The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Volume 34 Number 04 **April 2008**

Calendar of Events

Monthly Meeting

FRIDAY, APRIL 18
7:30 PM, 1001 Malott
DVD IMAX Presentation
DESTINY IN SPACE

SPRING PUBLIC OBSERVING SCHEDULE
Weather Permitting
Memorial Stadium
Sunday, April 27
9:00-10:30 PM

President:
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Report from the Officers:

Sorry for the delay in getting this issue out. We were waiting to see if we could finalize the arrangements for a Girl Scout Astronomy event in April, but the dates we had available couldn't be meshed with the Girl Scout schedule. We will see if we can arrange a setup for a later date. There was no meeting in March due to Spring Break, but we will be back to our normal schedule this month with a meeting on Friday April 18. Continuing a theme from earlier this year, we will have another IMAX DVD presentation, DESTINY IN SPACE, narrated by Leonard Nimoy. More important for this meeting is the discussion of Astronomy Day in May, now set for Saturday, May 10. The daytime portion of the Astronomy Day program will take place at the Lawrence Public Library, both outside near the south entrance (for solar viewing) and in the auditorium (for displays and presentations) from 1-4 PM. Not only is the library excited about having us use their facility for the event, they have offered to co-host

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Of Local Interest — Rick Heschmeyer

Promoting Science Education through Astronomy

On Friday, February 29th, Rex Powell and I participated in the Enhanced Teaching Curriculum Program at Clear Creek Elementary School in Shawnee, KS. This year's subject was astronomy and involved all four 3rd

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From the Officers, continued

(Continued from page 1)

the event, allowing them to help us a great deal with publicity, etc. In addition, members of the children's staff at the library have already expressed interested in helping with the event that day. As you can see, it's beginning to look like this could be a BIG event, so every AAL member that can assist, even if just with crowd control, would be appreciated. ***PLEASE ATTEND*** the meeting this month so that we can begin the coordination of these events with the largest amount of people and therefore the smallest work load per person. Rick has done a great job getting these events going and it would be a positive thing for the club to respond with a large list of volunteers, even for only a short time on the day of the event.

As the summer nears, the schedule of regional and national star parties/conventions is starting to expand. Last month we noted the ALCON Expo 2008 in Des Moines, July 18-19 and included a brochure for the Heart of America Star Party. This month we have received the materials for the 15th Annual NSP/Nebraska Star Party, to take place Sunday July 27 through Friday August 1 at the Snake Campground at Merritt Reservoir, 27 miles south of Valentine, Nebraska. For those in the region, this is a first-rate event with, weather permitting, beautifully dark skies amidst the rolling prairie of western Nebraska. More details on the event can be found at www.NebraskaStarParty.org.

Our bad luck with the weather continues. Thanks to the cloudy skies and storms, we again cancelled the observing session at the stadium in March, meaning we have been shut out so far this semester. We do have one date remaining on the schedule for observing at the stadium, April 27. Note that we are starting at 9PM due to late sunset this time of year. Fortunately, it should, at least, be a comfortable night temperature-wise. If any changes are required, we will let you know. Otherwise, feel free to join us as a helper or an observer - either way is fine. If you have any suggestions for talks, speakers, or public events, please feel free to contact us, particularly Rick Heschmeyer (rcjbm@sbcglobal.net), the events coordinator for the club. Hope to see you at the meeting on the 18th. ALL for now.

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grade classrooms at the school, a total of 102 children. It began immediately after lunch and ran until the end of the school day. The area run by Rex and I involved two activities for the children. Rex brought several meteorites and tektites from his extensive collection, and discussed where meteorites come from, how they are found and the different types of meteorites. My portion of the area was devoted to safely viewing the Sun. After spending some time teaching the children some fun facts about the Sun, they were able to view our nearest star through two different telescopes using white light filters, as well as viewing the Sun through a Hydrogen-Alpha telescope.

At the end of the session each student received a certificate saying they had looked at the Sun and had held a 4.5 billion year old space rock! Based on the excitement and interest shown by the children, as well as the very good questions they asked, Rex and I thought that the event was a great success. I have since received several emails from the PTO organizers and from the 3rd grade teachers themselves commenting on how much the children enjoyed our area, and to expect additional invitations in the future. This was a great example of how outreach by the club can be enjoyable and fulfilling for both the recipients of the outreach and those performing the outreach. Many thanks to Rex for bringing some absolutely awesome meteorites and tektites to share with the kids (and me!) and to Bruce Twarog for forwarding the request to us. I hope to see each of our AAL members at future events such as this.

About the Astronomy Associates of Lawrence

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the second Friday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. Approximately the last Sunday of each month we have an open house on Memorial Stadium. Periodic star parties are scheduled as well. For more information, please contact the club officers:Luis Vargas at lcvargas@ku.edu, Gary Webber at gwebber@ku.edu, our faculty advisor, Prof. Bruce Twarog at btwarog@ku.edu. our events coordinator, Rick Heschmeyer at rcjbm@sbcglobal.net. Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Fridays and Sundays when events are scheduled. The information about AAL can be found at **http://www.ku.edu/~aal.**

Copies of the *Celestial Mechanic* can also be found on the web at
http://www.ku.edu/~aal/celestialmechanic

Source Of Solar Wind Discovered

Science Daily

An international team of scientists have found the source of the stream of particles that make up the solar wind. In a presentation on Wednesday 2 April at the RAS National Astronomy Meeting (NAM 2008) in Belfast, Professor Louise Harra of the UCL-Mullard Space Science Laboratory will explain how astronomers have used a UK-led instrument on the orbiting Hinode space observatory to finally track down the starting point for the wind.

The solar wind consists of electrically charged particles that flow out from the Sun in all directions. Even at their slowest, the particles race along at 200 km per second, taking less than 10 days to travel from the Sun to the Earth. When stronger gusts of the wind run into the magnetic field of the Earth there can be dramatic consequences, from creating beautiful displays of the northern and southern lights (aurorae) to interfering with electronic systems on satellites and sometimes even overloading electrical power grids on the ground.

From its launch in the autumn of 2006, scientists have used the Hinode mission to study the Sun in unprecedented detail. One of the instruments on the probe, the UK-built Extreme Ultraviolet Imaging Spectrometer (EIS) measures the speed at which material flows out from the Sun.

The Sun is a cauldron of hot gas shaped by magnetic fields, which create bright regions of activity on the solar surface. Using EIS, the scientists found that at the edges of these bright regions hot gas spurts out at high speeds. Magnetic fields connect the regions together, even when they are widely separated. For example, in the Hinode images that Prof Harra will present on Wednesday, magnetic fields linked two regions almost 500000 km apart – a distance equivalent to 40 Earths placed side by side in space. When magnetic fields from two regions collide they allow hot gas to escape from the Sun – this material flows out as the solar wind.

Professor Louise Harra of UCL-Mullard Space Science Laboratory says, “It is fantastic to finally be able to pinpoint the source of the solar wind – it has been debated for many years and now we have the final piece of the jigsaw. In the future we want to be able to work out how the wind is transported through the solar system”.

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Astronomers will be able to fill an important gap--they know that water and organics are abundant in the interstellar medium but not what happens to them after they are incorporated into a disk. "Are these molecules destroyed, preserved or enhanced in the disk?" said Carr. "Now that we can identify these molecules and inventory them, we will have a better understanding of the origins and evolution of the basic building blocks of life--where they come from and how they evolve." Carr and Najita's research results appear in the March 14 issue of Science. Taking advantage of Spitzer's spectroscopic capabilities, another group of scientists looked for water molecules in the disks around young stars and found them--twice.

"This is one of the very few times that water vapor has been directly shown to exist in the inner part of a protoplanetary disk–the most likely place for terrestrial planets to form," said Colette Salyk, a graduate student in geological and planetary sciences at the California Institute of Technology in Pasadena. She is the lead author on a paper about the results in the March 20 issue of Astrophysical Journal Letters.

Salyk and her colleagues used Spitzer to look at dozens of young stars with protoplanetary disks and found water in many. They honed in on two stars and followed up the initial detection of water with complementary high-resolution measurements from the Keck II Telescope in Hawaii. "While we don't detect nearly as much water as exists in the oceans on Earth, we see essentially only the disk's surface, so the implication is that the water is quite abundant," said Geoffrey Blake, professor of cosmochemistry and planetary sciences at Caltech and one of the paper's co-authors.

"This is a much larger story than just one or two disks," said Blake. "Spitzer can efficiently measure these water signatures in many objects, so this is just the beginning of what we will learn." "With upcoming Spitzer observations and data in hand," Carr added, "we will develop a good understanding of the distribution and abundance of water and organics in planet-forming disks."

NASA's Space Place

Tracking Wildlife from Space

by Patrick Barry

It's 10 o'clock, and do you know where your Oriental Honey Buzzard is?

Tracking the whereabouts of birds and other migrating wildlife across thousands of miles of land, air, and sea is no easy feat. Yet to protect the habitats of endangered species, scientists need to know where these roving animals go during their seasonal travels.

Rather than chasing these animals around the globe, a growing number of scientists are leveraging the bird's-eye view of orbiting satellites to easily monitor animals' movements anywhere in the world.

The system piggybacks on weather satellites called Polar Operational Environmental Satellites, which are operated by the National Oceanic and Atmospheric Administration (NOAA), as well as a European satellite called MetOp. Sensors aboard these satellites pick up signals beamed from portable transmitters on the Earth's surface, 850 kilometers below. NOAA began the project—called Argos—in cooperation with NASA and the French space agency (CNES) in 1974. At that time, scientists placed these transmitters primarily on buoys and balloons to study the oceans and atmosphere. As electronics shrank and new satellites' sensors became more sensitive, the transmitters became small and light enough by the 1990s that scientists could mount them safely on animals. Yes, even on birds like the Oriental Honey Buzzard.

“Scientists just never had the capability of doing this before,” says Christopher O'Connors, Program Manager for Argos at NOAA.

Today, transmitters weigh as little as 1/20th of a pound and require a fraction of a watt of power. The satellites can detect these feeble signals in part because the transmitters broadcast at frequencies between 401 and 403 MHz, a part of the spectrum reserved for environmental uses. That way there's very little interference from other sources of radio noise.

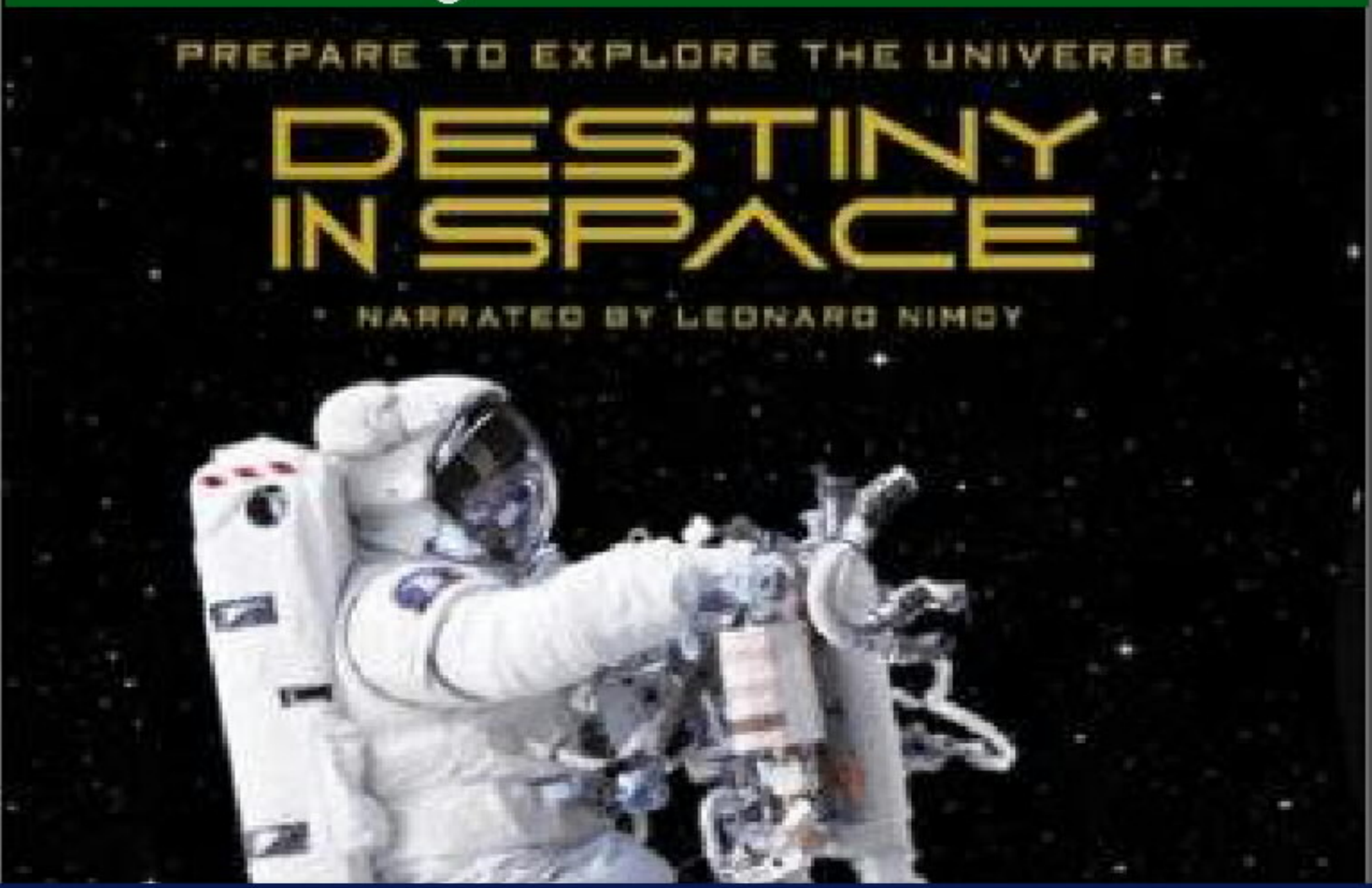
“Argos is being used more and more for animal tracking,” O’Connors says. More than 17,000 transmitters are currently being tracked by Argos, and almost 4,000 of them are on wildlife. “The animal research has been the most interesting area in terms of innovative science.”

For example, researchers in Japan used Argos to track endangered Grey-faced Buzzards and Oriental Honey Buzzards for thousands of kilometers along the birds' migrations through Japan and Southeast Asia. Scientists have also mapped the movements of loggerhead sea turtles off the west coast of Africa. Other studies have documented migrations of wood storks, Malaysian elephants, porcupine caribou, right whales, and walruses, to name a few.

Argos data is available online at www.argos-system.org, so every evening, scientists can check the whereabouts of all their herds, schools, and flocks. Kids can learn about some of these endangered species and play a memory game with them at spaceplace.nasa.gov/en/kids/poes_tracking.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

The Astronomy Associates of Lawrence present



FRIDAY APRIL 18, 2008

7:30 PM, 1001 Malott Hall

University of Kansas

FREE & OPEN TO THE PUBLIC

Exploding Star Shows Rare View Of Early Stages Of A Supernova

HST Press Release

The latest image from the NASA/ESA Hubble Space Telescope reveals a sharp view of the spiral galaxy NGC 2397. This image also shows a rare Hubble view of the early stages of a supernova - SN 2006bc, discovered in March 2006. NGC 2397, pictured in this image from Hubble, is a classic spiral galaxy with long prominent dust lanes along the edges of its arms, seen as dark patches and streaks silhouetted against the starlight. Hubble's exquisite resolution allows the study of individual stars in nearby galaxies.

Sharp view of the spiral galaxy NGC 2397 includes view of early stages of a supernova - SN 2006bc. (Credit: NASA, ESA & Stephen Smartt (Queen's University Belfast, UK))

Located nearly 60 million light-years away from Earth, the galaxy NGC 2397 is typical of most spirals, with mostly older, yellow and red stars in its central portion, while star formation continues in the outer, bluer spiral arms. The brightest of these young, blue stars can be seen individually in this high resolution view from the Hubble's Advanced Camera for Surveys (ACS).

One atypical feature of this Hubble image is the view of supernova SN 2006bc taken when its brightness was on the decrease. Astronomers from Queen's University Belfast in Northern Ireland, led by Professor of Astronomy Stephen J. Smartt, requested the image as part of a long project studying the massive exploding stars — supernovae. Exactly which types of star will explode and the lowest mass of star that can produce a supernova are not known.

When a supernova is discovered in a nearby galaxy the group begins a painstaking search of earlier Hubble images of the same galaxy to locate the star that later exploded; often one of hundreds of millions of stars in the galaxy. This is a little like sifting through days of CCTV footage to find one frame showing a suspect. If the astronomers find a star at the location of the later explosion, they may work out the mass and type of star from its brightness and color. Only six such stars have been identified before they exploded and the Queen's team have discovered the nature of five of them.

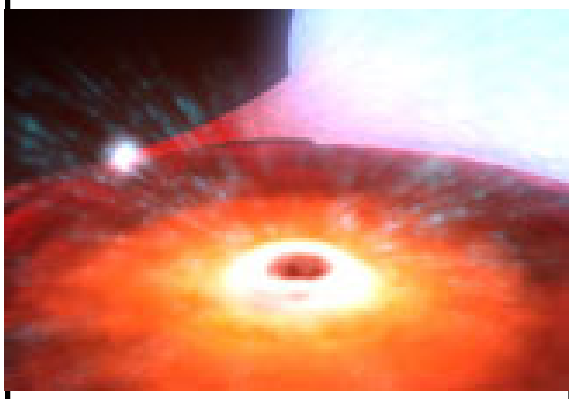
In their latest work on Hubble images, to be presented at the UK National Astronomy Meeting 2008 in Belfast, the Queen's team reveals the results of their ten-year search for these elusive supernova precursor stars. It appears that stars with masses as low as seven times the mass of the Sun can explode as supernovae. The team have not found any very massive stars that exploded, suggesting that the most massive stars may collapse to form black holes either without producing a supernova or by producing one that is too faint to observe. This intriguing possibility will be discussed at the meeting. The Royal Astronomical Society National Astronomy Meeting (NAM) 2008 will take place at Queen's University Belfast from 31 March to 4 April.

The images were obtained on 14 October 2006 with Hubble's Advanced Camera for Surveys (ACS) through three different color filters (blue, green and near-infrared).

Smallest Black Hole Found

By Andrea Thompson, Space.com

NASA scientists have identified the smallest, lightest black hole yet found. The new lightweight record-holder weighs in at about 3.8 times the mass of our sun and is only 15 miles (24 kilometers) in diameter.



The lowest-mass known black hole belongs to a binary system named XTE J1650-500. The black hole has about 3.8 times the mass of our sun, and is orbited by a companion star, as depicted in this illustration. Credit: NASA/

"This black hole is really pushing the limits," said study team leader Nikolai Shaposhnikov of NASA's Goddard Space Flight Center in Greenbelt, Md. "For many years astronomers have wanted to know the smallest possible size of a black hole, and this little guy is a big step toward answering that question."

The low-mass black hole sits in a binary system in our galaxy known as XTE J1650-500 in the southern hemisphere constellation Ara. NASA's Rossi X-ray Timing Explorer (RXTE) satellite discovered the system in 2001, and astronomers soon realized that the system harbored a relatively lightweight black hole. But the black hole's mass had never been precisely measured.

Black holes can't be seen, but they're identified by the activity around them, which also helps astronomers estimate a size of the region inside the activity, and how much mass must be in that confined region to generate all the surrounding activity. More specifically, astronomers can weigh black holes by using a relationship between the apparent size of the black hole and the X-rays emitted by the torrent of gas that swirls into the black hole's disk from its companion star.

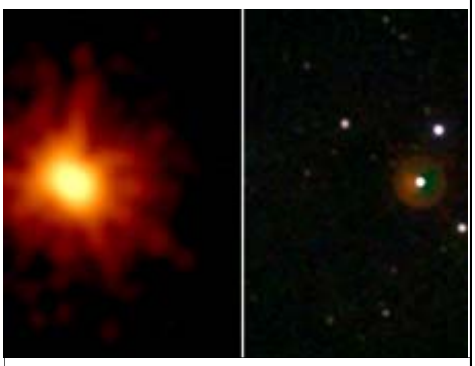
As the gas piles up near the black hole, it "becomes very dense and congested," like a traffic jam, Shaposhnikov said at a press conference announcing the find. "So matter has to literally squeeze into the black hole." As it is squeezed, the gas heats up and radiates X-rays. The intensity of the X-rays varies in a pattern repeated over a nearly regular interval. Astronomers have long suspected that the frequency of this signal, called the quasi-periodic oscillation, or QPO, depends on the mass of the black hole. As the black hole gets bigger, the zone of swirling gas is pushed farther out, so the QPO ticks away slowly. But for smaller black holes, the gas sits closer in and the QPO ticks rapidly. Shaposhnikov and his colleague Lev Titarchuk of George Mason University used this method to weigh XTE J1650-500 and found a mass of 3.8 suns. This value is well below the previous record holder GRO 1655-40, which tips the scales at about 6.3 suns. This new mass measurement could help shed light on what the smallest star that will produce a black hole is. Astronomers know that some unknown critical threshold, possibly between 1.7 and 2.7 solar masses, marks the boundary between a star that generates a black hole upon its death and one that produces a neutron star.

"This new result brings us much closer to the theoretically predicted limit," Shaposhnikov said. Knowing this boundary would help scientists understand the behavior of matter when it is scrunched to extraordinarily high densities. "The question of black hole masses has concerned us for more than a decade now," said astrophysicist Vicky Kalogera of Northwestern University, who was not involved with the study, during the press conference. Scientists had predicted that there should be more black holes at the lower end of the mass range than astronomers had identified, so this study helps clear up some confusion as to where these lightweight black holes were, she added. Kalogera did caution that the method used by Shaposhnikov and Titarchuk is not the main way that black hole masses are measured, but noted that their measurements of the masses of other black holes agreed well with the results from the standard method. Shaposhnikov and Titarchuk presented their findings on March 31 at the American Astronomical Society's High-Energy Astrophysics Division meeting in Los Angeles.

NASA Satellite Detects Naked-Eye Explosion Halfway Across Universe
NASA Press Release

A powerful stellar explosion detected March 19 by NASA's Swift satellite has shattered the record for the most distant object that could be seen with the naked eye.

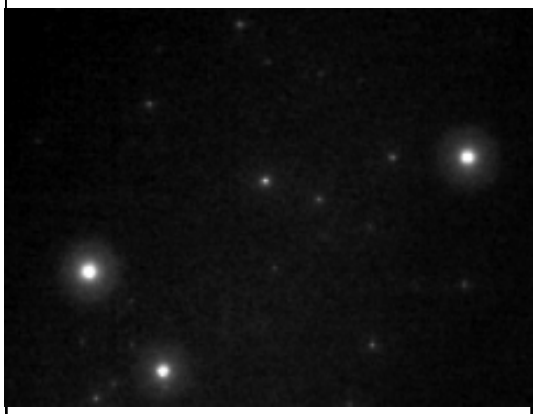
The explosion was a gamma ray burst. Most gamma ray bursts occur when massive stars run out of nuclear fuel. Their cores collapse to form black holes or neutron stars, releasing an intense burst of high-energy gamma rays and ejecting particle jets that rip through space at nearly the speed of light like turbocharged cosmic blowtorches. When the jets plow into surrounding interstellar clouds, they heat the gas, often generating bright afterglows. Gamma ray bursts are the most luminous explosions in the universe since the big bang.



The extremely luminous afterglow of GRB 080319B was imaged by Swift's X-ray Telescope (left) and Optical/ Ultraviolet Telescope (right). This was by far the brightest gamma-ray burst afterglow ever seen. **Credit:** NASA/ Swift/Stefan Immler, et al.

"This burst was a whopper," said Swift principal investigator Neil Gehrels of NASA's Goddard Space Flight Center in Greenbelt, Md. "It blows away every gamma ray burst we've seen so far." Swift's Burst Alert Telescope picked up the burst at 2:12 a.m. EDT, March 19, and pinpointed the coordinates in the constellation Boötes. Telescopes in space and on the ground quickly moved to observe the afterglow. The burst is named GRB 080319B, because it was the second gamma ray burst detected that day.

Swift's other two instruments, the X-ray Telescope and the Ultraviolet/Optical Telescope, also observed brilliant afterglows. Several ground-based telescopes saw the afterglow brighten to visual magnitudes between 5 and 6 in the logarithmic magnitude scale used by astronomers. The brighter an object is, the lower its magnitude number. From a dark location in the countryside, people with normal vision can see stars slightly fainter than magnitude 6. That means the afterglow would have been dim, but visible to the naked eye.



GRB 080319B's optical afterglow appears in the center of this image from Pi of the Sky, a Polish group that monitors the sky for afterglows and other short-lived sources. **Credit:** Pi of the Sky

Later that evening, the Very Large Telescope in Chile and the Hobby-Eberly Telescope in Texas measured the burst's redshift at 0.94. A redshift is a measure of the distance to an object. A redshift of 0.94 translates into a distance of 7.5 billion light years, meaning the explosion took place 7.5 billion years ago, a time when the universe was less than half its current age and Earth had yet to form. This is more than halfway across the visible universe.

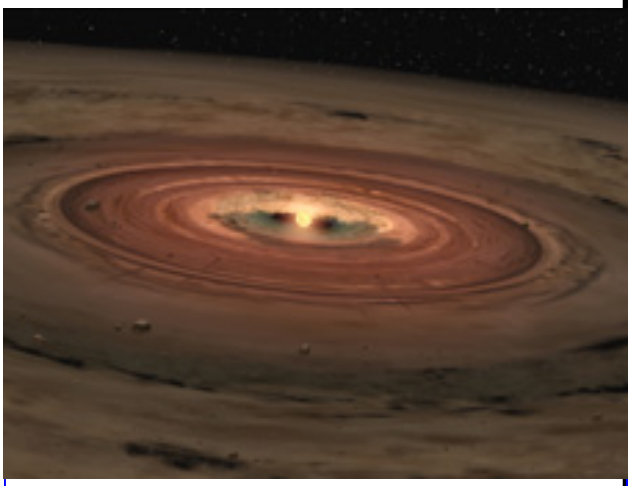
"No other known object or type of explosion could be seen by the naked eye at such an immense distance," said Swift science team member Stephen Holland of Goddard. "If someone just happened to be looking at the right place at the right time, they saw the most distant object ever seen by human eyes without optical aid." GRB 080319B's optical afterglow was 2.5 million times more luminous than the most luminous supernova ever recorded, making it the most intrinsically bright object ever observed by humans in the universe. The most distant previous object that could have been seen by the naked eye is the nearby galaxy M33, a relatively short 2.9 million light-years from Earth. Analysis of GRB 080319B is just getting underway, so astronomers don't know why this burst and its afterglow were so bright. One possibility is the burst was more energetic than others, perhaps because of the mass, spin, or magnetic field of the progenitor star or its jet. Or perhaps it concentrated its energy in a narrow jet that was aimed directly at Earth.

GRB 080319B was one of four bursts that Swift detected, a Swift record for one day. "Coincidentally, the passing of Arthur C. Clarke seems to have set the universe ablaze with gamma ray bursts," said Swift science team member Judith Racusin of Penn State University in University Park, Pa.

Spitzer Finds Organics and Water Where New Planets May Grow

NASA PRESS RELEASE

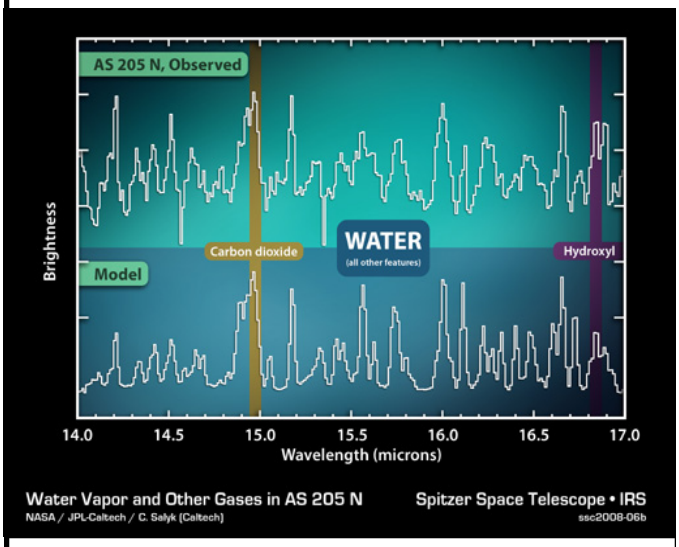
Researchers using NASA's Spitzer Space Telescope have discovered large amounts of simple organic gases and water vapor in a possible planet-forming region around an infant star, along with evidence that these molecules were created there. They've also found water in the same zone around two other young stars. By pushing the telescope's capabilities to a new level, astronomers now have a better view of the earliest stages of planetary formation, which may help shed light on the origins of our own solar system and the potential for life to develop in others.



This artist's concept shows a very young star encircled by a disk of gas and dust, the raw materials from which rocky planets such as Earth are thought to form. Image credit: NASA/JPL-Caltech

John Carr of the Naval Research Laboratory, Washington, and Joan Najita of the National Optical Astronomy Observatory, Tucson, Ariz., developed a new technique using Spitzer's infrared spectrograph to measure and analyze the chemical composition of the gases within protoplanetary disks. These are flattened disks of gas and dust that encircle young stars. Scientists believe they provide the building materials for planets and moons and eventually, over millions of years, evolve into orbiting planetary systems like our own. "Most of the material within the disks is gas," said Carr, "but until now it has been difficult to study the gas composition in the regions where planets should form. Much more attention has been given to the solid dust particles, which are easier to observe."

In their project, Carr and Najita took an in-depth look at the gases in the planet-forming region in the disk around the star AA Tauri. Less than a million years old, AA Tauri is a typical example of a young star with a protoplanetary disk. With their new procedures, they were able to detect the minute spectral signatures for three simple organic molecules--hydrogen cyanide, acetylene and carbon dioxide--plus water vapor. In addition, they found more of these substances in the disk than are found in the dense interstellar gas called molecular clouds from which the disk originated. "Molecular clouds provide the raw material from which the protoplanetary disks are created," said Carr. "So this is evidence for an active organic chemistry going on within the disk, forming and enhancing these molecules."



This plot of infrared data shows the strong signature of water vapor in the disk of gas and dust surrounding a young star. Image credit: NASA/JPL-Caltech

Spitzer's infrared spectrograph detected these same organic gases in a protoplanetary disk once before. But the observation was dependent on the star's disk being oriented in just the right way. Now researchers have a new method for studying the primordial mix of gases in the disks of hundreds of young star systems.

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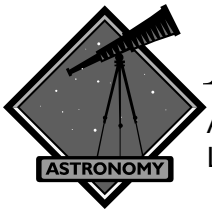
Celestial Mechanic April 2008



AAL

Astronomy Associates of Lawrence

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