

# SCIENCE & LIFE

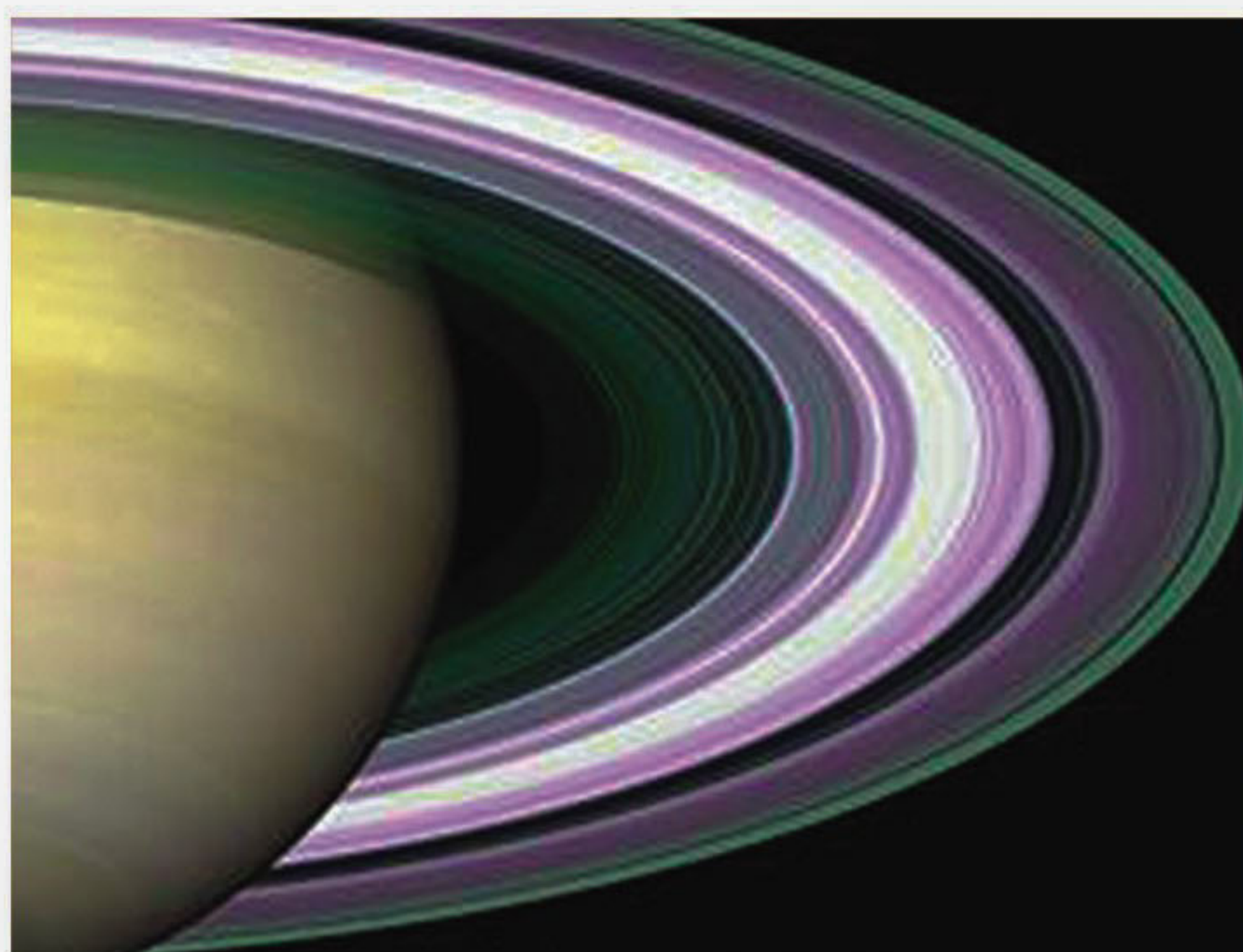
DHAKA TUESDAY DECEMBER 21, 2010, E-MAIL: science&life@thedailystar.net

## Story of Saturn's rings

OBADUR RAHMAN

THESE has always been a great deal of interest about Saturn's mystifying yet magnificent set of rings. In fact, the formation of the nine rings of this sixth and the second largest planet of our solar system has always intrigued astronomers for ages. But a recent study conducted by the Southwest Research Institute (SwRI), USA, is shedding some conclusive light on the origins of Saturn's majestic rings. The study has been published in details in Nature's Advance Online Publication of December 12.

About 4.5 billion years ago, around the time when our Earth was formed, a moon about the size of Titan (Saturn's largest satellite) violently coiled into the massive planet braving a large disk of hydrogen gas that circled the Saturn. And as the event took place, Saturn's powerful gravity simply stripped off the fated moon's icy outer layers and thus dawned the planet's stellar icy rings. Previous theories suggested that Saturn's many moons (62 known moons and hundreds of moonlets) either crashed into each other or an asteroid collided with some of them leaving a trail of debris that would eventually form the rings. But according to Dr. Robin M. Canup, associate vice president of SwRI and author of the paper, this wasn't the case after all. And in her own words, "This scenario would have likely



Saturn's icy rings could be the leftover mantle of a huge moon



Saturn

resulted in rings that were a mixture of rock and ice, rather than the ice-rich rings we see today". Saturn's rings are 90 to 95 % water-ice.

And since cosmic dust and debris from rocky meteoroids have polluted the rings after their formation, it is believed that these rings were actually consisted of pure ice. This means that if the rings were formed by a moon-on-moon crash or asteroid-on-moon collision, then there would have been more

space rocks in the rings. And this clearly strengthens Dr. Canup's particular hypothesis on Saturn's ring formation.

This ring formation theory also links to the deceased satellites of Saturn. Today, as we all know, Saturn has only one true gigantic moon, Titan. But it is believed that during the early days of formation of our solar system, several Titan-size satellites orbited the planet. And it was those fateful moons which one after another collided with Saturn in

the span of billions of years. Interestingly, each collision created a ring system which was subsequently destroyed by the collision of another moon which in effect formed another ring around the magnificent planet. And now Titan is the sole giant satellite of the planet, thanks to Saturn's powerful gravitational pull. It is to be noted that the water-ice around Saturn used to be 10 to 100 times more massive than the ones we see today. And this is due to the fact that these icy rings had shrink with

the passage of time. So, the ring around Saturn today is very likely the ruins of the last moon that collided with the planet. Experts believe in the near future NASA's Cassini aircraft, which entered the orbit around Saturn back in 2004, would be able to measure the rings' mass and the pollution rate. And at the same time it'll also be able to provide information about the rings' age.

The contributor is a freelance science writer.



### IN THE BLACKBOX

#### Where concepts form:



Illustration of brain

A small area deep in the brain called the perirhinal cortex is critical for forming unconscious conceptual memories, researchers at the UC Davis Center for Mind and Brain have found.

The perirhinal cortex was thought to be involved, like the neighboring hippocampus, in "declarative" or conscious memories, but the new results show that the picture is more complex, said lead author Wei-chun Wang, a graduate student at UC Davis.

The results were published Dec. 9 in the journal Neuron. We're all familiar with memories that rise from the unconscious mind. Imagine looking at a beach scene, said Wang. A little later, someone mentions surfing, and the beach scene pops back into your head.

Declarative memories, in contrast, are those where we recall being on that beach and watching that surf competition: "I remember being there."

Damage to a structure called the hippocampus affects such declarative "I remember" memories, but not conceptual memories, Wang said. Neuroscientists had previously thought the same was true for the perirhinal cortex, which is located immediately next to the hippocampus.

Wang and colleagues carried out memory tests on people diagnosed with amnesia, who had known damage to the perirhinal cortex or other brain areas. They also carried out functional magnetic resonance imaging (fMRI) scans of healthy volunteers while they performed memory tests.

In a typical test, they gave the subjects a long list of words, such as chair, table or spoon, and asked them to think about how pleasant they were.

Later, they asked the subjects to think up words in different categories, such as "furniture."

Amnesiacs with damage to the perirhinal cortex performed poorly on the tests, while the same brain area lit up in fMRI scans of the healthy control subjects.

The study helps us understand how memories are assembled in the brain and how different types of brain damage might impair memory, Wang said. For example, Alzheimer's disease often attacks the hippocampus and perirhinal cortex before other brain areas.

Source: Science Daily



### MATH MYSTERY



### BEACON OF TIDE

#### Goldbach conjecture

DEBASHISH CHAKRABARTY

Prime numbers provide a rich source of speculative mathematical ideas.

Today, prime numbers are fascinating but they are also of commercial importance, since the best commercial and military ciphers depend on their properties.

Here is another unproved conjecture about prime numbers. It is called the Goldbach conjecture and may be stated as follows:

Every even number greater than 4 can be written as the sum of two odd prime numbers

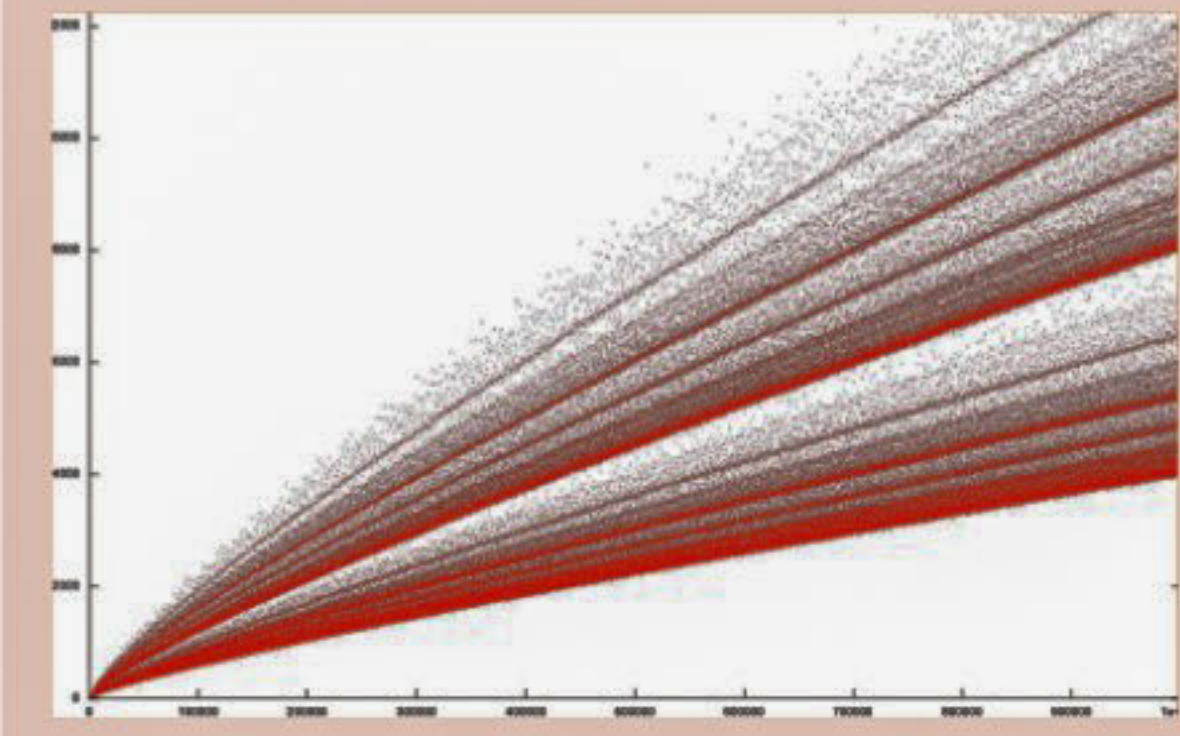
- For example:
- 8 = 3 + 5. Both 3 and 5 are prime numbers.
  - 20 = 13 + 7 = 17 + 3.
  - 42 = 23 + 19 = 29 + 13 = 31 + 11 = 37 + 5.

Notice that there can be more than one Goldbach pair. The conjecture says only that there is at least one, and has nothing to say about whether there may be more.

You can explore the Goldbach conjecture yourself with this Goldbach calculator. Simply enter an even integer, n, greater than 4 and the calculator will find all the Goldbach pairs.

Christian Goldbach (1690-1764) was a Prussian amateur mathematician and historian who lived in St Petersburg and Moscow. He made his conjecture in a letter to Leonhard Euler, who at first treated the letter with some disdain, regarding the result as trivial. Goldbach's conjecture, however, remains unproved to this day.

The writer is a student of the Department of Computer Science and Engineering, Brac University.



Goldbach pair count. For every even number, number of pairs is displayed

#### Sensing ocean magnetism

EUROPEAN scientists are going to try to measure the movement of the oceans by tracing their magnetism alone.

The effort will be achieved using three super-sensitive spacecraft called Swarm, which should launch in 2012.

The magnetic signal of the tides sweeping around the globe has been seen before, but the new mission would aim to observe far more detail.

It should provide additional data on how the oceans transfer heat around the Earth, a key feature of the climate.

"When salty ocean water flows through the magnetic field of the Earth, an electric field is generated and this electric field again makes a magnetic field," explained Dr Hermann Lühr, from the German Research Centre for Geosciences (GFZ) and a leading investigator on Swarm.

"We hope to have the possibility to measure the ocean currents which are so important for climate dynamics, because oceans are transporting a lot of heat. The German Champ mission was the first to see at least the tidal signal, but with Swarm we want to be able to monitor the currents themselves."

The new mission is one of the several innovative European Space Agency (Esa) endeavours being discussed this week here at the American Geophysical Union (AGU) Fall Meeting, the largest annual gathering of Earth and planetary scientists.

The major part of Earth's global magnetic field is generated by convection of molten iron within the planet's outer liquid core, but there are other components that contribute to the overall signal, including the magnetism retained in rocks.

Swarm's goal is to investigate all the components, but pulling out the small part produced by ocean movement will probably be its greatest challenge, concedes Dr Mark Drinkwater from Esa's Earth observation division.



The Swarm satellites have the look of giant mechanical rats

"We're talking about tens of thousands of nanoteslas for the total field measured at satellite level, of which one part in 50,000 approximately is contributed by ocean circulation," he told BBC News.

"So it's a akin to finding a needle in a haystack, but the modelling which has shown the retrievability of this element of the magnetic field has demonstrated that it might be possible with [our satellite system]."

It means the spacecraft themselves have to be built with extreme care. The magnetism generated by the satellites' own workings has to be minimised as much as possible, and thoroughly modelled to understand what interference it might be introducing into the scientific data.

Currently under construction with manufacturer EADS Astrium, the satellites look like giant mechanical rats with long tails.

The tails are booms designed to hold Swarm's sensitive magnetometer instruments away from the "noise" that would inevitably come from the electronics inside the main body of the spacecraft.

Every component put on the satellites has had to be tested, right down to the glues that have been used to bond some surfaces together. Any trace ferrous materials in the glues could ruin the measurements.

"You can't go near the spacecraft with a standard spanner or screwdriver - all the tools you would normally use on a spacecraft build. You have to de-gauss them," said platform project manager Andy Jones.

"You have to test them and make sure they're magnetically clean so they'll leave no trace, because if you touch a bolt with a magnetised spanner you will leave a field behind on that bolt."

The Champ spacecraft came out of orbit just a few weeks ago, burning up in the Earth's atmosphere.

Scientists reported first in 2003 that this satellite could sense the subtle magnetic field generated as the waters of the Earth moved under the gravitational tug of the Moon. This signal was apparent because of its very regular pattern.

Source: BBC



### TURMOIL AT HEART



### DID YOU KNOW?

#### Celestial Xmas bauble



Celestial Christmas bauble? This delicate shell, photographed by the NASA/ESA Hubble Space Telescope, seems to float serenely in space, but the apparent calm hides inner turmoil. Called SNR B0509-67.5 (or SNR 0509 for short), the bubble of gas is the remnant of a colossal explosion of a star, or supernova, in the Large Magellanic Cloud, a small galaxy about 160,000 light-years away. Ripples in the shell's surface may be caused either by subtle variations in the density of the gaseous environment, or possibly be driven from the interior by fragments from the initial explosion, astronomers say. The reddish shroud of gas is 23 light-years across and is expanding at more than 18 million km (11 million miles) per hour.

Source: World Science

#### Who is a Vegivore?



A vegivore is a person who craves or has a special fondness for vegetables. This need not be because the person has an aversion to eating meat but solely due to an intense craving for vegetables. To a vegivore, meat products may only seem like an accompaniment to add flavour to the dish. He/ she will find the vegetable dish more satiating than the meat dish.



### SUN CATCHERS

#### Hornet shows the way

THE possibility that a hornet might be harvesting sunlight for energy has researchers abuzz. Scientists have constructed an electricity-generating solar cell using a pigment from the oriental hornet, a team reports in the December Naturwissenschaften but much more evidence would be needed to link solar input to power output in the living beast.

Oriental hornets (*Vespa orientalis*) spend their days clearing soil from their underground nests to make room for nest expansion. While many wasps would go about such business in the cooler morning hours, previous research led by the late Jacob Ishay of Tel Aviv University noted that the nest-expanding activity peaks in sweltering midday. Experiments also showed that shining a light on the hornets generated voltage differences across their hard exoskeletons. These and other finds suggested that the hornets were maximizing exposure to sunlight. So Ishay's doctoral student, Marian Plotkin, decided to further investigate the brown and yellow pigments on the insect's cuticle.

Examination of the striped patch on the hornet's backside revealed a microstructure that traps incoming light, preventing reflection. And when the researchers extracted a yellow pigment called xanthopterin from the hornet's outer shell and plopped it into a solar cell that uses dyes to absorb light, the solar cell squeaked out some electricity.

The find is interesting but not surprising, says Andrew Parker of the Natural History Museum in London. The skins and shells of organisms from butterflies to diatoms can have complex microstructures that manipulate light. In some instances, such as a weevil with an opaline exoskeleton, this microstructure creates a brilliant color. Similar structures in other insects, such as the textured eyes of certain flies and moths that are active at dawn and dusk and need every available photon of light, may serve to maximize absorption.

The researchers have a long way to go to demonstrate that the oriental wasp is solar-powered, says Parker. The team hasn't shown that xanthopterin is linked to production of ATP, the energy-storing molecule of cells. And any number of pigments might eke out some electricity if stuck in a dye-sensitized solar cell.

Even if it turns out that this wasp uses the sun in a more ordinary manner, the idea that insects might get an energy buzz from sunlight isn't so farfetched. "Virtually everything that's been engineered in the physics world," Parker says, "turns up in nature."

Source: Science News



The stripe on the backside of an oriental hornet contains a yellow pigment capable of capturing light