Why is the sky dark at night?

QUAMRUL HAIDER Ph.D

IN 1826, a Viennese physician named Heinrich Olbers brought to the attention of astronomers one of the most basic questions in cosmology. Why is the sky dark at night? Since the night sky is filled with stars literally overlapping each other, shouldn't it be uniformly bright? Yet the night sky appears black with stars, planets, and galaxies scattered all over. This contradiction between theory and reality is known as "Olbers' paradox." At first, the question may seem stupid and nonsensical, but it has profound implications.

Olbers was a believer in the Newtonian model of the Universe. Newton believed that the stars and galaxies are homogeneously and isotropically distributed throughout the space. Over a long period of time, the attractive gravitational forces between the heavenly objects would cause all of them to fall together, and the Universe would soon be a compact blob. Obviously, this has not happened. This led Newton to conclude that the Universe is static and infinite dotted with stars. In other words, the Universe is eternal; it will exist forever without major changes in its structure.

Olbers could not reconcile dark night with a static, infinite Universe. He argued that if space, populated with stars and galaxies extends sufficiently far, then regardless of in what direction we look, our line of sight will eventually reach the surface of a star. Furthermore, if the Universe is infinitely old, there would be a star everywhere we looked in the night sky. Even if they appear very faint to us, the diminishing brightness of distant stars are exactly balanced by their increasing numbers. Hence, stars at all distances contribute equally to the total amount of light received on Earth. Thus the entire night sky should be covered with stars glowing brilliantly with no dark spaces between them.

COURTESY: GOOGLE IMAGES

The Night Sky

Olbers's paradox suggests that something is wrong with Newton's infinite, static Universe. The resolution of the paradox lies in the fact that the Universe is neither infinite, nor eternal, nor static. If we believe in the Big Bang Theory, the Universe is expanding with distant stars and galaxies receding from us at high velocities. When radiation or light is emitted from a receding source, it is Doppler shifted to larger wavelengths. In the jargon of physics, this is known as red shift. The intensely high energy gamma-rays (wavelength less than 0.00000000001 meter) and other forms of radiation that emanated after the Big Bang have been mostly red-shifted to microwave and radio wave regions (wavelength between 1mm and 1 km), losing nearly all of their energy. The red-shifted wavelengths are so large that they are outside the visible part of the electromagnetic spectrum. If there is no visible light, we won't see a glowing sky. Thus, an expanding Universe can make the night sky dark.

While the expansion of the Universe partially explains the paradox, it does not completely account for the darkness of the sky.

The finite age and size of the Universe is also responsible for dark nights. Irrespective of whether the Universe is finite or infinite in extent, its finite age of 14 billion years means it has a horizon beyond which stars and galaxies cannot be seen. It is highly likely that there are an infinite number of stars beyond that cosmic horizon and their light has not yet reached us. Interestingly, this argument was advanced in 1848 by the American poet and writer Edgar Allan Poe.

Another reason is the finite lifetime of the stars. After a few billion years or so stars consume their nuclear fuel, grow dark, and die. The gas and dust spewed back into space by the dying stars are used to give birth to new generations of stars. However, this process cannot continue forever. Eventually, all the nuclear fuel in the universe will be exhausted, and no new stars will be formed. So even if the universe were both infinitely old and large, there won't be enough fuel to keep the stars shining forever and fill up the space with starlight. Hence, the night sky is dark. The dark night is another evidence of the Big Bang model of the Universe.

Stars, in your multitude, scarce to be counted, filling the darkness with order and light. Victor Hugo, "Les Miserables."

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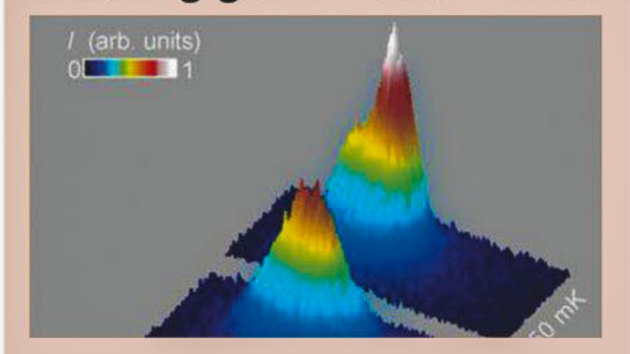
LIGHT & MATTER

Creating giant matter wave



As excitons cool to a fraction of a degree above absolute zero, they condense at the bottom of an electrostatic trap and spontaneously form coherent matter waves.

EXOTIC subatomic particles called excitons have been trapped and cooled to the point they formed a giant wave of matter, physicists report.

Excitons exist in materials called semiconductors, which have a certain range of electrical conductivity that makes them essential for modern electronics. When light is shined on a semiconductor, it can kick out an electron from an atom, creating a bound state between the "hole" that's left and the detached electron, called an exciton.

Now, researchers have cooled down excitons to the point that they form a single entity, a condensed state called an exciton condensate. And for the first time, the scientists have created this state within a trap in a lab.

"Condensation in a trap is important because it provides an opportunity to control a condensate," research team leader Leonid Butov of the University of California, San Diego, told LiveScience. "This is a powerful opportunity to study the properties of this state of matter."

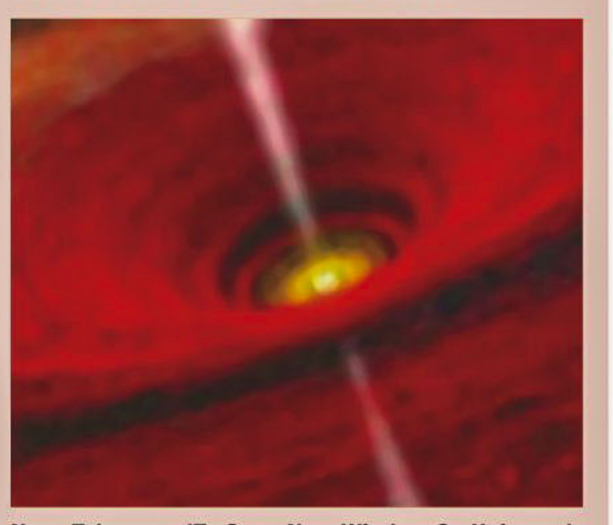
Excitons exist in nature they are integral to photosynthesis, for example but the particular type being manipulated here is rare, and could potentially be useful for applications such as solar energy and superfast computing. [Graphic: Nature's Tiniest Particles Explained]

"It's interesting physics," Butov said. "It's fundamental properties of light and matter."

Source: Live Science

COSMIC SLIT

New look of NuSTAR



Nasa Telescope 'To Open New Window On Universe'

NASA is launching a new telescope designed to study black holes and the sun that could "open a whole new window on the universe".

The Nuclear Spectroscopic Telescope Array, or NuSTAR, is scheduled to launch no earlier than June 13 from Kwajalein Atoll in the central Pacific Ocean.

Fiona Harrison, the NuSTAR principal investigator at the California Institute of Technology, said it will be the first space telescope to create focused images of high-energy cosmic X-rays.

"NuSTAR will make images that are ten times crisper and a hundred times more sensitive than any telescope that has operated in this region of the spectrum," she said.

The mission will work with other telescopes in space to provide a more complete picture of the most energetic and exotic objects, such as black holes and dead stars stars.

"NuSTAR uses several innovations for its unprecedented imaging capability and was made possible by many partners," said Yunjin Kim, the project manager for the mission at Nasa's Jet Propulsion Laboratory.

"We're all really excited to see the fruition of our work begin its mission in space."

Source: Yahoo News

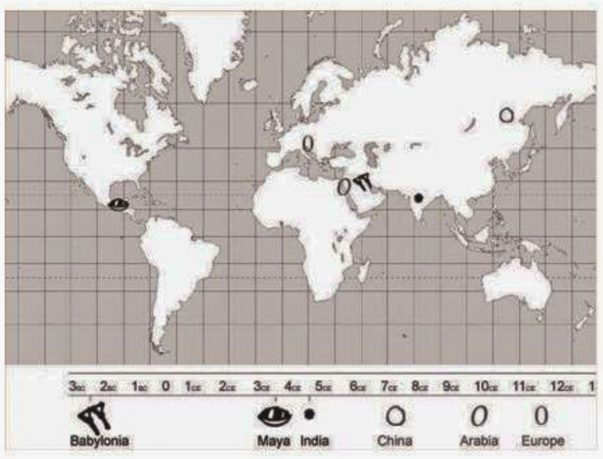
'NAUGHTY' TALE

The long trek of zero

OBAIDUR RAHMAN

THE digit 0 (zero), plays a central role in mathematics. It is believed that at around 2000 BC, it was the ancient Babylonians (modern-day Iraq) who first realized the need for a special marking to signify that a number is absent from a column. The 0 in 1035, for instance, points to the fact that there are no hundreds in that particular number. Instead of writing 0, these ancient people used space and later a punctuation symbol (two slanted wedges) to get the job done.

The ancient Greeks, regardless of their development in mathematics, many of which were learnt from ancient Egyptians, were quite hesitant about the use of zero. "How can nothing be something?," the would argue. This view changed and around 130 AD, the Greeks were using a small circle with a long over-bar as zero. By 525 AD Romans were using the term. Nulla and later only the letter N as a symbol for zero. The Mayans used a specific symbol for zero between 250 AD and 900 AD. Though their symbol did not look like the present-day 0, it was indicative of the high level of development they hand attained.



The story of zero throughout the ages.

The real birthplace of 0 is South-East Asia, where its extensive application in mathematics started from.

Today what we refer to as 0 is an ancient Indian invention. And the first proven document showing the application of 0 as a independent active numeral unit can be traced back to 7th century, developed by Indian mathematicians like Aryabhata (around 5th century AD) and later Brahmagupta (around 7th century AD). Around 650 AD, the Indian mathematician Brahmagupta applied dots to indicate zeros and these dots were referred as "sunya", meaning zero. It is said that Brahmagupta developed this "sunya" from the ancient Babylonian astronomy.

However, modern concept of zero indeed comes from his work, especially from his book Brahmasputha Siddhanta (The Opening of the Universe) where he penned down the standard rules for reaching zero through addition, subtraction and the results of other mathematical operations.

At around 825 AD noted Persian scientist and father of Algebra, Muhammad Ibn Musa al-Khwarizmi applied this mathematical knowledge in his book "On the Calculation with Hindu Numerals" which introduced the number zero. Next, the 8th century Chinese astronomer and mathematician of Indian descent, Gutama Siddha, introduced 0 in the Chinese numeral system. It consisted of counting rods as numeral system which used blank for zero. But it was through Al-Khwarzimi's work that Europe learnt about 0. The Italian mathematician Leonardo Fibonacci who in 1202 AD, based on Al-Khwarizimi's works wrote "Liber Abaci" meaning "The Book of Calculation" which not only introduced 0 to the existing Roman numeral system but also initiated the then feudal Europe with the numeral system that later became the most familiar numeral system known to mankind. Today it's called "The Hindu-Arabic Numeral System" as follows (0,1,2,3,4,5,6,7,8,9,10).

The contributor is a freelance science writer.

GENE-JACKER

Parasitic plants steal genes

NEW research published June 8 in BioMed Central's open access journal BMC Genomics reveals that the Malaysian parasitic plant Rafflesia cantleyi, with its 50cm diameter flowers, has 'stolen' genes from its host Tetrastigma rafflesiae. Analysis of these genes shows that their functions range from respiration to metabolism, and that some of them have even replaced the parasites own gene activity.

Vertical gene transfer is that between parents and their offspring, while horizontal gene transfer is the movement of genes between two different organisms. Bacteria use horizontal gene transfer to exchange resistance to antibiotics. Recent studies have shown that plants can also use horizontal gene transfer, especially parasitic plants and their hosts due to their intimate physical connections.

Rafflesia cantleyi is an obligate holoparasite (dependent on its host, and only that host, for sustenance), which grows on Tetrastigma rafflesiae, a member of the grape family. Researchers from Singapore, Malaysia and USA collaborated to systematically investigate the possibility of horizontal gene transfer between these two plants. By looking at the transcriptome (the transcribed products of switched on genes) they found 49 genes transcribed by the parasite, accounting for 2% of their total transcriptome, which originally belonged to the host. Three quarters of these transcripts appear to have replaced the parasites own version.

Most of these genes had been integrated into the parasite's nucleus, allowing the researchers to perform genomic analysis. Over time DNA randomly mutates and investigation of genetic drift between the genes for these transcripts, between the parasite and host, showed that some time has passed since the genes were acquired and that they were acquired gradually.

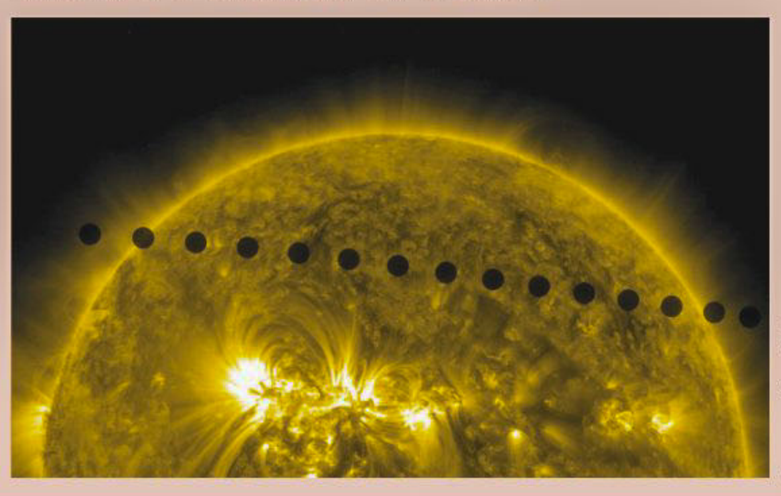
Prof Charles Davis, from the Harvard University Herbaria, who co-led this project with Prof Joshua Rest from Stony Brook University, explained, "The elevated rate of horizontal gene transfer between T. rafflesiae and its parasite R. cantleyi raises the possibility that there is a 'fitness' benefit to the parasite. For example they may improve the parasites ability to extract nutrients from the host, or help it evade the host's defences, as has been seen for a bacterial pathogen of citrus trees."

Source" Science Daily

Malaysian parasitic plant Rafflesia cantleyi has "stolen" genes from its host Tetrastigma rafflesiae.

MOMENT OF CENTURY

The rare transit of Venus

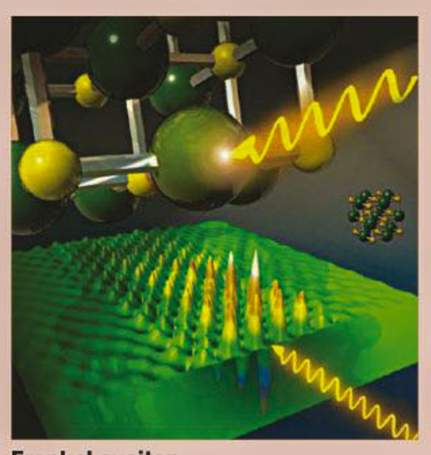


The transit of Venus across the sun is one of the rarest celestial sights visible from Earth, one that wowed scientists and amateur observers around the world Tuesday (June 5). The event, arguably the most anticipated skywatching display of the year, marked the last time Venus will cross the sun (as seen from Earth) for 105 years.

Source: Live Science

DID YOU KNOW?

What is exciton?



Frenkel exciton

The time dependence of the internal structure of the charge-transfer exciton in LiF, created by an idealized point source (represented by the wavy line). The absence of significant structural changes indicates that the relative motion of the electron and hole is frozen, which demonstrates that this is a Frenkel exciton.