And has made the moon a light therein, and made the sun a lamp?

Holy Qur'an 71:16

ASTRONOMICAL RESEARCH CENTER (A. R. C.)

Issue 17

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A. R. C. NEWS

Latest Astronomical News on the Internet

Inside This Issue :

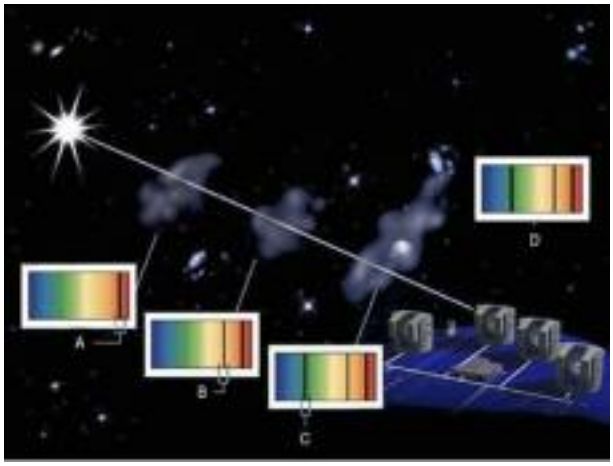
The only way the galaxy can be observed is through the imprint its interstellar gas leaves on the spectrum of a remote quasar, which is used as a beacon in the very distant Universe.

Taking the temperature of the cosmic background

Using ESO's Very Large Telescope, astronomers have made the first detection of a carbon monoxide molecule in a galaxy almost 11 billion light years away, a feat that has resulted in the most precise measurement of the cosmic temperature at such a remote epoch.

The only way the galaxy can be observed is through the imprint its interstellar gas leaves on the spectrum of a remote quasar, which is used as a beacon in the very distant Universe. "Interstellar clouds of gas in galaxies, located between the quasars and us on the same line of sight, absorb parts of the light emitted by the quasars. The resulting spectrum consequently presents dark 'valleys' that can be attributed to well-known elements and possibly molecules," explains Raghunathan Srianand who led the research.

Thanks to the power of the VLT, the team was able to discover the presence of normal and deuterated molecular hydrogen and carbon monoxide molecules in the interstellar medium of this remote galaxy. "This is the first time that these three molecules have been detected in absorption in front of a quasar, a detection that has remained elusive for more than a quarter of a century," says Cédric Ledoux of the European Southern Observatory (ESO). The same team had already broken the record for the most distant detection of molecular hydrogen in a young, 1.5 billion year old galaxy.

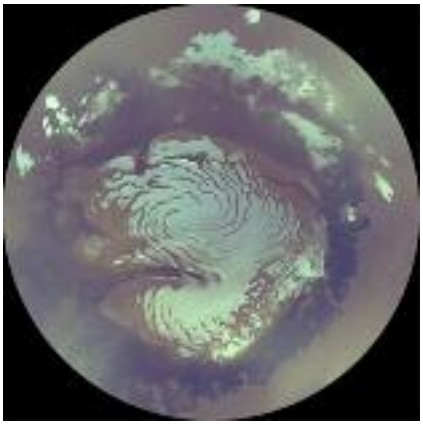


Even more impressively, the team also measured with the best ever precision yet, the temperature of the cosmic background radiation in the remote Universe. "Unlike other methods, measuring the temperature of the cosmic background using the carbon monoxide molecule involves very few assumptions," says Pasquier Noterdaeme, also of the ESO. According to Big Bang theory, the glow of this primeval fireball should have been warmer in the past, which is exactly what the new measurements confirm. "Given the current measured temperature of 2.725 Kelvin (K), one would expect that the temperature 11 billion years ago was about 9.3 K," says Patrick Petitjean. "Our unique set of VLT observations allows us to deduce a temperature of 9.15 K, plus or minus 0.7 K, in excellent agreement with the theory."

Based on the new observations, the astronomers have shown that the physical conditions prevailing in the interstellar gas in this remote galaxy are similar to what is seen in our Milky Way Galaxy. This pioneering analysis demonstrates that it is possible, combined with the detection of molecules such as molecular hydrogen and carbon monoxide, to use interstellar chemistry to tackle important cosmological issues, such as the formation and evolution of galaxies.

May 13, 2008
www.astronomynow.com

NASA satellite finds interior of Mars is colder

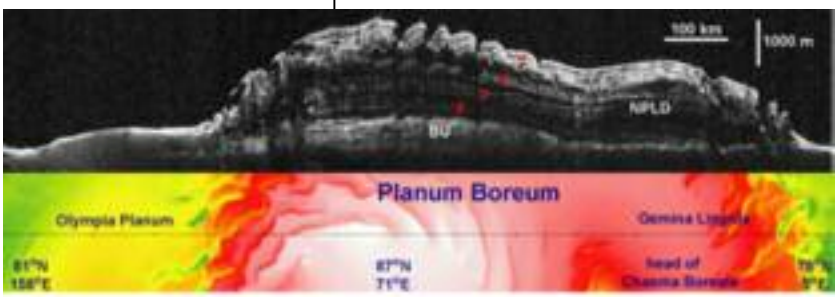


The findings suggest any liquid water that might exist below the planet's surface, and any possible organisms living in that water, would be located deeper than scientists had suspected.

New observations from NASA's Mars Reconnaissance Orbiter indicate that the crust and upper mantle of Mars are stiffer and colder than previously thought.

The findings suggest any liquid water that might exist below the planet's surface, and any possible organisms living in that water, would be located deeper than scientists had suspected.

"We found that the rocky surface of Mars is not bending under the load of the north polar ice cap," said Roger Phillips of the Southwest Research Institute in Boulder, Colo. Phillips is the lead author of a new report appearing in this week's online version of Science. "This implies that the planet's interior is more rigid, and thus colder, than we thought before."



Temperatures in the outer portion of a rocky planet like Mars increase with depth toward the interior. The thicker the lithosphere, the more gradually the temperatures increase.

The discovery was made using the Shallow Radar instrument on the spacecraft, which has provided the most detailed pictures to date of the interior layers of ice, sand and dust that make up the north polar cap on Mars. The radar images reveal long, continuous layers stretching up to 600 miles (1,000 kilometers), or about one-fifth the length of the United States.

"In our first glimpses inside the polar ice using the radar on Mars Reconnaissance Orbiter, we can clearly see stacks of icy material that trace the history of Mars' climate," said Jeffrey Plaut of NASA's Jet Propulsion Laboratory, Pasadena, Calif. Plaut is a science team member and a co-author of the paper. "Radar has opened up a new avenue for studying Mars' past."

The radar pictures show a smooth, flat border between the ice cap and the rocky Martian crust. On Earth, the weight of a similar stack of ice would cause the planet's surface to sag. The fact that the Martian surface is not bending means that its strong outer shell, or lithosphere -- a combination of its crust and upper mantle -- must be very thick and cold.

"The lithosphere of a planet is the rigid part. On Earth, the lithosphere is the part that breaks during an earthquake," said Suzanne Smrekar, deputy project scientist for Mars Reconnaissance Orbiter at JPL. "The ability of the radar to see through the ice cap and determine that there is no bending of the lithosphere gives us a good idea of present day temperatures inside Mars for the first time."

Temperatures in the outer portion of a rocky planet like Mars increase with depth toward the interior. The thicker the lithosphere, the more gradually the temperatures increase. The discovery of a thicker Martian lithosphere therefore implies that any liquid water lurking in aquifers below the surface would have to be deeper than previously calculated, where temperatures are warmer. Scientists speculate that any life on Mars associated with deep aquifers also would have to be buried deeper in the interior.

The radar pictures also reveal four zones of finely spaced layers of ice and dust separated by thick layers of nearly pure ice. Scientists think this pattern of thick, ice-free layers represents cycles of climate change on Mars on a time scale of roughly one million years. Such climate changes are caused by variations in the tilt of the planet's rotational axis and in the eccentricity of its orbit around the sun. The observations support the idea that the north polar ice cap is geologically active and relatively young, at about 4 million years.

On May 25, NASA's Phoenix Mars Lander is scheduled to touch down not far from the north polar ice cap. It will further investigate the history of water on Mars, and is expected to get the first up-close look at ice on the Red Planet.

The Shallow Radar instrument was provided by the Italian Space Agency, and its operations are led by the InfoCom Department, University of Rome "La Sapienza." Thales Alenia Space Italia, in Rome, is the Italian Space Agency's prime contractor for the radar instrument. Astro Aerospace of Carpinteria, Calif., a business unit of Los Angeles-based Northrop Grumman Corp., developed the instrument's antenna as a subcontractor to Thales Alenia Space Italia.

May 15, 2008
jpl.nasa.gov

Rare quartet of stars aids stellar evolution models

Astronomers have discovered an extremely rare quartet of stars, disguised as a single speck of light even through some of the world's most powerful telescopes, orbiting each other within a region smaller than Jupiter's orbit round the Sun.

Using high resolution spectrograph instruments on the Keck and Canada-France-Hawaii telescopes, which break up the star's light into a spectrum of different wavelengths, or colours, the astronomers could measure the stars' speeds and masses to infer the maximum sizes of their orbits. Originally thought to be one star, BD -22°5866 was resolved into four closely orbiting stars, arranged in two pairs. One pair orbits each other in less than 2.5 days with an orbital radius of 0.07 AU, and the second pair orbits with a period just under 55 days and at a maximum radius of 0.26 AU. In turn, the two pairs orbit each other with a maximum radius of just 5.8 AU, about the same as Jupiter's distance from the Sun.

"The extraordinarily tight configuration of this stellar system tells us that there may have been a single gaseous disc that forced them into such small orbits within the first 100,000 years of their evolution, as the stars could not have formed so close to one another," says Dr Shkolnik of the University of Hawaii's Institute for Astronomy. "This is the first evidence of a disc completely encompassing four stars. It is remarkable how much a single stellar spectrum can tell us about both the present and the past of these stars."

What makes the system even more unique is that the inner pair of stars eclipse each other, and by measuring how much light the eclipses block, the masses and radii of the stars can be inferred. The two stars are found to be almost identical, each being about 60% the size of the Sun.

Since most stars form as part of a binary or multiple star system, this new quadruple system will give astronomers previously unavailable physical information that will help develop models of stellar evolution.

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www.astronomynow.com

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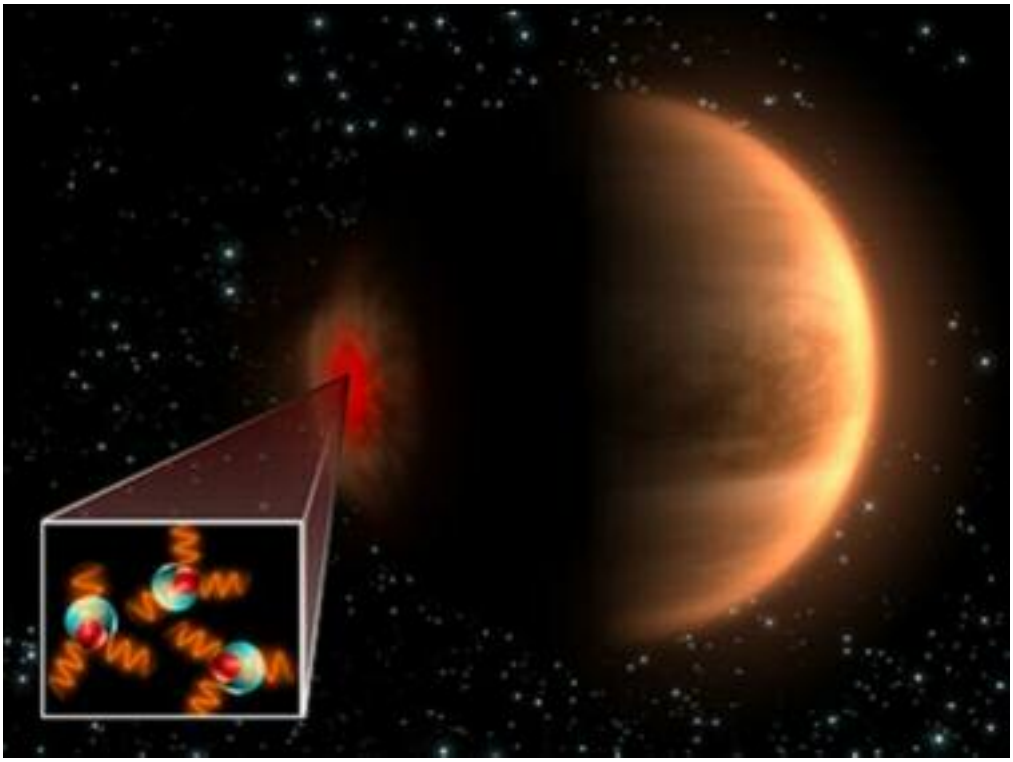
Key molecule discovered in Venusian atmosphere

Venus Express has made the first detection of the molecule hydroxyl in the upper atmosphere of Venus, giving scientists a vital tool to unlock the mechanics of our sister planet's dense atmosphere.



Hydroxyl, which is made up of one hydrogen and one oxygen atom, is thought to be important for a planet's atmosphere because it is highly reactive. On Earth it has a key role in purging pollutants from the atmosphere, and on Mars, although no actual detection of hydroxyl has been made, it is thought to help stabilise the carbon dioxide in the atmosphere, preventing it from turning into carbon monoxide. It is also thought to play a vital role in sterilising the martian soil, making the top layers inhospitable for microbial life.

Hydroxyl is difficult to detect, but was spotted on Venus by turning Venus Express away from the planet and squinting at the faintly visible layer of atmosphere surrounding the planet's disc. The VIRTIS (Venus Express Visible and Infrared Thermal Imaging Spectrometer) instrument spied the hydroxyl molecules by measuring the amount of infrared light that they give off. The molecules were found in the upper reaches of the atmosphere, 100 kilometres above the surface, in a narrow band just 10 kilometres wide.

"Venus Express has already shown us that Venus is much more Earth-like than once thought," says Giuseppe Piccioni, one of the principal investigators of the VIRTIS instrument. "The detection of hydroxyl brings it a step closer."

On Earth, the glow of hydroxyl has been closely linked to the abundance of ozone, an extremely important molecule that protects the Earth's biosphere from harmful ultraviolet rays. Moreover, the amount of radiation absorbed by ozone drives the heating and dynamics of a planet's atmosphere. The hydroxyl glow on Venus is now also thought to be related to the presence of ozone, and scientists will be able to take stock of the amount of ozone in the Venus atmosphere. Already Venus Express has shown that the amount of hydroxyl can change by up to 50 % from one orbit to the next; computer models will be able to tell how this change in ozone levels over short intervals affects the restless atmosphere of Venus. The detection of hydroxyl also provides new constraints on the chemistry and budgets of water vapour and carbon dioxide in the entire climate system of the planet.

This initial detection was based on just a few orbits of Venus Express; the VIRTIS team still have around 50 orbits to analyse and plan on making even more observations in the future.

May 19, 2008
www.astronomynow.com

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A pipsqueak star unleashes monster flare

On April 25, NASA's Swift satellite picked up the brightest flare ever seen from a normal star other than our Sun. The flare, an explosive release of energy from a star, packed the power of thousands of solar flares. It would have been visible to the naked eye if the star had been easily observable in the night sky at the time.

The star, known as EV Lacertae, isn't much to write home about. It's a run-of-the-mill red dwarf, by far the most common type of star in the universe. It shines with only one percent of the Sun's light, and contains only a third of the Sun's mass. At a distance of only 16 light-years, EV Lacertae is one of our closest stellar neighbors. But with its feeble light output, its faint magnitude-10 glow is far below naked-eye visibility.

"Here's a small, cool star that shot off a monster flare. This star has a record of producing flares, but this one takes the cake," says Rachel Osten, a Hubble Fellow at the University of Maryland, College Park and NASA's Goddard Space Flight Center in Greenbelt, Md. "Flares like this would deplete the atmospheres of life-bearing planets, sterilizing their surfaces."

The flare was first seen by the Russian-built Konus instrument on NASA's Wind satellite in the early morning hours of April 25. Swift's X-ray Telescope caught the flare less than two minutes later, and quickly slewed to point toward EV Lacertae. When Swift tried to observe the star with its Ultraviolet/Optical Telescope, the flare was so bright that the instrument shut itself down for safety reasons. The star remained bright in X-rays for 8 hours before settling back to normal.

EV Lacertae can be likened to an unruly child that throws frequent temper tantrums. The star is relatively young, with an estimated age of a few hundred million years. The star rotates once every four days, which is much faster than the sun, which rotates once every four weeks. EV Lacertae's fast rotation generates strong localized magnetic fields, making it more than 100 times as magnetically powerful as the Sun's field. The energy stored in its magnetic field powers these giant flares.

EV Lacertae's constellation, Lacerta, is visible in the spring for only a few hours each night in the Northern Hemisphere. But if the star had been more easily visible, the flare probably would have been bright enough that the star could have been seen with the naked eye for one to two hours.

The flare's incredible brightness enabled Swift to make detailed measurements. "This gives us a golden opportunity to study a stellar flare on a second-by-second basis to see how it evolved," says Stephen Drake of NASA Goddard.

Since EV Lacertae is 15 times younger than our Sun, it gives us a window into our solar system's early history. Younger stars rotate faster and generate more powerful flares, so in its first billion years the sun must have let loose millions of energetic flares that would have profoundly affected Earth and the other planets.

Flares release energy across the electromagnetic spectrum, but the extremely high gas temperatures produced by flares can only be studied with high-energy telescopes like those on Swift. Swift's wide field and rapid repointing capabilities, designed to study gamma-ray bursts, make it ideal for studying stellar flares. Most other X-ray observatories have studied this star and others like it, but they have to be extremely lucky to catch and study powerful flares due to their much smaller fields of view.

Says Eric Feigelson of Penn State University in University Park, Pa., "I find it remarkable that a satellite designed to detect the explosive birth of black holes in distant galaxies can also detect explosions on stars in the immediate neighborhood of our Sun."

May 20, 2008
www.gsfc.nasa.gov

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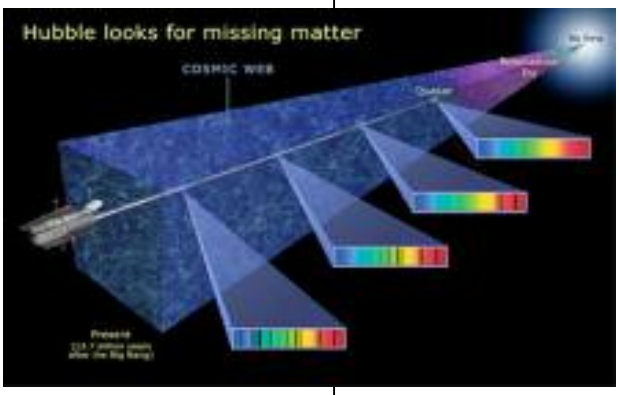
Hubble finds missing matter, probes intergalactic web

The questions "where have the local baryons gone, and what are their properties?" are being answered with greater certainty than ever before.



The team also found that about 20 percent of the baryons reside in the voids between the web-like filaments. Within these voids could be faint dwarf galaxies or wisps of matter that could turn into stars and galaxies in billions of years.

Although the universe contains billions of galaxies, only a small amount of its matter is locked up in these behemoths. Most of the universe's matter that was created during and just after the Big Bang must be found elsewhere.

Now, in an extensive search of the local universe, astronomers say they have definitively found about half of the missing normal matter, called baryons, in the spaces between the galaxies. This important component of the universe is known as the "intergalactic medium," or IGM, and it extends essentially throughout all of space, from just outside our Milky Way galaxy to the most distant regions of space observed by astronomers.

The questions "where have the local baryons gone, and what are their properties?" are being answered with greater certainty than ever before.

"We think we are seeing the strands of a web-like structure that forms the backbone of the universe," Mike Shull of the University of Colorado explained. "What we are confirming in detail is that intergalactic space, which intuitively might seem to be empty, is in fact the reservoir for most of the normal, baryonic matter in the universe."

Hubble observations made nearly a decade ago by Todd Tripp and colleagues first reported finding the hottest portion of this missing matter in the local universe. That study utilized spectroscopic observations of one quasar to look for absorbing intergalactic gas along the path to the quasar.

In the May 20 issue of The Astrophysical Journal, Charles Danforth and Shull report on observations taken along sight-lines to 28 quasars. Their analysis represents the most detailed observations to date of how the IGM looks within about four billion light-years of Earth.

Baryons are protons, neutrons, and other subatomic particles that make up ordinary matter such as hydrogen, helium, and heavier elements. Baryonic matter forms stars, planets, moons, and even the interstellar gas and dust from which new stars are born.

Astronomers caution that the missing baryonic matter is not to be confused with "dark matter," a mysterious and exotic form of matter that is only detected via its gravitational pull.

Danforth and Shull, of the Department of Astrophysical and Planetary Sciences at the University of Colorado in Boulder, looked for the missing baryonic matter by using the light from distant quasars (the bright cores of galaxies with active black holes) to probe spider-web-like structure that permeates the seemingly invisible space between galaxies, like shining a flashlight through fog.

Using the Space Telescope Imaging Spectrograph (STIS) aboard NASA's Hubble Space Telescope and NASA's Far Ultraviolet Spectroscopic Explorer (FUSE), the astronomers found hot gas, mostly oxygen and hydrogen, which provide a three-dimensional probe of intergalactic space. STIS and FUSE found the spectral "fingerprints" of intervening oxygen and hydrogen superimposed on the quasars' light.

The bright quasar light was measured to penetrate more than 650 filaments of hydrogen in the cosmic web. Eighty-three filaments were found laced with highly ionized oxygen in which five electrons have been stripped away.

The presence of highly ionized oxygen (and other elements) between the galaxies is believed to trace large quantities of invisible, hot, ionized hydrogen in the universe. These vast reservoirs of hydrogen have largely escaped detection because they are too hot to be seen in visible light, yet too cool to be seen in X-rays.

The oxygen "tracer" was probably created when exploding stars in galaxies spewed the oxygen back into intergalactic space where it mixed with the pre-existing hydrogen via a shock-wave which heated the oxygen to very high temperatures.

The team also found that about 20 percent of the baryons reside in the voids between the web-like filaments. Within these voids could be faint dwarf galaxies or wisps of matter that could turn into stars and galaxies in billions of years.

Probing this vast cosmic web will be a key goal for the Cosmic Origins Spectrograph (COS), a new science instrument that astronauts plan to install on Hubble during Servicing Mission 4 later this year.

"COS will allow us to make more robust and more detailed core samples of the cosmic web," Shull said. "We predict that COS will find considerably more of the missing baryonic matter."

The COS team hopes to observe 100 additional quasars and build up a survey of more than 10,000 hydrogen filaments in the cosmic web, many laced with heavy elements from early stars.

May 20, 2008
www.stsci.edu

Mighty winds blow in Jupiter's Little Red Spot

Using data from NASA's New Horizons spacecraft and two telescopes at Earth, an international team of scientists has found that one of the solar system's largest and newest storms - Jupiter's Little Red Spot - has some of the highest wind speeds ever detected on any planet.

New Horizons researchers combined observations from their Pluto-bound spacecraft, which flew past Jupiter in February 2007; data from the Hubble Space Telescope orbiting Earth; and the European Southern Observatory's Very Large Telescope, perched on an Atacama Desert mountain in Chile. This is the first time that high-resolution, close-up imaging of the Little Red Spot has been combined with powerful Earth-orbital and ground-based imagery made at ultraviolet through mid-infrared wavelengths. Jupiter's "LRS" is an anticyclone, a storm whose winds circulate in the opposite direction to that of a cyclone - counterclockwise, in this case. It is nearly the size of Earth and as red as the similar, but larger and more well known, Great Red Spot (GRS). The dramatic evolution of the LRS began with the merger of three smaller white storms that had been observed since the 1930s. Two of these storms coalesced in 1998, and the combined pair merged with a third major Jovian storm in 2000. In late 2005 ‹ for reasons still unknown ‹ the combined storm turned red. The new observations confirm that wind speeds in the LRS have increased substantially over the wind speeds in the precursor storms, which had been observed by NASA's Voyager and Galileo missions in past decades. Researchers measured the latest wind speeds and directions using two image mosaics from New Horizons' telescopic Long Range Reconnaissance Imager (LORRI), taken 30 minutes apart in order to track the motion of cloud features. New Horizons obtained the images from a distance of approximately 2.4 million kilometers (1.5 million miles) from Jupiter at a resolution of 14.4 kilometers (8.9 miles) per pixel. The LRS' maximum winds speeds of about 384 miles per hour far exceed the 156 mile-per-hour threshold that would make it a Category 5 storm on Earth. "This storm is still developing, and some of the changes remain mysterious," says Dr. Andrew Cheng of the Johns Hopkins University Applied Physics Laboratory (APL), Laurel, Md., who led the study team. "This unique set of observations is giving us hints about the storm's structure and makeup; from this, we expect to learn much more about how these large atmospheric disturbances form on worlds across the solar system." Jupiter's venerable Great Red Spot has decreased steadily in size over the past several decades. In addition, a rare "global upheaval" in Jupiter's atmosphere began before New Horizons visited last year. This upheaval involved the disappearance of activity in the South Equatorial Belt (which left the GRS as an isolated storm), the appearance of a south tropical disturbance north of the Little Red Spot, and other spectacular cloud changes. "This was a rare opportunity to combine observations from a powerful suite of instruments, as Jupiter will not be visited again by a spacecraft until 2016 at the earliest," says Cheng, whose team publishes its work in the June 2008 Astronomical Journal. Scientists combined LORRI maps of cloud motions with visible-color images from Hubble, and mid-infrared images from the Very Large Telescope. The latter technique allows scientists to "see" thermal structure and dynamics beneath the visible cloud layers, because thermal infrared wavelengths (indicating heat) can pass through the higher clouds. "The new observations confirm that the thermal structures, wind speeds, and cloud features of the LRS are very similar to those of the GRS," says Dr. Hal Weaver, a member of the study team from APL and the New Horizons project scientist. "Both the LRS and the GRS extend into the stratosphere, to far higher altitudes than for the smaller storms on Jupiter." The observations offer clues to the mystery of why the GRS, and now also the LRS, may be so red. The wind speeds and overall strength of the LRS increased substantially in the seven years between the Galileo and the New Horizons observations, during which the storm became red. "This supports the idea that a common dynamical mechanism explains the reddening of the two largest anticyclonic systems on Jupiter, one possibility of which is that storm winds dredge up material from below," says Dr. Amy Simon-Miller of NASA's Goddard Space Flight Center, Greenbelt, Md.

May 21, 2008
www.jhuapl.edu

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A. R. C. NEWS
Internal, Scientific, Cultural, latest astronomical news on the Internet

Astronomical Research Center Activities

Some of the activities:

- Educational Facilities
- Research Facilities
- Receive and Transmit Atomic-Clock waves
- Institution of a virtual observatory
- Cosmic radio observation project
- Calculation and distribution of timings of religious duties
- Organizing scientific conferences with invitations to scholars and experts
- Publishing new titles on the field of Astronomy
- Building an observatory and a big planetarium

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SPECIAL REPORT

Scientists witness a once-in-a-lifetime event

When she peered into the screen of her computer one day in January, Alicia Soderberg was supposed to see a small, dull glowing smudge in one corner, the evidence of a month-old supernova that would help her better understand the mystery of these huge exploding stars.

What the Princeton University astronomer saw instead was anything but dull. As Soderberg and Edo Berger, a postdoctoral research associate at Princeton, studied the X-ray emissions conveyed from space by NASA's Swift satellite, they saw an extremely bright light that seemed to jump out of the sky.

They didn't know it, but they had just become the first astronomers to have caught a star in the act of exploding. The once-in-a-lifetime event, described in a paper published in the May 22 issue of Nature, has transfixed the worldwide astronomical community.

Soderberg regards the discovery as a case of extreme serendipity. The satellite was pointing in the right place at the right time, she said, because she had asked Neil Gehrels, Swift's lead scientist at NASA's Goddard Space Flight Center in Greenbelt, Md., to turn it that way to look at another supernova. And while she was away lecturing, she had asked her colleague, Berger, to keep an eye on the data for her.

Soderberg and Berger wanted to observe a supernova known as SN 2007uy in the spiral galaxy NGC 2770, located 90 million light years from Earth in the constellation Lynx. They could plan to do that because they are able to view images captured by the telescope a few hours after the observation merely by downloading the data from the Swift website. The sudden appearance nearby of the X-ray burst of the newer supernova, easily captured by the NASA satellite with multiple instruments that can detect gamma rays, X-rays and ultraviolet light, has set scientists on a new path.

"This phenomenon had been predicted more than 30 years ago, but is now observed for the first time," said Roger Chevalier, the W.H. Vanderbilt Professor of Astronomy at the University of Virginia. "These are the earliest observations of light from a supernova after the central collapse that initiated the explosion."

A typical supernova occurs when the core of a vast star runs out of nuclear fuel and collapses under its own gravity to form an ultra-dense object known as a neutron star. The next activity is what the scientists were able to see for themselves -- the newborn neutron star first compresses then rebounds, triggering a shock wave that plows through the star's gaseous outer layers and rips the star apart.

Until now, astronomers have only been able to observe supernovae brightening days or weeks after the event, when the expanding shell of debris is energized by the decay of radioactive elements forged in the explosion.

Supernovae are fascinating to researchers because, in the destruction of their progenitor and in their own creation, all the elements in the universe are produced and injected into galaxies. A small fraction of supernovae turn into black holes and emit gamma rays, according to Soderberg. Most act the way this one, called SN 2008D, does.

Soderberg has been studying these astronomical objects for years, though she didn't start out doing that.

She grew up in Falmouth, Mass., on Cape Cod, loving nature and expecting someday to be an environmental scientist.

With the discovery of the X-ray outburst, Soderberg immediately mounted an international observing campaign to study the newest supernova. Scientists peered at SN 2008D using the Hubble Space Telescope, the Chandra X-ray Observatory, the Very Large Array in New Mexico, the 200-inch and 60-inch telescopes at the Palomar Observatory in California, the 3.5-meter telescope at the Apache Point Observatory in New Mexico, and the Gemini North Telescope and the Keck 1 Telescope, both in Hawaii.

May 21, 2008
www.princeton.edu