And He hath made subject to you the sun and the moon, both diligently pursuing their courses; and the night and the day hath He (also) made subject to you.

Holy Qur'an 14:33

ASTRONOMICAL RESEARCH CENTER (A. R. C.)

Issue 16

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A. R. C. NEWS

Latest Astronomical News on the Internet

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The galactic centre is about 26 000 light-years from Earth, meaning we see events as they occurred 26 000 years ago.

Milky Way's black hole awoke from slumber 300 years ago

A team of Japanese astronomers using ESA's XMM-Newton, along with NASA and Japanese X-ray satellites, has discovered that our galaxy's central black hole let loose a powerful flare three centuries ago.

The finding helps resolve a long-standing mystery: why is the Milky Way's black hole so quiescent? The black hole, known as Sagittarius A-star (A*), is a certified monster, containing about 4 million times the mass of our Sun. Yet the energy radiated from its surroundings is thousands of millions of times weaker than the radiation emitted from central black holes in other galaxies.

"We have wondered why the Milky Way's black hole appears to be a slumbering giant," says team leader Tatsuya Inui of Kyoto University in Japan. "But now we realise that the black hole was far more active in the past. Perhaps it's just resting after a major outburst."

The observations, collected between 1994 and 2005, revealed that clouds of gas near the central black hole brightened and faded quickly in X-ray light as they responded to X-ray pulses emanating from just outside the black hole. When gas spirals inward toward the black hole, it heats up to millions of degrees and emits X-rays. As more matter piles up near the black hole, the X-ray output becomes greater.

These X-ray pulses take 300 years to traverse the distance between the central black hole and a large cloud known as Sagittarius B2, so the cloud responds to events that occurred 300 years earlier.

When the X-rays reach the cloud, they collide with iron atoms, kicking out electrons that are close to the atomic nucleus. When electrons from farther out fill in these gaps, the iron atoms emit X-rays. But after the X-ray pulse passes through, the cloud fades to its normal brightness.

Amazingly, a region in Sagittarius B2 only 10 light-years across, varied considerably in brightness in just 5 years. These brightenings are known as light echoes. By resolving the X-ray spectral line from iron, Suzaku's observations were crucial for eliminating the possibility that subatomic particles caused the light echoes.

"By observing how this cloud lit up and faded over 10 years, we could trace back the black hole's activity 300 years ago," says team member Katsuji Koyama of Kyoto University. "The black hole was a million times brighter three centuries ago. It must have unleashed an incredibly powerful flare."

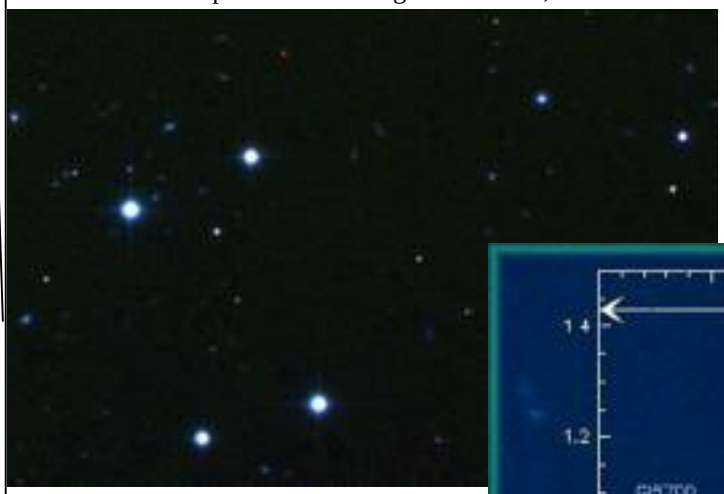
This new study builds upon research by several groups who pioneered the light-echo technique. Last year, a team led by Michael Muno, who now works at the California Institute of Technology in, California, USA, used Chandra observations of X-ray light echoes to show that Sagittarius A* generated a powerful burst of X-rays about 50 years ago ‹ about a dozen years before astronomers had satellites that could detect X-rays from outer space. "The outburst three centuries ago was 10 times brighter than the one we detected," says Muno.

The galactic centre is about 26 000 light-years from Earth, meaning we see events as they occurred 26 000 years ago. Astronomers still lack a detailed understanding of why Sagittarius A* varies so much in its activity. One possibility, says Koyama, is that a supernova a few centuries ago plowed-up gas and swept it into the black hole, leading to a temporary feeding frenzy that awoke the black hole from its slumber and produced the giant flare.

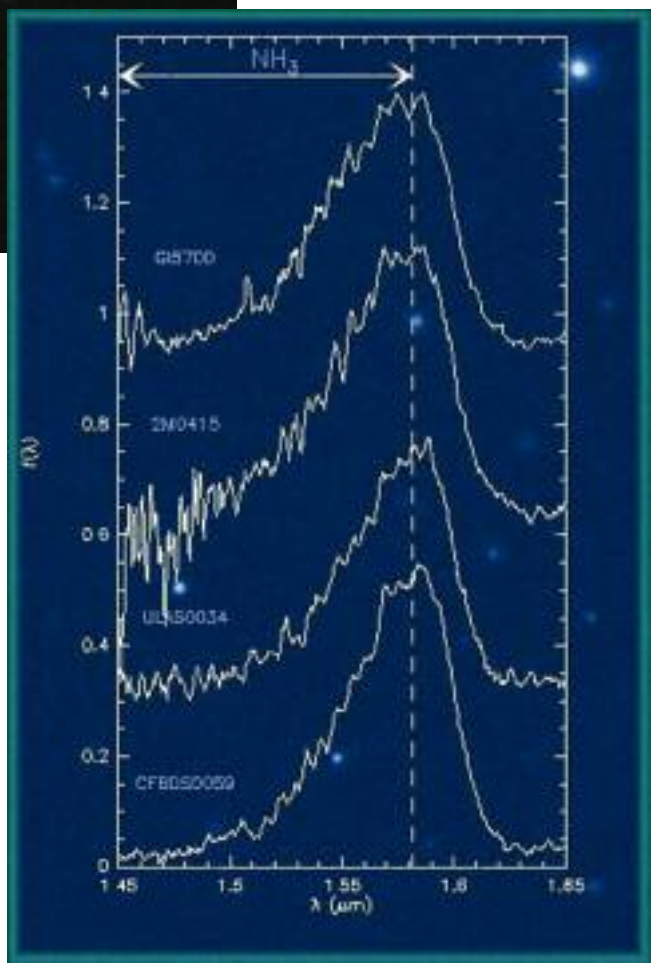
April 15, 2007
www.esa.int

The coolest brown dwarf

An international team of astronomers has discovered the coldest brown dwarf ever observed, bringing scientists one step closer to bridging the gap between stars and planets.



The new brown dwarf, which has been assigned the index number CFBDS J005910.83-011401.3, was discovered in the framework of the Canada France Brown Dwarfs survey, and was observed using the Canada France Hawaii Telescope and the Gemini North Telescope.



The new brown dwarf, which has been assigned the index number CFBDS J005910.83-011401.3, was discovered in the framework of the Canada France Brown Dwarfs survey, and was observed using the Canada France Hawaii Telescope and the Gemini North Telescope, both located in Hawaii, and the ESO/NTT in Chile. It has a temperature of about 350 degrees Celsius and mass 15-30 times that of Jupiter and is an isolated object that doesn't orbit another star. Because of their low masses, the central temperatures of brown dwarfs are not high enough to maintain thermonuclear fusion reactions over a prolonged period. Our Sun, in contrast, spends most of its life burning hydrogen, maintaining a constant internal temperature, whereas brown dwarfs get cooler and cooler after being formed.

Since the first detection of brown dwarfs in 1995, scientists have noticed that they share certain characteristics with gas planets. For example, clouds of dust, aerosols and methane were detected in their atmospheres, just as for Jupiter and Saturn. However, there are still major differences: in the brown dwarf atmospheres water is always in the gaseous state, whereas it condenses into water ice in giant planets, and ammonia has never previously been detected in brown dwarfs, while it is major component of Jupiter's atmosphere. The newly discovered brown dwarf bears the closest resemblance to a giant planet because of its low temperature and presence of ammonia.

Two classes of brown dwarf have currently been identified: L dwarfs (temperature 1200-2000 degrees Celsius and clouds of dust and aerosols in their high atmosphere) and T dwarfs (temperatures lower than 1200 degrees Celsius, and methane in their atmosphere). Because it contains ammonia and has an even lower temperature, CFBDS0059 might be the prototype of a new class, to be called Y dwarfs, and would provide the next rung on the ladder towards the giant planets, which have temperatures of less than -100 degrees.

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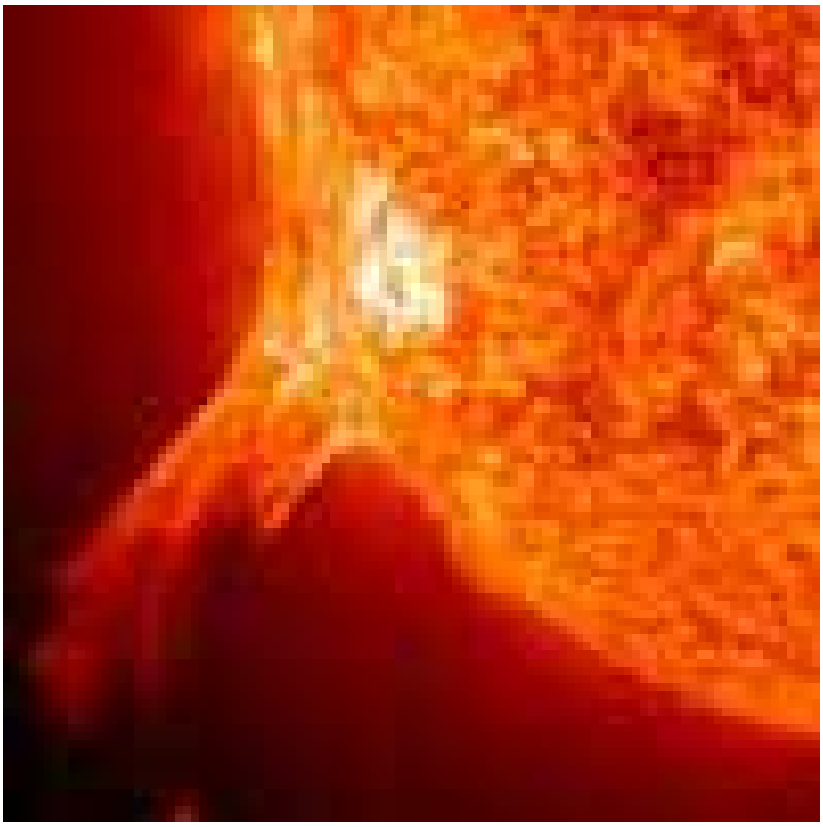
April 15, 2007
www.astronomynow.com

Solar flares set the Sun quaking, satellite shows

Data from the ESA/NASA spacecraft SOHO shows clearly that powerful star quakes ripple around the Sun in the wake of mighty solar flares that explode above its surface. The observations give solar physicists new insight into a long-running solar mystery and may even provide a way of studying other stars.



The outermost quarter of the Sun's interior is a constantly churning maelstrom of hot gas. Turbulence in this region causes ripples that criss-cross the solar surface, making it heave up and down in a patchwork pattern of peaks and troughs.

The joint ESA-NASA Solar and Heliospheric Observatory (SOHO) has proved to be an exceptional spacecraft for studying this phenomenon. Discovering how the ripples move around the Sun has provided valuable information about the Sun's interior conditions. A class of oscillations called the 5-minute oscillations with a frequency of around 3 millihertz have proven particularly useful.

According to conventional thinking, the 5-minute oscillations can be thought of as the sound you would get from a bell sitting in the middle of the desert and constantly being touched by random sand grains, blown on the wind. But what Christopher Karoff and Hans Kjeldsen, both at the University of Aarhus, Denmark, saw in the data, was very different.

"The signal we saw was like someone occasionally walking up to the bell and striking it, which told us that there was something missing from our understanding of how the Sun works," Karoff says.

So they began looking for the culprit and discovered an unexpected correlation with solar flares. It seemed that when the number of solar flares went up, so did the strength of the 5-minute oscillations.

"The strength of the correlation was so strong that there can be no doubt about it," says Karoff.

A similar phenomenon is known on Earth in the aftermath of large earthquakes. For example, after the 2004 Sumatra-Andaman Earthquake, the whole Earth rang with seismic waves like a vibrating bell for several weeks.

The correlation is not the end of the story. Now the researchers have to work to understand the mechanism by which the flares cause the oscillations. "We are not completely sure how the solar flares excite the global oscillations," says Karoff.

In a broader context, the correlation suggests that, by looking for similar oscillations within other stars, astronomers can monitor them for flares. Already, Karoff has used high-technology instruments at major ground-based telescopes to look at other Sun-like stars. In several cases, he detected the tell-tale signs of oscillations that might originate from flares.

"Now we need to monitor these stars for hundreds of days," he says. That will require dedicated spacecraft, such as the CNES mission with ESA participation, COROT. The hard work, it seems, is just starting.

April 18, 2007
www.esa.int

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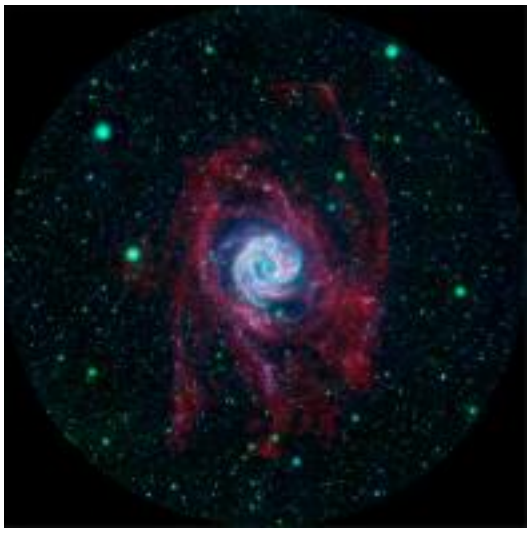
Stellar birth observed in the galactic wilderness

A new image from NASA's Galaxy Evolution Explorer shows baby stars sprouting in the backwoods of a galaxy -- a relatively desolate region of space more than 100,000 light-years from the galaxy's bustling center.

The striking image, a composite of ultraviolet data from the Galaxy Evolution Explorer and radio data from the National Science Foundation's Very Large Array in New Mexico, shows the Southern Pinwheel galaxy, also known simply as M83.



In the new view, the main spiral, or stellar, disk of M83 looks like a pink and blue pinwheel, while its outer arms appear to flap away from the galaxy like giant red streamers. It is within these so-called extended galaxy arms that, to the surprise of astronomers, new stars are forming.

"It is absolutely stunning that we find such an enormous number of young stars up to 140,000 light-years away from the center of M83," said Frank Bigiel of the Max Planck Institute for Astronomy in Germany, lead investigator of the new Galaxy Evolution Explorer observations. For comparison, the diameter of M83 is only 40,000 light-years across.

Some of the "outback" stars in M83's extended arms were first spotted by the Galaxy Evolution Explorer in 2005. Remote stars were also discovered around other galaxies by the ultraviolet telescope over subsequent years. This came as a surprise to astronomers because the outlying regions of a galaxy are assumed to be relatively barren and lack high concentrations of the ingredients needed for stars to form.

The newest Galaxy Evolution Explorer observations of M83 (colored blue and green) were taken over a longer period of time and reveal many more young clusters of stars at the farthest reaches of the galaxy. To better understand how stars could form in such unexpected territory, Bigiel and his colleagues turned to radio observations from the Very Large Array (red). Light emitted in the radio portion of the electromagnetic spectrum can be used to locate gaseous hydrogen atoms, or raw ingredients of stars. When the astronomers combined the radio and Galaxy Evolution Explorer data, they were delighted to see they matched up.

"The degree to which the ultraviolet emission and therefore the distribution of young stars follows the distribution of the atomic hydrogen gas out to the largest distances is absolutely remarkable," said Fabian Walter, also of the Max Planck Institute for Astronomy, who led the radio observations of hydrogen in the galaxy.

The astronomers speculate that the young stars seen far out in M83 could have formed under conditions resembling those of the early universe, a time when space was not yet enriched with dust and heavier elements.

"Even with today's most powerful telescopes, it is extremely difficult to study the first generation of star formation. These new observations provide a unique opportunity to study how early generation stars might have formed," said co-investigator Mark Seibert of the Observatories of the Carnegie Institution of Washington in Pasadena.

M83 is located 15 million light-years away in the southern constellation Hydra.

Other investigators include: Barry Madore of The Observatories of the Carnegie Institution of Washington; Armando Gil de Paz of the Complutense University of Madrid, Spain; David Thilker of Johns Hopkins University, Baltimore; Elias Brinks of the University of Hertfordshire, England; and Erwin de Blok of the University of Cape Town, South Africa.

The California Institute of Technology in Pasadena leads the Galaxy Evolution Explorer mission and is responsible for science operations and data analysis. NASA's Jet Propulsion Laboratory, also in Pasadena, manages the mission and built the science instrument. Caltech manages JPL for NASA. The mission was developed under NASA's Explorers Program managed by NASA's Goddard Space Flight Center, Greenbelt, Md. Researchers sponsored by Yonsei University in South Korea and the Centre National d'Etudes Spatiales (CNES) in France collaborated on this mission.

April 17, 2007
jpl.nasa.gov

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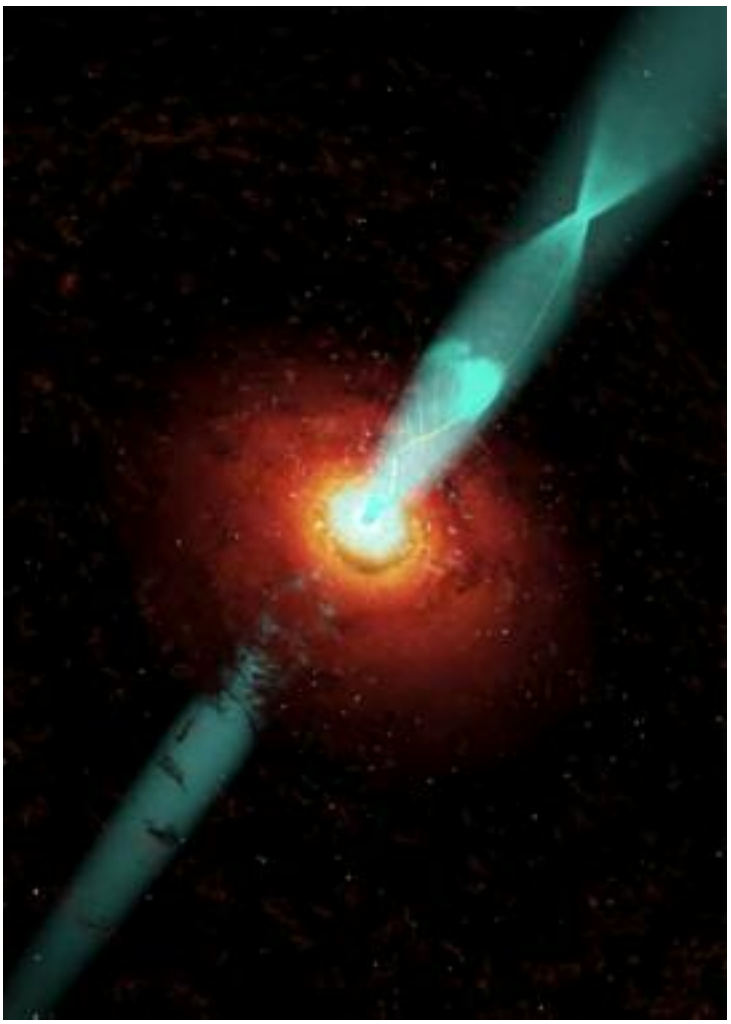
Unlocking the secrets of a massive black hole

The mechanism by which black holes expel powerful jets of particles at nearly the speed of light has long been speculated, but thanks to new observations of a blazar in action, these theories can now be substantiated.



Blazars are among the most energetic objects in the Universe, and are fueled by super massive black holes at the core of certain giant elliptical galaxies. Periodically, they emit jets of high-energy plasma at almost the speed of light. The leading theory says the jets are accelerated by tightly twisted magnetic fields close to the black hole, and using the unrivaled resolution of the National Radio Astronomy Observatory's Very Long Baseline Array (VLBA), astronomers have watched material winding a corkscrew outward path as dictated by this theory.

Scientists from all over the world aimed a variety of telescopes at blazar BL Lacertae (BL Lac), which is located some 950 million light-years from Earth. Over a period of several years, optical, X-ray and radio observations were conducted. "Everything we see supports the idea that twisted, coiled magnetic fields are propelling the material outward," says Alan Marscher of Boston University, leader of the international research team. "This is a major advance in our understanding of a remarkable process that occurs throughout the Universe."

The researchers say that the outbursts of radiation from blazars are triggered near the black hole, where some explosive event, such as "reconnection" of magnetic field in places where oppositely directed magnetic fields come into contact, shoots extra energy down the jet, which probably forms a shock wave that moves down the jet in a spiral path. This light and other radiation emitted by the moving material would brighten when its rotating path was aimed most directly toward Earth. A few weeks later, after the emission has faded as the material cools and expands, the researchers predict a second brightening brought about by the compression of the material by a stationary shock wave created by a pressure difference between the jet and the gas of the surrounding galaxy.

"That behavior is exactly what we saw," says Marscher. "We got an unprecedented view of the inner portion of one of these jets and gained information that's very important to understanding how these tremendous particle accelerators work."

Scientists hope to get a closer look at blazar jets when NASA launches its Gamma-ray Large Area Space Telescope (GLAST) satellite observatory in May. "We'll be using GLAST data to examine this object and 28 others that we are observing in a similar way," Marscher told *Astronomy Now*. "We are observing 5 of these with NASA's Rossi X-ray Timing Explorer as well, at least until the end of the year."

April 24, 2007
www.astronomynow.com

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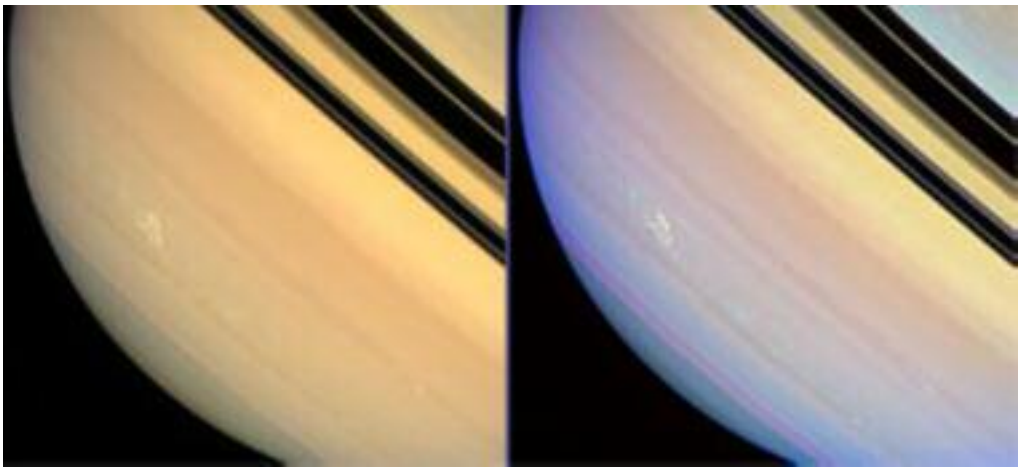
NASA spacecraft tracks raging Saturn storm

Lightning flashes within the persistent storm produce radio waves called Saturn electrostatic discharges, which the radio and plasma wave science instrument first detected on Nov. 27, 2007.

As a powerful electrical storm rages on Saturn with lightning bolts 10,000 times more powerful than those found on Earth, the Cassini spacecraft continues its five-month watch over the dramatic events.

Scientists with NASA's Cassini-Huygens mission have been tracking the visibly bright, lightning-generating storm -- the longest continually observed electrical storm ever monitored by Cassini.



Saturn's electrical storms resemble terrestrial thunderstorms, but on a much larger scale. Storms on Saturn have diameters of several thousand kilometers (thousands of miles), and radio signals produced by their lightning are thousands of times more powerful than those produced by terrestrial thunderstorms.

Lightning flashes within the persistent storm produce radio waves called Saturn electrostatic discharges, which the radio and plasma wave science instrument first detected on Nov. 27, 2007.

Cassini's imaging cameras monitored the position and appearance of the storm, first spotting it about a week later, on Dec. 6.

"The electrostatic radio outbursts have waxed and waned in intensity for five months now," said Georg Fischer, an associate with the radio and plasma wave science team at the University of Iowa, Iowa City. "We saw similar storms in 2004 and 2006 that each lasted for nearly a month, but this storm is longer-lived by far. And it appeared after nearly two years during which we did not detect any electrical storm activity from Saturn."

The new storm is located in Saturn's southern hemisphere -- in a region nicknamed "Storm Alley" by mission scientists -- where the previous lightning storms were observed by Cassini.

"In order to see the storm, the imaging cameras have to be looking at the right place at the right time, and whenever our cameras see the storm, the radio outbursts are there," said Ulyana Dyudina, an associate of the Cassini imaging team at the California Institute of Technology in Pasadena, Calif.

Cassini's radio plasma wave instrument detects the storm every time it rotates into view, which happens every 10 hours and 40 minutes, the approximate length of a Saturn day. Every few seconds the storm gives off a radio pulse lasting for about a tenth of a second, which is typical of lightning bolts and other electrical discharges. These radio waves are detected even when the storm is over the horizon as viewed from Cassini, a result of the bending of radio waves by the planet's atmosphere.

Amateur astronomers have kept track of the storm over its five-month lifetime. "Since Cassini's camera cannot track the storm every day, the amateur data are invaluable," said Fischer. "I am in continuous contact with astronomers from around the world."

The long-lived storm will likely provide information on the processes powering Saturn's intense lightning activity. Cassini scientists will continue to monitor Storm Alley as the seasons change, bringing the onset of autumn to the planet's southern hemisphere.

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The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of Caltech, manages the Cassini mission for NASA's Science Mission Directorate, Washington, D.C. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging team is based at the Space Science Institute, Boulder, Colo. The radio and plasma wave science team is based at the University of Iowa, Iowa City.

April 29, 2007
jpl.nasa.gov

Compact galaxies in early universe pack a big punch

Imagine receiving an announcement touting the birth of a baby 20 inches long and weighing 180 pounds. After reading this puzzling message, you would immediately think the baby's weight was a misprint.

Astronomers looking at galaxies in the universe's distant past received a similar perplexing announcement when they found nine young, compact galaxies, each weighing in at 200 billion times the mass of the Sun. The galaxies, each only 5,000 light-years across, are a fraction of the size of today's grownup galaxies but contain approximately the same number of stars. Each galaxy could fit inside the central hub of our Milky Way Galaxy.

Astronomers used NASA's Hubble Space Telescope and the W.M. Keck Observatory on Mauna Kea, Hawaii, to study the galaxies as they existed 11 billion years ago, when the universe was less than 3 billion years old.

"Seeing the compact sizes of these galaxies is a puzzle," said Pieter G. van Dokkum of Yale University in New Haven, Conn., who led the study. "No massive galaxy at this distance has ever been observed to be so compact. It is not yet clear how they would build themselves up to become the large galaxies we see today. They would have to change a lot over 11 billion years, growing five times bigger. They could get larger by colliding with other galaxies, but such collisions may not be the complete answer."

To determine the sizes of the galaxies, the team used the Near Infrared Camera and Multi-Object Spectrometer on Hubble. The Keck observations were carried out with assistance of a powerful laser to correct for image blurring caused by the Earth's atmosphere. "Only Hubble and Keck can see the sizes of these galaxies because they are very small and far away," van Dokkum explained.

Van Dokkum and his colleagues studied the galaxies in 2006 with the Gemini South Telescope Near-Infrared Spectrograph, on Cerro Pachon in the Chilean Andes. Those observations provided the galaxies' distances and showed that the stars are a half a billion to a billion years old. The most massive stars had already exploded as supernovae.

"In the Hubble Deep Field, astronomers found that star-forming galaxies are small," said Marijn Franx of Leiden University, The Netherlands. "However, these galaxies were also very low in mass. They weigh much less than our Milky Way. Our study, which surveyed a much larger area than in the Hubble Deep Field, surprisingly shows that galaxies with the same weight as our Milky Way were also very small in the past. All galaxies look really different in early times, even massive ones that formed their stars early."

The ultradense galaxies might comprise half of all galaxies of that mass 11 billion years ago, van Dokkum said, forming the building blocks of today's largest galaxies.

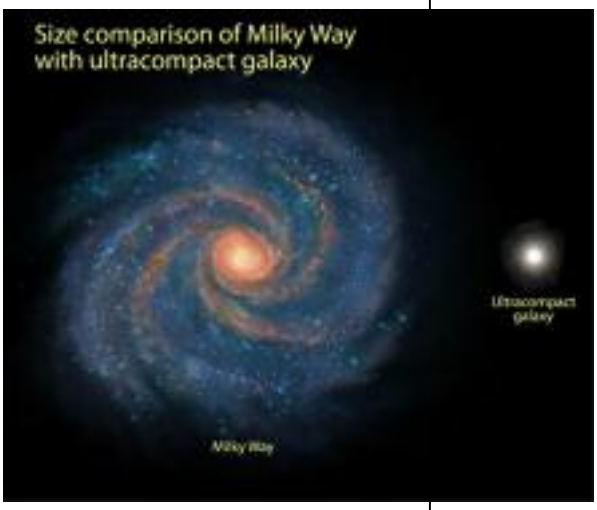
How did these small, crowded galaxies form? One way, suggested van Dokkum, involves the interaction of dark matter and hydrogen gas in the nascent universe. Dark matter is an invisible form of matter that accounts for most of the universe's mass. Shortly after the Big Bang, the universe contained an uneven landscape of dark matter. Hydrogen gas became trapped in puddles of the invisible material and began spinning rapidly in dark matter's gravitational whirlpool, forming stars at a furious rate.

Based on the galaxies' masses, which are derived from their color, the astronomers estimated that the stars are spinning around their galactic disks at roughly 890,000 to 1 million miles an hour (400 to 500 kilometers a second). Stars in today's galaxies, by contrast, are traveling at about half that speed because they are larger and rotate more slowly than the compact galaxies.

These galaxies are ideal targets for the Wide Field Camera 3, which is scheduled to be installed aboard Hubble during Servicing Mission 4 in the fall of 2008. "We hope to use the Wide Field Camera 3 to find thousands of these galaxies. The Hubble images, together with the laser adaptive optics at Keck and similar large telescopes, should lead to a better understanding of the evolution of galaxies early in the life of the universe," said Garth Illingworth of the University of California, Santa Cruz, and Lick Observatory.

The findings appeared in the April 10 issue of The Astrophysical Journal Letters.

April 29, 2007
oposite.stsci.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

Astronomical Research Center (A. R. C.)

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SPECIAL REPORT

Plethora of interacting galaxies on Hubble's birthday

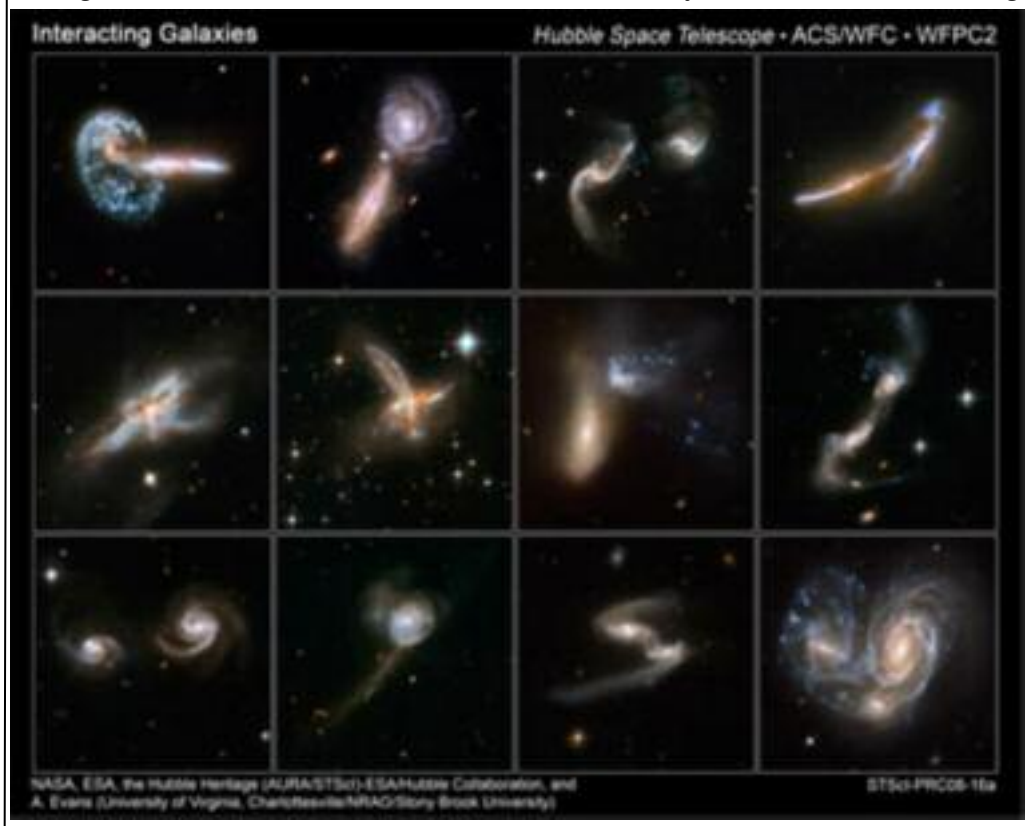
Astronomy textbooks typically present galaxies as staid, solitary, and majestic island worlds of glittering stars.

But galaxies have a wild side. They have flirtatious close encounters that sometimes end in grand mergers and overflowing "maternity wards" of new star birth as the colliding galaxies morph into wondrous new shapes.

Today, in celebration of the Hubble Space Telescope's 18th launch anniversary, 59 views of colliding galaxies constitute the largest collection of Hubble images ever released to the public. This new Hubble atlas dramatically illustrates how galaxy collisions produce a remarkable variety of intricate structures in never-before-seen detail.

Astronomers observe only one out of a million galaxies in the nearby universe in the act of colliding. However, galaxy mergers were much more common long ago when they were closer together, because the expanding universe was smaller. Astronomers study how gravity choreographs their motions in the game of celestial bumper cars and try to observe them in action.

For all their violence, galactic smash-ups take place at a glacial rate by human standards - timescales on the order of several hundred million years. The images in the Hubble atlas capture snapshots of the various merging galaxies at various stages in their collision.



Most of the 59 new Hubble images are part of a large investigation of luminous and ultra-luminous infrared galaxies called the GOALS project (Great Observatories All-sky LIRG Survey). This survey combines observations from Hubble, NASA's Spitzer Space Telescope, NASA's Chandra X-ray Observatory, and NASA's Galaxy Evolution Explorer. The majority of the Hubble observations are led by Aaron S. Evans of University of Virginia, Charlottesville/NRAO/Stony Brook University.

April 24, 2007
www.hubblesite.org/newscenter/