution of body armour



A depiction of the 520-million-year-old fossil *Diania cactiformis* in life

FOSSILS of an ancient "walking cactus" suggest how ancestors of today's lobsters, insects, spiders and related groups went from squishy to spiky. Dating back about 520 million years, the fossilized prickly creature is not a plant but a thumb-sized, wormlike animal with 10 pairs of long, sturdy legs, says Jianni Liu of Northwest University in Xi'an, China. Discovered in southwestern China, it probably scuttled along the bottom of shallow seas, she says. In the Feb. 24 Nature, she and her colleagues christen the species *Diania cactiformis*, in honor of its spiky look.

Its armored leggy look surprised Liu when she first saw it. "I fell in love with this strange guy," she says. "Later when I observed it carefully under the microscope, I realized it was not only a funny one but an important one."

The creature's 10 legs appear to have carried a hard, outer covering of armor and joints that let them bend. Those features would make the species the earliest known worm-with-legs to have a hardened outer covering and also the first to have jointed legs, Liu says. An armored outer skeleton and jointed legs today distinguish the arthropods, the major lineage including crustaceans, insects, spiders and mites. Thus the cactus sea creature might be a sister to arthropod ancestors.

"The significance of the find is that arthropods are, in terms of species, the most successful group on the planet," Liu says. "The secret of their success seems to be their legs." Ancient appendages evolved with diverse lifestyles, forming claws for example, or gilled structures for underwater life. Even legs for moving around diversified into paddles for swimming or launchers for jumping.

Source: Science News



## METAL TRANSPORTER



## STRANGE COUSIN

### New form of sulphur



Artist's impression of the S3- molecule in a diamond anvil cell

SULFUR is the sixth most abundant element on Earth and plays a key role in many geological and biological processes. A French-German team including CNRS1 and the Université Paul Sabatier has identified, on the basis of laboratory measurements, a novel form of sulfur present in geological fluids: the S3-ion. The discovery calls existing theories about the geological transport of sulfur into question, and could provide ways of identifying new deposits of precious metals such as gold and copper.

These findings are published in the Feb. 25, 2011 issue of the journal Science.

Until now, geochemists believed that inside Earth, only two forms of molecules contained sulfur: sulfides (based on H2S or S2-) and sulfates (based on H2SO4 or SO42-). Yet they had no way of directly plunging a probe into the hydrothermal fluids that flow through rocks to verify this theory. To get round this problem and test their hypothesis, the French-German team first created fluids similar to those in Earth's crust and mantle, i.e. aqueous solutions containing elementary sulfur (S) and thiosulfates (molecules containing the S2O32-ion). They then used a diamond anvil cell to bring the fluids to the temperatures and pressures found at depths of several kilometers (several hundred degrees and tens of thousands of atmospheres).

Source: Science Daily

# New device to trap antimatter

Creating matter's strange cousin antimatter is tricky, but holding onto it is even trickier. Now scientists are working on a new device that may be able to trap antimatter long enough to study it.

Antimatter is like a mirror image of matter. For every matter particle (say an electron, for example), a matching antimatter particle is thought to exist (in this case, a positron) with the same mass, but an opposite charge.

The problem is that whenever antimatter comes into contact with regular matter, the two annihilate. So any container or bottle made of matter that attempts to capture antimatter inside would be instantly destroyed, along with the precious antimatter sample one tried to put inside the bottle.

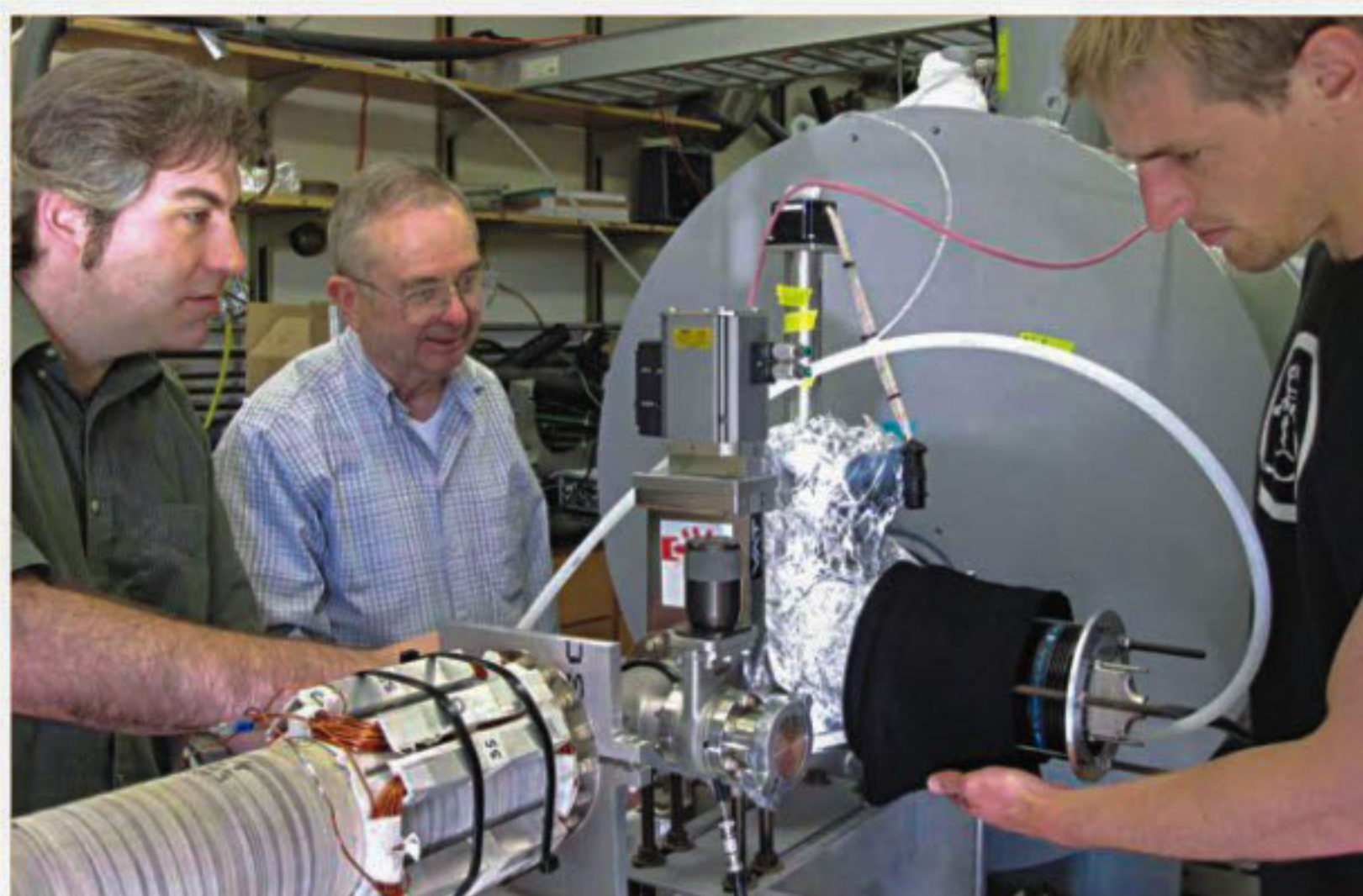
Physicist Clifford Surko of the University of California, San Diego is hard at work to overcome that issue. He and his colleagues are building what they call the world's largest trap for low-energy positrons a device they say will be able to store more than a trillion antimatter particles at once.

The key is using magnetic and electric fields, instead of matter, to construct the walls of an antimatter "bottle."

"We are now working to accumulate trillions of positrons or more in a novel 'multicell' trap an array of magnetic bottles akin to a hotel with many rooms, with each room containing tens of billions of antiparticles," Surko said in a statement.

Surko presented his work today (Feb. 18) here at the annual meeting of the American Association for the Advancement of Science.

The researchers are also developing



UCSD physicists James Danielson, Clifford Surko and Craig Schallhorn (left to right) inspect the world's largest antimatter trap

methods to cool antiparticles to super-cold temperatures so that the particles' movements are slowed and they can be studied.

The scientists also want to compress large clouds of antiparticles into high-density clumps that can be tailored for practical applications.

"One can then carefully push them out of the bottle in a thin stream, a beam, much like squeezing a tube of toothpaste," Surko said. "These beams provide new ways to study how antiparticles interact or react with ordinary matter. They are very useful, for example, in understanding the properties of material surfaces."

Surko said another project is to create a portable antimatter bottle that could be taken out of the lab and into various

industrial and medical situations. "If you could have a portable trap it would greatly amplify the uses and applications of antimatter in our world."

Antimatter may sound exotic, but it's already used in everyday technology, such as medical PET (Positron Emission Tomography) scanners.

During a PET scan, the patient is injected with radioactive tracer molecules that emit positrons when they decay. These positrons then come into contact with electrons in the body, and the two annihilate, releasing two gamma-ray photons. The gamma-ray photons are then detected by the scanner, giving a 3-D image of what's going on inside the body.

Source: Live science

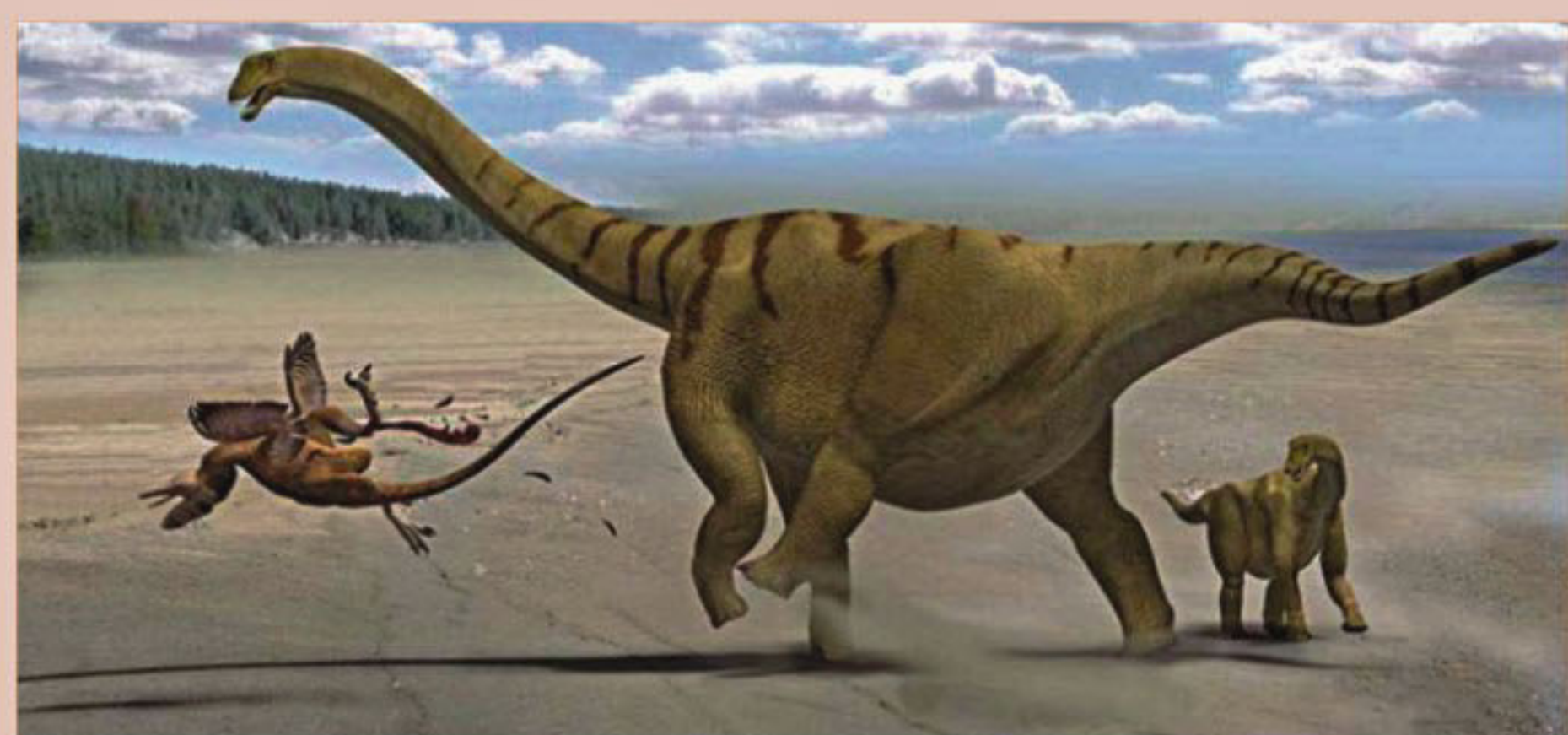


## 'THUNDER THIGHS'



## DID YOU KNOW?

### The giant sauropod



This life restoration shows the adult *Brontosaurus* as a mother, protecting her baby from a predator by using her powerful thigh muscles to deliver a devastating kick

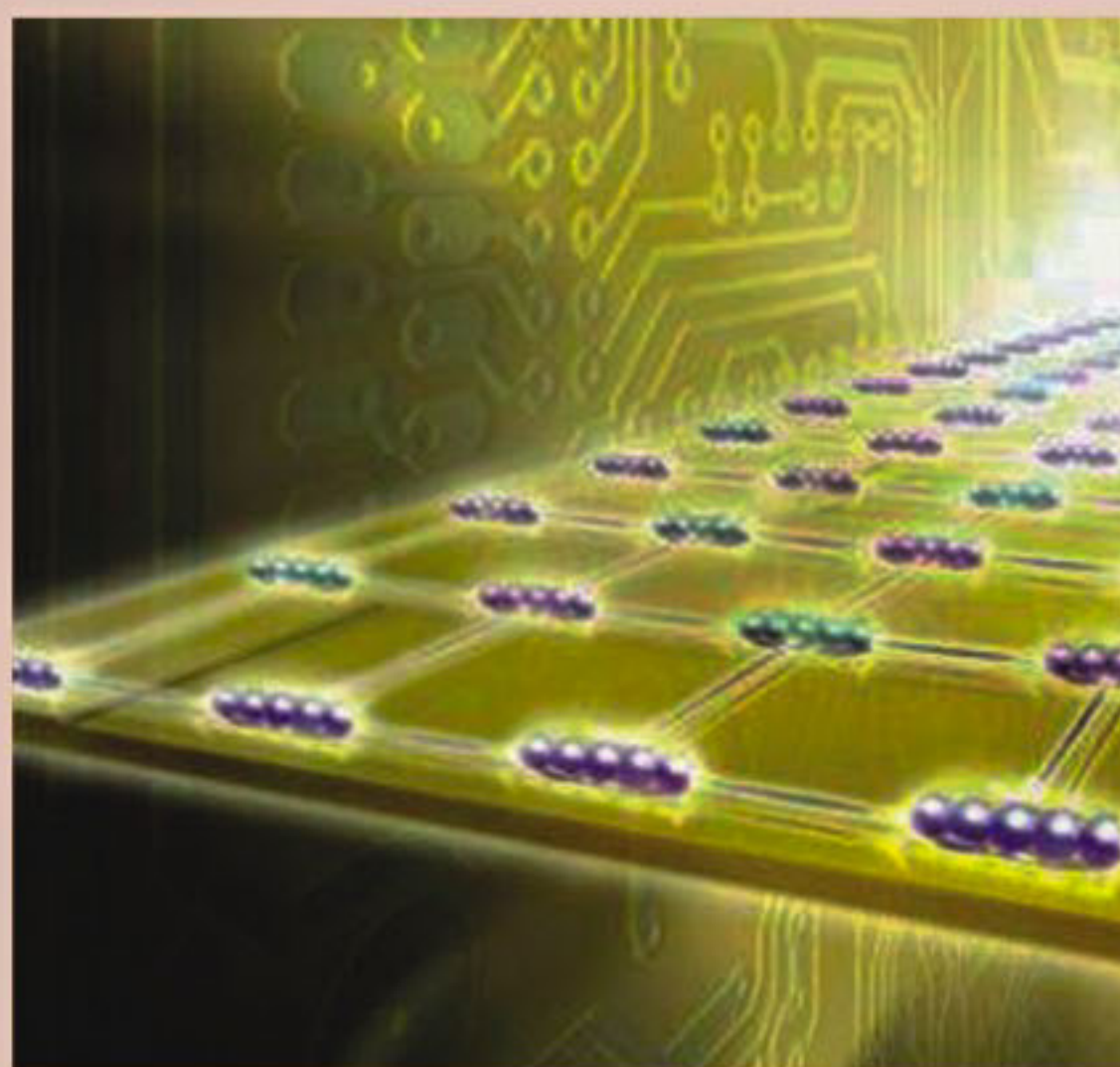
Source: Live science

### What's the medicinal value of eel?



In China and Japan eel is not only eaten as food but is also known for its medicinal properties. Ancient Koreans believed eel helped relieve fatigue and sexual debility. Eel skin or kadaagel also has medicinal properties. Its tightening ability makes it

useful as a type of brace to relieve sprains.



Quantum antennae enable the exchange of quantum information between two separate memory cells



## ATOMIC ANTENNA

### Transmitting quantum info

THE Austrian research group led by physicist Rainer Blatt suggests a fundamentally novel architecture for quantum computation. They have experimentally demonstrated quantum antennas, which enable the exchange of quantum information between two separate memory cells located on a computer chip. This offers new opportunities to build practical quantum computers.

The researchers have published their work in the scientific journal Nature.

Six years ago scientists at the University of Innsbruck realized the first quantum byte -- a quantum computer with eight entangled quantum particles; a record that still stands. "Nevertheless, to make practical use of a quantum computer that performs calculations, we need a lot more quantum bits," says Prof. Rainer Blatt, who, with his research team at the Institute for Experimental Physics, created the first quantum byte in an electromagnetic ion trap. "In these traps we cannot string together large numbers of ions and control them simultaneously."

To solve this problem, the scientists have started to design a quantum computer based on a system of many small registers, which have to be linked. To achieve this, Innsbruck quantum physicists have now developed a revolutionary approach based on a concept formulated by theoretical physicists Ignacio Cirac and Peter Zoller. In their experiment, the physicists electromagnetically coupled two groups of ions over a distance of about 50 micrometers. Here, the motion of the particles serves as an antenna. "The particles oscillate like electrons in the poles of a TV antenna and thereby generate an electromagnetic field," explains Blatt. "If one antenna is tuned to the other one, the receiving end picks up the signal of the sender, which results in coupling." The energy exchange taking place in this process could be the basis for fundamental computing operations of a quantum computer.

Source: Science Daily