

World Science News In Review

[Astronomy]

Astronomers Discover "Big Baby" Galaxy at Edge of Observable Universe

Recent images from NASA's Hubble telescope and the Very Large Telescope at the European Southern Observatory have uncovered a so-called "big baby" galaxy located nearly as far away as astronomers can see into the universe. Due to its size and age, the new discovery is challenging current theories about galaxy formation. In particular, the light currently reaching Earth from the galaxy was emitted when the universe was only 800 million years old; currently, the universe is about 14 billion years old. However, the galaxy contains a mass of stars equivalent to 8 times that of the Milky Way, a much older galaxy. This fact contradicts scientists' general belief that larger galaxies are constructed through the combination of many smaller ones over a long period of time.

Moreover, no one is sure of the exact distance to the new galaxy, because it is located at the very edge of telescope sensitivity—Hubble can only view it in infrared light. "The fact that we don't see it in the deepest optical images ever taken is one of the reasons we believe it's as old as it is," said Mark Dickinson of the National Optical Astronomy Observatory in Tucson, Arizona. Astronomers cite the discovery as another reason to invest in the construction of more powerful telescopes that can delve more deeply into the universe's past.

—J. Hill

Source: "Massive 'Big Baby' Galaxy Found in Distant Quadrant of Space."
http://news.nationalgeographic.com/news/2005/09/0928_050928_baby_galaxy.html

"Lost" Dark Matter Discovered In Space, Scientists Say

In 2003, a group of astronomers found that the slower movements of certain stars in a particular type of galaxy indicated an absence of dark matter, an invisible substance that comprises more than 90 percent of the universe's mass. A new computer-simulation based study explains this unusual phenomenon and agrees with the theory that these particular galaxies are embedded in haloes of dark matter, according to Avishai Dekel, a physics professor at the Hebrew University of Jerusalem in Israel and the chief author of the study, which appeared in the September 29, 2005 issue of *Nature*.



Dark matter exerts a gravitational influence in and around spiral galaxies, including the Milky Way, which results in stars in the outskirts of spiral galaxies moving just as quickly as those do closer to the center. In 2003, scientists discovered that stars on the outskirts of elliptical galaxies moved more slowly than those in the center, suggesting an absence of dark matter, a discovery that mystified the scientific community.

To find out if elliptical galaxies actually lacked dark matter, a team of researchers did computer simulations of merges of spiral galaxies (which are thought to form elliptical galaxies), and discovered that the slow-moving stars found in the 2003 study had actually been thrown into elongated orbits

perpendicular to the astronomer's line of sight. According to Professor Dekel, these elongated orbits means that the stars could have been moving at a high velocity without much motion toward or away from the viewer while still appearing to be slow moving.

Other scientists, such as Michael Merrifield, an astrophysicist at the University of Nottingham in England, and Aaron Romanovsky of the University of Concepcion in Chile, believe that the presence of dark matter in elliptical galaxies is still questionable. However, both agree that the progress Dekel and the other astronomers are making is critical to understanding the structure of galaxies and how they are formed.

—C. Wallace



Source: "'Lost' Dark Matter Discovered in Space, Scientists Say"
http://news.nationalgeographic.com/news/2005/09/0928_050928_dark_matter.html

Astronomers Observe the Most Distant Explosion in the Universe

Astronomers recently detected the most distant gamma-ray burst (GRB) to date. The burst, named GRB050904, was first detected by NASA's Swift satellite and later determined to have a redshift of 6.29, which establishes its distance to be 12.6 billion light-years from Earth. "This burst smashes the old distance record by 500 million light-years. We are finally starting to see the remnants of some of the oldest objects in the universe," says astronomer Daniel Reichart of the University of North Carolina at Chapel Hill. The more distant the event, the earlier its origin. Since the universe is estimated to be roughly 13.5 billion years old, a distance of 12.6 light-years from Earth means that the explosion happened just 900 million years after the birth of the universe.

Gamma-ray bursts are the most powerful phenomena in the universe. They consist of flashes of gamma-rays that last from a few seconds to hours depending on its source, followed by days of X-ray afterglow. The recent burst is so powerful that within minutes it released 300 times more energy than the sun will every output during its entire life.

—R. Hu

Source: "Astronomers Observe the Most Distant Explosion in the Universe"
<http://scientificamerican.com/article.cfm?chanID=sa003&articleID=0002C383-EA12-1325-A63983414B7FFE87>

[Medicine]

Stem Cells Repair Damaged Spinal Cords in Mice

According to a new study performed within the Department of Physical Medicine and Rehabilitation at the University of California, Irvine, human stem cells can be injected into mice to repair damaged spinal cords and help partially paralyzed mice walk again. The results of the study were reported on September 20, 2005 in the journal *Proceedings of the National Academy of Sciences*.

The different types of stem cells range from bone marrow to fetal tissue to embryos, and all of these stem cells have the ability to transform into different types of human cells and tissues.

StemCells, Inc, a company based in Palo Alto, California, provided the fetal brain stem cells that the UC Irvine researchers used in their experiment. The scientists used mice to duplicate the spinal cord injuries caused to humans in car accidents, and found that the stem cells develop into different neural cell types after they travel up the spinal cord. In less than four months, mice that had received human stem cells had begun to show long-term recovery of motor function.

To prove the mice recovered because of human stem cell injections, the UC Irvine researchers injected the test mice with diphtheria toxin to kill the human stem cells and rescind the mice's improved walking ability, implying that the human neural stem cells were the main factor in the mice's recovery.

The study is significant because it provides "evidence that human stem cells prepared by this group can integrate with the host tissue and directly participate in the repair process of spinal cord injury", according to Itzhak Fischer, chair of the Department of Neurobiology and Anatomy at Drexel University in Philadelphia, Pennsylvania.

Many questions remain, such as how soon after an injury stem cells have to be transplanted in order to regenerate damaged cells and tissues. Despite such questions, scientists have greatly progressed in their understanding of stems cells and their potential benefits. —C. Wallace

Source: "Stem Cells Repair Damaged Spinal Cords in Mice"
http://news.nationalgeographic.com/news/2005/09/0920_050920_spinal-cord.html

Green Tea May Prevent Alzheimer's Disease

A component of green tea has shown to be remarkably successful in reducing the beta-amyloid plaques that are characteristic of Alzheimer's disease. Researchers at the University of South Florida tested epigallocatechin-3-gallate (EGCG) in laboratory mice that had been genetically modified to develop Alzheimer's-like damage in the brain. The results: after several months of daily injections with EGCG, the mice showed a 54 percent decrease in the amount of plaque buildup. EGCG, a major antioxidant in green tea, had already been tabbed as a potential cancer preventer. The USF data provides evidence that EGCG decreases the production of the brain-clogging beta-amyloid protein that is a major symptom and believed cause of Alzheimer's disease.

"If beta-amyloid pathology in this Alzheimer's mouse model is representative of Alzheimer's disease pathology in humans, EGCG dietary supplements may be effective in preventing the disease," said Jun Tan, the senior study author. Dr. Tan and colleagues also demonstrated that the other flavinoids in green tea hinder EGCG's ability to prevent beta-amyloid plaque buildup. According to their studies, Tan said that humans would likely need 1500 to 1600 mg of pure EGCG daily to reproduce the effects, a dosage that has already been found safe in some healthy human volunteers.

What remains for the USF researchers is to show that this plaque-reducing effect of EGCG has clear cognitive benefits, such as reducing memory loss in the mice. Then, said Dr. Tan, "we believe clinical trials of EGCG to treat Alzheimer's disease would be warranted." —P. Mulligan

Source: "Green Tea May Prevent Alzheimer's Disease"
<http://nutrition.about.com/b/a/204037.htm>

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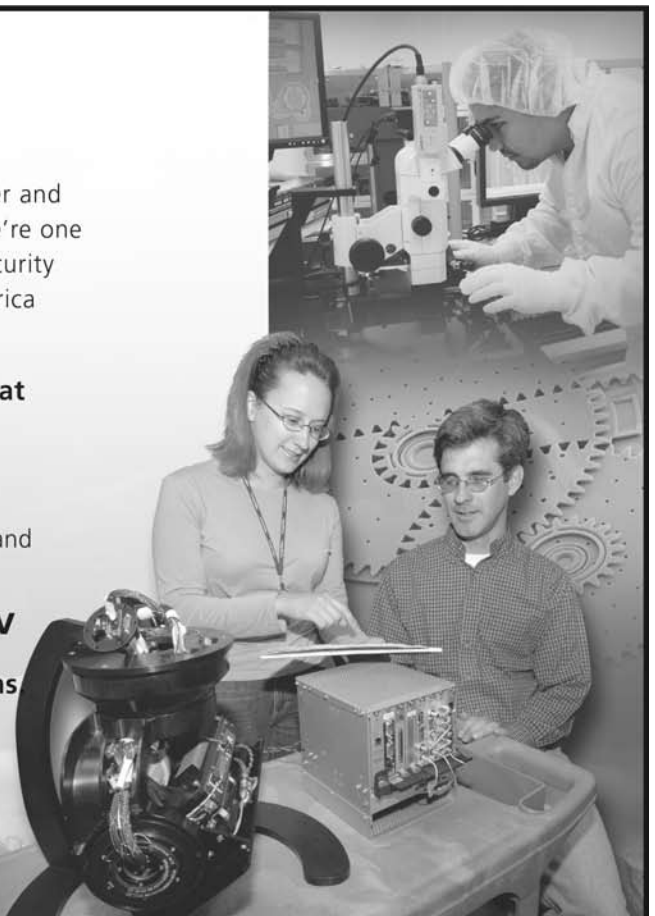
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Frog Peptides Block HIV In Lab Study

Need another reason to conserve the environment? Researchers at Vanderbilt University Medical Center may have found a blocker of HIV in compounds secreted by species of tropical frogs. These frogs produce and store antimicrobial peptides in the granular glands of their skin. In response to skin injury, they release large amounts of peptides to fight against pathogens like bacteria, fungus, and viruses.

How does HIV infection work? First, HIV is picked up in the mucosal surface tissues (linings of the nose, lung, intestine, etc.) by the dendritic cells, which are sentinels of the immune system. Normally the dendritic cells degrade the pathogens into smaller fragments and present them to the T-cells in the lymph node for destruction. In the case of HIV, the virus somehow hides inside the dendritic cells untouched and later invades the T-cells through a Trojan-horse mechanism. "This is why after 20 years we still don't have a vaccine for this virus," said Unutmaz, associate professor of Microbiology and Immunology at Vanderbilt University.

To test the ability of frog peptides to block HIV, postdoctoral fellow VanCompernelle of Unutmaz's group treated dendritic cells harboring HIV with frog peptides and then added the T-cells. Without peptide treatment, there was a high rate of T-cell infection. With peptides, the virus was completely gone while the T-cells remain unharmed. This result suggests a new hypothesis that HIV regular cycles to the surface of the dendritic cell to scan for T-cells instead of hiding inside the entire time. If this hypothesis of HIV behavior proves to be correct, researcher may be able to create a vaccine that targets HIV captured by dendritic cells.

—R. Hu

Source: "Frog Peptides Block HIV In Lab Study"

<http://www.sciencedaily.com/releases/2005/09/050930080923.htm>

[Geology]

New Evidence Adds Fuel to Long-Standing Geology Debate

A new study by geologist Alison Olcott, a Ph.D. student at the University of Southern California, has given significant support to one side of a decades-old controversy. The debate stems from questions about the type of climate present on Earth during a glacial period between 750 million and 600 million years ago. While geologists agree that ice was present even at the equator, they do not agree on whether the Earth was a "snowball" covered in kilometer-thick ice or whether there were large areas of open water surrounded by thin ice. Scientists believe that thick ice would have led to the extinction of plants and animals through a lack of oxygen and sunlight.

In the new study, Olcott examined rock from the Poço Verde Formation in Paracatú, Brazil and found it to contain the remains of prehistoric photosynthetic organisms. Thus, there must have been a significant amount of sunlight present in order for such organisms to thrive. Moreover, since the sample did not come from a small abnormal geologic area, but rather a fairly homogeneous one, Olcott believes it statistically unlikely that the organism lived in a tiny hole of open water in a region of thick ice. Overall, while the evidence does not fully settle the controversy, it does solidly support those who oppose the "snowball Earth" theory.

—J. Hill

Source: "Snowball Earth Theory Comes Under Fire."

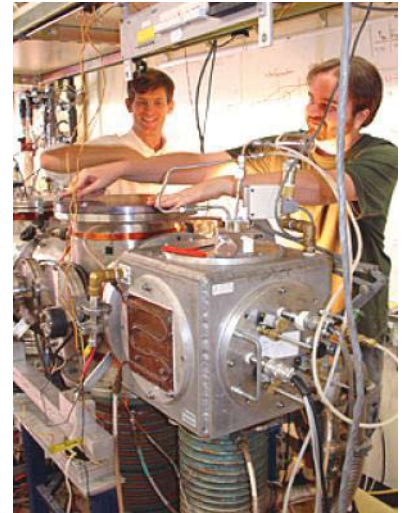
<http://sci.am.com/article.cfm?chanID=sa003&articleID=000E134A-5B19-133C-9A8E83414B7F4945>

[Physics]

Physicists Measure Tiny Force That Limits How Far Machines Can Shrink

By the wave-particle duality theory of matter, atoms can exhibit both particle-like and wave-like behavior. Their wave-like nature is described by the de Broglie wavelength and phase. In the 1920's quantum physicists had an idea that as speeding atoms approach a surface, their de Broglie waves are altered by the interaction with the surface. Recent experiments of physicists John D. Perrault and Alexander D. Cronin at the University of Arizona gave the first fundamental confirmation of this idea.

Using a 12-foot long atom interferometer brought from MIT, Perrault and Cronin performed direct measurements and found that 25 nanometers is the distance at which van der Waal's interaction between a surface and an atom starts to cause a phase shift in the atom wave. Closer than 25 nm, between 10 and 20 nm from the surface, van der Waal's force is so strong that the atom is "sucked toward the surface with a force a million times its weight". The atom wavelength is shortened as it accelerates toward the surface.



The measurements of Perrault and Cronin have a direct impact on nanotechnology and atom optics because they set a limit on how small devices can go before microscopic forces kick in and disrupts operation. —MURJ Staff

Source: "Physicists Measure Tiny Force That Limits How Far Machines Can Shrink"

<http://www.sciencedaily.com/releases/2005/09/050923154827.htm>

"Observation of atom wave phase shifts induced by vander Waals atom-surface interactions"

http://xxx.lanl.gov/PS_cache/physics/pdf/0505/0505160.pdf

