The Daily Star

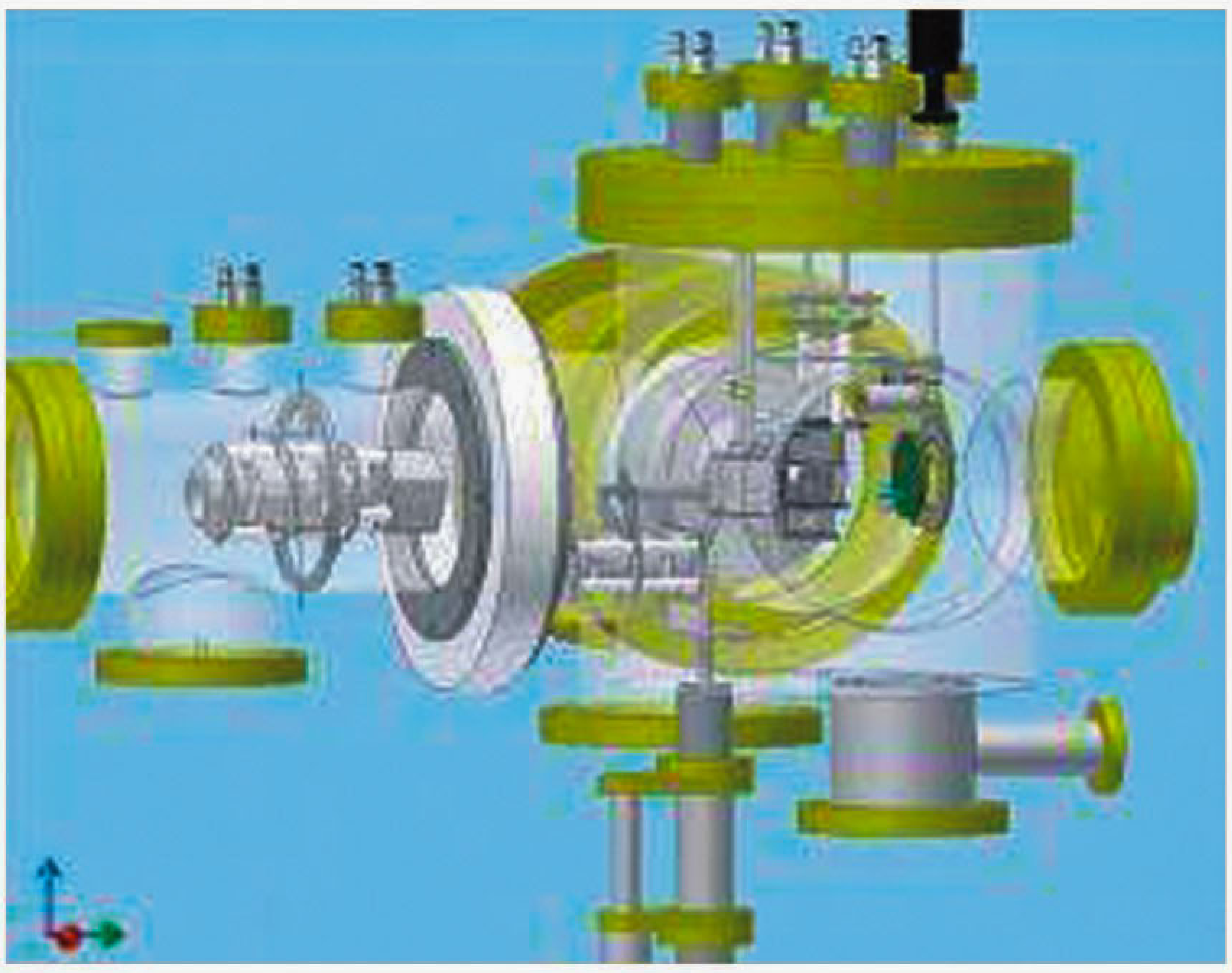
SCIENCE & LIFE

DHAKA TUESDAY DECEMBER 28, 2010, E-MAIL: science&life@thedailystar.net

Atomic collisions in new light

ANTIMATTER, a substance that often features in science fiction, is routinely created at the CERN particle physics laboratory in Geneva, Switzerland, to provide us with a better understanding of atoms and molecules. Now, Japanese scientists at RIKEN, as part of a collaborative team with researchers from Denmark, Japan, the United Kingdom and Hungary, have shown that antiprotonsparticles with the same mass as a proton but negatively chargedcollide with molecules in a very different way from their interaction with atoms. The result sets an important benchmark for testing future atomic-collision theories.

RIKEN scientist Yasunori Yamazaki explains that to assess such collisions: "We shot the simplest negatively charged particles, slow antiprotons, at the simplest molecular target, molecular hydrogen." Slow antiprotons are a unique probe of atoms and molecules because their negative charge does not attract electronsthereby simplifying theoretical modelling. Further, slower projectile speeds mean longer-lasting, stronger interactions and avoid the need for complicated relativistic calculations.



A schematic diagram of the antiproton decelerator at CERN that is used to smash antiprotons and hydrogen molecules together so that the remaining particles can be analyzed to provide insight to their interactions

The scientists at CERN created antiprotons by firing a beam of high-speed protons into a block of the metal iridium. Then, in a facility known as the Antiproton Decelerator, they used magnets to focus the antiprotons before applying strong electric fields to slow them down to approximately 10% of the speed of light. Yamazaki and his colleagues trapped and cooled these antiprotons to 0.01% of the velocity of light before accelerating them one by one to the desired velocity. They then slammed antiprotons into a gas of molecular deuteriuma pair of bound hydrogen atoms each with a nucleus comprising one proton and one neutronand used sensitive equipment to detect the remnants of the collision.

Yamazaki and the team found that the likelihood of the ionization of the deuterium molecules scales linearly with the antiproton velocity. This is contrary to what is expected for the atomic target, hydrogen. "This was a big surprise, and it infers that our understanding of atomic collision dynamics, even at a qualitative level, is still in its infancy," says Yamazaki. The team suggests that molecular targets provide a mechanism for suppressing the ionization process. As an antiproton approaches one of the protons in the molecule, the presence of the second proton shifts the orbiting electron cloud. The slower the antiproton, the more time the electron has to adjust, and hence the smaller the chance of ionization.

The team now hopes to investigate how ionization depends on the antiprotontarget distance and the orientation at the moment of collision.

Source: Physorg.com

DIVINE MATHEMATICIAN

Fibonacci numbers in nature

In Douglas Adams' "The Hitchhiker's Guide to the Galaxy," a super computer reveals that the meaning of life is the number 42. While Fibonacci's rabbit experiment doesn't tackle such deep questions, its answers resonate throughout nature

IS there a magic equation to the universe? A series of numbers capable of unraveling the most complicated organic properties or deciphering the plot of "Lost"? Probably not. But thanks to one medieval man's obsession with rabbits, we have a sequence of numbers that reflect various patterns found in nature.

In 1202, Italian mathematician Leonardo Pisano (also known as Fibonacci, meaning "son of Bonacci") pondered the question: Given optimal conditions, how many pairs of rabbits can be produced from a single pair of rabbits in one year? This thought experiment dictates that the female rabbits always give birth to pairs, and each pair consists of one male and one female.

Think about it -- two newborn rabbits are placed in a fenced-in yard and left to, well, breed like rabbits. Rabbits can't reproduce until they are at least one month old, so for the first month, only one pair remains. At the end of the second month, the female gives birth, leaving two pairs of rabbits. When month three rolls around, the original pair of rabbits produce yet another pair of newborns while their earlier offspring grow to adulthood. This leaves three pairs of rabbit, two of which will give birth to two more pairs the following month.

The order goes as follows: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 and on to infinity. Each number is the sum of the previous two. This series of numbers is known as the Fibonacci numbers or the Fibonacci sequence. The ratio between the numbers (1.618034) is frequently called the golden ratio or golden number.

At first glance, Fibonacci's experiment might seem to offer little beyond the world of speculative rabbit breeding. But the sequence frequently appears in the natural world -- a fact that has intrigued scientists for centuries.

Want to see how these fascinating numbers are expressed in nature? No need to visit your local pet store; all you have to do is look around you.

Source: Howstuffworks

NUMBERS GAME

Counting stars

DEBASHISH CHAKRBARTY

THE story made the top of the first page of the National section of the New York Times. It was on the nightly news. The universe contains three times more stars than previously thought!

300,000,000,000,000,000,000,000 stars in the visible universe. Not 100,000,000,000,000,000,000,000.

Now that's news! I'm being facetious, of course. A few comments, the result is tentative. Its significance has to do with the relative distribution of stars of various sizes in elliptical versus spiral galaxies, which may -- if true -- help in understanding how the different types of galaxies formed. But all of that is about elliptical versus spiral galaxies got lost in the fine print. The big news! Three times more stars that previously thought!

So what? One big, incomprehensible number replaced by another big incomprehensible number. Not even an order of magnitude different.

When in the winter of 1609-10 Galileo turned his new telescope on the faint blur called "the Beehive" in Cancer, he counted 36 stars, invisible to the unaided eye. To the three stars of Orion's belt his instrument added 50. When he examined the Milky Way the stars he saw defied enumeration. Now that was newsworthy! The universe wasn't made only for us.

"He tells the numbers of the stars, He calls each by name," sings the psalmist. With Galileo's telescope the stars became too numerous to be namable, even by a deity, One hundred sextillion or three hundred sextillion. The change in the number is not important to anyone but the professional cosmologist with an interest in galaxy formation. For the rest of us, it is the number itself we should set about accommodating.

The writer is a student of BRAC University

REVISITING NATURE

Machine that mimics plant life

A prototype solar device has been unveiled which mimics plant life, turning the Sun's energy into fuel.

The machine uses the Sun's rays and a metal oxide called ceria to break down carbon dioxide or water into fuels which can be stored and transported.

Conventional photovoltaic panels must use the electricity they generate in situ, and cannot deliver power at night.

The prototype, which was devised by researchers in the US and Switzerland, uses a quartz window and cavity to concentrate sunlight into a cylinder lined with cerium oxide, also known as ceria.

Ceria has a natural propensity to exhale oxygen as it heats up and inhale it as it cools down.

If as in the prototype, carbon dioxide and/or water are pumped into the vessel, the ceria will rapidly strip the oxygen from them as it cools, creating hydrogen and/or carbon monoxide.

Hydrogen produced could be used to fuel hydrogen fuel cells in cars, for example, while a combination of hydrogen and carbon monoxide can be used to create "syngas" for fuel.

It is this harnessing of ceria's properties in the solar reactor which represents the major breakthrough, say the inventors of the device. They also say the metal is readily available, being the most abundant of the "rare-earth" metals.

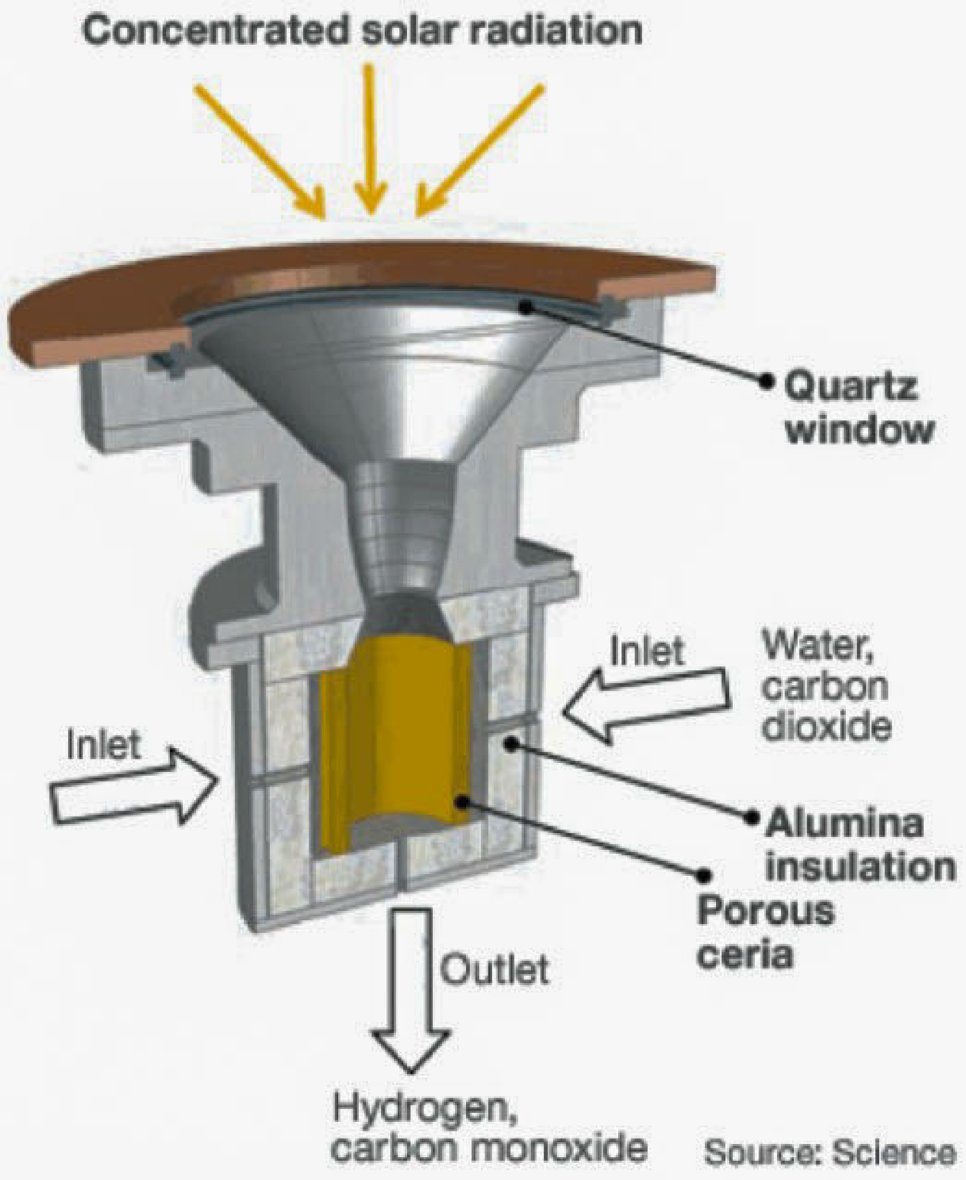
Methane can be produced using the same machine, they say.

Refinements needed

The prototype is grossly inefficient, the fuel created harnessing only between 0.7% and 0.8% of the solar energy taken into the vessel.

Most of the energy is lost through heat loss through the reactor's wall or through the re-radiation of sunlight back through the device's aperture.

But the researchers are confident that efficiency rates of up to 19% can be achieved through better insulation and smaller apertures. Such efficiency rates, they say, could make for a viable commercial device.



In the prototype, sunlight heats a ceria cylinder which breaks down water or carbon dioxide

"The chemistry of the material is really well suited to this process," says Professor Sossina Haile of the California Institute of Technology (Caltech). "This is the first demonstration of doing the full shebang, running it under (light) photons in a reactor."

She says the reactor could be used to create transportation fuels or be adopted in large-scale energy plants, where solar-sourced power could be available throughout the day and night.

However, she admits the fate of this and other devices in development is tied to whether states adopt a low-carbon policy.

"It's very much tied to policy. If we had a carbon policy, something like this would move forward a lot more quickly," she told the BBC.

It has been suggested that the device mimics plants, which also use carbon dioxide, water and sunlight to create energy as part of the process of photosynthesis. But Professor Haile thinks the analogy is over-simplistic.

Source: BBC Science

TRAP IN ABYSS

Detecting elusive neutrino

TIS the season for good tidings from the North Pole, but this week some particle physicists are giddy about a humongous gift at the South Pole. The world's largest detector for high-energy neutrinos was completed December 18 when scientists lowered the last of 5,160 sensors more than a mile beneath the ice of the Antarctic plateau.

The IceCube Neutrino Observatory will hunt for tiny particles that are common in the universe, but rarely interact with other matter. In fact, trillions of neutrinos pass through a person's body each second. They rain down onto Earth as cosmic rays strike the upper atmosphere. Neutrinos also shoot out of the violent insides of stellar explosions, churn regularly from the sun and may even arise from the ambient leftovers of the Big Bang.

IceCube is tuned to find high-energy neutrinos like the ones bursting from active galactic nuclei, which are bright sources that are likely the radiation from a black hole gobbling the mass around it, and gamma ray bursts, intense beams of light from a star collapsing into a black hole. The $279 million observatory is a full cubic kilometer in volume, or 1,000 times bigger than the Super-Kamiokande neutrino detector in Japan. While IceCube is less sensitive than the Super-K, scientists will need the huge volume to see long streaks of muons, exotic leftovers from collisions between neutrinos and water nuclei.

IceCube's sensors are designed to detect a flash of blue light when neutrinos collide with a water molecule. Ice at the South Pole is remarkably pure, so impinging neutrinos will almost certainly interact with water, not a different molecule. And because each new snowfall adds weight, packing down the ice below, there are a lot of molecules for a neutrino to hit.

Unlike most physics experiments, IceCube began taking data while under construction. Since 2005, it has already seen neutrinos with energies as high as 100 trillion electron-volts, seven times the maximum power that will be produced by collisions between protons at the Large Hadron Collider near Geneva, Switzerland.

Source: Science News

Scientists completed the largest neutrino detector with the lowering of the last of more than 5,000 neutrino sensors into holes (one shown) bored deep into the Antarctic ice sheet with hot water drills

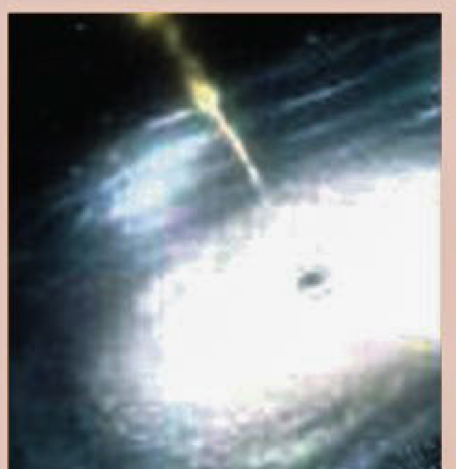
ISLAND RULE

What factors encourage a species to alter its dimensions on islands? What, in short, determines whether a creature will get Brobdingnagian or Lilliputian? In time, the red deer that long ago reached Jersey from France became six times smaller than their mainland counterparts.

NOVA EVOLUTION

DID YOU KNOW?

What is black energy?



In astronomy, black energy is a hypothetical form of energy that permeates all of space and tends to increase the rate of expansion of the universe. Black energy currently accounts for 73% of the total mass-energy of the universe. Black energy has been used as a crucial ingredient in a recent attempt to formulate a cyclic model for the universe. The nature of black energy is very homogeneous, not too dense.