The Daily Star

SCIENCE & LIFE

DHAKA TUESDAY NOVEMBER 16, 2010, E-MAIL: science&life@thedailystar.net

Bridging universes

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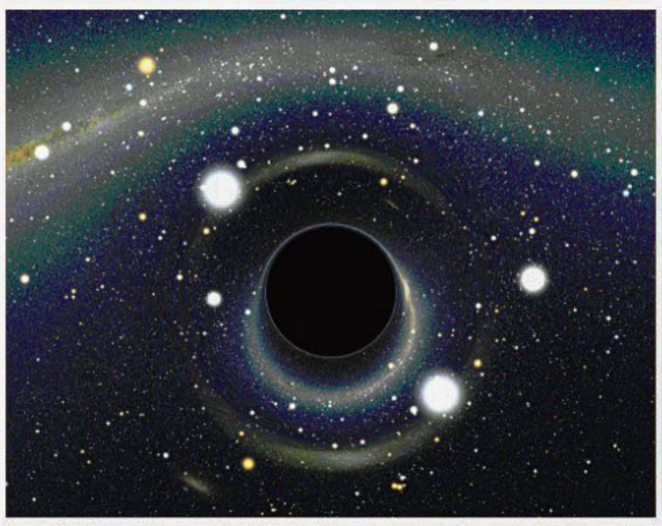
A 'baby universe' is connected to its 'parent universe' by a bridge-known as Einstein-Rosen Bridge. It is a short-cut path in spacetime which is called wormhole. The physics of this wormhole is presented here.

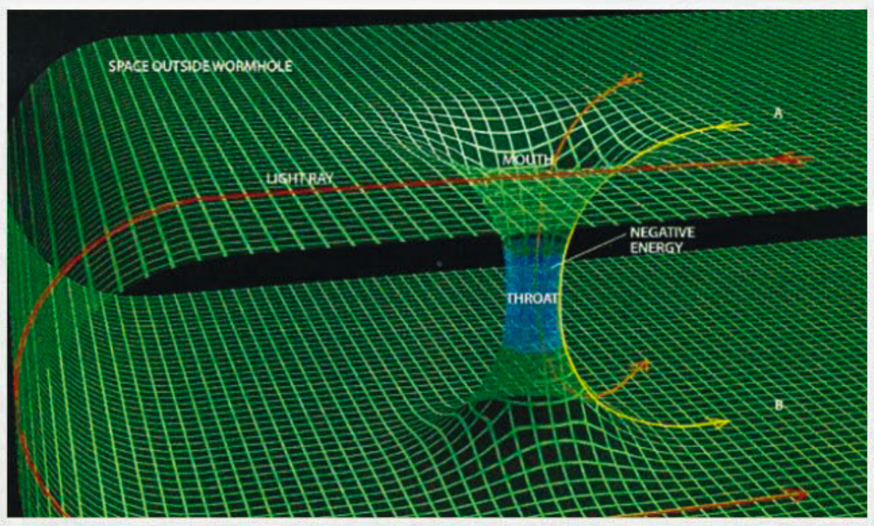
Wormhole is a prediction of general theory of relativity published by Albert Einstein in 1915. This theory describes the gravitational field created by matter. The matter moves in the field created by itself. Therefore gravitational theory of Albert Einstein is a complete theory. It is a set of ten nonlinear equations which are very difficult to solve. Einstein solved them with some approximations. The solution he found is a stationary universe. Stationary universe means a universe which does not change with time. But as early as 1916, a young German Astrophysicist Karl Schwarzschild found the first exact solution of Einstein's field equations. His solution predicted the non-stationary solution. The non-stationary solution means that the universe changes with time.

The Schwarzschild solution admits negative square root as well as positive square root solutions for the geometry. The positive one is the black hole and the negative one is the white hole. A black hole is a region of space from which nothing, not even light, can escape. It is the result of the deformation of spacetime caused by a very compact mass. Around a black hole there is an undetectable surface which marks the point of no return, called an event horizon. It is called "black" because it absorbs all the light that hits it, reflecting nothing.

A white hole, in general relativity, is a hypothetical region of spacetime which cannot be entered from the outside, but from which matter and light may escape. In this sense it is the reverse of a black hole, which can be entered from the outside, but from which nothing, including light, may escape. However, it is theoretically possible for a traveler to enter a rotating black hole, avoid the singularity, and travel into a rotating white hole which allows the traveler to escape into another universe. This traveling path is the wormhole.



Analogy to a wormhole in a curved 2-D space



Simulated view of a black hole in front of the Large Magellanic Cloud

A wormhole is a hypothetical feature of spacetime. It is a "shortcut" through spacetime. There is no observational evidence for wormholes. But on a theoretical level there are valid solutions containing wormholes. The American theoretical physicist John Archibald Wheeler coined the term wormhole in 1957; however, in 1921, the German mathematician Hermann Weyl already had proposed the wormhole theory, in connection with mass analysis of electromagnetic field energy.

A black hole and a white whole are connected by a path which is called the Einstein Rosen Bridge. The EinsteinRosen Bridge was discovered by Albert Einstein and his colleague Nathan Rosen which was published in 1935. However in 1962, John A. Wheeler and Robert W. Fuller published a paper showing that this type of wormhole is unstable. It was proposed that quasars (quasi-stellar radio sources) are white hole forming the ends of worm holes.

What is the Einstein-Rosen Bridge? The Einstein-Rosen Bridge is a geometrical property of a black hole. It manifests that on the other side of a black hole there is another set of dimensions attached to the one from our universe. This makes passage through this bridge and hence into another universe a mathematical possibility. There are three basic properties of a black hole: its mass, its spin, and its charge. Once these three are known, the black hole is completely specified. A static black hole, that is one of no spin and no charge, is called a Schwarzschild hole. A black hole whose spin and/or whose charge is non-zero is a Reissner-Nordström hole.

The complete Schwarzschild geometry consists of a black hole, a white hole, and two Universes connected at their horizons by a wormhole. Schwarzschild solution to Einstein's equations actually describes a wormhole connecting two regions of flat space-time; two universes, or two parts of the same universe.

A white hole is a black hole running backwards in time. Just as black holes swallow things, so white holes spit them out. However white holes cannot exist, since they violate the second law of thermodynamics.

General Relativity is time symmetric. It does not know about the second law of thermodynamics. It does not know about which way cause and effect go. However we do. The negative square root solution outside the horizon represents another Universe. The wormhole joining the two separate Universes is known as the Einstein-Rosen Bridge.

The prediction of the existence of black holes did not trouble Einstein, but he found that the black holes contained a singularity at its centre. This is a point of infinite density where time comes to an end. At the point of the singularity, all the known laws of physics start to breakdown. For Einstein this was a very troubling thought and he did not like them. The idea that they were shielding from the outside world by the event horizon of the black hole was not enough for him. He did not like the "concept that if you can not see it then do not worry about it."

So he went to work with Nathan Rosen in 1935. They produced a paper that gave the evidence for a bridge between a black hole and a white hole; this was called the Einstein-Rosen Bridge.

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MAGIC SEED

Cure-all Kalijira

Kalijira seeds

MALIHA AFRIN

KALIJIRA (scientific name 'Nigella sativa'), also called 'black cumin' in English, is an annual flowering plant, which grows to a height of 25-40 cm with finely divided leaves. The flowers are of pale blue colour with 4-9 petals. The fruit is composed of 3-7 follicles, each containing numerous seeds. It is mainly used for flavouring food as well as for medicinal purposes. It is not cultivated on a large scale and the seeds are collected mostly from plants growing in the wild.

Kalijira has a pungent smell with bitter taste. It has been traditionally used both as a herb and as a source of oil for centuries in Asia, Middle East and Africa to treat various ailments including asthma, bronchitis, rheumatism and related inflammatory diseases. It is a 'diuretic', which increases the flow of urine and is used as a carminative to relieve gastric problem. It is used to increase milk production and to heal childbirth-related fever in nursing mothers and to stimulate women's menstrual discharges. The Muslims regard it as one of the best curative medicines available. According to sahih hadith even Prophet Mohammed (sm) praised kalijira seed for its potential to cure about every disease except death.

Kalijira seed contains 35-40% fatty oil and a small portion of volatile oil. The flavour of the seed is for its volatile oil. The fatty oil obtained by extracting the seed is used for edible purposes. The seed contains a bitter taste (nigellin), tannins, resins, proteins and reducing sugars (mainly glucose). The Kalijira oil contains mainly carvone (about 60%) and a smaller portion of d- limonene and cymene. 'Nigellone', another extract of the oil, is known to cure cough and bronchial asthma.

Scientists at the Kimmel Cancer Centre at Thomas Jefferson University in Philadelphia have found that 'Thymoquinone' an extract of Kalijira oil, can heal pancreatic cancer at an early stage of the disease. However, the studies are in the preliminary phase.

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LUNAR PUZZLE

Moon's bulge

The Lunar far side as seen by the Lunar Orbiter Laser Altimeter

A bulge of elevated topography on the far side of the moon -- known as the lunar far side highlands -- has defied explanation for decades. But a new study led by researchers at the University of California, Santa Cruz, shows that the highlands may be the result of tidal forces acting early in the moon's history when its solid outer crust floated on an ocean of liquid rock.

Ian Garrick-Bethell, an assistant professor of Earth and planetary sciences at UC Santa Cruz, found that the shape of the moon's bulge can be described by a surprisingly simple mathematical function. "What's interesting is that the form of the mathematical function implies that tides had something to do with the formation of that terrain," said Garrick-Bethell, who is the first author of a paper on the new findings published in the November 11 issue of Science.

The paper describes a process for formation of the lunar highlands that involves tidal heating of the moon's crust about 4.4 billion years ago. At that time, not long after the moon's formation, the crust was decoupled from the mantle below it by an intervening ocean of magma. As a result, the gravitational pull of the Earth caused tidal flexing and heating of the crust. At the polar regions, where the flexing and heating was greatest, the crust became thinner, while the thickest crust would have formed in the regions in line with the Earth.

Source: Science Daily

TIME'S DAWN

The farthest galaxy around

OBAIDUR RAHMAN

OUR Universe is decorated with the most ancient celestial marvels. One predates the other. Recently, European astronomers, with the aid of European Southern Observatory's (ESO) Very Large Telescope (VLT), have discovered something that is the remotest and as such the most ancient of cosmic wonders. This distinguished and most senior citizen of our Universe is called UDFy-38135539, which is located in the constellation of Fornax. Back in 2009, this galaxy's image was first captured in the Hubble Ultra Deep Field (UDF) by the Hubble telescope's Wide Field Camera 3. And since then the careful analysis of the very faint glow of this galaxy revealed that this galaxy, which contains roughly a billion stars, was formed within the 600 million years of the very Big Bang that started the journey of this very cosmos about 13.7 billion years ago. And astonishingly, it has taken 13.1 billion years for lights from that galaxy to reach Earth! According to Dr. Matt Lehnert of Observatoire de Paris who is the lead author of the paper, "Using the ESO Very Large Telescope we have confirmed that a galaxy spotted earlier using Hubble is the most remote object identified so far in the Universe". It is important to note that astronomers determine the cosmic distances by measuring the redshift which is an estimate of how much an object's emitted light has been stretched in wavelength during it course of journey across our expanding Universe. To put it simply, redshift allows astronomers to calculate any celestial object's age. And it was found that UDFy-38135539 (UDFy from now on, for the sake of easy reading) has a redshift of 8.55. This means that the redshift of UDFy tops the previous record holder of the oldest object in the Universe. And that was a short-lived gamma-ray burst and called GRB 090423, which had a redshift of about 8.2 and was, formed about 630 millions after the Big Bang.

An artist's impression shows the young galaxy UDFy-38135539 gathering up the hydrogen and helium gas surrounding it and forming many young stars

Published in the 21st issue of the journal, Nature, scientists explain that this is quite an exciting discovery because, UDFy, with it's 8.55 redshift, is the first ever galaxy known to man which have lived fully within the seeming era of re-ionization of the Universe which lasted for about 150 million to 800 million years after the great Big Bang. At that point in time, intense ultraviolet radiation from the first stars was clearing the dense fog of neutral hydrogen that filled the cosmos by splitting its hydrogen atoms into electrons and protons. And it is this process that is known as re-ionization, which is in fact transformed the cosmos from an obscure haze to the typically empty space we know it today. One of the factors of this discovery that puzzles astronomers is that, the glow from UDFy seems like not strong enough to tunnel its way through the thick hydrogen fog on its own. And scientists believe that there must be other fainter and less massive galaxies in its vicinity, which assisted greatly to clear out the neighborhood of UDFy. And such fainter galaxies are yet to be identified by the Hubble UDF.

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THEYLIKE IT HOT

TROPICAL BIODIVERSITY

Warm spell spurred it all

SOME like it hot, including the plants living in South America's tropical rain forests 56 million years ago. As global average temperatures spiked 5 degrees Celsius over a period of 10,000 years a geologic blink of an eye plant diversity in northern South America also soared, researchers report in the Nov. 12 Science.

"We were expecting to find rapid extinction, a total change in the forest," says study leader Carlos Jaramillo, a biologist at the Smithsonian Tropical Research Institute in Balboa, Panama. "What we found was just the opposite a very fast addition of many new species, and a huge spike in the diversity of tropical plants."

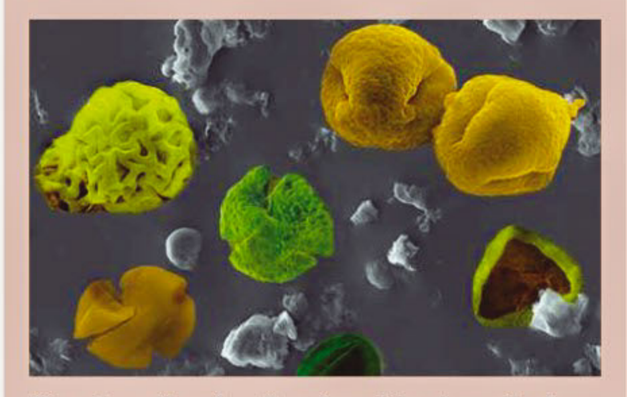
The study raises new questions about how tropical rain forests might respond as atmospheric carbon dioxide levels rise because of fossil fuel burning and other industrial activities. The researchers say that today's forests may not respond to warming in the same way that ancient forests did, but the findings do suggest that at least some plants are surprisingly adaptable.

"This kind of work is critically important," says Scott Wing, a paleobotanist at the Smithsonian Institution in Washington, D.C., who was not involved in the study. "We're beginning to map out what happened in different places during this huge perturbation of the carbon cycle and climate system. It's our best bet at seeing the results of something that's already happened."

Researchers call the warming the Paleocene-Eocene Thermal Maximum, because it took place at the boundary between the Paleocene and Eocene epochs of geologic time. Changes in ocean chemistry, such as "burps" of methane gas released from the seafloor, are thought to have rapidly built up greenhouse gases in the atmosphere and caused the warming. It's the closest analog scientists have to the global warming they expect in the future, though on a much slower scale; today, instead of a 5-degree increase over 10,000 years, researchers expect a 2-degree increase over just the next century, with more in store after that.

Only a few places preserve evidence of how plants and animals responded to the Paleocene-Eocene heat, and most of those are in temperate or northern latitudes. In Wyoming, for instance, Wing and other researchers have found fossils suggesting that as things heated up, species from more southern regions moved into the area temporarily. But many tropical forests are already in the hottest places on the globe, hence there is no place from which warmer-adapted species might move. Many scientists think that tropical forests are already close to the maximum temperature they can survive.

Source: Science News



The diversity of pollen found in deposits from northern South America

PHYSICIST CAT

How cats drink

Cats are better physicists than dogs, according to a new study at least when it comes to drinking.

A cat lapping milk strikes a delicate balance between gravity and inertia, the research finds. Unlike dogs, which use their tongues to scoop water into their mouths, a cat uses the tip of its tongue to pull water upward, closing its jaws before gravity pulls the column of liquid back toward earth.

The method requires cats to lap at just the right speed to balance the inertial force that keeps the water moving upward with the gravitational force pulling the water back down.

"Perhaps the most intriguing part of what we found was that the cats seemed to know just exactly how rapidly or how fast they should lap," study researcher Roman Stocker, a professor of civil and environmental engineering at the Massachusetts Institute of Technology, told LiveScience. "By lapping at the right time, [cats] take optimal advantage of this balance between inertia and gravity."

Source: Live Science

DID YOU KNOW?

What's in the camel's hump?

Camels do not store water in their humps, as it is commonly believed. The humps are actually reservoirs of fatty tissue. Concentrating body fat in their humps minimizes heat-trapping insulation throughout the rest of their body, which may be an adaptation to living in hot climates. When this tissue is metabolized, it acts as a source of energy and yields more than 1g of water for each 1g of fat converted through reaction with oxygen from air.